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Emerging Issues in Occupational Health Psychology

Edited by
Jose M. León-Pérez, Mindy K. Shoss, Aristides I. Ferreira and Gabriele Giorgi

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Editorial

Emerging Issues in Occupational Health Psychology

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The world of work is changing dramatically due to continuous technological advancements and globalization (the so-called industry 4.0), the health crisis due to the COVID-19 outbreak, and the ongoing global economic crisis, all of which have forced adaptation to new ways of organizing work that have been slowly incorporated during the last few decades (e.g., home working and teleworking), climate change demands, and social movements such as those trying to offer more sustainable alternatives to the current economic model of neoliberalism and the demand-driven manufacturing system, among other factors. Moreover, several studies have shown that workers' health and well-being can be at higher risk when organizations face relevant changes and economic turbulence [1].

In that sense, after a peer-review process involving international experts, the 21 papers accepted in this Special Issue are reviews and empirical contributions that highlight the emergence of new psychosocial risks for employees' health and well-being, which are challenging the existing theoretical models and evidence-based practices in Occupational Health Psychology (OHP).

Undoubtedly, the COVID-19 pandemic has posed some challenges. As usually occurs when an unexpected catastrophe happens, researchers are exploring the short- and long-term consequences on health and well-being, comparing with previous situations or another similar health-related crisis. In this sense, most studies have focused on the negative aspects of the COVID-19 pandemic. For example, Nicola Magnavita and colleagues conceptualize the COVID-19 pandemic crisis as a macro stressor that is negatively affecting the mental health of workers, particularly those in the healthcare sector [2]. Similarly, Martin Sanchez-Gomez and colleagues considered that the COVID-19 pandemic is a traumatic event that is associated with feelings of fear and impaired mental health [3]. Drawing on the Cognitive Activation Theory of Stress [4], they conducted two studies comprising more than 1100 participants in total. Their data supported the idea that the COVID-19 pandemic is associated with intrusive thoughts that keep people in a hyperactivated state (i.e., hyperarousal) which, in turn, diminishes mental health and increases negative emotions such as fear of social activities and being infected. On the other hand, taking a more positive approach, Georgia Libera Finstad and colleagues [5] reviewed previous studies that have explored resilience and growth at work after being exposed to a traumatic event such as the COVID-19 pandemic.

In a similar vein, other studies have focused on the changes in the work design and working procedures that have been triggered by the COVID-19 pandemic, especially regarding remote work or telework. For example, Ward van Zoonen and colleagues explored the factors influencing adjustment to remote work during the beginning of the COVID-19-related lockdown in a sample of 5452 Finnish employees [6]. Their findings identified the interplay between both environmental and contextual factors in predicting adjustment to

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remote work. Additionally, Carla Estrada-Muñoz and colleagues [7] concluded that the lack of technological skills can endanger a risk of technostress in Chilean teachers.

Another issue that some studies in this Special Issue have covered is the development of scales to measure factors of psychosocial risks at work in particular groups such as the fatigue inventory adapted to coronary artery disease workers by Julija Gecaite-Stonciene and colleagues [8]. Indeed, people with cardiovascular disease have a higher risk of experiencing fatigue at work and, therefore, normative data in this population are needed. Regarding methodological issues, the study conducted by Aristides I. Ferreira and colleagues [9] addresses one important issue in advancing the field of OHP: combining self-report measures with physiological measures. As one of the typical limitations that studies include is the lack of physiological measures compared to self-reported measures, they discuss studies integrating physiological and self-reported measures and offer interesting further research avenues. Particularly, they reviewed the role of biomarkers and hormones in the relationship between presenteeism (another emerging topic in OHP) and performance.

Furthermore, from a methodological point of view, OHP should incorporate more complex designs beyond cross-sectional survey studies to capture dynamic processes in a changing environment. For example, Ieva Urbanaviciute et al. [10] conducted a study with two measurement points in a sample of 959 employees working in Switzerland. They used a latent transition approach to explore dynamics between psychosocial work environment and employee well-being. Additionally, Oliver Weigelt et al. [11] reported the results of a weekly diary study that explores how positive and negative events affect engagement over time. According to theoretical frameworks that advocate for analyzing how certain events can produce behavioral change in organizational contexts [12,13], they focus on the effects that exposure to discrete events at work have on workers' engagement through the emotions associated with such events. Their results revealed "that positive events accumulate to feed continuously high levels of work engagement over periods of several months" (p. 23). Finally, following a qualitative approach, Isabell Koinig and Sandra Diehl [14] report the key role of healthy leadership and the adoption of workplace health promotion practices, as part of the organizational culture, to develop healthy organizations.

Following a similar positive approach, some authors have explored how personal and social resources can increase employee well-being and performance. For example, Wenqing Tian et al. [15] analyzed some mechanisms that can shed some light on the relationship between job crafting and creativity at the individual level. Additionally, Jean-Sébastien Boudrias et al. [16], in line with the happy-productive worker hypothesis, explore the boundary conditions for the association between employee well-being and proactive performance. Finally, Xiulan Cheng et al. [17] examine how emotional intelligence mediates the relationship between mindfulness and psychological distress in a sample of kindergarten teachers.

In line with the United Nations' goals for a sustainable and healthy development [18], several studies have analyzed how certain features of individuals, teams, and organizations are associated with more sustainable and productive behaviors in complex environments. For example, Silu Chen et al. [19] reported how more sustainable and green HR practices can promote workers' green behaviors in industries with high environmental impact; Xiao Deng et al. [20] examined how more dynamic environments are associated with higher entrepreneurial innovation; and Silu Chen et al. [21] investigated how paradoxical leadership (i.e., using strategies that simultaneously balance and satisfy both structural and individual needs) is related to task performance.

Finally, from a stressor–stress–strain perspective, several studies have explored the association of diverse work-related factors with key outcome variables in OHP. Mateo-Rodríguez et al. [22] focused on occupational risk factors for work ability depending on sociodemographic information, which is crucial for identifying exposure risk groups and therefore implementing more accurate and/or tailored measures. Miriam Benítez et al. [23] conceived intragroup conflict as an interpersonal stressor that can negatively affect well-

being at the team level and, in turn, decrease the quality of service the unit provides (reported by customers). Gabriela Petereit-Haack et al. [24] conducted a systematic review and meta-analysis of the occupational risks that are related to post-traumatic stress disorder and trauma-related depression. Anne Richter et al. [25], in line with the differentiation between challenge versus hindrance stressors, challenge more traditional stress models and explore how job demands can being associated with positive outcomes. Additionally, Lu et al. [26] revealed the importance of examining the work and family interface by introducing different aspects of gender that capture better nontraditional gender identities.

In sum, the studies included in this Special Issue come from several disciplines and cultural contexts, involving authors from more than 15 different countries. These studies use strong and innovative theoretical approaches to provide evidence regarding the importance of working characteristics and resources to promote healthier and more sustainable environments in which employees can be happy and productive. Moreover, their findings offer several clues for implementing measures and developing healthier organizations in an uncertain and changing environment, particularly in the post-pandemic era. We hope the readers can benefit from the insights of these papers and that their findings can attract the attention of the scientific community in order to pursue further investigation into emerging issues in OHP.

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Article

Occupational Stress and Mental Health among Anesthetists during the COVID-19 Pandemic

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Abstract: Anesthetist-intensivists who treat patients with coronavirus disease 19 (COVID-19) are exposed to significant biological and psychosocial risks. Our study investigated the occupational and health conditions of anesthesiologists in a COVID-19 hub hospital in Latium, Italy. Ninety out of a total of 155 eligible workers (59%; male 48%) participated in the cross-sectional survey. Occupational stress was assessed with the Effort Reward Imbalance (ERI) questionnaire, organizational justice with the Colquitt Scale, insomnia with the Sleep Condition Indicator (SCI), and mental health with the Goldberg Anxiety and Depression Scale (GADS). A considerable percentage of workers (71.1%) reported high work-related stress, with an imbalance between high effort and low rewards. The level of perceived organizational justice was modest. Physical activity and meditation—the behaviors most commonly adopted to increase resilience—decreased. Workers also reported insomnia (36.7%), anxiety (27.8%), and depression (51.1%). The effort made for work was significantly correlated with the presence of depressive symptoms (r = 0.396). Anesthetists need to be in good health in order to ensure optimal care for COVID-19 patients. Their state of health can be improved by providing an increase in individual resources with interventions for better work organization.

Keywords: anxiety; depression; emergency; healthcare workers; infectious disease; insomnia; logistic regression; organizational justice; SARS-CoV-2; sleep

1. Introduction

Intensivists have played a vital role in the treatment of patients with coronavirus disease 2019 (COVID-19) caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). When the first cases of the COVID-19 disease were reported in Italy, it was already clear that SARS-CoV-2 could be transmitted from human to human [1]. Equally evident was the need to adopt very different measures from those previously used to safeguard workers [2]. The rapidity with which the pandemic spread severely tested the ability of the health service to respond. Nationally, there was a grave shortage of protective devices, e.g., masks and disinfectants, and mechanical ventilators for patient care. In many hospitals, emergency rooms, in-patient departments for respiratory and infectious diseases, and intensive care units (ICUs) were suddenly inundated with confirmed and suspected COVID-19 cases, and healthcare personnel were swiftly overwhelmed [3]. In early March 2020, in a matter of days, a second COVID-19 hospital was set up in Rome by the Agostino Gemelli Scientific

Hospitalization and Care Institutes (IRCCS) Foundation in conjunction with the Latium Region to treat cases of infection from the new coronavirus, and a team of hospital anesthetists was assigned to this new type of patient.

It has been known for some time that anesthetists are exposed to a high level of hematogenous [4,5] and aerogenic [6] occupational biological risk. During epidemics, front-line anesthetists are among the most vulnerable professional healthcare workers (HCWs) on account of infections and mental health problems [7]. During the COVID-19 pandemic, they were exposed to a completely new, and therefore partially unknown, biological risk. SARS-Cov-2 is transmitted mainly by droplets and close contact but transmission by aerosol is also possible. Viral particles of <5 μm can remain suspended in the air for a few hours and travel over long distances, especially if they are attached to atmospheric particulates [8,9]. Intensive care unit (ICU) staff are at higher risk of COVID-19 infection especially during aerosol-generating airway procedures (e.g., tracheal intubation, replacement/removal of the endotracheal/tracheostomy tube, and bronchial fibroscopy) and cardiopulmonary resuscitation (CPR) [10]. The epidemic has forced international bodies to modify guidelines for resuscitation [11–14] and surgical practices [15–18]. Anesthetists have to determine the best therapeutic management of patients and keep themselves safe while doing so [19,20]. Moreover, they have to test the effectiveness of these new indications and new therapeutic protocols directly, without being able to rely on evidence from previous experiences, under conditions of extreme pressure when all available beds are allocated. Consequently, the COVID-19 pandemic led to a certain amount of therapeutic and logistic uncertainty that required close monitoring and the presence of trained personnel [21]. Younger anesthesiologists often found themselves experiencing greater uncertainty and more difficulty in performing according to standard procedures [22]. In some cases of COVID-19, not enough importance was given to the need to protect HCWs. As a result, many anesthesiologists were among the front-line physicians who died after contracting the disease while caring for patients [23].

The new working conditions during the pandemic have exacerbated compassion fatigue resulting from an empathic response to suffering people [24,25], which can be associated with therapeutic failure and contact with relatives at the end of life [26,27]. Workplace violence was already a significant risk for emergency medicine physicians [28] that had a five-fold risk of suffering physical violence compared to doctors working in services (odds ratio (OR) = 5.12, confidence interval (95%CI) = 2.21–12.39) [29]. The current pandemic has caused significant mortality over a short time and has necessitated an increase in provision of both critical care and palliative care for anesthesiologists deployed to units caring for patients with COVID-19 [30]. For this reason, anesthetists, and especially female junior doctors specializing in anesthesia, have been found to be at high risk of burnout [31–34], a syndrome characterized by emotional exhaustion, low personal accomplishment, and depersonalization, and to have a high suicide rate [35]. Given the crucial role they play in managing the epidemic, the realization of online platforms to provide free mental health care for anesthetists has been proposed [36].

All these considerations suggest that anesthesiologists who have had to face up to the epidemic have perceived levels of organizational correctness and stress that have resulted in insomnia, anxiety, and depression. To test this hypothesis, we set out to evaluate the health of anesthetists engaged in the treatment of patients with COVID-19. Our assessment focused particularly on the conditions of occupational stress to which they were exposed at the height of the epidemic, on the perception of correctness in the organization of safety measures, and on the main factors that could increase resilience. As an outcome, we measured the possible early psychological effects of distress. We invited all anesthesiologists of a COVID-19 hospital in Rome to provide anonymous information on these topics via an online platform.

2. Materials and Methods

2.1. Participants

At the "A. Gemelli" University hospital in Rome, a cross-sectional study was conducted on anesthetists directly engaged in the care of suspected or confirmed cases of COVID-19.

All workers (155) were confidentially contacted by email and invited to participate in the survey proposed on the SurveyMonkey© online platform. The answers were collected anonymously on a specific file without any individual reference. Participation was completely voluntary and no economic incentive was provided for response. Participants were enrolled between 27 April and 27 May 2020. Two weeks after commencing the investigation, a reminder mail was sent with the preliminary results of the study.

Ninety out of the 155 eligible workers completed the survey (participation rate = 58.1%). Participants were mainly young (76.7% under 35 years of age), female (47, 52.2%) workers. Forty (44.4%) had a permanent employment contract, while the remainder had been given short-term internships.

Most workers (66.6%) were living with a partner without the presence of children (84.4%) or relatives who were not self-sufficient (94.4%). A noteworthy feature was the absence of persons who could help in case of need (23.3%). Approximately one in four (23.3%) reported unprotected exposure to SARS-CoV-2 patients (Table 1).

Table 1. Characteristics of the population.

Variable	N	%
Gender, male	43	47.8
Age, <35 years	69	76.7
Family status, single	30	33.3
With children	14	15.6
With old/disabled relatives	5	5.6
Without social support	21	23.3
Reporting unprotected exposure to COVID-19 patients	21	23.3

The research was conducted in accordance with the Helsinki Declaration. Ethics approval was obtained from the Catholic University Ethics Committee (ID 3292).

Given the cross-sectional study design, there was no imputation for missing data and the results were based on completed survey responses.

2.2. Questionnaire

Before carrying out our study, we consulted a focus group composed of qualified anesthetists in order to identify the specific stress factors affecting the profession and provide indications for compiling the questionnaire. On the basis of this interview, three questions were formulated concerning the workload and specific occupational stressors that arose during the epidemic and the subsequent lifestyle changes. The questionnaire was composed of 59 questions divided into 6 sections. The average time required for completion was 6 min.

The first section (6 items) regarded socio-demographic factors that could influence the outcome, e.g., gender, age class (younger or older than 35 years), marital status (single/coupled), presence of underage children or cohabiting non self-sufficient relatives, and presence of persons who could help in case of need.

The second section (5 items) investigated the main changes in occupation and lifestyle resulting from the epidemic. The anesthesiologists were asked to indicate the extent of their workload in the first months of the epidemic compared to the past, by choosing one of 5 responses ranging from "much less than usual" to "much greater than usual". Similarly, they were required to indicate (with the same 5-point Likert-type scale) how much time had been spent on physical activity and, respectively, meditation, prayer, or spiritual/mental activities in the first months of the epidemic, compared to the past.

Furthermore, they were asked to indicate whether they agreed that during the epidemic, their work had become more monotonous and repetitive, and that the task of informing relatives of the death of a patient had been more frequent; in these two questions, they could chose the answer from two 5-point Likert scales ranging from "I don't agree" to "I absolutely agree".

Occupational stress was assessed with the "Effort Reward Imbalance" (ERI) model [37]. The Italian version [38] of the short questionnaire [39] was used. This consisted of 10 items with responses ranging on a 4-point Likert scale from "1 = strongly disagree" to "4 = strongly agree". The effort subscale was based on three questions (e.g., "I'm always under pressure for the workload"); the total score ranged from 3 to 12. The reward sub-scale was based on seven questions (e.g., "Considering all my efforts and what I have achieved, I receive the respect and prestige I deserve at work"); consequently, this score ranged from 7 to 28. Internal consistency reliability, which is an indicator of the adhesion of the questions to the same construct, is usually measured with Cronbach's alpha, a statistic calculated from the pairwise correlations between items, ranging between negative infinity and one [40]. The reliability of the two effort and reward sub-scales in this study was 0.679 and 0.731, respectively, both in the acceptable range [41]. Stress was measured as a weighted relationship between effort and reward: conventionally, an ERI greater than unity is believed to indicate an imbalance between effort and rewards.

Organizational justice, which refers to processes and procedures employed to resolve conflicts or allocate resources [42], was measured using the Italian version [43] of the Colquitt Scale [44,45]. Procedural justice (PJ) was measured by 7 items (e.g., "Were you able to express your views and feelings during those procedures?"); informational justice (IJ) was measured with 5 items (e.g., "Do you think the communications you received were reliable?"). Each question was answered according to a 5-point Likert scale, from 1 = "I absolutely don't agree" to 5 = "I strongly agree", thus giving a sub-scale ranging from 7 to 35, and an IJ subscale ranging from 5 to 25. The score for organizational justice (OJ), which is the sum of the two previous sub-scales, ranged from 12 to 60. In this study, the reliability of the questionnaire, measured by Cronbach's alpha, was 0.861 for PJ (good) and 0.696 for IJ (acceptable).

Sleep quality was measured with the Italian version [46] of the "Sleep Condition Indicator" (SCI) [47], a brief scale (8 items) that evaluates insomnia disorder in everyday clinical practice, according to the Diagnostic Statistic Manual 5 (DSM5). Each question (e.g., "How many nights a week have you had a problem with your sleep during the past month?") was graded on a 5-point Likert scale. The final score ranged between 0 and 32; a score of ≤16 revealed possible insomnia disorder. Cronbach's alpha was 0.860 (good).

Psychological symptoms of anxiety (9 items) and depression (9 items) were measured with the Italian version [48] of the "Goldberg Anxiety and Depression Scale" (GADS) [49]. Typical questions were: "Have you felt keyed up, on edge?" for anxiety, and "have you lost confidence in yourself?" for depression. The reference time frame was the last 15 days. The anxiety and depression scores were calculated by adding one point for each positive answer. Persons with an anxiety score of 5 points or more, or a depression score of 2 or more, are over 50% more likely to be diagnosed as anxious or depressed by a psychiatrist; this probability increases rapidly in proportion to the score. In this study, the reliability of the GADS subscales, measured by Cronbach's alpha, was 0.725 for anxiety and 0.627 for depression (acceptable).

2.3. Statistics

Categorical variables were measured in terms of frequency. Continuous variables were analyzed in terms of mean and standard deviation. Student's *t*-test or Mann–Whitney's U test for nonparametric variables were used to compare the distribution of continuous variables in subgroups of workers defined by gender or age.

Simple linear regression was used to evaluate the effect of demographic, social, or work-related factors on occupational stress and to assess the effect of stress and justice perception on anxiety and depression scores.

Logistic regression was used to evaluate the relationship between stress, organizational justice, and cases of anxiety or depression.

Analyses were performed using IBM/SPSS 26.0 (IBM Corporation, Armonk, NY, USA).

3. Results

3.1. Changes due to the Pandemic, Stress and Perceived Justice

During the SARS-CoV-2 pandemic, workers reported an increase or high increase in workload (63.3%) in addition to an increase both in monotony (33.4%) and the need to inform relatives of the death of a patient (48.9%). Free time spent on physical activity and meditation was reduced or severely reduced for most of the participants (84.4% and 57.8% for physical and spiritual activities, respectively) (Table 2).

Table 2. Changes reported during the COVID-19 outbreak, and prevalence of high stress, insomnia, anxiety, and depression in anesthesiologists.

Reported Effect	N	%
Increased/much increased workload	57	63.3
The work became more repetitive and monotonous	30	33.4
More frequent need to inform of the death of a relative	44	48.9
The time for physical exercise was shorter/much shorter	76	84.4
The time for meditation was shorter/much shorter	52	57.8
High stress (effort/reward weighted ratio >1)	64	71.1
Insomniac (SCI score ≥16)	33	36.7
Anxious (GADS anxiety score ≥5)	25	27.8
Depressed (GADS depression score ≥2)	46	51.1

SCI = Sleep Condition Indicator; GADS = Goldberg Anxiety and Depression Scale.

Accordingly, evaluations of occupational stress indicated a rather high average effort level and a moderate reward level: effort (range 3–12) = 8.17 ± 1.81; reward (range 7–28) = 16.48 ± 3.56. The mean values of the two stress-related variables were, respectively, 68% and 58% of the maximum values of their scales. Consequently, ERI was higher than unit, indicating high work-related stress in 71.1% of anesthesiologists.

Perceived levels of organizational justice reported in the sample were far from optimal. Procedural justice (range 7–35) was, on average, 17.58 ± 5.02, i.e., 50% of the maximum; informative justice (range 5–25) was 13.87 ± 3.39, i.e., 55% of the maximum. Organizational justice was 31.44 ± 7.38, 52% of the maximum. An analysis of the responses indicated that workers perceived a scarce ability to influence and modify the outcome of procedures. This was accompanied by a general uncertainty about the rationality and accuracy of the procedures to be adopted. In addition, workers expressed doubts regarding the reliability of communications and explanations concerning the pandemic in progress.

3.2. Prevalence and Distribution of Neuropsychological Disorders

The quality of sleep in the sample was not high. The SCI final score was, on average, 19.96 ± 5.43, 62% of the theoretical maximum. According to the DSM5 criteria, 33 workers (36.7%) suffered from insomnia.

The GADS yielded an average score of 3.20 ± 2.34 for anxiety and 2.10 ± 1.84 for depression. Twenty-five workers (27.8%) were classified as anxious and 46 (51.1%) as depressed.

Female anesthesiologists reported higher effort, lower reward and justice, lower sleep quality, and higher anxiety and depression scores than their male colleagues; however, the disparity failed to reach statistical significance. Similarly, younger workers reported non-significant higher stress levels, lower justice perception, and a higher prevalence of anxiety and depression compared to older colleagues.

In a simple linear regression model, the level of stress perceived by each worker (ERI) was not significantly associated with gender, age, presence of family or social risk factors, nor with changes in the levels of monotony of work and workload. Although compassion fatigue was high in distressed anesthetists, it failed to reach a significant level. Exposure to confirmed COVID-19 patients without adequate protection and the perception of low organizational justice were significantly associated with stress (Table 3).

Table 3. Linear regression analysis. Relationship between socio-demographic factors, work changes, organizational justice and perceived work-related stress (ERI).

Predictors	ERI	
	Standardized Beta	*p*
Gender	0.084	0.407
Age	0.029	0.809
Family status	−0.003	0.973
Children	−0.147	0.238
Relatives or disabled people	0.006	0.954
Without social support	0.143	0.171
Workload	0.120	0.213
Monotony	0.118	0.226
Compassion fatigue	0.190	0.057
Unprotected exposure	−0.248	0.014
Organizational justice	−0.383	0.000
Determination coefficient of the model (R^2)		0.329

Gender: 0 = male, 1 = female; Age class: 0 = < 35 years; 1 = > 35; Family status: 0 = single, 1 = married; Children: 0 = yes, 1 = no; Relatives or disabled people: 0 = yes, 1 = no; Without social support 0 = yes, 1 = no; Workload: 1 = much less, 5 = much greater; Monotony: 1 = much less, 5 = much greater; Compassion fatigue: 1 = much less, 5 = much greater; Unprotected exposure: 1 = yes, 2 = no; Organizational justice: score range = 12–56.

Simple linear regression analysis showed that anxiety and depression levels in the sample were significantly associated with efforts made at work (Effort) (Table 4).

Table 4. Linear regression analysis. Relationship between demographic factors, stress, justice, and mental health variables.

Variable	Anxiety		Depression	
	Standardized Beta	*p*	Standardized Beta	*p*
Gender	0.085	0.435	0.007	0.943
Age	−0.095	0.386	−0.110	0.282
Effort	0.224	0.050	0.396	0.000
Reward	0.099	0.417	0.141	0.220
Procedural justice	−0.127	0.323	−0.155	0.200
Informational justice	0.004	0.973	−0.059	0.625

Gender: 0 = male, 1 = female; Age class: 0 = < 35 years; 1 = > 35; Effort range 3–12; Reward range 8–25; Procedural justice range 7–35; Informational justice range 5–21.

Univariate logistic regression revealed that effort was a significant predictor of the risk of being depressed (OR = 1.539; 95%CI = 1.162–2.039). This association was confirmed in a multivariate logistic regression model, adjusted for gender, age, rewards, and justice (OR = 1.709; 95%CI = 1.225–2.386) (Table 5).

Table 5. Logistic regression analysis. Univariate and multivariate associations of work-related variables with anxiety and depression cases in anesthesiologists.

Variable	Anxiety		Depression	
	Model I OR (95%CI)	Model II OR (95%CI)	Model I OR (95%CI)	Model II OR (95%CI)
Effort	1.216 (0.925–1.599)	1.308 (0.938–1.823)	1.539 (1.162–2.039) ***	1.709 (1.225–2.386) ***
Reward	1.023 (0.897–1.166)	1.142 (0.961–1.357)	0.989 (0.880–1.112)	1.103 (0.941–1.292)
Procedural justice	0.945 (0.854–1.046)	0.979 (0.865–1.109)	0.965 (0.888–1.050)	0.990 (0.886–1.107)
Informational justice	0.883 (0.769–1.014)	0.870 (0.724–1.045)	0.935 (0.825–1.060)	0.962 (0.812–1.140)

Model I: univariate; Model II: multivariate, adjusted for gender, age, and containing all the work-related variables (effort, reward, procedural justice, and informational justice). *** $p < 0.001$.

4. Discussion

This cross-sectional study, conducted on a large percentage of the anesthetists employed in a COVID-19 hub hospital in the Latium region of Italy, demonstrated that alongside existing occupational stressors connected with their work, there were also additional stressors closely related to the pandemic. In fact, these physicians perceived organizational problems related to the sphere of procedural and informational justice and were exposed to high levels of occupational stress. They reported sleep problems, anxiety, and depression with a frequency that was not negligible. Effort, i.e., occupational psychophysical commitment, was the major predictor of these problems. The question is: how many of the mental health problems that we have observed are attributable to the epidemic?

In epidemiological studies designed to evaluate the effect of the pandemic on the mental health of HCWs, a problem often arises due to a lack of reference values. Medical activities are stressful even when there is no pandemic, and some doctors suffer from excessive stress, anxiety, and depression for causes other than COVID-19 [50–52]. Currently, no longitudinal studies are available to enable us to compare the situation before, during, and after the outbreak of COVID-19. Available cross-sectional studies, which have found rates of anxiety and depression in anesthetists comparable to ours [53,54], lack control groups when external references are used, e.g., stress levels or mental health in other populations; consequently, they are often unreliable due to methodological or chronological differences [55]. To get an idea of the pre-COVID-19 situation, we can consider some of the most recent studies conducted on HCWs before the pandemic. In Australian nurses, in 2018, the prevalence rates of depression, anxiety, and stress were found to be 32.4%, 41.2%, and 41.2% respectively [56]. The overall prevalence of psychological distress among nurses in a teaching hospital in Malaysia in 2019 was 41%, and the prevalence of stress, anxiety, and depression were 14.4%, 39.3%, and 18.8%, respectively [57]. In a 2017 study, Australian midwives reported moderate/severe/extreme levels of depression (17.3%), anxiety (20.4%), and stress (22.1%) symptoms [58]. In the USA, nearly one-quarter of hospice workers were moderately to severely depressed, and nearly one-third reported moderate to severe symptoms of anxiety [59]. In 2018, 58.1% of doctors who worked at cancer hospitals were identified as having burnout, depression (12.3%), and anxiety (19.4%) [60]. Beyond the fact that these data demonstrate the existence of some problems even before the pandemic, due to methodological problems, they are not directly comparable with our findings. To avoid this problem, we have identified, in the literature, an experience conducted on a comparable sample. The study was conducted on the HCWs of a local health unit [61] in the same Italian region, during the same chronological period, with a similar method. In that survey, 86 physicians, whose work did not include unprotected exposure to COVID-19 patients, reported an average stress level measured with the ERI model of 0.90 ± 0.31, which was significantly much lower than that observed in our study (1.25 ± 0.51). Moreover, in that situation, which is the one commonly experienced by National Health Service doctors, 37.2% of the sample had high stress levels (ERI > 1), 9.3% suffered from anxiety (GADS score ≥ 5), and 11.6% suffered from depressive symptoms (GADS score ≥ 2). In our present study, an obvious difference between the aforementioned levels and

those of the COVID-19 hospital anesthesiologists was observed. In our opinion, this difference could be attributed to the pandemic.

The results of our survey are not surprising if we analyze data reported in the literature. Excessive occupational stress could result from concerns about the risk of infection and lack of confidence in the safety measures adopted [62]. During epidemics, risk management in hospitals is not easy, inadequate risk assessment can occur [63], and it is not always possible to adequately safeguard the health of HCWs [64]. Anesthesiologists involved in aerosol-generating procedures, such as tracheal intubation, are at an elevated risk of acquiring COVID-19 [65]. A multicenter study conducted in 503 hospitals in 17 different countries observed a 10.7% incidence of infection in anesthetists participating in the tracheal intubation of patients with suspected or confirmed COVID-19, and the risk rate was higher in women [66]. Other medical activities involving patients with COVID-19 have also been associated with unwanted exposures: 11.4% of Chinese anesthetists who performed spinal anesthesia on patients with COVID-19 were infected [67]. In our study, although most unprotected exposures were prevented by adopting safety measures in the hospital, twenty-one of the respondents (23%) reported at least one work-related unprotected exposure. This percentage was significantly lower than that recorded in the United States, where 58% of anesthesiologists and affiliated intensive care providers at the Columbia University Irving Medical Center reported unprotected exposures, 54% of which were high-risk [68]. Nevertheless, our data indicate that further improvements can be made in anesthetist safety levels.

The anesthetists participating in our survey were well aware of the risk and the need to adopt scrupulous safety procedures. However, the novel situation and the difficulty encountered in changing work habits undoubtedly prompted anesthetists to make an additional effort demonstrated in the high levels recorded in the effort subscale of the Siegrist ERI model. Despite the additional effort during this period, doctors received no increase in material rewards for their work. On the contrary, in some cases, the latter decreased due to the unsatisfactory results of some therapies. This created an imbalance in the relationship between effort and rewards, resulting in a generalized condition of excessive occupational stress. This condition is not new in front-line workers and has been reported in all health professionals who have dealt with the epidemic [69]. Compassion fatigue resulting from symptom management and end-of-life care may also have induced increased stress. At the time of our survey, three out of four anesthesiologists were suffering from distress; over prolonged periods, this can seriously affect physical and mental health, lead to an increase in errors, and, ultimately, become dangerous for patients.

Most of the anesthesiologists who participated in the survey also reported a reduction in their physical activity during the pandemic. Physical activity/exercise was the most common and effective form of coping behavior adopted by 59% of American HCWs exposed to the pandemic [70]. A reduction in the time devoted to meditation was also reported in our survey. Spirituality is a well-known resource against work-related stress [71,72]. The simultaneous weakening of two important ways of combatting stress put the mental and physical wellbeing of our sample at high risk.

A considerable number of reports have been published on mental health problems that have arisen in HCWs due to COVID-19. After Lai et al. [73] estimated the prevalence of distress in Chinese HCWs to be 71.5% (a rate comparable to that observed in our study), several reviews [74–77] and three meta-analyses [78–80] have confirmed a high prevalence of psychological distress, poor sleep quality, anxiety, and depression/depressive symptoms in HCWs working with COVID-19 patients. In HCWs treating COVID-19 patients, the pooled prevalence of anxiety has been estimated to range from 23.2% [79] to 32.0% [80] and that of depression from 22.8% [79] to 28% [80]. These values are similar to those observed in our investigation. In the literature, women and young anesthetists generally have a higher prevalence rate for these problems than their colleagues [81–84]. In our sample, the prevalence of distress (ERI > 1) in female anesthetists was 78.7% and that of anxiety was 29.8%, compared to 62.8% and 25.6%, respectively, in their male colleagues. Given the small sample size, the difference was not significant, but the trend was not rejected. The same was true for the greater

frequency of stress, anxiety, and depression in younger workers, who reported these problems in 72.5%, 30.4%, and 55.1%, respectively, as compared to 66.7%, 19.0%, and 38.1% in their older colleagues.

In addition to confirming the existence of this phenomenon, we made a deeper analysis of its causes with a statistical model, demonstrating that the effort made during work is significantly associated with mental problems. This result corroborates findings for another high-stress profession – the police force—in which the Effort score was a predictor of anxiety and depression [85] sick leave [86], metabolic syndrome [87], and sleep problems [88]. This observation clearly indicates that to prevent occupational stress, instead of increasing economic or other rewards, it is more important to reorganize the work, so as to reduce the effort made by each individual worker.

The main advantage of this study is that it was conducted on a representative sample of anesthesiologists from a hub hospital at the height of occupational commitment to the COVID-19 epidemic. Its principal limitation consists in the cross-sectional nature of the study, which prevents us from making inferences on the sequence of events and does not exclude the possibility of reverse causation. In fact, it is well known that persons undergoing anxiety and depression can have sleep disturbances and suffer from occupational stressors more than others [89]. However, the proposed sequence, in which exposure to the working conditions produced by the epidemic caused stress and consequently induced anxiety, depression, and insomnia, seems to us to be the most plausible. Another limitation, common to all the studies conducted in this period, is that they refer to a rather short period, during which the chronic effects of stress have not had time to manifest themselves. Only investigations conducted over a longer period and potential future longitudinal studies will provide us with a better knowledge of the relationships between work factors and alterations in the state of the physical and mental health of workers. Finally, self-reporting represents a further limitation of this study, despite the use of standardized questionnaires, which, in previous research, have proven to be well-correlated to the phenomena investigated.

Looking at the survey results, we were quite surprised at the fairly high rate of colleagues who said they had uncontrolled exposures and we are determined to investigate these aspects for hospital job safety reasons. A repetition of the survey in the stabilization phase of the epidemic could make us understand how occupational stress levels change over time. A repeated cross-sectional approach, moreover, can give some insights on the relationships between stress, sleep, and mental health problems.

5. Conclusions

Our analysis of the working conditions in an important health center dedicated to the treatment of patients with COVID-19 has revealed the possibility of improving the condition of the anesthesiologist-intensivists, of counteracting their state of stress, and thereby preventing negative effects on mental health. Interventions to improve worker resilience and deal effectively with COVID-19 stress in HCWs have been proposed [90]. These programs will certainly be more effective if accompanied by organizational measures aimed at reducing the effort of workers in health care activities. Numerous structural measures have proved effective in reducing the psycho-physical burden of workers. Science-based, data-driven cooperative organization measures, including balance between workload and staffing, shift scheduling, workplace environment design, and employee training, are the first defense against workers' distress [91]. The workers should receive education and training to mitigate fatigue and fatigue-related risks [92] and must closely monitor their sleep health conditions, relaxation abilities, and general well-being [93]. Improving the health conditions of anesthesiologists is also of crucial importance in order to guarantee the quality of care, especially during a pandemic [94].

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Article

COVID-19 Pandemic as a Traumatic Event and Its Associations with Fear and Mental Health: A Cognitive-Activation Approach

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Abstract: The COVID-19 global pandemic still represents a major threat with detrimental health consequences. Analyzing the psychological outcomes, COVID-19 could be interpreted as a collective traumatic event that can generate symptoms related to post-traumatic stress disorder (PTSD). Considering this, the purpose of this paper is twofold: first, to investigate the relationship between intrusive thoughts and fear related to the COVID-19 pandemic and between intrusive thoughts and mental health; second, to test the mediating role of hyperarousal and avoidance in these two relationships. In order to reach these aims, the present study investigated these relationships and tested a mediation model in two cross-sectional studies in Italy. Altogether, 627 individuals and 495 workers completed an online survey for study 1 and study 2, respectively. Mediation analyses were performed via the SPSS macro PROCESS; the significance of total, direct, and indirect effect was tested via bootstrapping. The results showed that within the PTSD framework, hyperarousal compared with avoidance mediated the relationship between intrusion and the analyzed outcomes. In conclusion, the present study provided empirical evidence for the influence of hyperarousal on individual consequences such as fear of COVID-19 and mental health. Research, as well as theoretical and practical implications, are discussed.

Keywords: COVID-19; mental health; PTSD; pattern; intrusion; hyperarousal; avoidance

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1. Introduction

Since the World Health Organization (WHO) declared a state of international health emergency due to the Coronavirus outbreak, COVID-19 has led to an unexpected evolution of contagion and a scenario of death and isolation. Many countries have adopted lockdown measures and have radically changed their lifestyles by switching to protective devices and social distancing. Several studies carried out during the pandemic testify to the significant impact COVID-19 pandemic has had on the mental health of individuals, causing stress, anxiety, depressive symptoms, insomnia, denial, anger, and fear [1]. The quarantine status led to negative psychological consequences like health anxiety, financial worry, and loneliness [2]. In addition, "headline stress disorder" can be observed during this pandemic. This disorder is characterized by high emotional response (such as stress and anxiety) to the endless media reports that may cause physical symptoms including palpitation and insomnia [3]. Therefore, COVID-19 pandemic can be interpreted, to all

intents and purposes, as a collective traumatic event that can generate posttraumatic symptoms [4]. From this perspective, research and clinical practice showed that trauma per se is a powerful risk factor for mental disorders being posttraumatic stress disorder (PTSD) characteristic of the most common ones [5,6]. PTSD can be defined as a disorder that may occur in people who have experienced or witnessed a traumatic event such as, for example, a natural disaster [5]. In this regard, recent scientific evidence has highlighted the existence of a relationship between the COVID-19 pandemic and increased levels of PTSD [7,8]. According to the International Classification of Diseases (ICD-11) [9], PTSD is composed of three core symptoms: 'Intrusions' or intrusive thoughts such as repeated and involuntary memories or concerns about the traumatic event that interrupt a flow of thought (also distressing dreams or flashbacks of the traumatic event, which can be so vivid that people feel they are re-living the traumatic experience); 'Avoidance' or purposefully avoiding people, places, activities, objects, and situations that may trigger distressing memories related to the traumatic event; and 'Hyperarousal' or excessive vigilance that occurs with exaggerated startle response, difficulty in concentrating or remembering. These symptoms were reported in the first studies conducted on the COVID-19 emergency in China and Italy [7,10,11].

Within the literature, intrusion seems to be the most frequent symptom followed by hyperarousal and avoidance [12]. More specifically, intrusive thoughts compared to other elements are recognized as a hallmark and troublesome features of PTSD [13]. However, as Bridgland and colleagues noticed, most theoretical models do not account for potential threats looming in the future as the causes of PTSD [8]. In response, we integrate a three-dimensional approach to study PTSD (e.g., intrusion, hyperarousal, and avoidance) with the Cognitive-Activation Theory of Stress (CATS) to address the relationship between the dimensions of PTSD (i.e., intrusion, hyperarousal, and avoidance) and the COVID-19 pandemic-related fear and mental health in different Italian samples [14–18].

The emphasis on identifying the optimal structural model of PTSD has at least two main practical implications: a direct implication in diagnostic procedure and the assessment of comorbidity with other psychopathologies [19,20].

1.1. COVID-19 Pandemic Trauma and Fear Feelings

COVID-19 has led to a drastic scenario of infections and serious consequences for the health of individuals. Furthermore, the pandemic spreads a general fear that dramatically affects people's lives. Specifically, anxiety is due to two reasons; fear of infection and the symptomatic consequences that may result from it [21,22].

Recent research conducted in Pakistan investigated the presence, intensity, and dynamics of fear of the coronavirus among general population [23]. Participants were given an online questionnaire, which included information on socio-personal data and closed-and-open-ended questions regarding coronavirus fear. Respondents who had a high level of fear were asked to describe its nature. The results showed that the level of fear was higher for women. Furthermore, nine main themes were extrapolated from their responses: 'Corona fear' (fear of the disease itself, fear of not receiving treatment, fear of falling ill, fear of spreading the disease to family members, contagiousness, timelessness of the disease, rapid spread, and the burden of caring for the family if infected), loss (loss of loved ones and loss of job), fear of isolation (fear of living away from one's family and staying at home for a long time), fear associated with religion, fear of death (fear of dying, fear of the death of others, fear of dying before reaching one's goals and having a horrible death), the consequences of COVID-19 in terms of blocking the future, the underdevelopment of the country, fear of psychological consequences (sense of powerlessness, sense of uncertainty, fear of being wrong and stress/depression, anxiety about increased mortality, dependence and inactivity) and finally, empathy (for the poorest people and concern for the global spread of the disease).

Furthermore, fear of COVID-19 has consequences for both physical and psychological health and a greater impact on the most vulnerable population. This is also confirmed by

the results of a study conducted in the United States that investigated the prevalence of fear and its consequences, describing the variation among the most socially vulnerable subpopulations [24]. The study revealed a population that is worried, afraid, and uncertain about the pandemic situation and its consequences for the individual, the family, and the community as a whole. Fear of contagion pervades multiple aspects of life to the point of being a pervasive thought that has also led the most vulnerable people to commit suicide. In particular, a study carried out in India examined 69 cases of suicide and analyzed related media information [25]. It has been hypothesized that most of the suicides were caused by the fear of contracting the infection, although after the autopsy most of the subjects tested negative for COVID-19. Furthermore, the prevalence of men in suicide cases was higher regardless of age group (19–95 years).

In this sense, we follow a cognitive appraisal model of PTSD. These models suggest that cognitive factors, particularly appraisals of ongoing threat, are crucial to understand trauma response. For example, Horowitz's (1982) model of PTSD, considers intrusion as the primary factor in the onset of post-traumatic symptoms that may precede hyperarousal and avoidance responses. In turn, this activation (i.e., hyperarousal) and avoidance may increase negative feelings such as fear of the COVID-19 pandemic. In this aspect, according to CATS theory, the COVID-19 pandemic can be interpreted as a traumatic experience itself associated with PTSD symptoms [7,8]. Furthermore, this trauma elicits intrusive thoughts, which can be considered as a threatening stressor (i.e., cognitive activation) that sustains a physiological activation (i.e., hyperarousal) that leads the individual to cope with the stressor (in this case, to avoid the stressor or traumatic event) [26]. Then, as the exposure to the COVID-19 pandemic continues, the cognitive-activation persists (and probably repeatedly activates the HPA axis) with its potentially negative consequences in terms of both increased negative feelings such as anger, irritability, or fear, and diminished mental health.

Therefore, taking as a baseline these previous findings, the first aim (Study 1) was to investigate the relationship between the dimensions of PTSD (i.e., intrusion, hyperarousal, and avoidance) and the COVID-19 pandemic-related fear among general population. In particular, we investigated whether the relationship between intrusion and fear of COVID-19 is mediated by hyperarousal and avoidance. In other words, we hypothesize that the causal relationship between intrusion and fear of COVID-19 will be mediated by hyperarousal and avoidance. The proposed multiple sequential mediation model can be seen in Figure 1.

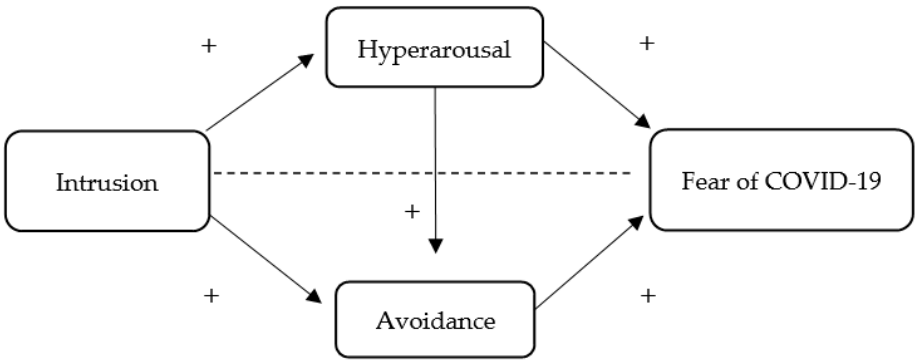

Figure 1. Sequential mediation model proposed to test the associations between intrusive thoughts, hyperarousal, avoidance, and fear of COVID-19 (Study 1). +: positive relationship.

1.2. COVID-19 Pandemic Trauma and Mental Health

The results of the referred literature highlight the extent to which the COVID-19 pandemic may have a significant impact on the psychological health of individuals. A recent research conducted in Hubei province attempted to extrapolate the main symptoms of PTSD as a result of the pandemic. In the network of COVID-19 pandemic-related

PTSD symptoms, results showed strong connections between avoidance of thoughts and avoidance of reminders, between hypervigilance and exaggerated alarm response, between intrusive thoughts and nightmares, between flashbacks and hyperresponsiveness to emotional signals, and between detachment and limited affection. Furthermore, the study suggested that the main symptom was self-destructive/reckless behavior, which was positively correlated with the presence of depression and loss of interest [27].

Furthermore, previous studies have shown an association between PTSD symptoms related to the COVID-19 pandemic and several measures of mental health, including anxiety, depression, and psychological functioning [8]. For example, a meta-analysis examined the effect of 62 studies addressing the impact of PTSD symptoms on general health and concluded that people with high levels of PTSD symptoms also reported poorer health outcomes [28]. Similarly, a study of 168 returning veterans found that PTSD symptoms have a unique contribution to mental health (6%) when controlling for the effect of several predictors such as severity of trauma exposure, physical injury, or substance abuse [29].

Therefore, following the same rationale as in the previous section, we assume that the COVID-19 pandemic is a traumatic event that leads to experiencing PTSD symptoms, which, in turn, are associated to poorer mental health. As mentioned above, based on CATS theory and cognitive appraisal models of PTSD, cognitive mechanisms (i.e., intrusion) produce a physiological activation (hyperarousal) that prompts the coping response (avoidance in this case, as the event cannot be controlled or solved); however, as this cognition-activation persists and the coping strategies are maladaptive or unsuccessful, individuals' mental health is negatively affected. Thus, the second aim (Study 2) was to investigate the relationship between the PTSD dimensions (i.e., intrusion, hyperarousal, and avoidance) and mental health in a sample of Italian workers. In this case, we hypothesized that the relationship between intrusion and mental health will be mediated by hyperarousal and avoidance. This mediation model is illustrated in Figure 2.

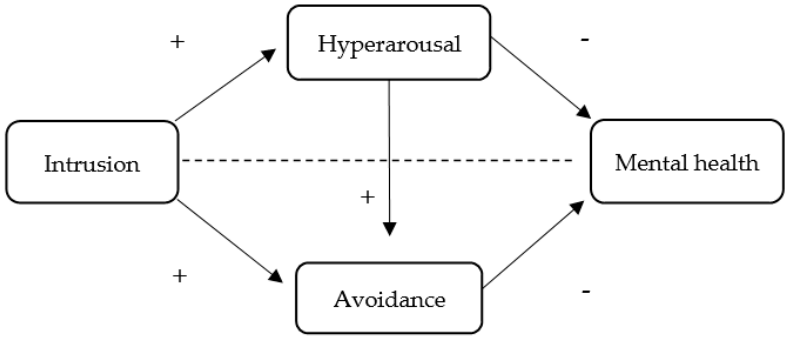

Figure 2. Sequential mediation model proposed to test the associations between intrusive thoughts, hyperarousal, avoidance, and mental health (Study 2). +: positive relationship; −: negative relationship.

2. Materials and Methods

2.1. Sample and Design

In Study 1, we followed a cross-sectional design. The study was developed during the second half of 2020 and early 2021, in parallel with the COVID-19 pandemic. Study 1 sample consisted of 627 subjects. Table 1 shows the socio-demographic characteristics of the participants.

Table 1. Socio-demographic characteristics of the sample (Study 1, $N = 627$).

Characteristics	
Age (Mean, SD)	31.4, 13.9
Gender	(%)
Male	35.2
Female	64.8
Marital status	(%)
Single	71.5
Married	28.5
Educational level	(%)
Primary	1.9
Secondary	48.6
University	39.4
Master	8.3
PhD	1.8
Job status	(%)
Student	22.3
Unemployed	17.6
Employed	60.1

Similarly, Study 2 followed a cross-sectional design and was developed during the second half of 2020 and the beginning of 2021. The sample of the second study consisted of 495 workers selected from several Italian companies. Table 2 shows the socio-demographic characteristics of these participants.

Table 2. Socio-demographic characteristics of the sample (Study 2, $N = 495$).

Characteristics	
Gender	(%)
Men	67.7
Women	32.3
Organizational seniority	(%)
4 years or less	19.1
5–9 years	43
10–20 years	21.8
More than 20 years	16.1
Job category	(%)
Chief	3.1
Middle management	20.1
Employee	76.8

2.1.1. PTSD Generated by COVID-19

The Impact of Event Scale in its six-item version was used to assess the stress generated by the COVID-19 pandemic (IES-6) [30]. For this purpose, the items were translated into Italian. The respondents were instructed to answer the questionnaire considering the Coronavirus pandemic as the potentially stressful event. This questionnaire is an abbreviated version of the original IES-R, a 22-item screening test to assess posttraumatic stress disorder (PTSD) [31]. The items are related to feelings of distress experienced over the last 7 days, expressly following a specific traumatic situation, which, in our case, is the COVID-19 pandemic. Following a five-point Likert scale, the IES-6 includes two items for each of the dimensions of posttraumatic stress: intrusion (e.g., "Since the beginning of the COVID-19 emergency, I thought about it when I didn't mean to"), avoidance (e.g., "Since the beginning of the COVID-19 emergency, I was aware that I still had a lot of feelings about it, but I didn't deal with them") and hyperarousal (e.g., "Since the beginning of the COVID-

19 emergency, I had trouble concentrating"). The internal reliability of the variables was adequate (Study 1: Intrusion = 0.85, Hyperarousal = 0.82 and Avoidance = 0.66; Study 2: Intrusion = 0.86, Hyperarousal = 0.73 and Avoidance = 0.66). This scale was used in both Study 1 and Study 2.

2.1.2. Fear of COVID-19

We measured the extent to which the pandemic constituted a threat to people with an eight-item scale developed for this purpose (e.g., I am afraid of contracting the virus). The scale uses a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). A total score is calculated by obtaining the sum of all eight items. The higher the score, the greater the fear of COVID-19. This questionnaire demonstrated a stable unidimensional structure and showed adequate psychometric properties (see Table 3). Moreover, its internal consistency was high ($\alpha = 0.90$). This scale was used only in Study 1.

Table 3. Items and psychometric properties of the fear of COVID-19 questionnaire.

Item	Factorloading *	Item-Total Correlation	Mean (SD)	Skewness	Kurtosis
1. I am afraid of contracting the virus	0.477	0.69	3.61 (1.09)	−0.419	−0.475
2. I am afraid of the possibility of buying potentially contaminated goods	0.488	0.70	2.71 (1.28)	0.234	−0.995
3. I am afraid of buying goods in shops	0.567	0.75	2.44 (1.15)	0.405	−0.683
4. I am afraid of using urban transport	0.691	0.83	4 (1.15)	−1.087	0.425
5. I am afraid of using trains	0.763	0.87	3.72 (1.23)	−0.728	−0.410
6. I am afraid of using planes	0.651	0.81	3.61 (1.24)	−0.558	−0.711
7. I am afraid of going to facilities to use health services (general practitioner, hospitals, etc.)	0.502	0.71	3.58 (1.15)	−0.595	−0.034
8. I am afraid of going to facilities for basic necessities (bank, post office, supermarket, etc.).	0.642	0.80	2.96 (1.06)	−0.082	−0.555

Note: * Extraction method: Factor loadings using the extraction method: unweighted least squares. SD = standard deviation.

2.1.3. Mental Health

The Italian version of the General Health Questionnaire (GHQ-12) was used in order to assess the symptoms of mental distress [32]. This is a self-administered questionnaire adapted from the original developed by Goldberg and Williams to assess non-specific psychiatric disorders [33]. Following a four-point Likert-scale, participants answered 12 items based on their current experience of mental distress (e.g., I was unable to enjoy daily activities). It is important to note that in this study, unlike the original questionnaire, the scoring was performed in the opposite direction. Thus, the higher the score, the greater the mental health. Cronbach's alpha values indicate a good level of reliability ($\alpha = 0.86$). This scale was used only in Study 2.

2.2. Procedure

Following similar previous studies, participants in Study 1 were recruited through psychology graduates and PhD students who had experience in psychological assessment. The procedure was performed based on the recommendations offered by Wheeler et al. to apply this type of sampling technique [34]. The test battery was developed using the Google Forms platform and was emailed using a research lab database of 2702 people. 627 subjects completed the full form (response rate = 23.2%). The format included a first page in which it was mandatory to demonstrate a minimum age of 18 and in which the voluntary and confidential nature of the collaboration was clarified. All the participants accepted the conditions of this research. The whole process was conducted in accordance with the Declaration of Helsinki. Given the observational nature of the study along with the absence of any involvement of therapeutic medication, no formal approval of the Institutional Review Board of the local Ethics Committee was required. Furthermore, the

American Psychological Association's (APA) Ethical Principles of Psychologists and Code of Conduct were followed.

In Study 2, participants were recruited from several Italian companies following a convenience sampling procedure. Firstly, the researchers of this study contacted several companies from various sectors and informed Human Resources (HR) managers of the opportunity to participate. Once accepted, an email invitation was sent to 786 people, 495 of whom responded (response rate = 62.9%). All participants agreed to participate voluntarily in the research and stated that they were at least 18 years old. The questionnaires were administered through the Google Forms platform. The whole process was performed following the APA Ethical Principles and Code of Conduct and in accordance with the Declaration of Helsinki. Given the observational nature of the study, and in the absence of any involvement of therapeutic medication, no formal approval of the Institutional Review Board of the local Ethics Committee was required.

2.3. Data Analysis

The statistics software IBM SPSS® (v. 26, package for Windows, SPSS Inc., Chicago, IL, USA) was used to analyze the data. Initially, the distribution of the variables was analyzed using the Kolmogorov–Smirnov test to check for normality. After establishing the normality of the distribution, the descriptive statistics, including the mean and the standard deviation and Pearson correlations between Intrusion (independent variable), hyperarousal (first mediator), avoidance (second mediator), and fear of COVID-19 (dependent variable of Study 1)/mental health (dependent variable of Study 2) were obtained. Secondly, reliability analyses were performed for the study variables. Furthermore, the SPSS macro PROCESS 3.3 (Andrew F. Hayes, AB, Canada) was used to test the proposed associations regarding the mediation models (Figures 1 and 2) [35]. Then, a standard procedure was followed using a 10,000 bootstrap sample, which produced 95% bias-corrected confidence intervals. A path is statistically significant if the associated 95% confidence interval (CI; bias corrected) does not include zero. The level of significance was set at $p \leq 0.05$.

3. Results

3.1. Descriptive Analyses

Descriptive statistics (i.e., means, standard deviations) and bivariate correlations between the study variables regarding Study 1 and Study are described in Tables 4 and 5, respectively. As expected, intrusion correlated positively with hyperarousal (r = 0.65 in Study 1; r = 0.63 in Study 2), avoidance (r = 0.53 in Study 1; r = 0.52 in Study 2), and fear of COVID-19 (r = 0.42 in Study 1). Also, Intrusion correlated negatively with mental health (r = −0.25 in Study 2). Furthermore, hyperarousal (r = 0.41) and avoidance (r = 0.36) were positively correlated to fear of COVID-19 (Study 1); whereas hyperarousal (r = −0.49) and avoidance (r = −0.43) were negatively correlated to mental health (Study 2).

Table 4. Mean, standard deviation, and correlations among the study variables in Study 1.

	M	SD	1	2	3
1. Intrusion	3.40	1.07			
2. Hyperarousal	2.75	1.08	0.65 **		
3. Avoidance	2.84	1.19	0.53 **	0.75 **	
4. Fear of COVID-19	26.63	7.21	0.42 **	0.41 **	0.36 **

Note: $N = 627$. M = mean. SD = standard deviation. ** $p < 0.01$.

Table 5. Mean, standard deviation, and correlations among the study variables in Study 2.

	M	SD	1	2	3
1. Intrusion	2.92	1.08			
2. Hyperarousal	2.09	0.96	0.63 **		
3. Avoidance	2.12	1.11	0.52 **	0.70 *	
4. Mental health	1.98	0.45	−0.25 **	−0.49 **	−0.43 **

Note: N = 495. M = mean. SD = standard deviation. * $p < 0.05$; ** $p < 0.01$.

3.2. Multiple Mediation Analyses

The first multiple mediation analysis was performed to test the associations between intrusive thoughts, hyperarousal, avoidance, and fear of COVID-19. As can be seen in Figure 3, intrusion was positively and significantly related to hyperarousal (a_1 = 0.65; $p < 0.01$), and avoidance (a_2 = 0.07; $p < 0.01$). The relationship between intrusion and fear of COVID-19 (c = 0.42; $p < 0.01$) was partially mediated by hyperarousal. Meanwhile, the direct effect kept its significance (c′ = 0.88; $p < 0.01$). Once the multiple mediation pathways were tested, only path 1 (a_1b_1 = intrusion–hyperarousal–fear of COVID-19) was significant (B = 0.41; SE = 0.13; 95% CI = 0.14; 0.67). Thus, higher intrusion activity resulted in higher hyperarousal, which increased the fear of COVID-19.

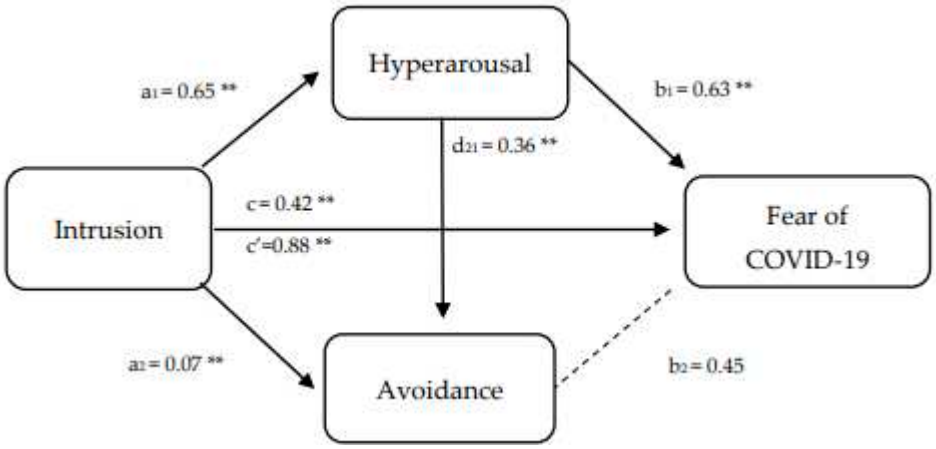

Figure 3. Sequential mediation model proposed to test the associations between intrusive thoughts, hyperarousal, avoidance, and fear of COVID-19. ** $p < 0.01$.

The second multiple mediation analysis was performed to test the associations between intrusive thoughts, hyperarousal, avoidance, and mental health. As can be seen in Figure 4, intrusion was positively and significantly related to hyperarousal (a_1 = 0.55; $p < 0.01$), and avoidance (a_2 = 0.13; $p < 0.01$). The relationship between intrusion and mental health (c = −0.10; p = 0.02) was partially mediated by hyperarousal and the direct effect continued to be significant (c′ = −0.05; $p < 0.01$). Once the multiple mediation pathways were tested, three significant paths were found: path 1 (a_1b_1 = intrusion-hyperarousal-mental health; B = −0.11; SE = 0.02; 95% CI = 0.07; 0.15), path 2 ($a_1d_{21}b_2$ = intrusion-hyperarousal-avoidance-mental health; B = −0.07; SE = 0.02; 95% CI = 0.02; 0.12), and path 3 (a_2b_2 = intrusion-avoidance-mental health; B = −0.02; SE = 0.01; 95% CI = 0.01; 0.04). After examining the pairwise contrasts of indirect effects, the first path was found to be the most important. Thus, greater intrusion activity resulted in higher hyperarousal, which reduced perceived mental health.

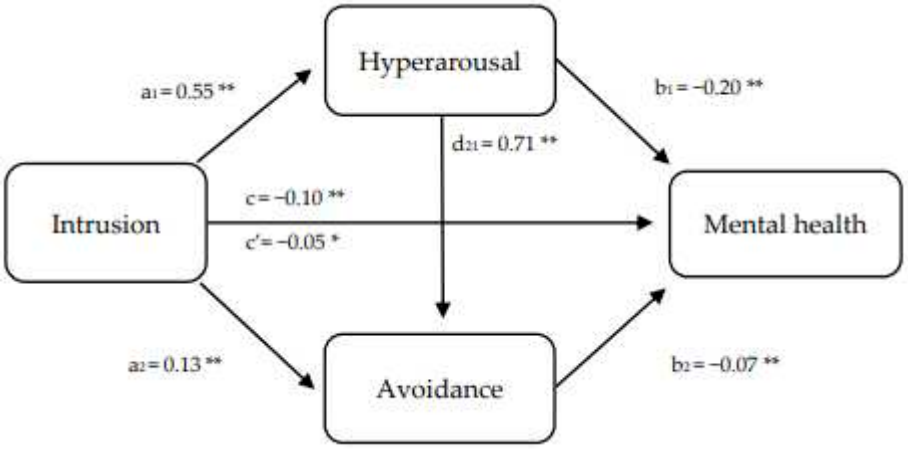

Figure 4. Sequential mediation model proposed to test the associations between intrusive thoughts, hyperarousal, avoidance, and mental health. * $p < 0.05$. ** $p < 0.01$.

4. Discussion

This study aimed to further-develop the understanding of the consequences of COVID-19 pandemic within the PTSD framework. Specifically, hyperarousal and avoidance have been suggested as possible underlying mechanisms between intrusion, considered as the primary factor in the onset of post-traumatic symptoms of PTSD, and two different outcomes, that is, fear of COVID-19 and mental health. Nowadays, PTSD is widely recognized as one of the most probable psychosocial consequences of the COVID-19 pandemic (e.g., [11]). Although interest on the psychological impact of COVID-19 pandemic is increasing (e.g., [36]) existing research has not fully considered yet the role of PTSD and its consequences on mental health and COVID-19 related issues. In the present research, two studies were designed to address this gap by developing and testing two independent models in which two dimensions of PTSD, hyperarousal and avoidance, mediated the effects of intrusion on two individual outcomes. Study 1 examined the association of intrusion with a type of individual reaction closely related to COVID-19: fear of COVID-19. Study 2 investigated the relationship between intrusion and mental health. Both models are drawn on the theoretical model of Horowitz, which considers intrusive thoughts as a factor that may precede avoidance and hyperarousal [37].

The current findings provided further evidence for this approach. First, the results supported the relationship between the variables. In this regard, in Study 1 intrusion correlated positively with hyperarousal, avoidance, and fear of COVID-19. Furthermore, hyperarousal and avoidance were negatively related to fear of COVID-19. In Study 2, intrusion correlated positively with hyperarousal and avoidance and negatively with mental health. Similarly to Study 1, hyperarousal and avoidance were negatively correlated with mental health. With respect to path model in study 1, intrusion had a positive and significant direct effect on fear of COVID-19; furthermore, the indirect effect of intrusion on fear of COVID-19 via two mediators (hyperarousal and avoidance) was positive and significant only for hyperarousal. Regarding the path model in Study 2, intrusion had a positive and significant direct effect on mental health. Furthermore, the indirect effect of intrusion on fear of COVID-19 via two mediators (hyperarousal and avoidance) was negative and significant only in the case of hyperarousal. Therefore, hyperarousal mediated the relationship between intrusion and two individual outcomes, emphasizing the key role that hyperarousal plays in the domain of PTSD. Despite the fact that intrusive symptoms can generate higher levels of avoidance, this study highlighted the prevalence of hyperarousal over it [38].

This result supports the idea that COVID-19 pandemic is a pervasive and specific mass traumatic event that people fundamentally perceive by shifting to a position of hypervigilance rather than avoidance. Such findings are coherent with the CATS theory,

which proposes that cognition leads to physiological activation [18]. Practically speaking, the contingent situation makes people constantly think about the traumatic event of the COVID-19 pandemic and this leads to feel nervous and alarmed, having excessive vigilance. Moreover, as they cannot avoid the traumatic event and get rid of the stressor, they experience negative emotions and fear subsequently affecting their mental health in a harmful manner.

The present study highlighted the key role of hyperarousal in the relationship between intrusive thoughts and fear of COVID-19 and intrusive thoughts and mental health, showing its strategic role for a better understanding of psychological health promotion strategies. In summary, our findings broaden research findings on COVID-19 and PTSD, as they can be used and applied to better explain the individual consequences of the COVID-19 pandemic.

4.1. Limitation and Future Directions

Despite the precautions, the present work has several limitations that need to be considered in the future. First, despite having stated the theoretical foundations that support our proposals, the current research followed a cross-sectional design, which does not allow for causal inference about the relationships among the study variables. Future research should employ longitudinal designs to replicate these findings and shed light on how PTSD could lead to different individual outcomes such as fear of COVID-19 and mental health consequences. Furthermore, future studies are needed to support the link between the three fundamental factors of PTSD. In this regard, we are aware that the model tested via a cross-sectional study is not the best way to examine a mediation effects [39]. However, we are supported by both theoretical and empirical evidence so that we can be a little more confident that the direction may follow the proposed path [13,37]. Future research needs to address the potential bidirectional associations between PTSD symptoms and negative emotions and possible negative spirals in which fear of the COVID-19 pandemic can reinforce intrusive thoughts and maintain an elevated physiological activation or, in contrast, potential adaptation to the traumatic event that may help people cope with the situation [40,41].

A second weakness is related to the non-probabilistic sampling technique. In both studies, the samples were recruited following a convenience sampling procedure, which may have undermined the generalization of our results. However, as described above, both samples were composed of a heterogeneous group of people, covering different age groups with a balanced gender distribution. Moreover, the recommendations offered by Wheeler et al. were followed [34]. This perspective supports this method of data acquisition as it has shown good levels of validity and reliability and is usually employed in organizational psychology. Furthermore, the COVID-19 pandemic forced this type of data collection inasmuch as traditional paper and pencil questionnaires were very difficult to administer. Future research should test the generalizability of these results in larger representative samples. There is another limitation in relation to the sample, in this case corresponding to Study 2. In view of the possible reluctance of certain workers to participate in the study, after consulting with the HR departments of different companies, it was decided to collect the lowest quantity of sociodemographic data so that no worker could be identified. Thus, the age of the participants was not asked.

Finally, the complex emotional situation resulting from the pandemic should be taken into account. In general, individuals have experienced unstable feelings and these may have changed their perception, influencing the responses to the questionnaires [42]. Indeed, it should be noted that this research uses self-report measures that may include cognitive bias [43]. Despite possible limitations, this research provides support for the theoretical basis and offers interesting insights into the relationship between the COVID-19 pandemic as traumatic event, mental health, and fear of COVID-19.

4.2. Implications

Despite these limitations, some practical and theoretical implications can be drawn from the present study. Starting from the latter, previous research has highlighted a significant gap in the current literature on PTSD (e.g., [44]) in particular regarding the absence of recent studies related to the Horowitz model and cognitive appraisal theories. Consequently, one of the aims of this study was to fill this gap. We found support for the role of intrusive thoughts as the primary factor in the onset of post-traumatic symptoms, which may precede hyperarousal and avoidance responses. Moreover, our results suggest that hyperarousal, compared to avoidance, plays a mediating role in the relationship between intrusion and individual outcomes. Future research should further investigate these relationships, analyzing the impact of hyperarousal net of intrusion. Hence, our findings shed new light on the Horowitz's theoretical approach and CATS theory to understanding post trauma reactions and explaining the effects of mass traumatic events as the COVID-19 pandemic.

From a practical point of view, the results of this study provide relevant information for clinical and prevention programs, demonstrating the importance of considering intrusive thoughts and hyperarousal as primary symptoms to be treated within the COVID-19 pandemic. Since PTSD is generally associated with poor functioning and a low quality of life (e.g., [45]), our results show that this could also happen within the COVID-19 experience, with detrimental consequences for psychological well-being. Based on our findings, further studies need to be designed to investigate the efficacy of specific interventions for PTSD. These interventions, even within organizational contexts, should support individuals towards a better understanding of their inner feelings and inner self through empowerment processes [46]. The implementation of workplace health promotion programs is advisable, as practical interventions have demonstrated a positive return on investment [47,48]. Furthermore, emotional skills programs could have a significant impact on individual and work outcomes [49,50]. Healthcare professionals, such as psychologists, should provide programs aimed at both the acquisition of healthy life skills and psychoeducation. On the one hand, methods of positive interactions with oneself and others should be proposed. On the other hand, useful information for self-screening should be provided, including information about the negative consequences of stress related to COVID-19 and PTSD.

5. Conclusions

The COVID-19 pandemic has disrupted the lives of individuals across the globe on a personal, social, and occupational level, with negative consequences for psychological functioning. This study brought new insight on the relationship between PTSD and individual outcomes, such as fear of COVID-19 and mental health, during the COVID-19 pandemic in Italy. Furthermore, to the best of our knowledge, this is the first research that investigates the relationship between intrusion as a central dimension of PTSD and two different types of individual outcomes using a mediation model. More specifically, the hypotheses are supported because intrusive thoughts had a significant negative effect on hyperarousal, compared with avoidance, and the former partially mediated the effect of intrusion on fear of COVID-19 and mental health. The present study analyzes hyperarousal and avoidance, defined according to the Horowitz model and CATS theory, in order to provide a new explanation for PTSD and its consequences. As the results are limited by the Italian context and the cross-sectional design, further studies using longitudinal designs and considering other possible mediators and cultural contexts are needed to support the conclusions. Nevertheless, these findings provide interesting theoretical and practical insights.

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Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The data presented in this study are available on request from the corresponding author. The data are not publicly available due to privacy issues.

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Review

Resilience, Coping Strategies and Posttraumatic Growth in the Workplace Following COVID-19: A Narrative Review on the Positive Aspects of Trauma

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Abstract: The COVID-19 pandemic represents a traumatic event that has profoundly changed working conditions with detrimental consequences for workers' health, in particular for the healthcare population directly involved in addressing the emergency. Nevertheless, previous research has demonstrated that traumatic experiences can also lead to positive reactions, stimulating resilience and feelings of growth. The aim of this narrative review is to investigate the positive aspects associated with the COVID-19 pandemic and the possible health prevention and promotion strategies by analyzing the available scientific evidence. In particular, we focus on the constructs of resilience, coping strategies and posttraumatic growth (PTG). A literature search was performed on the PubMed, EMBASE, Scopus, Web of Science, Google Scholar and Psycinfo databases. Forty-six articles were included in the literature synthesis. Psychological resilience is a fundamental variable for reducing and preventing the negative psychological effects of the pandemic and is associated with lower levels of depression, anxiety and burnout. At the individual and organizational level, resilience plays a crucial role in enhancing wellbeing in healthcare and non-healthcare workers. Connected to resilience, adaptive coping strategies are essential for managing the emergency and work-related stress. Several positive factors influencing resilience have been highlighted in the development of PTG. At the same time, high levels of resilience and positive coping strategies can enhance personal growth. Considering the possible long-term coexistence and consequences of COVID-19, organizational interventions should aim to improve workers' adaptive coping skills, resilience and PTG in order to promote wellbeing.

Keywords: COVID-19 pandemic; SARS-CoV-2; trauma; growth; psychological health; workers' wellbeing; occupational health and safety

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1. Introduction

A new type of coronavirus (SARS-CoV-2) causing coronavirus disease 2019 (COVID-19) was identified in December 2019, and on 11 March 2020, the World Health Organization [WHO] declared COVID-19 a global pandemic [1]. Science has made great strides in controlling COVID-19 infection, particularly because of vaccine development. However, predictions on future scenarios point to a possible coexistence with COVID-19 for many years, underlining the need to address the psychological aftermath of the pandemic [2,3]. Pandemics and bio-disasters have been associated with detrimental consequences for the physical and mental health of individuals, especially in the case of healthcare professionals

who generally carry the greatest burden [4,5]. Data from previous experiences, as in the case of Severe Acute Respiratory Syndrome (SARS) of 2003, Middle East Respiratory Syndrome (MERS) of 2013–2016 and Ebola of 2014–2016, display an alarming picture with symptoms such as anxiety, depression, burnout and post-traumatic stress disorder (PTSD) that persist even after 1–3 years [6,7]. Likewise, there is growing evidence that COVID-19 is associated with post-traumatic symptoms and psychological disorders, especially for frontline health workers [8,9]. For example, a recent meta-analysis [4] analyzed 65 studies for a total sample of 79,437 participants and highlighted a prevalence of 34.4%, 31.8%, 40.3%, 11.4%, 27.8%, 46.1% and 37.4% for anxiety, depression, stress, post-traumatic stress syndrome, insomnia, psychological distress and burnout, respectively. Furthermore, the COVID-19 pandemic is characterized by peculiarities not found in previous disasters such as prolonged insecurity and global economic and social consequences, representing a mass traumatic event [5,10].

The post-disaster mental health literature and trauma research have actually shown that adverse effects on psychological health do not always occur and that traumatic experiences can even lead to positive emotional states and growth [11–16]. Even after experiencing terrible events, the evidence suggests that people may experience some positive aspects, such as in the case of bereavement, rape, cancer, terrorism, natural disasters and even epidemics, as in the case of the MERS outbreak [14–17]. The ability to adapt to unpleasant situations and to recover quickly from trauma has been studied through the constructs of resilience, posttraumatic growth (PTG) and coping strategies [11,12,14,18,19]. Research has not yet reached unanimous agreement on the definition and conceptualization of resilience. Generally, the construct can be defined as positive adaptation despite adverse conditions or as the ability to maintain adequate functioning despite destructive events [12,20–22]. Posttraumatic growth defines the positive psychological change that occurs following highly stressful and demanding life situations. The positive transformation originally involved three domains, which were then extended to five thanks to the development of the Post-traumatic Growth Inventory (PTGI): "personal strength", "relating to others", "appreciation of life", "openness to new possibilities" and "spiritual change" [13,14]. The concept underlying the PTG experience concerns the disruption of the individual's belief system, which is called the "assumptive world". The following process of emotional regulation and sense making will then lead to growth as a result of the rebuilding attempt [14–16]. As for the relationship between the constructs, the research results are still inconclusive [16]. For example, according to Tedeschi and Calhoun [14] the adversity experienced is greater in the case of PTG, which involves a qualitative transformation in functioning that exceeds the ability to resist traumatic circumstances. Nevertheless, some studies show a significant relationship between resilience and PTG [17,23]. Eventually, another factor that strongly affects the psychological outcomes of disaster-exposed employees refers to coping, which can be defined as the set of adaptive or maladaptive cognitive/behavioral strategies used to deal with adverse and stressful events [11,24]. Coping strategies can be generally classified as problem-focused (e.g., trying to solve the situation, address the cause) and emotion-focused (e.g., reinterpretation, distancing) or as approach-focused (i.e., strategies aimed at dealing with stressor) and avoidance-focused (i.e., maladaptive avoidance of the situation) [19,24]. Furthermore, approach-focused coping styles such as proactive behaviors, seeking social support and facing the situation are associated with greater resilience [11]. Similarly, active strategies such as problem-focused coping and active-relational coping are significantly associated with increased PTG [25].

Hence, the literature shows that the aftermath of tragic events can have a positive impact in terms of personal growth and meaning, suggesting that resilient attitudes may be more prevalent than expected [11,12,15,18]. In this regard, Bonanno [12] challenged the grief work assumption, arguing that the most common reaction to highly traumatic events are not symptoms of distress such as PTSD and depression as much as resilience. For example, analyzing the reactions of New York residents after 11 September 2001, Bonanno and colleagues [26] found resilience, defined as the absence of PTSD, in 65.1% of the sample (N = 2752). Nevertheless, this perspective does not imply that resilient people

do not experience symptoms of discomfort but rather that these do not compromise the general trajectory of functioning [12,27]. Evidence shows that traumatic events can bring positive aspects with prevalence rates for growth ranging 30–70% and 40–75% for more traumatizing professions [11,15,28]. In addition, growth also occurs in cases of vicarious or secondary trauma as for professionals who work closely with victims of adverse events (e.g., health personnel, social workers) [29]. Regarding the specific context of bio-disasters, a recent study analyzed PTG in a sample of healthcare workers (HCWs) involved in the 2015 MERS epidemic in South Korea [17]. The results showed that resilience was the only significant predictor of PTG while the interviews showed that resilience was experienced in terms of the hardiness, persistence, optimism and support sub factors.

As scholars have pointed out, evidence-based approaches are needed to protect workers' health and promote successful adaptation in the aftermath of COVID-19. However, most of the available studies have investigated the negative outcomes of the COVID-19 pandemic, highlighting a gap in research examining whether the positive aspects are achievable and how this can be done [3,11,12,18]. In light of this, the purpose of this narrative review is to collect the available evidence on the positive and adaptive aspects in the context of the COVID-19 pandemic. In particular, our main objective is to analyze the protective factors for the mental health of workers with reference to the constructs of resilience, coping and PTG.

2. Materials and Methods

2.1. Literature Research and Data Collection

A literature search was performed on the PubMed, EMBASE, Scopus, Web of Science, Google Scholar and Psycinfo databases from 15 April 2021 up to 31 May 2021. The search strategy used a combination of free text and controlled vocabulary, including the keywords "resilience", "coping strategies", "posttraumatic growth", "personal growth", "workers", "employees", "covid-19", "pandemic". A manual research was also performed screening the bibliographic references of the most relevant selected papers. The research was based on the following PICO scheme:

- Population: Workers from any sector.
- Intervention: The consequences of the COVID-19 pandemic in the workplace.
- Comparison: Not considered.
- Outcome: Resilience, coping strategies, posttraumatic growth, personal growth.

Two independent reviewers (G.L.F. and L.G.L.) read titles and abstracts of the papers identified by the search strategy and carried out a first screening; a further selection was subsequently made by analyzing the full text of the articles. Investigators provided their judgment on the inclusion of each document separately, and disagreements were resolved by discussion with a third reviewer (C.P.). Data were manually extracted in a chart developed jointly by the authors, including title, authors, year of publication, type of study, type of job, sample, country where the investigation took place, aims and variables analyzed and a short summary of the findings. In this article, we merged title, authors and year of publication into the category "reference" (see Table 1). After the collection of the relevant data, a synthesis of the evidence was performed following a qualitative and narrative approach. In particular, the findings for each topic (posttraumatic growth, resilience, coping strategies) were collected together, identifying similarities and differences between the selected studies, as well as relationships, risk factors and outcomes.

Table 1. Summary of articles included in the narrative review.

Reference	Research Design/Sample/Nation	Variables Considered/Main Aims	Brief Summary	Topic
Cui et al. [30]	Cross-sectional/167 frontline nurses/China	Post-traumatic growth (PTG) prevalence/rumination/socio-demographic variables.	In the sample of nurses, the level of PTG was medium to high. This was influenced by years of work, self-confidence with respect to frontline work, risk awareness, psychological training and deliberate rumination.	PTG
Nowicki et al. [31]	Cross-sectional/325 nurses/Poland	Level of post-traumatic stress/perceived social support/opinions about the positive and negative consequences of the pandemic/sense of security and sense of meaning.	The team of nurses presented with intense post-traumatic symptoms with high avoidance symptoms. The pandemic had induced a reduced sense of security with an intense reflection on issues related to the security of oneself, others and the world. The respondents valued the meaning of life but were less likely to seek it out. In addition, PTG was detected, highlighted by positive changes in the existing situation.	PTG
Lee and Lee [32]	Qualitative study/Nurses with at least 1 year of general experience and 2 months of experience in a COVID-19 ward/South Korea	Experience in patient care in a COVID-19 hospital.	Nine themes were identified: pushed onto the battlefield without any preparation, fighting on the front line, altered daily life, low morale, unexpectedly long war, ambivalence towards patients, forces that keep me going, giving meaning to my work and taking another step forward in one's own growth. Nurses who have interfaced with COVID-19 patients have experienced both negative and positive consequences such as PTG.	PTG
Kalaitzaki and Rovithis [33]	Cross-sectional/673 healthcare workers/Greece	The role of resilience and coping strategies in the secondary stress of Greek health workers and PTG following lockdown. Secondary traumatic stress (STS) and vicarious posttraumatic growth (VPTG).	The results suggested that greater resilience corresponded to lower levels of STS and higher levels of VPTG. PTG was associated with the use of positive coping strategies.	PTG, RESILIENCE AND COPING STRATEGIES
Kowalski et al. [34]	Brief report/179 Mechanical Turk workers/United States of America (USA)	Benefit seeking, PTG, coping style (positive reframing), optimism/pessimism, gratitude, general well-being, personal satisfaction.	Results showed a decline in satisfaction with work, leisure, fitness, mental health and finances in the midst of the pandemic. Benefit finding in relation to COVID-19 was significantly related to PTG, coping, gratitude and mental health. The most common positive aspects of the pandemic included more time with family and friends, a slower pace of life and improvements in physical health.	PTG AND COPING STRATEGIES

Table 1. *Cont.*

Reference	Research Design/Sample/Nation	Variables Considered/Main Aims	Brief Summary	Topic
Liu et al. [35]	Cross-sectional/200 nurses/China	PTG, perceived job benefits, resilience and intention to stay at work.	The results showed that resilience had the strongest direct effect on intention to stay. Perceived professional benefits were a mediating factor in the association between resilience and intention to stay. The multiple serial mediations of PTG and perceived occupational benefits in the relationship between resilience and intention to stay were statistically significant.	PTG AND RESILIENCE
Chen et al. [36]	Cross-sectional/12,596 nurses/Not available (N.A.)	Assessment of trauma, burnout, PTG and influence of associated factors such as age, gender, level of education, assignment, affiliated department and patient care with COVID-19.	Nurses, ICU nurses, nurses working in COVID-19 hospitals and wards involved in treating COVID-19 patients all have worse mental health outcomes.	PTG
Moreno-Jiménez et al. [37]	Longitudinal study/172 health professionals/Spain	Workload, fear of infection, lack of staff and personal protective equipment (PPE), harmonious passion, STS and PTG.	Results revealed that in the second survey, workload and fear of contagion were positive predictors for STS, whereas harmonious passion was a negative predictor. Fear of contagion at time 1 and time 2 seemed to positively predict PTG, as did harmonious passion. Lack of staff/PPE, appeared to be a moderator as PTG was greater when workload was high, particularly in those with a high staff/PPE shortages.	PTG
Babore et al. [38]	Cross-sectional/595 healthcare professionals/Italy	Protective and risk factors for stress with reference to: socio-demographic variables, direct exposure to COVID-19 and coping strategies	The results suggested that a positive attitude towards the stressful situation was the main protective factor. Social support seeking, avoidance strategies and working with COVID-19 patients were risk factors.	COPING STRATEGIES
Hines et al. [39]	Longitudinal study/96 healthcare workers/USA	Moral injury and distress scores are expected to be higher during the first three months of the COVID-19 pandemic and should be affected by resilience factors such as job type, social support and sleep problems.	Moral injury scores remained stable for three months, while distress decreased. A favourable work environment is associated with lower moral impairment, whereas a stressful and less favourable environment is associated with increased moral impairment. Distress was not influenced by any occupational or resilience factors at baseline, except for poor sleep.	RESILIENCE

Table 1. *Cont.*

Reference	Research Design/Sample/Nation	Variables Considered/Main Aims	Brief Summary	Topic
Serrão et al. [40]	Cross-sectional/2008 healthcare workers/Portugal	Analysis of the mediating role of resilience in the relationship between depression and burnout (personal, work-related and patient-related).	Psychological resilience partly mediated the relationship between depression and all three dimensions of burnout.	RESILIENCE
Zadok-Gurman et al. [41]	Prospective controlled trial with an intervention group (N = 35) and a comparison control group (N = 32)/67 teachers/Israel	Evaluation of the effect of IBSR on resilience, burnout, mindfulness and stress among teachers during the COVID-19 pandemic.	Mixed IBSR intervention improved teacher resilience and psychological and subjective well-being. At the same time, the control group experienced higher levels of burnout and a reduction in well-being.	RESILIENCE
Lorente et al. [42]	Cross-sectional/421 nurses/Spain	Evaluation of the impact of stressors (work overload, insufficient preparation to cope with job demands, lack of support, death and fear of infection) during the peak of the COVID-19 pandemic on the psychological distress of nurses. In addition, the mediating role of problem-focused and emotion-focused coping strategies and resilience is analysed.	All stressors have a significant, direct and negative relationship with nurses' psychological distress; emotion-focused strategies are negatively related to nurses' psychological distress directly and indirectly through resilience; problem-focused strategies are positively related to nurses' psychological distress and negatively and indirectly through emotion-focused strategies.	RESILIENCE AND COPING STRATEGIES
Munawar and Choudhry [43]	Qualitative study/15 frontline emergency HWCs/Pakistan	Coping strategies and COVID-19 psychological impact.	The most frequently used coping strategies were religious coping and a passion to serve humanity and the country.	COPING STRATEGIES
Hong et al. [44]	Cross-sectional/824 nurses/South Korea	The effect of resilience on mental health, work-related stress and anxiety in relation to the COVID-19 pandemic.	A high level of general anxiety, work-related stress during viral epidemics and a low level of resilience were predictors of depression in healthcare workers.	RESILIENCE
Afshari et al. [45]	Cross-sectional/387 nurses/Iran	Resilience score and demographic predictive factors among nurses working in hospitals involved in addressing COVID-19.	The results of this study showed that age, work experience and education level had a significant positive correlation with nurses' resilience score. The nurses' resilience score was low. Multiple regression analysis indicated that work experience and level of education were predictors of resilience.	RESILIENCE

Table 1. *Cont.*

Reference	Research Design/Sample/Nation	Variables Considered/Main Aims	Brief Summary	Topic
Mosheva et al. [46]	Cross-sectional/1106 doctors/Israel	Association between pandemic-related stressors (PRSF) and anxiety and assessment of the potential effect of resilience on anxiety.	The results show a negative association between resilience and anxiety. Four salient PRSFs (mental exhaustion, anxiety about being infected, anxiety about infecting family members and sleep difficulties) were positively associated with anxiety scores.	RESILIENCE
Shechter et al. [47]	Cross-sectional/657 healthcare professionals/USA	Distress, coping and preferences for support	61% of participants reported a greater sense of meaning/purpose from the COVID-19 outbreak. Physical activity/exercise was the most common coping strategy (59%) and access to an individual therapist with self-guided online counselling (33%) was of greatest interest.	COPING STRATEGIES
Huang et al. [48]	Comparative study/802 in total: 374 nurses and 430 nursing students/China	Comparison of emotional responses and coping strategies between nurses and students.	For the group of professional nurses, anxiety, fear, sadness and anger were significantly higher than for college students. More nurses used problem-focused coping strategies than students did.	COPING STRATEGIES
Vagni et al. [49]	Cross-sectional/210 in total: 121 healthcare workers and 89 emergency workers/Italy	Investigation of the relationship between coping strategies used by healthcare professionals and emergency workers to manage emergency-related stressors COVID-19.	The results suggested that the healthcare worker group had higher levels of stress and arousal and used more problem-focused coping strategies than the emergency worker group.	COPING STRATEGIES
Tahara et al. [50]	Cross-sectional/661 healthcare workers/Japan	Analysis of risk and coping factors associated with the mental state of healthcare workers.	The results suggest that female gender, low levels of communication with friends and high anxiety were associated with poorer mental health. Conversely, good health, high job satisfaction and high satisfaction with new activities were associated with a reduction in mental health problems. Most participants chose an avoidance strategy, and participants with poorer mental health were more likely to adopt social support seeking as their coping strategy.	COPING STRATEGIES
Prazeres et al. [51]	Cross-sectional/222 healthcare workers/Portugal	The role of religious-spiritual coping in relation to COVID-19 fear and anxiety in health care workers.	Participants with higher levels on the hope/optimism dimension of the spirituality scale showed less anxiety related to COVID-19.	COPING STRATEGIES

Table 1. *Cont.*

Reference	Research Design/Sample/Nation	Variables Considered/Main Aims	Brief Summary	Topic
Bozdag and Ergu [52]	Cross-sectional/214 healthcare workers/Turkey	Assessment of the psychological resilience of healthcare workers taking into account individual and environmental variables.	Psychological resilience was significantly and positively correlated with life satisfaction, positive affect, perceived social support subscales, age, adoption of personal COVID-19 precautions, diet and quality of sleep while was negatively correlated with negative affect, feeling personally at risk as a healthcare professional and worried about being infected.	RESILIENCE
Lyu et al. [53]	longitudinal study 1—cross-sectional study 2/134 frontline healthcare workers in the first phase and 401 frontline healthcare workers in the second phase/China	The study explores the longitudinal relationship between resilience, PTG and the role of burnout.	Cross-lagged analysis showed that resilience at Time 1 positively predicted PTG at Time 2, which in turn positively predicted resilience at Time 3. PTG at Time 1 also positively predicted resilience at Time 2 (Study 1). Job burnout was negatively related to both resilience and PTG; in particular, emotional exhaustion moderated the link between PTG and resilience (Study 2).	PTG AND RESILIENCE
Huffman et al. [54]	Cross-sectional/785 healthcare providers, medical trainees and administrators/USA	The impact of the COVID-19 pandemic on the psychological well-being of healthcare workers, medical trainees and administrators and identify sources of stress.	Greater resilience was associated with less stress, anxiety, fatigue and sleep problems. Additionally, increased resilience and grit were protective factors in managing personal and systemic stressors at the height of the COVID-19 pandemic.	RESILIENCE
Oluwaseyi Ojo et al. [55]	Cross-sectional/259 employees/Malaysia	Based on the conservation of resources theory, the study investigates the work, social and personal resources underlying employee resilience and the impact of resilience in stimulating work engagement during the COVID-19 pandemic.	The results of the path modelling analysis showed a significant impact of self-efficacy, facilitating conditions and support from family and friends on employee resilience. Furthermore, resilience was significantly associated with engagement.	RESILIENCE
MacIntyre et al. [56]	Cross-sectional/600 language teachers/Several countries from Europe, North America, South America, Asia, Middle East	The survey measured stressors and 14 coping strategies grouped into two types, 'approach' and 'avoidant'.	Correlations suggested that positive psychological outcomes (well-being, health, happiness, resilience and growth during trauma) were positively correlated with coping and negatively correlated with avoidance. Avoidant coping increased as stress increased, demonstrating a possible cost of using avoidant coping strategies.	COPING STRATEGIES

Table 1. *Cont.*

Reference	Research Design/Sample/Nation	Variables Considered/Main Aims	Brief Summary	Topic
Vagni et al. [57]	Cross-sectional/236 in total: 140 healthcare workers and 96 emergency workers/Italy	The aim was to assess which stressors caused secondary trauma and to assess the protective role of the hardiness construct.	Healthcare workers had higher levels of stress and arousal than the emergency worker group, and those involved in COVID-19 treatment were exposed to a high degree of stress and were at high risk of developing secondary trauma. Commitment was associated with high levels of stress, arousal and intrusion, while control showed a protective function. Stress and hardiness accounted for 37% and 17% of the variance in arousal and intrusion, respectively.	COPING STRATEGIES
Li et al. [58]	Comparative study/455 nurses and 424 general population/China	Evaluation of PTG of Chinese nurses and the general population during the COVID-19 pandemic.	The results highlighted some differences in the PTGI score between nurses and the GP, both in the total score and in the 3 dimensions of new possibilities, personal strength and spiritual change. There were also differences between first-line nurses (FLN) and non-first-line nurses (nFLN). Psychological counselling from the WeChat network and self-relaxation were valid coping strategies for relieving nurses' stress.	PTG
Tuan [59]	Cross-sectional/672 employees in the tourism sector/Vietnam	Study of the role of core beliefs challenge in promoting workers' resilience.	The results revealed a positive association between workers' core beliefs challenge and their resilience. Cognitive reappraisal was found to be a mediator in the relationship between core beliefs challenge and resilience, whereas no evidence was found regarding the mediating role of expressive suppression. Family strain negatively moderated the relationship between core beliefs challenge and both emotion regulation strategies.	RESILIENCE
Fino et al. [60].	Cross-sectional/202 healthcare workers/Italy	Analysis of the relationship between post-traumatic stress and PTG, the moderating role of resilience, emotion regulation and social support. Hypothesis: A high level of distress would be associated with PTG in health workers with high resilience, high emotion regulation skills and high social support.	The moderating role of resilience was significant, as indicated by the model and the PTSD-by-resilience interaction. Greater positive reappraisal of events was associated with high levels of post-traumatic growth at normal and above normal levels, but not with low levels of PTSD.	PTG AND RESILIENCE

Table 1. *Cont.*

Reference	Research Design/Sample/Nation	Variables Considered/Main Aims	Brief Summary	Topic
Li et al. [61]	Predictive study/356 front-line nurses/China	Assessment of psychological well-being and factors associated with PTSD before and after nurses worked in COVID-19 wards.	The level of stress and the prevalence of PTSD increased significantly after working in COVID-19 units. Work experience of less than 2 years was significantly associated with a high risk of developing PTSD. Nurses working in COVID-19 wards were significantly more likely to suffer from PTSD than those working in other COVID-19-related units. Resilience was negatively associated with PTSD.	RESILIENCE
Zhang et al. [62]	Cross-sectional/180 front-line nurses/China	Analysis of the mediating roles of positive and negative affect in the relationship between resilience and burnout in Wuhan hospital nurses at the peak of the COVID-19 pandemic.	Resilience showed significant negative correlations with burnout and emotional exhaustion, depersonalization, reduced personal accomplishment. Resilience correlates positively with positive affect. The excellent preparation to resilience of frontline nurses and the associated positive effect can reduce the risk of burnout.	RESILIENCE
Debanjan et al. [63]	Cross-sectional/172 Physicians working at COVID-19 Hospitals/India	Understanding adversity and defining the resilience framework of doctors in COVID-19 hospitals, through a qualitative approach.	The resilience "framework" of these workers is a process that has emerged as doctors have faced fears of infection, uncertainty, stigma, guilt and social isolation. Unmet needs were flexible work policies, administrative measures for better medical protection, media sensitivity to the image of HCWs, effective risk communication for their health and social inclusion. Resilience consisted of three facets: forming a "resilient identity", managing resilience and working through socio-occupational distress.	RESILIENCE AND COPING STRATEGIES
Coulombe et al. [64]	Cross-sectional/1122 workers from different sectors/Canada	The study aims to explore associations of potential resilience factors at multiple ecological levels (i.e., trait resilience, family functioning, social support from friends, social participation and trust in health care institutions) with mental health and well-being outcomes and their role as moderators against the negative effects of the pandemic.	Meaning of life was positively associated with trait resilience, better family functioning, greater social support from friends, social participation and trust in healthcare institutions. Lower stress was associated with better family functioning, trust in healthcare institutions and greater trait resilience.	RESILIENCE

Table 1. *Cont.*

Reference	Research Design/Sample/Nation	Variables Considered/Main Aims	Brief Summary	Topic
Croghan et al. [65]	Cross-sectional/302 healthcare workers/USA	The purpose of the study was to assess the level of stress, resilience and ability to cope among HCWs during the initial stages of the pandemic and to determine inter-professional differences.	HCWs reported moderate-high stress scores, and normal levels of resilience and coping, the MD/NP/PA group had the highest resilience, while nurses had the lowest. Nurses also had higher stress levels compared to the MD/PA/NP group; older age was associated with higher resilience.	RESILIENCE
Di Giuseppe et al. [66]	Cross-sectional/233 healthcare workers/Italy	This study aimed to identify protective factors against perceived stress and burnout and factors that can improve resilience among health workers.	Mature defences were positively associated with resilience and personal accomplishment, while they have negative influences on stress and burnout. Neurotic and immature defences followed the opposite trend. Lower age, female gender, higher exposure to COVID-19, lower resilience and less adaptive defensive functioning were the best predictors of perceived stress and emotional exhaustion among healthcare professionals.	COPING STRATEGIES
Di Trani et al. [67]	Cross-sectional/267 healthcare workers/Italy	The general aim of this study was to explore the burnout dimensions among Italian HCWs during the COVID-19 emergency and to evaluate their relationships with some psychological features (resilience and intolerance to uncertainty).	HCWs at high risk of burnout showed significantly lower levels of resilience and higher levels of uncertainty intolerance. Levels of resilience and the ability to tolerate uncertainty were significant factors in determining the impact of the COVID-19 emergency on HCWs. The use of emotional strategies that allow individuals to remain in a critical situation without the need to control it seems to protect against burnout in these circumstances.	RESILIENCE
Fleuren et al. [68]	Cross-sectional/1126 healthcare workers/The Netherlands	The study aims to investigate the relationships between resilience, team social climate and depressive complaints, specifically focusing on infection-related fears as a relevant explanatory mechanism.	This model shows that personal resilience is negatively associated with depressive complaints and concerns about infections, which in turn are positively related to depressive symptoms. Team social climate is associated with a lower effect of worries about being infected and infecting others on depressive complaints. Resilience can be an important individual resource in preventing depressive complaints.	RESILIENCE

Table 1. *Cont.*

Reference	Research Design/Sample/Nation	Variables Considered/Main Aims	Brief Summary	Topic
Hou et al. [69]	Cross-sectional/1472 healthcare workers/China	The study examined the effect of social support on the mental health of healthcare workers and its underlying mechanisms regarding the mediating role of resilience and the moderating role of age during the epidemic.	The results highlighted the protective role of social support in mental health among healthcare professionals. Resilience could be one of the pathways through which social support contributes to mental health. The effect of social support on mental health through resilience is attenuated in middle-aged healthcare workers compared to younger ones.	RESILIENCE
Sinu et al. [70]	Cross-sectional/120 frontline healthcare workers/India	This study aims to determine burnout and resilience levels and associated factors among frontline nurses caring for COVID-19 patients.	Resilience showed a significant negative relationship with emotional exhaustion and reduced professional efficacy. Emotional exhaustion and reduced personal accomplishments are significantly negatively correlated with total resilience, but there is no significant relationship between depersonalization and resilience. Increasing resilience among nurses will help mitigate the symptoms of burnout.	RESILIENCE
Lin et al. [71]	Cross-sectional/114 healthcare workers/China	Investigation of the resilience of non-local healthcare workers sent to support local healthcare workers in treating the COVID-19 outbreak.	Resilience correlated negatively with anxiety and depression but positively with active coping styles. Active coping, depression, anxiety and training/support provided by the respondent's permanent hospital were significantly associated with resilience.	RESILIENCE AND COPING STRATEGIES
Maiorano et al. [72]	Cross-sectional/140 healthcare workers and 100 emergency workers/Italy	The study aims to investigate the direct and mediated effects of coping strategies and hardiness on secondary trauma among Italian medical staff and emergency workers involved in the first phase of the COVID-19 pandemic.	Physicians, nurses and rescuers were exposed to similar levels of organizational, cognitive, social and emotional stress. The use of cognitive and emotional avoidance strategies, especially in an initial emergency phase seems to allow these workers to limit their sense of helplessness and inability, favoring resilience and the activation of proactive attitudes. Stopping negative emotions seems to reduce stress levels and arousal and intrusive aspects of the trauma. Older workers showed a greater tendency to adopt avoidance strategies toward negative thoughts and emotions, but exhibited higher levels of arousal. Age seems to allow health and emergency workers to stop the intrusive aspects of the trauma, thus making them more committed to the intervention and less influenced by the consequences.	COPING STRATEGIES

Table 1. *Cont.*

Reference	Research Design/Sample/Nation	Variables Considered/Main Aims	Brief Summary	Topic
McFadden et al. [73]	Cross-sectional/3425 healthcare workers and social workers/United Kingdom (UK)	This study examines the relationship between coping strategies and wellbeing and quality of working life in nurses, midwives, allied health professionals, social care workers and social workers who worked in health and social care in the UK during its first wave of COVID-19.	Positive coping strategies, such as active coping and seeking help, have been associated with higher well-being and a better quality of working life. Negative coping strategies showed an opposite trend. The most frequently used coping strategy was acceptance. Avoidance coping was associated with lower well-being. Among the more adaptive coping strategies, active coping and seeking help were found to help be protective factors. Active coping, help seeking, religion, humour, work-family segmentation, working to improve skills, recreation and relaxation and exercise were all coping strategies employed by workers (personal job resources) that protected them from low wellbeing.	COPING STRATEGIES
Roca et al. [74]	Qualitative study/22 nursing students/Spain	The study aimed to qualitatively explore the experiences and emotional responses of senior nursing students who volunteered to provide health assistance at the peak of the COVID-19 pandemic and to identify coping measures taken to deal with the situation.	The coping strategies used in the work context were teamwork, psychological assistance by the healthcare institution, seeking information on COVID-19 care and peer support, primarily through social networks. Other personal strategies included receiving support from family and friends, recreational activities, self-reliance, humour and religion.	COPING STRATEGIES
Zhou et al. [75]	Longitudinal study/107 healthcare workers/China	The study aims to examine the effects of perceived organizational support, self-efficacy and two types of coping strategies on the PTSD symptoms of frontline healthcare workers fighting against COVID-19 in Wuhan.	Perceived organizational support reduced PTSD symptoms through the mediating effect of problem-focused coping and the sequential mediating effect of self-efficacy and problem-focused coping strategies. Emotion-focused coping is less likely to be used and is not effective for reducing PTSD symptoms. Self-efficacy predicted reduction of PTSD symptoms by the mediating effect of problem-focused coping.	COPING STRATEGIES

2.2. Inclusion Criteria

The inclusion criteria followed the PICO scheme mentioned above; in particular, we included articles focusing on positive mental aspects related to the COVID-19 pandemic in the workplace, including articles analyzing resilience and coping strategies applied by workers to deal with the psychological strain of managing the pandemic at work. Articles analyzing posttraumatic growth and personal growth consequent to pandemic were also included.

2.3. Exclusion Criteria

Articles written in languages other of English were excluded. Reports of less academic significance, letters to the editors, non-peer reviewed articles, individual contributions and purely descriptive studies published in scientific conferences without any quantitative and qualitative inferences were excluded from this review. Furthermore, review articles were not included in the literature synthesis but discussed in other paragraphs. Studies regarding the general population and not specifically focused on workers were also excluded.

3. Results

The online search retrieved a total of 1504 papers: Pubmed (232), Scopus (68), Embase (55), Web of Science (231), PsycInfo (64) and Google Scholar (854). Among these studies, 1444 records were excluded because they did not match the inclusion criteria, while 57 full texts were assessed for eligibility. After removing duplicates, 46 articles were included in the literature synthesis. The process of the literature search and the selection of papers is shown in Figure 1. The included studies and the main findings are included in Table 1.

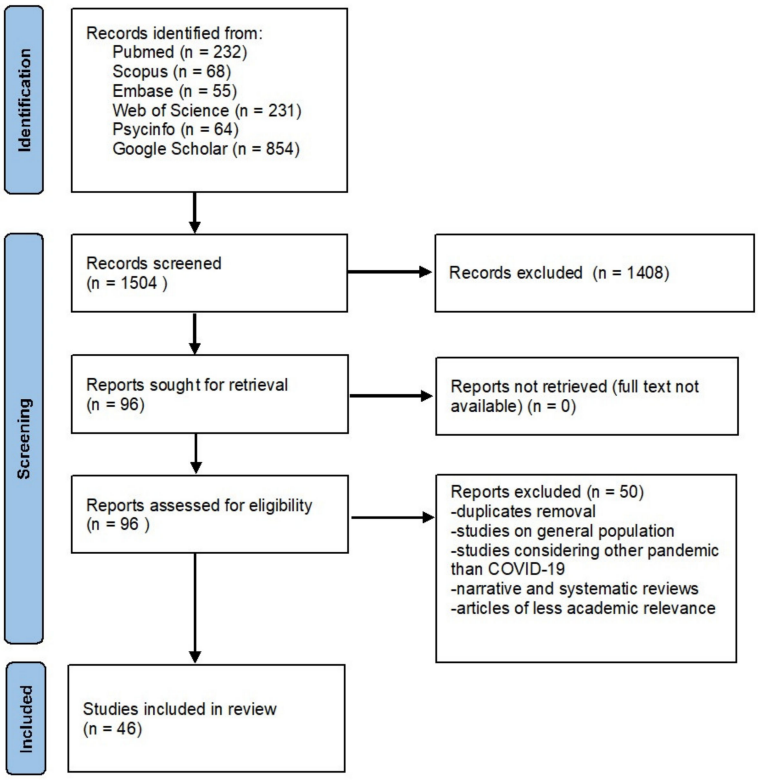

Figure 1. Flow diagram of the literature search and articles selection (adapted from PRISMA 2020 guidelines for systematic reviews) [76].

The articles selected were published in several countries, representing a comprehensive sample from various parts of the world, except for Africa and South America, where no published article met the inclusion criteria. The most representative area was Europe (15 articles, 32.7% of the total) and among these, Italy was the country where most of the

research was conducted (seven articles, 15% of the total). Among the individual countries, China was the most represented with 10 articles (21.3%). Six articles were published in North America (five in USA and one in Canada, 12.8%). Israel (2), India (2), Pakistan (1), Iran (1), Korea (2), Japan (1) and South-East Asia (2) were also present.

Three major topics were identified and analyzed: resilience, coping strategies and posttraumatic growth. The findings for each topic are described in the following paragraphs and further summarized in Table 2.

Table 2. Main findings and implications analyzed by topic.

Topic	Overall Findings	Implications
Resilience	• It is positively associated with PTG, life and professional satisfaction. • It is negatively associated with work-related stress, anxiety and depression. • Age, work experience and level of education positively correlate with resilience. • Resilience boosts work engagement and plays a mediating role between depression and burnout.	• Multi-level interventions are necessary to ensure the resilience of the workforce. • Team leaders should build a sense of collective efficacy through effective communication and transparency. • Counselling sessions, cognitive behavioral techniques and relaxation strategies are useful interventions to translate workers' resources into workplace resilience.
Coping Strategies	• Positive attitude towards the problem, peer support, self-reliance, problem negotiation and self-care are key positive coping strategies. • Emotion and problem-focused attitudes are two common coping strategies associated with positive and negative mental outcomes. • Escape-avoidance coping strategies are associated with higher levels of occupational stress. • Younger age and female gender predict less adaptive functioning.	• A supportive work environment is necessary for the development of adequate coping strategies. • Organizations should devise interventions specifically designed to boost positive and active attitudes and decrease avoidance behaviors. • In order to deal with the traumatic contents, workers should learn to recognize and be aware of their thoughts and emotions.
Posttraumatic growth	• Frontline healthcare workers seem to have higher levels of PTG. • PTG is influenced by the length of service, self-confidence, awareness of the risk of contagion and psychological intervention or training. • PTG is often experienced through "deliberate rumination" or through a positive reappraisal of events. • Adaptive coping strategies and resilience contribute to the development of PTG.	• Organizations should guide workers in perceiving moments of extreme crisis as opportunities. • Workers should be involved in specific programs and workshops dedicated to positive reinterpretation and reframing. • Deliberate cognitive processing along with adequate emotional and instrumental support are among the key factors for successful growth.

3.1. Resilience

Despite the numerous negative psychosocial effects of the COVID-19 pandemic, positive consequences in the workplace are also possible. Among the selected studies, 25 articles analyzed resilience during the COVID-19 pandemic, alone or together with other constructs. Studies concerning this aspect mainly included healthcare professionals as a sample (nurses, surgeons, medical assistants, etc.) and, to a lesser extent, non-healthcare workers. All the studies analyzed followed a cross-sectional design except for two longitudinal studies, one prospective controlled trial and one predictive study.

Resilience was associated in different ways with positive and negative (growth/stress) lockdown outcomes. Resilience correlated with Secondary Traumatic Stress (STS), age correlated with PTG, while education and nearly all coping strategies correlated with both STS and PTG [33]. In Chinese nurses working during the COVID-19 emergency, resilience had the strongest direct effect on intention to stay and significantly influenced PTG and

perceived professional benefits [35]. In a study concerning moral injury among healthcare workers in the US [39], moral injury remained stable over three months, while distress decreased but was not affected by any baseline occupational or resiliency factors. Moreover, resilience played a mediating role between depression and burnout [40,62,70]. Individuals at high risk of burnout showed significantly lower levels of resilience [66]. Furthermore, an Inquiry-Based Stress Reduction (IBSR) intervention improved resilience for a sample of teachers in Israel [41]. Through resilience, emotion-focused strategies were negatively related to psychological distress directly and indirectly in a sample of Spanish nurses [42]. Resilience was negatively correlated with depression, stress and anxiety [44,46,54,65,68,71]. Age, work experience and level of education had a significant positive correlation with nurses' resilience score [45]. Resilience had a positive and significant correlation with life satisfaction, positive affect, perceived social support, participants' age, adoption of personal precautions against coronavirus, nutrition and sleep quality [52]. A Chinese study [53] found that resilience positively predicted PTG and vice versa, creating a cycle of reinforcement between resilience and PTG over time. In addition, burnout was negatively associated with both resilience and PTG. A study conducted on a sample of Malaysian employees showed that resilience was significantly associated with work engagement. Furthermore, self-efficacy influenced work engagement directly and indirectly through resilience [55]. A research carried out on a sample of Vietnamese tourism employees highlighted that core beliefs challenge was positively related to workers' resilience while cognitive reappraisal played a mediating role in this relationship [59]. Resilience also plays a crucial moderating role in the relationship between PTSD and PTG: High levels of resilience enhanced PTG beyond the mean level [60]. In another study carried out on a sample of Chinese front-line nurses, resilience was negatively associated with PTSD [61]. An Indian study conceptualized a resilience "framework" pointing out three concepts: Forming a "resilient identity", the resilience "management" and working through socio-occupational distress [63]. Canadian research [64] underlined the importance of resilience factors (i.e., trait resilience, family functioning, social support, social participation and trust in healthcare institutions) in association with mental health and well-being. Lower stress correlated with higher trait resilience, which, among the five factors, seemed to be the most important. Resilience is also a mediator between the effects of social support and mental health among HCWs [69].

3.2. Coping Strategies

Sixteen of the studies (34%) included in the review analyzed coping strategies applied in the workplace to deal with the pandemic emergency. Most studies used a cross-sectional design and surveys to explore the type of coping strategies and their association with psychological outcomes. Only two studies used a qualitative approach and one study employed a longitudinal design. Fourteen studies explored coping strategies among health-care workers, while the other two investigated this topic in teachers and mechanical Turk workers, respectively. In healthcare workers, coping strategies seem to play a fundamental role in the management of the emergency and the related occupational stress. Positive and negative coping strategies were identified. The former were associated with a reduction in poor mental health outcomes [38,42,51,66,71,72,74,75]. Active coping strategies were also positively associated with resilience [71]. The key positive coping strategies were a positive attitude towards the problem, social network, peer support, teamwork, self-reliance, problem negotiation and self-care [38,63,74]. Seeking social support was a common coping strategy. In addition, in some studies, this strategy was adopted to a greater extent by workers with lower mental well-being [38,50]. A problem-focused attitude was found to be a protective factor for reducing anxiety and depression [38,48] while another study highlighted an association between this coping strategy and higher levels of nurses' psychological distress [42]. Emotion-focused strategies were negatively related to nurses' psychological distress directly and indirectly through resilience [42] and were mostly employed by men [48]. Comparing problem and emotion-focused cop-

ing strategies, only problem-focused coping was effective in reducing PTSD symptoms, mediating the positive effect of organizational support [75]. PTG was also linked to coping strategies, being predicted by a mixture of adaptive and maladaptive strategies [33]. Escape-avoidance coping strategy was common [50] and was associated in some studies with a higher level of stress along with overcommitment [33,38,43,49]. At the same time, as pointed out by Maiorano et al., [72] avoidance strategies allowed workers in the first phase of emergency to limit their sense of helplessness and inability, favoring resilience and the activation of proactive attitudes. Religious practices were also investigated as coping strategies, being highlighted as common [43] but not significant in reducing stress levels [38,51], although workers with higher levels in the hope/optimism dimension in the field of spirituality showed less coronavirus-related anxiety [51]. Finally, lower age and female gender, along with lower resilience and less adaptive defensive functioning, were predictors of stress [38,50,66]. Even in non-healthcare workers, coping strategies were common methods for dealing with the new conditions dictated by the pandemic [34]. In teachers, similarly to healthcare workers, avoidance coping strategies were associated with higher stress and reduced positive psychological outcomes [56].

3.3. Posttraumatic Growth (PTG)

Among the selected studies, nine articles (19%) analyzed PTG during the COVID-19 pandemic, alone or in combination with the other constructs. All of the selected articles were studies analyzing prevalence, level and possible association of PTG in healthcare workers who dealt with the health emergency at some level. Six articles out of nine (66%) explored the PTG of nurses, while the other three had generic healthcare workers as a sample. Most of the studies used the Post Traumatic Growth Inventory Scale (PTGI by [13]) to assess the impact of this variable on HCWs, one study used the Changes in Outlook Questionnaire (CIOQ by [77]) and one study used a qualitative approach through interviews with the subjects involved. Pandemic-related distress and growth are connected in a complex relationship that depends on intra- and inter-personal factors [60]. In nurses working in the COVID-19 emergency, an intensification of traumatic stress symptoms has emerged, for example regarding symptoms of avoidance [31]. At the same time, they also reported positive changes in the existing situation, which may be an expression of adaptation in the form of PTG [31]. In particular, healthcare workers working on the frontline seem to have higher levels of PTG compared to non-frontline healthcare workers [32,36,58]. Some factors have been recognized as being associated with PTG: In one study [30], PTG was influenced by the length of service, self-confidence in frontline work and psychological intervention or training during the epidemic. Workers have often experienced PTG through "deliberate rumination", a process of seeking value and meaning to their own experience [30,32] or through the tendency to positively reappraise events [60]. Fear of contagion and awareness of the risk were found to be associated with PTG [30,37] while lack of personal accomplishment was a key negative influence factor [36]. In another study [33], a combination of adaptive coping strategies predicted the level of PTG, as described also by study [58]; passion for work was also a determinant for the development of PTG [37]. Other personal factors associated with PTG were sex, fertility and marital status [58]. Moreover, resilience seems to play an important role in the development of PTG, as reported in study [35], which showed that the higher the nurse's resilience, the easier it is to perceive professional benefits, which results in stronger intent to continue working on the frontline. High levels of resilience enhanced growth beyond mean and clinically relevant levels of PTSD [60].

4. Discussion

Since the beginning of the COVID-19 pandemic, scholars have collected substantial evidence regarding the tremendous impact of this situation on the workforce, especially in the case of healthcare workers dealing directly with the disease [8,78,79]. The sudden and massive outbreak of COVID-19 has overwhelmed even the most advanced healthcare

systems and has significantly affected almost all business sectors, leading to the need for organizational changes. After an initial pandemic phase characterized by a significant lack of resources, the situation continues to exert extreme pressures on healthcare professionals [80,81]. Furthermore, in non-health settings, the economic crisis, the implementation of safety and contagion measures, the adoption of remote work, increased and decreased workloads and the overall uncertainty about the future have negatively affected the mental health of workers in several economic sectors [78]. To the best of our knowledge, this review represents the first attempt to comprehensively analyze the positive aspects of COVID-19 seen as a traumatic experience in the workplace. Indeed, a better understanding of the mental processes underlying traumatic experiences and their determinants seems crucial in planning occupational safety and health practices.

Most of the retrieved articles considered healthcare professionals as a sample, as the literature has extensively analyzed the impact of the sanitary emergency on these workers. Despite the negative mental effects, dealing with the COVID-19 pandemic has forced workers to develop resilience strategies, as during other outbreaks [17]. As already mentioned, resilience is generally defined as the ability to adapt and maintain adequate functioning despite adverse events and can be conceptualized as a trait, outcome or process [20–22]. For healthcare workers, coping with mental health problems such as anxiety, depression and burnout during the emergency can be challenging. Overwhelmed by the workload, the lack of material and human resources, workers also face an increased risk of 'moral injury' when addressing the ethical challenges of the pandemic and the discrimination experienced due to the fear of contagion by the general population [82,83]. As evidenced by previous research, psychological resilience is a fundamental variable in reducing and preventing the negative psychological effects of the pandemic [18]. In our review, we found that resilience is associated with lower levels of depression, anxiety and burnout [44,46,53,54,65,68,71]. Resilience improves personal growth and perceived professional benefits [33,53] and has a positive impact on work engagement even in non-healthcare workers [28]. Overall, we found that age and work experience positively correlate with aspects of resilience in workers. A relevant point is that resilience is considered not only at the individual level, as a key role is played by the organizational resilience mechanisms that shape the way healthcare professionals experience the crisis [3,84,85]. Resilience seems to be a pivotal variable in dealing with work-related stress, even in the toughest situations, such as the COVID-19 pandemic. The close relationship between the organizational and personal levels underscores the need for practical measures to support and strengthen resilience, including education, resilience training and interventions to create the feeling of being prepared [86,87] Furthermore, interventions should focus on young and less experienced workers, as they are the most vulnerable in terms of developing resilience. Closely related to resilience, we found that coping strategies play a fundamental role in the management of the emergency and the related occupational stress. Negative coping mechanisms like escape and avoidance strategies or overcommitment seem to be associated with worse mental outcomes [33,38,43,49,56], while positive attitude towards the problem, social network, peer support, teamwork, self-reliance, problem negotiation and self-care [38,63,74] play a positive role in reducing stress and boosting resilience. Consistent with research on previous epidemics/pandemics, dysfunctional attachment and maladaptive coping have been highlighted as risk factors for reduced mental well-being [86]. At the same time, resilience indicators (hardiness, vigor) and self-efficacy were found to be protective factors for good mental health outcomes [88]. As pointed out from previous research [89] we found some differences between different categories of healthcare professionals, with nurses experiencing less resilience and more occupational stress [65]. In our view, this may be partly related to the tremendous workload of nursing professionals in caring for COVID-19 patients, who have demanding needs (e.g., pronation in ICU). Interestingly, being a female worker and having less work experience appear to be negative factors for developing adequate forms of coping and resilience, and this may be associated with previous findings on the need for specific training and education to build resilience mech-

anisms [66,72,86]. Arguably, professional experience and higher education levels can be seen as protective factors, as 'experienced' workers have more psychological and even professional resources to learn from the disaster rather than being overwhelmed. The negative association between the female gender and the development of effective coping strategies is consistent with previous research on this aspect. Indeed, women tend to adopt emotion-focused strategies to change their feelings, and these types of strategies can be less effective in coping with stressful situations than problem-focused methods [75], which are more common among men. However, other studies suggest that male workers [48] also adopt emotion-focused coping strategies and more research is needed to explain the mechanisms underlying gender differences. Fighting daily with the virus, as in the context of pandemics, can be considered a form of bio-disaster and traumatic experience. For those involved in the recovery and relief efforts during and after a disaster, the experience has frequently been reported as fulfilling, worthwhile, rewarding and meaningful and can make workers feel they have benefited both personally and professionally [90–95]. In the context of the COVID-19 pandemic, posttraumatic growth forms have been detected in healthcare workers after the early stages, especially in those on the front line [32,36,58]. Several positive factors influencing resilience have also been highlighted in the development of PTG, such as the length of service, self-confidence in frontline work and psychological intervention or training during the epidemic [30]. It seems that more experienced workers express a higher level of PTG, probably due to a higher initial level of awareness, as previously highlighted. At the same time, high levels of resilience and positive coping strategies enhance personal growth so that intervention fostering resilience are likely to help develop PTG [30,36,58].

4.1. Strengths and Limitations

This narrative review represents one of the first attempts to identify the possible positive aspects associated with the COVID-19 pandemic in the workplace. To the best of our knowledge, this is the first comprehensive review addressing personal and psychological growth during and after the COVID-19 pandemic. This review provides in-depth insight into the positive mechanisms underlying workers' resilience, especially HCWs. Identifying such positive associations seems fundamental to guide policy makers and stakeholders towards the future organization of work. Despite its narrative approach, this review used PRISMA compliant method to search the literature, adding value to the evidence retrieved [76]. Nevertheless, despite having followed the guidelines of the literature, some limitations should be addressed. The included studies were conducted in several countries with differences in terms of culture and healthcare systems. The pressure on the workforce may vary according to the type of pandemic management, the level of material and immaterial resources and the time of the pandemic in which the study was conducted while social norms could shape the psychological response, resulting in different experiences of the traumatic event [8,96]. Hence, the level of resilience, PTG and the type and role of coping strategies could have been influenced by the different external circumstances (e.g., prolonged versus brief COVID-19 experience could influence the level of PTG as it takes longer to develop [35]). Another limitation could lie in the heterogeneity of the measurements and in the fact that most of the studies relied on self-report measures. Even if this review includes longitudinal studies that investigate PTG resilience and coping strategies (e.g., [37,39,75]), the majority of the studies employed a cross-sectional design, limiting the strength of the conclusions and the possibility of making causal inferences on the relationships between the variables. A further limitation concerns the lack of heterogeneity of occupations, with most of the research conducted in the healthcare domain with healthcare workers samples (e.g., nurses). Nevertheless, this population was the most affected by the COVID-19 pandemic, making it a suitable target for studying the consequences of traumatic experiences [4,8]. Future reviews could investigate the role of other positive psychology constructs in determining post-disaster mental health outcomes [14,21].

4.2. Practical Implications

This narrative review offers interesting insights into the possible positive outcomes of the COVID-19 pandemic seen as a mass traumatic event and stimulates reflection on what kind of interventions could be implemented. Indeed, health promotion and prevention strategies are essential to foster successful adaptation to challenging environmental conditions [4,5,83]. Previous research has highlighted that the constructs of resilience, PTG and coping strategies are intertwined in a complex relationship (e.g., [23,25]). For example, fostering PTG can lead to enhanced self-efficacy, cognitive flexibility, resilience and better coping skills. Similarly, greater resilience can lead to higher levels of PTG creating a virtuous cycle, as suggested by longitudinal findings [53]. Hence, organizations should implement interventions to foster resilience, PTG and adaptive coping through counselling services, social connection strategies and targeted training with the aim of creating positive cycles [11,33]. For example, trauma risk management has proven to be an effective strategy for enhancing the ability of workers to provide support to other colleagues, thus creating a growth environment, while practices such as self-care, small group discussions, mindfulness programs, computer-based trainings and competency training are effective in promoting resilience [3,11]. Some practical implications are listed in Table 2.

5. Conclusions

The COVID-19 pandemic can be analyzed as a traumatic event that can lead to detrimental consequences for the health of the workers, in particular for the healthcare population and for those directly involved in the management of the emergency. However, positive outcomes are also possible, as underlined by the trauma literature on resilience, coping strategies and posttraumatic growth. Considering the possible coexistence with COVID-19 and the long-term consequences, organizational interventions should be aimed at improving adaptive coping skills, resilience and the PTG of employees, thus leading to fulfilling experiences in a virtuous circle.

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Factors Influencing Adjustment to Remote Work: Employees' Initial Responses to the COVID-19 Pandemic

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Abstract: The COVID-19 crisis has disrupted when, where, and how employees work. Drawing on a sample of 5452 Finnish employees, this study explores the factors associated with employees' abrupt adjustment to remote work. Specifically, this study examines *structural* factors (i.e., work independence and the clarity of job criteria), *relational* factors (i.e., interpersonal trust and social isolation), *contextual* factors of work (i.e., change in work location and perceived disruption), and *communication* dynamics (i.e., organizational communication quality and communication technology use (CTU)) as mechanisms underlying adjustment to remote work. The findings demonstrate that structural and contextual factors are important predictors of adjustment and that these relationships are moderated by communication quality and CTU. Contrary to previous research, trust in peers and supervisors does not support adjustment to remote work. We discuss the implications of these findings for practice during and beyond times of crisis.

Keywords: work adjustment; remote work; structural factors; relational factors; contextual factors; COVID-19 pandemic

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1. Introduction

Even the most conservative estimates anticipate that at least 45 million jobs in the EU-27 labor market (approximately 23% of the total EU-27 employment) are directly at risk from the coronavirus disease 2019 (COVID-19) disruptions [1]. The outbreak of COVID-19 has had a drastic impact on work at a global scale [2]. Changes in when, where, and how work is completed are profound, evidenced, for instance, by widespread remote work directives [3–5]. The extent to which employees can adjust to remote work is crucial for individual outcomes (e.g., mental health, well-being, job satisfaction) and organizational outcomes (e.g., organizational performance). Hence, this study explores factors related to employees' adjustment to remote work practices during the first phases of the COVID-19 pandemic. In achieving the aim of this study, we contribute to emerging research on the impact of the COVID-19 pandemic on work [3,5–8].

In line with Raghuram et al. [9], we view adjustment to remote work as an overall state of adaptation to environmental demands and conditions. Several critical indicators of

adjustment to remote work have been identified, including employees' satisfaction with remote work conditions, perceived job performance as a consequence of remote work, and the ability to balance work and non-work demands [9,10]. In contrast to previous investigations of adjustment [9], the COVID-19 crisis required organizations and their employees to abruptly change their work environments and ways of working. As such, there is a need to understand what factors are related to employees' adjustment to remote work during this crisis [6]. Based on the theory of work adjustment [11,12] and previous work on individual adjustment in a work context [10,13] and adaptation to virtual work [9], we identify and examine a framework of environmental factors that may affect individual adjustment to remote work during the COVID-19 pandemic. Specifically, based on cross-sectional survey data, we provide empirical insights into the extent to which employees' adjustment to remote work is associated with *structural* factors (i.e., work independence and clarity of job criteria), *relational* factors (i.e., social isolation and interpersonal trust), and *contextual* factors (i.e., perceived disruption and change in work location). Furthermore, we investigate moderating factors (i.e., organizational communication quality and communication technology use (CTU)) that potentially influence the relationships underlying employees' adjustment to remote work. Organizational communication quality has been found to be pivotal when dealing with uncertainty and crises, including organizational responses to the COVID-19 pandemic [14]. At the same time, technological advances have been heralded for their ability to facilitate work across spatial distances and both synchronous and asynchronous collaboration [15–18]. Hence, we investigate the role of organizational communication quality and CTU in qualifying the impact of structural, relational, and contextual factors on adjustment to remote work.

Remote work settings involve temporal and spatial dispersion and depend on CTU to allow employees to interact across these boundaries [19–23]. Remote work is defined as "work done by an individual while at a different location than the person(s) directly supervising and/or paying for it" [24] (p. 2). In the context of the COVID-19 pandemic, this location was typically employees' homes. Although previous studies have indicated that working from home might help employees collaborate across time zones, concentrate better than in the primary work location, and accomplish work tasks [25], it is unclear what factors impact employees' ability to adjust to new demands of their work environment when they are mandated to work from home. We use remote work to refer to the current situation in which employees are mandated to work from home during the pandemic (i.e., the Finnish government introduced the Emergency Powers Act on 16 March, 2020, and advised all workplaces in Finland to utilize remote work if possible).

2. Literature Review and Hypotheses

This study takes a work adjustment perspective to examine how employees have adjusted to an abrupt transition to remote work. Adjustment to new work contexts typically involves adaptation to new environmental stimuli or demands. It has been suggested [9] that adjustment to virtual work refers to employees' ability to adapt to virtual work modes as they transition from traditional office environments to remote work. Specifically, adjustment refers to an overall state of adaptation because a transition to remote work highlights the inherent tradeoffs involved in adjustment [9]. Several aspects are considered critical indicators of employees' successful adaptation to a virtual work including satisfaction, commitment, productivity, and the ability to balance work and nonwork demands. Successful adaptation often requires a trade-off between these aspects. To examine the underlying factors that impact employees' adjustment to remote work, we identified several structural, relational, and contextual factors that may impact employees' adaptation (see Figure 1). These factors align with those proposed by Raghuram and colleagues [9], but we extend this framework by including crisis-specific concepts such as perceived disruptions and social isolation. Our conceptual model (see Figure 1) has its theoretical roots in the theory of work adjustment [11,12,26] and in the interactional model of individual adjustment [13]. It identifies several categories of factors relevant to individual adjustment, including in-

dividual, job, and organizational factors. Recently, Carillo and colleagues [6] adopted a similar approach to identify the individual, job, and organizational factors underlying telework adjustment in a crisis context. We further extend this work by exploring the role of several moderating factors, including organizational communication quality and CTU.

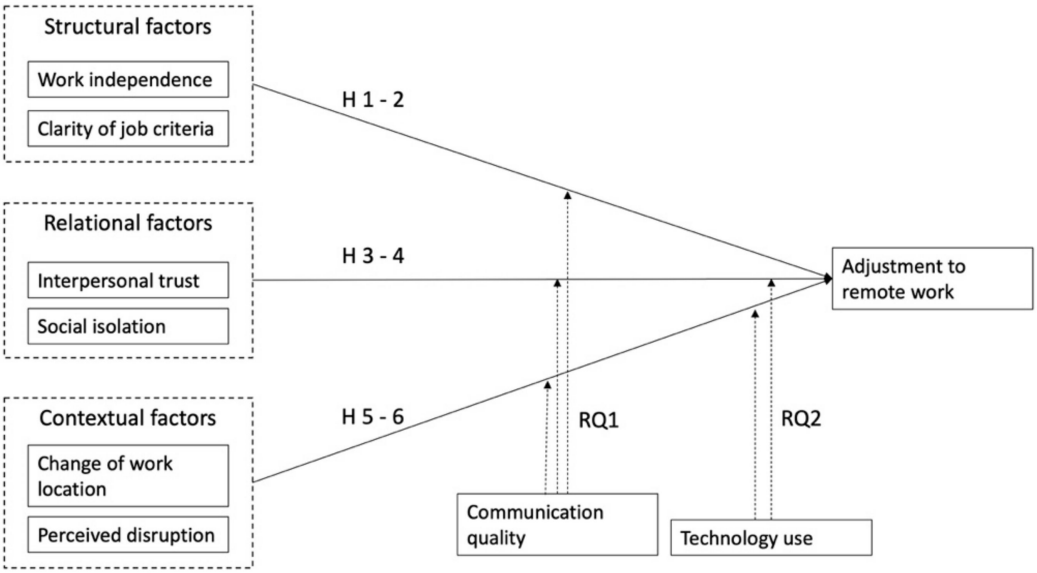

Figure 1. Hypothesized model.

2.1. Structural Factors

Structural factors are the fundamental preconditions and organizational expectations related to a job description that may facilitate or forestall the possibilities to work remotely. Key aspects include work independence and clarity of job criteria [9]. When work can be conducted independently and the criteria for a specific job are clear, employees may be more confident in their ability to complete work remotely, facilitating better adjustment.

2.1.1. Work Independence

Work independence refers to the ability of remote employees to complete tasks without having to engage in continual interaction with their coworkers [27]. Work independence can be facilitated by supporting asynchronous work, for example, allowing access to common databases through technology and ensuring that colleagues can connect with others if needed [9]. Remote employees, who must rely continually on their coworkers, thereby making them reciprocally or sequentially interdependent with others, are likely to experience time pressures, loss of control, and a decline in personal productivity [28,29]. However, independence may facilitate adjustment to remote work [9] because it allows workers to exercise more control over their behavior, for instance, when drawing boundaries between work and nonwork [30] or when enacting discipline to organize their work and apply their skills in an isolated work environment [9]. Hence, employees with greater degrees of independence are found to experience greater adjustment to a remote work context [9]. This is in line with research suggesting that individuals have an innate need for autonomy and self-determination [31,32]. Thus, we propose the following:

Hypothesis 1 (H1). *Work independence is positively associated with employees' adjustment to remote work.*

2.1.2. Clarity of Job Criteria

The clarity of job criteria means that performance assessment at work is perceived as objective, quantifiable, and transparent [9]. Clear and explicit criteria are especially beneficial to guide the performance of remote employees and develop accurate expecta-

tions among them [9,30]. This is because remote employees, compared with non-remote employees, have fewer opportunities to seek or receive informal performance feedback or clarifications from their supervisors and coworkers. Unclear evaluation criteria may lead to insecurity and uncertainty concerning work-related expectations. However, when clear and explicit evaluation criteria are in place, remote employees may be even more capable of managing themselves, which may lead to enhanced performance and satisfaction [9,30]. Additionally, clear evaluation criteria can help build mutual expectations and perceptions of procedural fairness and establish perceptions of equity among remote employees who cannot use physical behaviors to compare work outcomes [29,33]. When evaluation criteria are clearly understood, remote employees are also more likely to work on initiatives that are valued by their organization [34]. Hence, we propose the following:

Hypothesis 2 (H2). *Clarity of job criteria is positively associated with employees' adjustment to remote work.*

2.2. Relational Factors

Relational factors refer to the social relationships and forms of collaboration within an organization. In the context of remote work, they relate to, for example, support and interpersonal trust [9] among employees working remotely and their supervisors and coworkers. Hence, we examine how trust can help to overcome barriers to adjusting to remote work [9]. In addition, issues of social isolation at work are especially profound during the COVID-19 pandemic; hence, we investigate how these issues may deter adjustment to remote work [35].

2.2.1. Interpersonal Trust

Because remote work inherently involves physical and psychological distances, factors that create a stronger sense of relationships between coworkers may prevent physical distance from becoming psychological distance [9] and are expected to have a positive influence on employees' ability to adjust to remote work [36]. Feelings of trust, for instance, may give remote employees greater confidence in their role within the work group or organization and facilitate further adjustment [37]. Interpersonal trust can be defined as the willingness to accept vulnerability and a positive expectation of others' trustworthiness [38]. It has been shown to have a positive effect on workplace cooperation [39], knowledge sharing [40], and organizational commitment [41]. Trusting relations between employees [42] and employees' trust in supervisors [43] enhance organizational change and can therefore affect how employees adjust to remote work. Trust also lowers the need for both employees and their supervisors to monitor and verify each other's work in the virtual context [44] and is crucial to the effectiveness of virtual workers [45]. Thus, we hypothesize the following:

Hypothesis 3 (H3). *Interpersonal trust is positively associated with employees' adjustment to remote work.*

2.2.2. Social Isolation

Social isolation is related to physical and psychological distance between coworkers. Isolation can be defined as the perception of a lack of availability of support and recognition, missed opportunities for informal interactions with coworkers, and not being part of the group [35]. In other words, isolation is a state of mind or a belief that one is out of touch with others in the workplace; as such, the desire to feel socially connected is thwarted [46]. In a remote work setting, perceptions of social isolation may be exacerbated, even though it is proposed that isolation is created mainly due to the lack of availability and not just spatial distance [35]. Perceived isolation has been identified as a potential obstacle for effectiveness among remote employees [47] and may reduce job satisfaction [46]. Hence, we hypothesize the following:

Hypothesis 4 (H4). *Social isolation is negatively associated with employees' adjustment to remote work.*

2.3. Contextual Factors

We extend previous models [9] of adjustment by explicitly considering the COVID-19 context within which adjustments are required. Specifically, we suggest that the severity of the change in work location—here, the discrepancy between earlier remote work experience and current remote work frequency—and the extent of broader disruptions of work routines triggered by the COVID-19 crisis impact on employees' adjustment to the "new normal" [5,48].

2.3.1. Change in Work Location

The sudden requirement to work from home has led most employees to increase the frequency with which they work from home. For some, these changes are more substantial because they either did not engage in remote work practices or did so to a very limited extent prior to the COVID-19 outbreak. In contrast, for employees who are more familiar with these work practices either because they frequently work remotely or are used to working with dispersed colleagues, these new work realities may require less adjustment. Limited connections and access in remote locations seem to be the main challenges of virtual working spaces despite recent technological advances. We examine the role of changes in work location as the discrepancy between current remote work practices and remote work practices before the COVID-19 crisis. Transitioning to a remote work location may require adjustment to the working environment, including physical, technological, and social conditions of work [16]. The intuitive hypothesis here is that larger differences indicate more substantial changes in where work is conducted, which in turn could complicate adjustment.

Hypothesis 5 (H5). *Changes in work location are negatively associated with employees' adjustment to remote work.*

2.3.2. Disruption of Work Routines

Unlearning refers to the "breakdown of routines, habits, and cognitive frameworks" [49] (p. 509). We use the term disruption to refer to an unlearning process in which routines, habits, norms, and procedures are changing [50] as a result of the COVID-19 pandemic. The adjustment required by employees depends on the level of disruption experienced by employees: greater disruption requires greater adjustment. Prior research demonstrates that environmental turbulence causes organizations and their subunits to face performance gaps, work stress, toxic work environments, and blame shifting as well as anxiety and fears [50]. Hence, we hypothesize the following:

Hypothesis 6 (H6). *Disruption of work routines is negatively associated with employees' adjustment to remote work.*

2.4. Moderating Factors

In addition to structural, relational, and contextual factors, remote work is structured and shaped by communication technologies that enable employees to interact across temporal and spatial boundaries. The quality of organizational communication and the frequency of CTU in times of changing work environments and dispersed work may prove to be of particular importance for employees to adjust to new work conditions. Organizational communication quality is defined here as the informativeness, accuracy, and timeliness of communication about organizational changes during the pandemic [51].

2.4.1. Organizational Communication Quality and Relational and Contextual Factors

Communication has been found to mitigate the relationship between geographical distribution and conflict [52]. Although not directly related to adjustment, these findings imply that communication might have a positive impact on conflict identification and conflict handling, and as such may optimize remote work effectiveness and satisfaction, which are key indicators of adjustment. In addition, high-quality organizational communication can be viewed as a sign of organizational support that may help employees refocus on collective goals [53] to meet their performance expectations. In the absence of a traditional office environment, the role of organizational communication may be even more profound because it may substitute in part for a lack of face-to-face interaction while facilitating the information purposes of social support networks that are normally present in organizations [54]. Finally, communication tends to clarify role expectations and enhance performance by reducing uncertainty [51]. Therefore, we ask the following question:

RQ1: *Does organizational communication quality moderate the impact of structural, relational, and contextual factors underlying adjustment?*

2.4.2. Communication Technology Use and Relational and Contextual Factors

Communication technologies are the enabling force behind most remote work settings, allowing workers to maintain necessary levels of connectivity to share information and coordinate work across various boundaries [55,56]. In addition, the effective use of communication technology is an important facilitator of trust in virtual teams [17,57,58]. Indeed, many organizations can be argued to have adopted some degree of virtual practices under the studied conditions, and collaboration strongly depends on the effective use of communication technology. ter Hoeven and van Zoonen [59] demonstrated that control over CTU reduces the negative consequences of spatial distance in remote work arrangements for helping behavior. Because CTU may amplify the positive association of relational factors (e.g., interpersonal trust) with adjustment while mitigating the negative impact of other relational factors (e.g., social isolation), we pose the following research question:

RQ2: *Does CTU moderate the impact of relational and contextual factors underlying adjustment?*

3. Materials and Methods

This cross-sectional study targeted employees who had been asked to work remotely in Finland since the lockdown began in mid-March 2020. The survey started on the 26th of March 2020 and was open for responses until the 13th of April 2020. Open survey invitations were published online, and we solicited the help of several large labor unions and ministries to distribute the survey link to their members. The survey included about 100 items in total, including background questions and attention checks. The survey was administered through the XM platform Qualtrics and programmed such that all statements needed to be answered for the survey to be completed and responses to be considered for analysis. Explicit informed consent was obtained from all participants prior to the survey. Data were exported to IBM statistical software packages SPSS and AMOS for further analysis. There were no missing values as we used forced response options, respondents who failed the attention checks or dropped out were automatically excluded. Embedded data (e.g., IP addresses) and identifying information (i.e., email addresses) were assessed to guard against duplicate responses, but were not used in the analysis stage. This convenience sampling procedure resulted in a total response of 5452 Finnish employees. Employees in our sample indicated low probabilities of job loss in the near future, with 84.4% indicating that this was (highly) improbable (M = 2.07 SD = 1.43; on a 7-point scale). The average age of the respondents was 45.3 years old (SD = 10.7). Most respondents were female (N = 3747; 69%), and 1593 were male (29%). Most respondents were employed by the state or public utility (N = 3267; 60%), while 1318 respondents worked for private enterprises (24%), and others worked in nongovernmental (2%) or semigovernmental (8%)

organizations. The respondents mostly worked in organizations with 50 to 249 employees (22%), 250 to 999 employees (29%), or more than 2000 employees (25%). The majority of respondents worked remotely 4 or more days per week (90.8%), 6.5% worked remotely 2 or 3 days, and 2.6% worked remotely 1 day per week or less. Furthermore, respondents indicated they worked 38.6 h per week on average (SD = 6.6), and the average reported overtime was 2.3 h per week (SD = 5.9). Approximately 14% of the respondents worked in a managerial position, their average organizational tenure was 10.9 years (SD = 10.1), most respondents were part of single (N = 1029; 19%) or two-person (N = 2152; 40%) households, and 40% had at least 1 child under the age of 18 in their household.

3.1. Measures

All statements were measured using seven-point response scales ranging from strongly disagree to strongly agree unless indicated otherwise. All survey items were derived from earlier studies and reviewed by the research team, but we did not conduct a pilot study. Table 1 lists all measurement items, including descriptive statistics and factor loadings.

3.1.1. Dependent Variable

Adjustment to remote work was measured with a five-item scale assessing satisfaction with remote work, perceived performance as the consequence of remote work, and ability to balance work and non-work demands. The measure was adopted from Raghuram et al. [9], who used it in the context of virtual work. Adjustment refers to an overall state of adaptation because a transition to remote work highlights the inherent tradeoffs involved in adjustment [9]. For instance, research by [9] indicated that expending greater efforts to increase (or maintain) productivity may come at the expense of greater work/nonwork balance. Hence, an overall measure of adjustment may most accurately assess employees' relative level of adaptation to environmental demands.

3.1.2. Structural Factors

Independence was measured using four items adopted from [60]. Similar to Raghuram et al. [9], respondents were asked to indicate the degree to which their performance was dependent on working with others. *Clarity of job criteria* was measured using four items adopted from [61]. The items deal with handling problems on the job, figuring out what should be done to accomplish one's work, and being sure of how the job needs to be done. Items are based on role conflict and role ambiguity scales proposed by House and colleagues [62].

3.1.3. Relational Factors

Interpersonal trust was measured using four items based on [61] adopted from [9]. In line with earlier research [9], our measurement strategy focused on an overall measure of trust rather than assessing the many specific determinants of trust. Two items relate how much the individual trusts his/her supervisor and colleagues, and two items measure the extent to which the respondent perceives that his/her supervisor and colleagues trust the individual. *Social isolation* was measured using three items derived from [35]. Social isolation measures the extent to which employees feel isolated and separated from others in the workplace.

3.1.4. Contextual Factors

Change of work location was measured by calculating the difference between remote work before the pandemic and current remote work frequency. Respondents were asked about the frequency with which they normally (before the pandemic) worked remotely, ranging from 1 (never) to 7 (6 or 7 days per week). Subsequently, we asked respondents to indicate the frequency with which they worked remotely since the moment their organization took measures related to the COVID-19 crisis. By subtracting the scores, we calculated

a difference score such that a higher value indicates a larger discrepancy in remote work practices compared with normal circumstances.

Perceived disruption was measured by adopting eight items from [50,63]. The items address changes in work routines. Since routines are reflected in operating procedures during the performance of work, changes in plans, deadlines, and information-sharing mechanisms are indicative of an overall disruption of work. We asked employees to indicate the extent to which several activities, including project plans and deadlines, have changed since the organization took measures related to the COVID-19 crisis.

3.1.5. Moderators

Organizational communication quality was measured using six items from Bordia et al. [64]. These items have previously been applied in the context of uncertainty during organizational change. Quality of communication was measured using items such as "the communication my organization provided adequately answered my questions about the changes."

Communication technology use was measured by asking respondents to indicate the frequency with which they used various technologies to communicate with their colleagues. The communication technologies we inquired about were email, telephone, instant messaging (e.g., WhatsApp), online meetings (e.g., through Zoom or MS Teams), collaborative tools (e.g., Google Drive or Office365), enterprise social media (e.g., Yammer), and public social media (e.g., Facebook). Responses ranged from 1 (never) to 7 (hourly). The items were computed to indicate an overall score for the frequency of CTU, with higher scores indicating more frequent communication with colleagues through these technologies.

Table 1. Measurement items and descriptive statistics.

Measurement Items	Mean (SD)	R^2	St. Factor Loading	Unst. Factor Loading	Se
Adjustment to remote work [9]					
All in all, I am satisfied with remote work	5.66 (1.43)	0.61	0.781	1.000	
Remote work allows me to perform my job better than I ever could when I worked in the office	4.39 (1.62)	0.76	0.871	1.261	0.02
If I were given the choice to return to a traditional office environment (i.e., no longer work remotely), I would be very unlikely to do so	3.98 (2.02)	0.43	0.657	1.184	0.02
Since I started working remotely, I have been able to balance my job and personal life	4.87 (1.75)	0.44	0.663	1.036	0.02
Since I started working remotely, my productivity (e.g., sales orders, output, support) has increased	4.39 (1.66)	0.70	0.835	1.076	0.02
Structural Factors					
Independence [59]					
I have to obtain information and advice from colleagues to complete my work (R) [c]	4.15 (1.66)	0.69	0.832	1.000	
I depend on colleagues for the completion of my work (R)	3.85 (1.75)	0.73	0.855	1.082	0.02
I rarely have to check in with other people to do my work	4.72 (1.61)	0.35	0.587	0.685	0.02
I have to work closely with other people to do my job properly (R)	4.06 (1.82)	0.43	0.659	0.869	0.02
Clarity of job criteria [60]					
I frequently don't know how to handle problems that occur in my job (R)	2.28 (1.30)	0.51	0.713	1.000	
I often find that I cannot figure out what should be done to accomplish my work (R)	1.96 (1.15)	0.76	0.869	1.073	0.02
I am frequently confused about what I have to do on my job (R)	1.86 (1.15)	0.80	0.894	1.100	0.02
I am frequently unsure about how to do my work (R)	1.94 (1.19)	0.77	0.875	1.115	0.02
Relational Factors					
Interpersonal trust [9]					
I trust my supervisors	5.64 (1.35)	0.60	0.773	1.000	
My supervisors trust me	5.84 (1.03)	0.48	0.694	0.690	0.02
I trust my peers	6.00 (0.86)	0.34	0.587	0.485	0.02
My peers trust me	5.96 (0.82)	0.29	0.541	0.422	0.02
Social isolation [35]					
I am separated from my coworkers	5.29 (1.67)	0.61	0.712	1.000	
I often feel I am no longer close to anyone	3.33 (1.71)	0.35	0.592	0.849	0.03
I am isolated from others at work	4.35 (1.82)	0.71	0.841	1.281	0.03
Contextual Factors					
Remote work location [a]					
How often did you normally (before the COVID-19 pandemic) work remotely (e.g., from home)?	2.77 (1.40)	-	-	-	-
How often have you worked at home during the COVID-19 pandemic?	5.70 (1.05)	-	-	-	-

Table 1. *Cont.*

Measurement Items	Mean (SD)	R^2	St. Factor Loading	Unst. Factor Loading	Se
Disruptions [50]					
During the COVID-19 crisis, the following aspects of my work changed:					
Work procedures	4.37 (1.74)	0.39	0.624	1.000	
Project plans	3.67 (1.51)	0.41	0.643	0.895	0.02
Technologies used to complete work tasks	3.80 (1.85)	0.42	0.649	1.108	0.03
Decision-making processes	3.35 (1.56)	0.44	0.666	0.957	0.02
My work tasks	2.97 (1.66)	0.51	0.715	1.092	0.03
The coordination of my work	3.56 (1.66)	0.54	0.737	1.130	0.03
The deadlines of work projects	3.41 (1.74)	0.38	0.619	0.994	0.03
Moderators					
Organizational communication quality [63]					
The communication my organization provided has been useful	5.65 (1.11)	0.71	0.840	1.000	
The communication my organization provided has adequately answered my questions about the changes	5.50 (1.28)	0.73	0.854	1.167	0.02
The communication my organization provided has been positive	5.25 (1.22)	0.55	0.743	0.975	0.02
The communication by my organization has been appropriate	5.63 (1.11)	0.79	0.890	1.056	0.01
The communication my organization provided has been timely	5.25 (1.36)	0.69	0.829	1.206	0.02
The communication my organization provided has been accurate	5.87 (1.02)	0.58	0.760	0.826	0.01
Communication technology use [b]					
Over the past two weeks, how often did you communicate about your work with colleagues using					
Phone calls	3.08 (1.37)	-	-	-	-
E-mails	4.79 (0.94)	-	-	-	-
Online meetings (e.g., Skype, MS Teams, Zoom)	4.27 (1.05)	-	-	-	-
Text or instant messaging (e.g., WhatsApp, Messenger)	3.06 (1.64)	-	-	-	-
Collaboration tools (e.g., Office 365, Google Drive)	2.81 (1.75)	-	-	-	-
Enterprise social media (e.g., Yammer, Happeo)	1.91 (1.45)	-	-	-	-
Public social media (e.g., Facebook, Twitter)	1.58 (1.15)	-	-	-	-

Notes: [a] Change was calculated as a difference score between two observed variables and therefore not included in the CFA; [b] a sum score indicating the average frequency of communication technology use was calculated and therefore not included in the CFA. [c] (R) indicates that items were reverse coded.

4. Results

4.1. Measurement Model

A confirmatory factor analysis (in AMOS) was used to examine the hypothesized factor structure and investigate the validity of our measurement model. Subsequently, we examined common method variance using a common latent factor approach.

The model demonstrated good model fit: χ^2 (469) = 4432.49; CFI = 0.96; TLI = 0.95; SRMR = 0.04; PClose 1.000; and RMSEA = 0.039 (CI: 0.038, 0.040). Following recommendations and threshold values reported by Hair et al. [65], the model demonstrated convergent and discriminant validity of the measures in our model (see Table 1). The average variance extracted (AVE) ranged between 0.43 and 0.71. Discriminant validity was examined through the maximum shared variance (MSV), which ranged between 0.07 and 0.37 for the constructs in our model and is smaller than the AVE values. Additionally, the square root of the AVE was greater than the inter-construct correlations. Inspection of the model parameters indicated the absence of cross-loadings, overall suggesting good discriminant validity. Reliability was examined through the composite reliabilities (CR) and the maximum reliability (H), which ranged between 0.75 and 0.93 and between 0.77 and 0.93, respectively.

Second, we examined common method variance using a common latent factor approach. Squared regression estimates indicated that common method variance was 3.6%, indicating that common method variance is not a substantial concern in our data. Curve estimations for all relationships in our model indicated that these relationships were sufficiently linear. Finally, the correlation between interpersonal trust and communication quality was relatively high (0.61; see Table 2). Hence, we inspected collinearity statistics (i.e., the variance inflation factor, VIF) for all independent variables and discovered no

problems with multicollinearity. In sum, these results justify further inspection of the structural model.

Table 2. Correlation Matrix of variables with validity statistics.

Variable	M (SD)	CR	AVE	MSV	MaxR(H)	1	2	3	4	5	6	7	8	9
1. Independence	4.20 (1.40)	0.83	0.55	0.07	0.86	**0.74**								
2. Clarity of job criteria	5.99 (1.05)	0.91	0.71	0.10	0.92	−0.27	**0.84**							
3. Interpersonal trust	5.86 (0.82)	0.75	0.43	0.37	0.77	0.06	0.32	**0.66**						
4. Social isolation	4.32 (1.41)	0.76	0.52	0.09	0.80	0.03	−0.25	−0.10	**0.72**					
5. Disruption	3.59 (1.21)	0.85	0.44	0.08	0.85	0.13	−0.28	−0.12	0.15	**0.67**				
6. Change [a]	3.92 (1.53)	–	–	–	–	0.14	−0.11	0.01	0.15	0.18	**–**			
7. Communication quality	5.53 (1.01)	0.93	0.67	0.37	0.93	0.05	*0.22*	0.61	−0.13	−0.11	−0.01	**0.82**		
8. Technology use [b]	3.07 (0.75)	–	–	–	–	0.27	0.10	0.09	0.13	0.12	0.07	0.11	–	
9. Adjustment	4.66 (1.34)	0.88	0.59	0.10	0.90	−0.25	0.32	0.06	−0.30	−0.26	−0.32	0.15	0.06	**0.77**

Notes: CR = composite reliability; AVE = average variance extracted; MSV = maximum shared variance; MaxR(H) = maximum reliability. Square root of the AVE is reported on the diagonal. [a] Change was calculated as a difference score between two observed variables and therefore not included in the CFA; [b] a sum score indicating the average frequency of communication technology use was calculated and therefore not included in the CFA. Technology use is treated as the index score, where higher scores mean higher general technology use. All correlations equal to or above 0.03 are significant at $p < 0.05$.

4.2. Controls

We considered several potentially confounding factors in our analysis. Specifically, we controlled for gender, age, working hours per week, managerial position, organizational tenure, and job security. Gender significantly predicted adjustment (B = 0.091, $p = 0.009$), suggesting that female respondents were better able to adjust to remote work. Gender did not affect any of the hypothesized relationships in the model. Age did not affect adjustment to remote work (B = 0.000, $p = 0.766$). Similarly, the number of work hours per week did not significantly affect adjustment to remote work (B = −0.001, $p = 0.691$). However, the results indicated that managerial positions had a significant and negative relationship with adjustment (B = −0.176, $p < 0.001$), suggesting that individuals in managerial positions seem to have more difficulties adjusting to remote work. Finally, organizational tenure (B = −0.001, $p = 0.202$) and job security (B = 0.012, $p = 0.274$) did not affect adjustment to remote work or any of the relationships in our model. In sum, all hypothesized relationships remained unaffected when these variables were included. Hence, these variables were excluded from the final model for reasons of parsimony.

4.3. Hypotheses Testing

The hypothesized model was examined using path modeling in AMOS by estimating regression coefficients between the structural, relational, and contextual factors on adjustment to work. Table 3 provides the standardized and unstandardized regression results for the full model.

Structural factors. Hypothesis 1 assumes that work independence is positively related to adjustment to remote work. The results demonstrate a significant positive relationship (B = 0.168 (0.143; 0.192), $p = 0.001$). Hence, hypothesis 1 is supported. In addition, hypothesis 2 reflects the assumption that clarity of job criteria makes it easier for employees to adapt to remote work. The findings demonstrate a significant positive relationship between the clarity of job criteria and adjustment to remote work (B = 0.174 (0.136; 0.211), $p = 0.001$). Hence, hypothesis 2 is also supported. Overall, these results provide strong support that the structural factors of an employee's job have an important influence on the employee's adjustment to remote work.

Relational factors. Hypothesis 3 posits that interpersonal trust is positively related to employees' adjustment to remote work. The results demonstrate a significant negative relationship between trust and adjustment (B = −0.069 (−0.117; −0.021), $p = 0.006$). Hence, contrary to our expectations, trust between coworkers and supervisors does not increase adjustment to remote work but rather decreases it. A possible explanation could be that employees who exhibit lower levels of trust in their peers and supervisors rather work (alone) remotely, as this gives them more autonomy from people they do not trust and,

therefore, they are less frequently confronted with such relationships. However, as the relationship is in the opposite direction than the one we hypothesized, we do not find support for hypothesis 3. Hypothesis 4 suggests that social isolation is negatively related to adjustment to remote work. The results demonstrate a significant negative relationship between perceived social isolation and adjustment to remote work (B = −0.178 (−0.202; −0.152), p = 0.001), providing support for Hypothesis 4.

Contextual factors. Hypothesis 5 reflects the rationale that the relative change in work locations influences employees' adjustment to remote work. The results show that a change in work location is negatively related to adjustment to remote work (B = −0.209 (−0.234; −0.186), p = 0.001). This result suggests that a larger change in work location (e.g., a change in remote work from half a day per week to five days per week versus a change in remote work from two days per week normally to five days per week currently) reduces employees' adjustment to remote work. Hence, hypothesis 5 is supported. This implies that employees who were already used to working remotely before the pandemic adjusted better to the new situation. Hypothesis 6 suggests that perceived disruption is negatively related to adjustment to remote work. The findings demonstrate a significant negative relationship (B = −0.122 (−0.153; −0.093), p = 0.001), providing support for hypothesis 6. The more work practices changed during the pandemic, the less employees were able to adjust.

Table 3. Parameter estimates of path model.

					Bootstrapping BC 95% CI		
		B	**SE**	**Beta**	**Lower**	**Upper**	***p***
	Hypotheses						
H1	Independence → Adjustment	0.168	0.012	0.175	0.143	0.192	0.001
H2	Clarity of job criteria → Adjustment	0.174	0.017	0.136	0.136	0.211	0.001
H3	Interpersonal trust → Adjustment	−0.069	0.023	−0.042	−0.117	−0.021	0.006
H4	Social isolation → Adjustment	−0.178	0.012	−0.188	−0.202	−0.152	0.001
H5	Remote work transition → Adjustment	−0.209	0.011	−0.239	−0.234	−0.186	0.001
H6	Perceived disruption → Adjustment	−0.122	0.014	−0.110	−0.153	−0.093	0.001
	RQ1: Communication quality × Relational and contextual factors						
RQ1	Communication quality × Trust → Adjustment	0.002	0.015	0.002	−0.039	0.041	0.995
	Communication quality × Isolation → Adjustment	0.019	0.010	0.023	−0.007	0.043	0.149
	Communication quality × Change in location → Adjustment	−0.045	0.010	−0.057	−0.070	−0.021	0.001
	Communication quality × Disruption → Adjustment	0.007	0.130	0.007	−0.025	0.036	0.722
	Communication quality × Independence → Adjustment	0.016	0.011	0.014	−0.012	0.039	0.263
	Communication quality × Clarity of job criteria → adjustment	−0.009	0.015	−0.010	−0.044	0.024	0.620
	RQ2: Communication technology use × Relational and contextual factors						
RQ2	Technology use × Trust → Adjustment	−0.107	0.024	−0.053	−0.168	−0.046	0.002
	Technology use × Isolation → Adjustment	0.009	0.015	0.007	−0.007	0.043	0.149
	Technology use × Change in location → Adjustment	−0.031	0.014	−0.028	−0.065	−0.001	0.045
	Technology use × Disruption → Adjustment	0.050	0.017	0.035	0.013	0.085	0.006

Notes: Bootstrapping is a technique from which the sampling distribution of statistic is estimated by taking repeated samples from the dataset. Bootstrapping was used to obtain model estimates. BC95% CI indicate the bias-corrected 95% confidence interval of the beta coefficient.

4.4. Moderations

Before discussing the interactions, it should be noted that both moderators, organizational communication quality (B = 0.114 [0.075; 0.152], p = 0.001) and the frequency of CTU (B = 0.103 [0.059; 0.152], p = 0.001), are significantly and positively related to adjustment. Note that all variables that comprise product terms were mean centered prior to testing the interactions. For all interactions, we inspected the values of the interactions effect at different values of the moderator using the Johnson–Neyman technique. When the interaction reported was not significant at all values of the moderator, we reported the value of

the moderator at which the interaction becomes significant. To facilitate interpretation, the mean-centered values are also reported as actual (raw) values.

Organizational communication quality. There was no significant interaction effect between organizational communication quality and trust (B = 0.002 (−0.039; 0.041), $p = 0.995$), social isolation (B = 0.019 (−0.007; 0.043), $p = 0.149$), and disruption (B = 0.007 (−0.025; 0.036), $p = 0.722$) on employees' adjustment to remote work. There was a significant interaction between organizational communication quality and change in work location (B = −0.045 (−0.070; −0.021), $p = 0.001$) on adjustment to remote work. This result suggests that at low levels of organizational communication quality starting at −4.11 (i.e., 1.42 in raw values), perceived change in work location negatively impacts adjustment to remote work. Organizational communication quality has a limited impact in mitigating this negative relationship. Finally, we did not find significant interactions between organizational communication quality and clarity of job criteria on adjustment (B = −0.010 (−0.044; 0.024), $p = 0.620$), nor did we find an interaction between communication quality and job independence on adjustment (B = 0.014 (−0.012; 0.039), $p = 0.263$).

Communication technology use. There were no significant interactions between social isolation and CTU (B = 0.009 (−0.007; 0.043), $p = 0.149$). CTU was found to moderate the negative relationship between trust and adjustment to remote work (B = −0.107 (−0.168; −0.046), $p = 0.002$). The result indicates that trust negatively affects adjustment to work when the mean-centered value of CTU is below 0.562 (i.e., 3.63 in raw values). This suggests that when CTU is low, trust stifles adjustment to remote work, but when CTU is high (above 0.562, approximately 22% of the responses), there is no significant negative effect of trust on adjustment to remote work. Arguably, frequent CTU is important when trust is low, to mitigate a decline in employees' commitment, satisfaction, and productivity. However, CTU is also important for adjustment when trust is high as a lack of communication may be more detrimental to adjustment in high-trusting environments. For instance, trust may be an indicator of high-quality relationships, missing out on such relationships in remote work settings may be detrimental to several aspects of adjustment, increasing the frequency of CTU to communicate and collaborate with trusted peers and supervisors might reduce the negative impact on employees' adjustment.

In addition, CTU was found to moderate the negative relationship between change in work location and adjustment (B = −0.031 (−0.065; −0.001), $p = 0.045$). The findings suggest that change is negatively related to adjustment at all levels of CTU. However, smaller levels of change and a higher frequency of CTU yield the highest levels of adjustment. At one standard deviation below the mean (−1.92) of change, adjustment is higher (5.33) when CTU is one standard deviation above the mean (0.786) rather than below the mean (−0.786), in which case adjustment is 5.07. Finally, CTU moderates the relationship between disruption and adjustment to remote work (B = 0.050 (0.013; 0.085), $p = 0.006$). The confidence interval of the slope indicates that disruption has a negative impact on adjustment to remote work at all levels of CTU. However, it should be noted that higher frequencies of CTU allow employees to adjust better to remote work when disruption is high than when the frequency of CTU in these situations is low.

5. Discussion

The findings of this cross-sectional study during the early phase of the COVID-19 outbreak in 2020 in Finland indicate that structural factors (i.e., high work independence and clarity of job criteria) make it easier for employees to adjust to remote work settings. In turn, relational factors (i.e., interpersonal trust and isolation) are negatively related to adjustment. Contrary to our expectations and to the earlier findings by [9], interpersonal trust was negatively associated with adjustment to remote work. Arguably, trust serves as a proxy for important interpersonal functions, such as socialization and support; when such cues are missing, employees may feel less satisfied and effective and may therefore experience lower levels of adjustment to remote work. Our findings also show that feelings of social isolation decrease adjustment to remote work, providing further evidence that

the social dynamics of work present a key barrier in adjustment during the COVID-19 pandemic. Furthermore, the results indicate that greater discrepancy between the amount of current and "normal" remote work and greater disruption in work practices (i.e., contextual factors) both decrease adjustment. These results imply that beyond smaller changes in work location, greater experience with remote work seems to enhance adjustment to remote work. Finally, the findings demonstrate a relatively small positive impact of organizational communication quality and CTU in adapting to increased remote work. Organizational communication quality does not mitigate the negative impacts of relational factors on adjustment (i.e., interpersonal trust and feelings of isolation) or facilitate the relationship between disruption of work practices and adjustment. However, more frequent use of various communication technologies with colleagues seems to mitigate the negative relationship between trust and adjustment, probably by reviving social relations. More research is needed to study the potential buffering effects of communication technology use and remote work adjustment.

5.1. Theoretical Implications

The findings have several theoretical implications. First, based on the theory of work adjustment [12] and the interactional model of individual adjustment [13], this study identified several crisis-specific environmental factors [6] in addition to "traditional" environmental factors proposed by [9] that may underlie employees' adjustment to remote work. For instance, we demonstrated that isolation is a relevant predictor that could be conceptualized as a relational factor underlying adjustment. In addition, we conceptualized contextual factors that include crisis-specific indicators such as changes in work location and perceived disruptions that impact adjustment. Finally, this study further considered how communication quality and CTU may mitigate some of the challenges in adapting to remote work. Ultimately, the study contributes to the literature on adjustment by identifying how employees' ability to adjust to abrupt transitions to remote work has been affected by various relevant factors of the work environment. Specifically, this study contributes to person–environment theories and the theory of work adjustment by identifying how the work environment may enable or constrain employees' ability to adapt. In other words, the work environment has reinforcement capabilities that can satisfy a person's needs (in this case, adjustment) [12].

Second, work independence and clarity of job criteria were positively and significantly related to work adjustment. This suggests that employees who know what is expected from them and can complete their tasks without others adjust better to working remotely. Hence, with regard to the structural factors underlying remote work, we were able to replicate the findings presented by [9] in the context of virtual work and add that these factors operate in similar ways across organizational settings during a global health pandemic characterized by abrupt lockdowns and en masse remote work directives. Furthermore, the findings align with [66], who find that telecommuters with higher autonomy report greater job satisfaction relative to those with less autonomy. Our findings are in line with previous literature linking performance management and goal-setting theory in co-located work settings. It has been established that specific goals can enhance motivation and performance by leading people to focus their attention on specific objectives [67], facilitate their attempts to achieve these objectives [68], persist in the face of setbacks [69], and invent new strategies to better deal with complex challenges related to goal attainment [70].

More broadly, the finding that work independence and clarity of job criteria are positively related to adjustment also signals a potentially important tension in remote work designs. While some level of independence and clarity at the individual level is desirable for job satisfaction, effectiveness, and performance in remote settings, modern work tasks require some level of interdependency, and employees may desire feedback, socialization and relatedness with peers. For example, in self-determination theory, relatedness is considered a basic human need that consists of interacting with, being connected to, and experiencing caring for others [31]. Recent studies on remote work [69] and global

work [54] demonstrate the importance of considering both the job characteristics (e.g., complexity and problem solving) and the social characteristics (e.g., social support and interdependence) of work. Research [54,55] indicates that as workers are afforded more autonomy and work becomes more unpredictable and volatile, employees need to adapt to contend with the demands of their work environment, including relational demands. This means that employees are active agents crafting their own jobs rather than passive recipients of work characteristics. This perspective aligns well with the findings of this study, which refer to agentic processes—here, independence and clarity, which empower employees to meet the demands of remote work and to adjust.

Third, with regard to the relational factors, our findings do not support the hypothesis of a positive relationship between interpersonal trust and adjustment to remote work. The negative relationship between trust and remote work adjustment is a counterintuitive finding that contradicts most of the past research on the relationship between trust and remote work [9,71]. The findings indicate that higher levels of interpersonal trust decrease individual's adjustment to remote work. Alternatively, the reverse is also true as employees who report low levels of trust seem to adjust better to remote work. This result can be understood from an "out of sight out of mind" perspective, suggesting that some employees may benefit from being separated from colleagues or supervisors they do not trust, or even distrust. Indeed, in the context of this pandemic, scholars have chronicled that the transition to remote work may have benefits for employees as they might be less exposed to toxic workplace relationships, or relieved from bullying colleagues [5]. Our findings align with such insights. In addition, trust among colleagues and in supervisors could be an indication of a valued interpersonal relationship. Having to miss such a relationship may reduce one's satisfaction with their job and make it more difficult to maintain productivity levels or overall job performance—all indicators of adjustment. Hence, employees who report high levels of trust in coworkers and supervisors and who feel trusted by them may be less satisfied with remote work, feel less effective, and feel less adjusted. Employees may even want to return to the office as soon as possible to reconnect with their colleagues because the gratification of social needs is arguably satisfied through recurring physical interactions with colleagues. Furthermore, trust built in the physical context may not have transferred to the technology-mediated interactions of remote work environments yet, and if the respondents see limited opportunities to do so, this could lead to a less gratifying remote work experience.

Finally, the notion that greater disruption requires greater adaptation certainly rings true for most individuals. The findings suggest that employees who experience greater disruption appear to face more difficulties adjusting to the work setting. Hence, it seems that disruption may indeed require adaptation, but the negative relationship suggests that employees have difficulty making the required adjustments, arguably because adaptation in these cases requires employees to learn new skills and competencies to deal with environmental demands. Hence, the findings demonstrate that employees' adjustment to abrupt remote work transitions is complicated by the perceived "strength" of the disruption. Overall, the findings suggest that factors underlying agentic processes (i.e., independence and clarity of job criteria) facilitate adaptation and the reappraisal of event outcomes, while relational factors—trust and isolation—operate as barriers to adjustment. This phenomenon calls for further research into the managerial and sociopsychological processes that help to understand the relationship between disruptive events and organizational outcomes.

5.2. Practical and Managerial Implication

This study investigated the antecedents of adjustment to remote work. Some factors are directly within the scope of organizational control (e.g., structural factors), while others may be more difficult to influence directly (e.g., contextual factors). However, the results provide important and actionable implications for organizations. First, our results indicate that employees who report higher levels of independence and clarity of job instructions are better able to adjust to remote work. In these circumstances, organizations could

provide clearer objectives and goals (decreasing ambiguity) and minimize interdependencies between organizational members by designing and allocating autonomous jobs and tasks where possible. In doing so, organizations facilitate agentic processes of individual employees, improving their adjustment to these settings. In addition, organizations need to ensure that there are adequate resources for employees to conduct work independently while maintaining interdependencies at the collective level. For instance, our findings show that CTU in particular, as well as organizational communication quality, may bolster adjustment to remote work.

Managing relational factors deserves slightly more thought because higher levels of trust reduce adjustment, but isolation also reduces adjustment. Social isolation can be reduced in various ways, such as through synchronous video meetings and informal communication. For example, virtual coffee breaks may help employees feel connected to their coworkers and may lead to less isolation in the workplace. In addition, these initiatives might be important in the context of trust. We found a negative relationship with adjustment; however, we argue that trust in this case signals the absence of important interpersonal cues in the physical workplace. Hence, facilitating interpersonal mechanisms of socialization and support might mitigate the negative impact of trust on adjustment. Furthermore, to facilitate greater adjustment in times where resources could be particularly scarce and feelings of isolation particularly high, scholars have suggested that teleconsultations and informal online support groups could help people stay connected [72–74].

In addition, the findings demonstrate that greater change in work location and greater perceived disruption hamper adjustment to remote work. This is important because it signals that organizations and managers should be attentive, especially to employees whose work processes require the greatest adaptation. Our findings show that employees with more experience in remote work adapt to new situations better because they have already learned some practices and competencies needed in remote work. This implies the importance of training. Organizational support for work–home issues significantly improves well-being [75] and may aid adjustment. For instance, organizations may support their employees through lower workloads or other job demands, giving them greater opportunities to adjust. Additionally, for employees working on vital processes, organizations could have different approaches based on the extent to which the work routines of individuals or groups are disrupted. For instance, these workers could be given priority to use workplace facilities.

5.3. Limitations and Future Research

Several limitations need to be acknowledged. First, this study relies on cross-sectional survey data obtained through a convenience sampling method. This method presents two limitations. First, the data do not permit any causal inferences and do not permit us to track how changes in, for instance, perceived disruptions and continued adjustment to the work environment develop over time. Second, the sampling method resulted in a relatively homogeneous group of employees, limiting the generalizability of the findings. The nonrandom sampling technique as well as the sample and population information do not provide sufficient auxiliary information to correct survey responses using weight adjustments. The sample consisted predominantly of Finnish civil servants (60%), many of whom engaged in what could best be described as knowledge work. In addition, we surveyed respondents who had the available means to participate in the study (e.g., stable Internet connection and time). Furthermore, the relatively stable work context of these employees and the Finnish socioeconomic system may be fertile ground for the adjustment of employees, which may not be the case in other types of occupations [5], other socioeconomic systems, or countries that were (at least at the time of the study) more strongly affected by the pandemic (e.g., France, Italy, and Spain) [6]. Future research is needed to demonstrate the generalizability of our findings across a broader range of occupations, countries, and socioeconomic systems.

Second, some of the effect sizes are relatively small, which raises questions about the predictive validity of the model. To substantiate these findings, future research is needed to confirm these results over time with various occupational groups in different socioeconomic systems. In addition, although the measures were adopted from previous studies, not all measures have been validated and we do not have pre-pandemic benchmark indices for our population, limiting our ability to draw a conclusion about the relative changes. In addition, responses were collected within the first month of the outbreak. Although this timeframe is considered appropriate to investigate adjustment processes, these processes are also likely to continue as the pandemic evolved. In addition, people now have had more time to adjust and find ways to meet challenges and demands associated with teleworking. Hence, it would be worthwhile to follow up on this study as the relative newness of the pandemic and associated teleworking has decreased. Finally, our findings suggest that employees seem to adjust well to remote work. This aligns with studies that conclude that the general attitude toward working from home seems positive [76]. However, this study was conducted in the early stages of the pandemic; therefore, limited assumptions can be made about the long-term implications. In addition, future research may probe more deeply into different aspects that are central to adjustment to remote work, such as those related to work–life dynamics. For instance, now is the opportune time to study whether childless and single employees face increased expectations and work responsibilities, and how these demands may interfere with non-work demands [3].

6. Conclusions

The findings presented in this study provide important insights into the factors that are consequential to employees' adjustment to remote work. These findings contribute to our understanding of how the COVID-19 pandemic has impacted work. This is important because the current crisis is far from over [74,77], future pandemics are increasingly likely [74], and other disruptive events, such as economic downturn, natural disasters, activism, and war, may require continuous adjustment from employees and organizations. Our findings contribute to an understanding of how employees adjust to (abrupt) changes in their work environment by identifying and demonstrating the interplay between various environmental and contextual factors.

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Technostress of Chilean Teachers in the Context of the COVID-19 Pandemic and Teleworking

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Abstract: This article shows the levels of technostress in primary and secondary education teachers in Chile, in the context of educational telework that Chile has adopted in connection with the health crisis by COVID-19. The information has been collected with the use of the RED-TIC scale, previously used in this country, whose validity and reliability of the instrument has been treated, for this case, with confirmatory factorial analysis (CFA) with a national coverage sample of 3006 teachers. The results show that 11% of teachers reveal techno anxiety and 7.2%, techno fatigue. Combining both manifestations, we find that 6.8% of teachers are techno stressed. Finally, fatigue and anxiety factors are higher for female teachers.

Keywords: mental health; technostress; education; dark side; information overload; skepticism; fatigue; anxiety; inefficacy; confirmatory factor analysis

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1. Introduction

The objective of this research is to measure the stress levels associated with the use of information and communication technologies (ICTs) and identify the existence of differences according to gender, in primary and secondary education teachers in the context of the COVID-19 pandemic, in Chile, where the complete closure of schools was implemented as sanitary measure. The importance of this study is its contribution to knowledge on the subject, as a basis for the formulation of strategies and measures that allow the effective and sustainable integration of ICTs in the educational field, which last beyond COVID-19 pandemic since the available evidence is scarce. In the case of Chile, COVID-19 pandemic has been a long-lasting phenomenon given that as reported by the COVID-19 Dashboard by the Center for Systems Science and Engineering (CSSE) at Johns Hopkins University, the occurrence time between the first and second wave was 10 months [1] (See Figure 1).

The demands and resources of work in the educational field, where primary and secondary school teachers develop, have an important role in stress and exhaustion. Work in public middle schools, and especially in urban areas, are related to greater manifestations of stress and exhaustion on teachers, due to high labor demands and scarce resources, and stress with lower levels of education. The emotional exhaustion of teachers is associated with high turnover rates and lower quality teaching, which impacts student participation and performance. The promotion of the school's organizational health, personal self-confidence, affiliation with colleagues, and having more resources academically, such as preventive interventions, are associated with less stress and exhaustion [2,3].

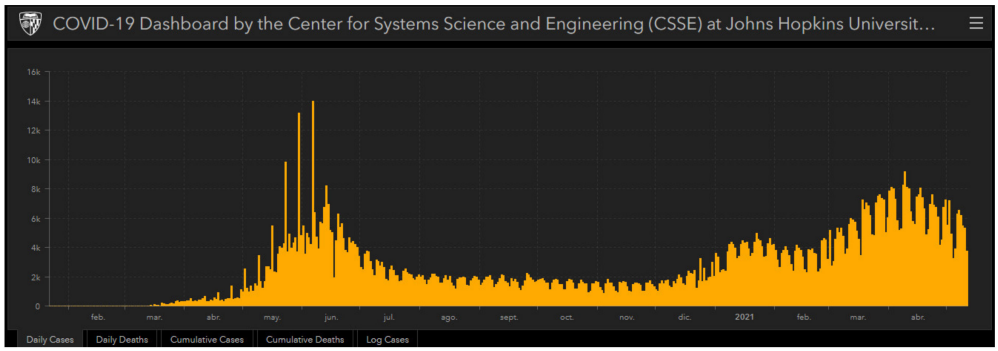

Figure 1. SARS-CoV-2 daily cases in Chile.

In a study developed by Alvites-Huamaní [4] on teaching stress and psychosocial factors in basic and higher education teachers in Latin America, North America, and Europe, a significant positive correlation was found between stress and psychosocial factors such as workplace conditions, workload, content and characteristics of duty, academic role and career development, social interaction, and organizational aspects. According to Mondal et al. [5] in their study on stress and job satisfaction in teachers, they found that they were partially satisfied and experienced stress levels from mild to moderate in their work, probably because of unfavorable working conditions, existing the need for more support and recognition from the institution.

According to research by Agai–Demjaha et al. [6], among the main stress-causing factors in teachers are the change in terms and conditions related to work without prior consultation, granting responsibilities, but without the authority to make decisions, the lack of resources to carry out the work, and limited access to training. The highest levels of stress in the face of changes in education are manifested in primary, older, and university-trained teachers. The highest stress levels in the face of a lack of authority to make decisions are manifested in primary school teachers, women, who work in their first job and with university education. High school teachers, who work in their first job and with university education, most often receive stress from lack of resources to do their job. As reported by Von der Embse et al. [7], the high stress level of teachers has an impact on students' mental and behavioral health, and therefore on school outcomes, making it relevant to implement effective intervention for stress management, such as allocating resources for classroom management training or student behavior management.

The integration of ICTs into education in recent years has become relevant, involving a transformation in how work is organized, requiring teachers to possess the skills to use and incorporate ICTs as a teaching and learning tool, which has caused stress associated with their use, called technostress. Technostress was originally defined as a condition resulting from an individual or organizational inability to adapt in a healthy way to the use of new technologies, which is modulated according to age, previous technological experiences, workload, perception of control and work climate, and, consequently, it affects people's performance, thus limiting their use of technology [8]. According to Tarafdar [9], it corresponds to the stress that people experience, due to the use of ICT, derived from the demands that these cause on the individual. Techno-anxiety is the best-known type of technostress, where the person experiences high levels of unpleasant physiological activation and feels tension and discomfort due to the present or future use of some type of ICT. The same anxiety leads to skeptical attitudes regarding the use of technologies, as well as negative thoughts about their own capacity and competence with ICT, and on the other hand, techno-fatigue is characterized by feelings of fatigue and mental and cognitive exhaustion due to the use technologies, also complemented by skeptical attitudes and beliefs of ineffectiveness with the use of ICT [10].

The stress associated with the use of ICT has been studied in different contexts [11], including at the level of university education [12,13]. Among the main reasons teachers experience techno-stresses are individual problems, technical problems, education-oriented

problems, health problems, and time problems. There are differences between women teachers and man teachers; in women, technostress is mainly associated with technical problems involving the need for technical support, software, and connection problems; instead in men, first, it is related to individual problems, such as self-efficacy and attitude towards technology use, and the economic situation [14].

Teachers who teach using video conferencing technology would be under constant scrutiny, with labor demands that can trigger in techno-stresses [15]. Thus, workers' acceptance of incorporating these new technologies into an organization to promote their effective use and well-being is relevant. Workers need to be involved in this transformation process, having opportunities where they are communicated and receive information on the implementation of technologies; receive training to improve their knowledge and skills in their use; and participate in specific training courses [16]. In a study on the use of social media at work, it was found that when workers see the personal advantage of using them, they tend to use them more, compared to when the employer requires them to use them. In this sense, it is essential to provide training to workers, as this contributes to improving their skills, having better regulatory mechanisms, fostering opportunities to establish meaningful connections with others, producing intrinsic motivation, and having a good state of mental health [17].

The COVID-19 pandemic has forced the transfer of face-to-face education to online education as a health measure while continuing teaching and learning processes. In this sense, teachers have had to adapt at an emergency rate to this new scenario, which involves the use of ICT to teach classes remotely. While this educational modality has pros where, the flexibility of schedules and spaces stands out, they also have cons, such as lack of social interaction with colleagues and teachers, lack of technological knowledge, quality of technological means and tools, and greater performance and dedication of time [18–20]. This is the reason that teacher's role in the effective use of ICTs as an educational tool is relevant in crisis situations and will continue to be after COVID-19, when it is supposed to return to normal. To this end, it must have technical training and the technological means to assimilate the pedagogical uses of ICT that it employs [20].

In research prior to COVID-19, it was already shown that lack of adjustment between the teacher and the demands of technological environment was associated with the techno-stress experienced by teachers while using ICT into the classroom that, in line with Al-Fudail and Mellar [21], would arise from the lack of adequacy, which manifests itself with psychological, physical, and behavioral symptoms, between the demands of technological environment, such as preparing technology or correcting errors and the skills of teachers, and among the needs of teachers in terms of having adequate technology, training, and support, and the offer. In addition, they state in their study that teachers report coping strategies such as trying to correct mistakes and seek technical assistance and training and blaming themselves or managing their feelings to accept the situation. On the other hand, they mention that the inputs that did not satisfy the needs of teaching were found in the areas of technological performance and technical and social support, and the main causes of technostress found were the lack of adequacy when teachers were unable to deal with technological errors, increase in labor demands, and not being able to make an effective use of technology into the classroom due to lack of pedagogical preparation.

In accordance with Panisoara et al. [22], burnout and technostress have a negative effect on the intention of continuity of online instruction during COVID-19 pandemic, on the other hand, intrinsic motivation would have the opposite effect. In the absence of this, continuing teaching could be achieved only based on an extrinsic motivation such as the fear of losing work or the need for a salary that ensures basic needs. A teacher's intrinsic motivation, in association with knowledge related to technology integration, can reduce an individual's perception of difficulty in relation to online instruction. If teachers do not perceive themselves with self-efficacy in the use of technology, they could stop online instruction. Since intrinsic motivation in work would be positively associated with technological pedagogical knowledge and teacher self-efficacy, it is important to generate

conditions that optimize skills acquisition in the use of technology, for which it is necessary to know the working conditions and technostress levels manifested by teachers at different educational levels.

Teachers' perception of support for innovation by educational institutions increases motivation at work, positive emotions to use ICTs in their classes, satisfaction, and job engagement. In turn, motivation has a positive relationship with personal and work resources. It means that those with greater competences in the use of ICTs feel more motivated and, at the same time, perceive positive emotions regarding the use of ICTs, with greater satisfaction, and therefore, work commitment. So, fostering digital self-efficacy and institutional support are key to optimizing the use of ICTs [23].

The incorporation of ICTs into the educational field requires a curriculum reform that implies a change in work routines, since techno-stressors such as techno-insecurity, techno-invasion and techno-overload increase exhaustion in teachers. In contrast, facilitating digital literacy would mitigate the negative impact of exhaustion and stressors such as techno-complexity, techno-insecurity, techno-invasion, and techno-overload [24]. The ability to integrate technology into the curriculum and technical and social school support have positive effects on the reduction of technostress in high school teachers and influence the need to use technology [25].

Syvänen et al. [26] mention that high levels of technology in teachers are related to having lower skills, negative attitudes, and less frequency in the use of ICTs, and, on the other hand, when there is a lower concordance of ICT with the style of teaching and scarce school support in their use. They showed that more experienced teachers, women, and subject teachers, who teach older groups, compared to those in the classroom, were more stressed. The latter factor, related to demands and work resources, where there are different curricular requirements of the different teaching contexts, are associated with technostress. In addition, the most common sources of technostress among teachers were lack of education and lack of interest. They propose that ICT skills can be promoted so that more experienced teachers train to less experienced teachers or share knowledge.

In agreement with Wang and Li [27], university requirements related to the use of ICTs, their suitability, and maintaining the skills and needs of teachers are factors that affect job performance and organizational management that includes organizational demands in the use of ICTs and the resources available to teachers to meet these demands; they would determine technostress by exerting a negative influence on job performance, affecting teachers of higher grades more than those of lower grades. They mention that technostress would be determined by organizational aspects rather than technological; it is relevant that the choice of ICTs that must be introduced, the form of implementation, and availability of support according to the needs of teachers is made through participatory instances.

Li and Wang's research [28] on the impact of techno-inhibitors and techno-creators on teachers' job performance highlights that inhibitors such as facilitating participation and providing technical support have mitigation effects on techno-overload, techno-complexity, and techno-insecurity. At the same time, techno-complexity and techno-insecurity have a significant negative influence, and facilitating literacy and participation have positive effects on job performance. While these findings focus on university professors, similar outcomes are expected in primary and secondary school teachers, given the common scenario in which teachers have forcibly adapted to the use of ICT as the main tool for working and interacting with their students during the COVID-19 pandemic.

2. Materials and Methods

It is used as a measuring instrument for Technostress (RED-TIC) [10], which has been applied in Chile prior to the COVID-19 pandemic for professors [29] as a semantic calibration with an internal consistency (Cronbach's alpha) of 94%. Additionally, following results [30] are observed in teachers: comparative fit index (CFI) = 0.900, root mean square error of approximation (RMSEA) = 0.103, Tucker–Lewis index (TLI) = 0.90, and standardized root mean square residual (SRMR) = 0.05 but based on a geographically

reduced sample to only 2 of the 17 politic-administrative regions in which the country is divided and without the current intensity of the docent telework.

The data collection was carried out with sampling at the national level on a population of 308,556 teachers, according to data from the Ministry of Education in Chile as of December 2019 [31], together with the trade union of workers Chilean Teachers Association ("Colegio de Profesores y Profesoras de Chile"), achieving a n = 3006 responses with coverage of 289 communes of the 346 in which the country is administratively divided. Sample has been stratified according to the criteria of the Ministry of Science, Technology, Knowledge, and Innovation [32], in 6 macrozones (MZs), according to the territorial concentration of the population. Thus, 433 cases (14.4%) were surveyed in MZ-north, 445 cases in MZ-center (14.8%), 685 cases in MZ-south center (22.8%), 360 cases in MZ-south (12.0%), 32 cases, MZ-austral (1.1%), and 1051 cases in Metropolitan Region (35.0%).

To calculate the size, a confidence level of 95% was established, with a heterogeneity of 50% and a margin of error of 1.78, obtaining the sample of 3006 professors and professors. The random selection of cases was made from the records of the College of Professors and Professors within each MZ, from their communal representations. The survey was administered electronically (between September and November 2020), from the databases containing the teacher records as of August 2020 and the resulting data set is a Supplementary Material to this article.

To measure technostress, the instrument was first validated, using a Confirmatory Factor Analysis (CFA), which is used in previous studies of technostress [12,13,33–36]. In this case, the Lavaan package [37] of the RStudio statistical software (RStudio Team, Boston, MA, USA) has been used. Instrument constructs must meet the reliability of internal consistency, convergent, and discriminatory validity, and to identify model fit, recommended global measures are estimated; the criteria to be followed are set out in Tables 1 and 2 [38–44].

Table 1. Validation measures of the theoretical constructs.

Convergent Validity	Load	>0.70
	Communality	>0.50
	Average variance extracted (AVE)	>0.50
Discriminant (Divergent) Validity	Heterotrait-monotrait ratio of correlations (HTMT)	<0.90
Internal Consistency Reliability	Cronbach's alpha	0.70–0.90
	Composite reliability (CR)	0.70–0.90

Table 2. Global measures of scale validation.

Adjustment Indices		**Quality of Model Adjustment**		
Chi-squared test	p-value	>0.05 Good		
Standardized root mean square residual	SRMR	<0.08 Good		
Root mean square error of approximation	RMSEA	≤0.05 Very good	0.05 < RMSEA ≤ 0.08 Good	0.08 < RMSEA ≤ 0.10 Suffering
Comparative fit index	CFI	≥0.95 Very good	0.90 ≤ CFI < 0.95 Good	0.80 ≤ CFI < 0.90 Suffering
Tucker–Lewis index	TLI	≥0.95 Very good	0.90 ≤ CFI < 0.95 Good	0.80 ≤ CFI < 0.90 Suffering

The average variance extracted (AVE) considered in this case is one of the criteria used to perform the heterotrait-monotrait (HTMT) test [45]. This AVE describes the variance considering the items that make up the construct, to prove that the data set of these items contributes to the construct by explaining more than half of its variance (dispersion). Thus, since it is a CFA, the load of each item should only contribute to the construct in which it is included. On the other hand, divergent validity tests the relationship between constructs by comparing their correlations, with a value of (HTMT) less (<) than 0.90, it is possible to ensure that the constructs measure different concepts [41].

Then, to establish whether there are differences between technostress scales of each dimension and the gender of the teachers, a Chi-square test is performed, and finally, a proportion test is carried out to identify significant differences by gender on each scale [45].

3. Results

The sample of 3006 teachers with national coverage indicates that 27.4% of all education professionals are male, while 71.7% are for female teachers and 1% are classified as "other" gender. In addition, 58.30% are primary school teachers, 35.2% are from secondary education, and the remaining 6.5% are from adult education. On the other hand, only 3.9% of teachers work less than 22 h per week, while another 50.2% spend between 23 and 43 h. That is, 45.9% have indicated maintaining 44 h of work per week, which corresponds to a full working day, according to Chilean legislation.

Regarding working conditions, 67.1% have an indefinite contract, 31% maintain a fixed-term contract, and 1.9% of teachers indicated that they have a contract at fees for task performed or does not have a formal contract.

In terms of the working day, 52.1% of teachers teach only in the morning, 40.6% teach in mixed days (morning, afternoon, and evening), another 4.6% work exclusively in the afternoon, while 2.1% work only in evening, and 0.6% did not answer the question. Alongside the above, it is also interesting to note that surveyed teachers have on average 19.5 years of teaching experience, with an average age equal to 44.4 years and a median of 43 years. Finally, it is important to note that 90.2% of the teachers surveyed indicated working in a single establishment and 97.2% pointed they have a professional university degree.

About validity and reliability procedures, for this dataset, the model has a good absolute fit, since the SRMR value is 0.054 (<0.080), and the root mean square error of approximation (RMSEA) is 0.098. However, the p-value of the Chi-square test is 0, so the null hypothesis is rejected because there is no good adjustment between the variance matrix and sample covariance compared to the theoretical ones. However, this test is sensitive to sample size, so having 3006 observations overlaps the SRMR result [46]. Regarding comparative adjustment measures, the IFC and TLI both have a value of 0.99, so the model has a good fit.

About the theoretical constructs or dimensions of technostress meet the criteria of internal consistency and convergent and discriminatory validation, as is shown in Table 3 and Figure 2, which details the structure of the factorial confirmatory analysis (CFA).

Table 3. Global measures of scale validation.

Factor	Variable *	Convergent Validity			Discriminant Validity	Internal Consistency Reliability	
		Load	Communality	AVE	HTMT	Cronbach Alpha	CR
Skepticism (S)	r_1	0.767	0.589	0.704	0.667	0.856	0.905
	r_2	0.812	0.659				
	r_3	0.879	0.773				
	r_4	0.893	0.797				
Fatigue (F)	r_5	0.880	0.774	0.853	0.868	0.942	0.959
	r_6	0.923	0.853				
	r_7	0.936	0.875				
	r_8	0.953	0.909				
Anxiety (A)	r_9	0.932	0.868	0.785	0.804	0.899	0.931
	r_10	0.834	0.695				
	r_11	0.877	0.768				
	r_12	0.899	0.809				
Inefficacy (I)	r_13	0.883	0.78	0.713	0.722	0.861	0.911
	r_14	0.902	0.813				
	r_15	0.749	0.561				
	r_16	0.835	0.697				

* See details in Appendix A.

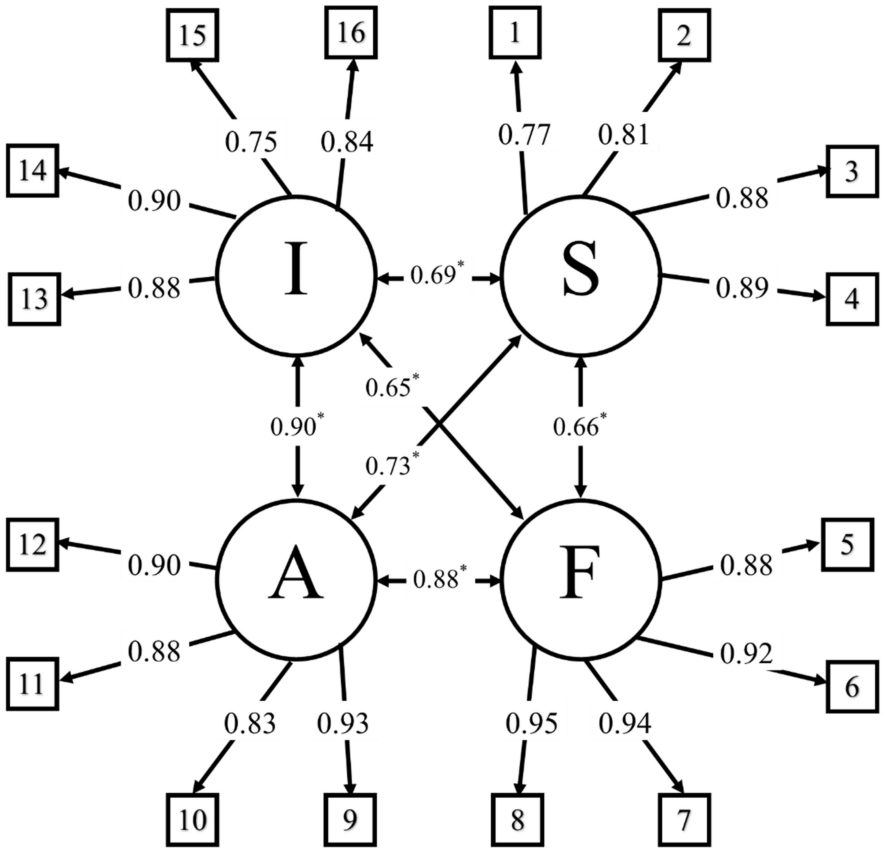

Figure 2. Confirmatory factor analysis for RED-TIC scale. * Double-headed arrows represent covariances in confirmatory factor analysis [41]. Factors are represented in circles, and variables 1 to 16 in boxes.

Figure 2 shows the results of the confirmatory factor analysis for the four factors that measure technostress on the RED-TIC scale [10,41]. Table 4 sets out the scores used to identify stress levels for each of the technostress dimensions and the result ratios [10].

Table 4. Scores correction by levels for the sample of teachers and teachers' ratio (TR) by technostress dimension (n = 3006).

Levels [a]	%	Skepticism	TRS *	Fatigue	TRF *	Anxiety	TRA *	Inefficacy	TRI *
Very low	>5%	0.00	0.000	0.00	0.081	0.00	0.146	0.00	0.243
Low	5–25%	0.00	0.262	0.01–1.00	0.170	0.00–0.50	0.114	0.01–1.00	0.278
Medium (low)	25–50%	0.01–1.00	0.243	1.01–3.00	0.252	0.51–1.75	0.257	1.01–1.50	0.108
Medium (high)	50–75%	1.01–2.75	0.264	3.01–5.00	0.295	1.76–3.75	0.247	1.51–2.50	0.149
High	75–95%	2.76–5.00	0.189	5.01–5.99	0.108	3.76–5.75	0.194	2.51–4.74	0.178
Very high	>95%	>5	0.043	>5.99	0.094	>5.75	0.042	>4.75	0.045
Mean		1.61	–	3.07	–	2.21	–	2.87	–
Standard Deviation		1.65	–	2.00	–	1.87	–	1.57	–

a. Levels according to the scaling and normalization of scores obtained with the RED-TIC scale [10]; *. Teachers' ratio in percentage of teachers classified at each level for each dimension of the RED-TIC scale (factor).

Moderating Variables

The study considered reviewing the possible differences between different attributes of teachers, i.e., reviewing variables such as education level at which teacher works, the weekly chronological hours of work in an educational establishment, type of employment contract, the day of the day when he mostly teaches classes, years of work in education, number of educational establishments in which he works, possession of professional title, and age. However, statistical procedures did not show for this set of variables statistically significant differences, which allow to distinguish differences in the manifestations of technostress.

As an example, see Table 5, the analysis of the day's shift variable in which teachers teach, the results of the Kruskal–Wallis test give a p-value < 0.05 only for the fatigue dimension, so the null hypothesis is rejected that there are no differences between the day's shift. See Table 5, there are differences in the very low and medium (low) stress levels for the teachers who work in both daytime and those who work in the evening.

Table 5. Teachers' ratio by technostress dimension Fatigue (n = 3006).

Levels	Both Daytime Journeys	Evening Journey
Very low	0.074 *	0.156 *
Low	0.167	0.172
Medium (low)	0.235 *	0.359 *
Medium (high)	0.294	0.188
High	0.115	0.031
Very high	0.115	0.094

* Statistically significant differences.

In this way, statistically significant differences were found only in the very low and medium low levels of the fatigue dimension. This would be showing that percentage of teachers who work on an evening workday present a higher level of fatigue compared to teachers working on the morning along with evening. That is, while differences were found, these are very marginal to point out that one group is more techno stressed than the others.

As for the gender variable, the analysis showed a more interesting scenario, which, in turn, contributes as a moderator to possible data variability problems due to the low response of male teachers within the surveyed population. Due to this, it was decided to carry out the Kruskal–Wallis test of differences in proportions, for each dimension(factor) of the RED-TIC scale. This test identifyies possible differences within the sample, and allows to control for differences in the size of each subsample. In this way, the results of the Chi-square test deliver a p-value < 0.05, in each case, so the null hypothesis is rejected that there are no differences between the gender and the levels of each techno-stress dimension (see Table 6).

Table 6. Chi-square test p-value for differences in gender proportions by dimension (factor) of the RED-TIC scale.

Dimension	p-Value
Skepticism	0.040 *
Fatigue	0.003 *
Anxiety	0.024 *
Inefficacy	0.000 *
Techno anxiety	0.491
Techno fatigue	0.505

* Statistically significant differences.

Thus, giving gender openness to Table 6, in anxiety dimension at the level of high anxiety, it is identified that the proportion of women is significantly higher than that of men, and, at the level of very low anxiety, the proportion of men is higher than that of women. Significant differences are found in medium-low levels and very high skepticism, the proportion of women with medium low skepticism level is higher than men (0.202 vs. 0.258). Differences in very low and very high inefficiency levels are significant, so the proportion of men is higher than for women at these levels. Finally, there are significant differences in levels of very low, high, and very high fatigue; at the level of very low fatigue, the proportion of men is higher than women, and at high and very high fatigue levels, the proportion of women is higher than men (see Table 7). The proportions for high (H) and very high (VH) levels that indicate the levels of concern for the different

dimensions (factors), manifestations (combination of factors), and technostress in general are calculated. The results shows that techno anxiety exist in 11.0% of all teachers, in which in male teachers the rate reaches 11.5% and in female teachers stands at 10.8%. Regarding techno fatigue, the results point to a 7.2% of total affected teachers, in which 6.5% and 7.4% of male and female teachers shows this manifestation, respectively. Accordingly, the total percentages of teachers who are affected by at least one of the 2 manifestations is 11.6%, and worryingly, 6.8% are jointly affected by both manifestations, which is 7.0% of female teachers and 6.4% of male teachers.

Table 7. Test of proportions for level by gender in technostress, manifestations and dimensions.

Levels	Skepticism		Fatigue		Anxiety		Inefficacy		Techno Anxiety		Techno Fatigue		Techno Stress	
	M	F	M	F	M	F	M	F	M	F	M	F	M	F
Very low	0.000	0.000	0.105 *	0.073 *	0.181 *	0.136 *	0.272 *	0.234 *	–	–	–	–	–	–
Low	0.278	0.260	0.167	0.174	0.119	0.118	0.262	0.286	–	–	–	–	–	–
Medium (low)	0.202 *	0.258 *	0.293	0.241	0.253	0.259	0.117	0.105	–	–	–	–	–	–
Medium (high)	0.285	0.258	0.293	0–294	0.253	0.243	0.133	0.154	–	–	–	–	–	–
High (H)	0.189	0.188	0.084 *	0.115 *	0.170 *	0.205 *	0.171	0.182	–	–	–	–	–	–
Very high (VH)	0.058 *	0.037 *	0.071 *	0.103 *	0.036	0.044	0.058 *	0.040*	–	–	–	–	–	–
H + VH	0.247	0.225	0.155 *	0.218 *	0.205 *	0.248 *	0.229	0.221	0.115	0.108	0.065	0.074	0.064	0.070
Dominant gender	–	–	–	F(+)	–	F(+)	–	–	–	–	–	–	–	–

* Statistically significant differences; M: male, F: female.

4. Discussion

In terms of validation procedures and results and scale adjustments, both the instruments applied and values and scores match with others recent research. In this way, in general terms, the other technostress measurement scales and the values of this research are like the studies of the last decade [30,33–35]. The previous local study focused on technostress of teachers in a prepandemic context [30]. However, in the three referenced research cases, the sample sizes are narrower (441, 267, and 537 cases reviewed) and, at the same time, they do not correspond to a study with a sample at the national level. Objectives of other technostress studies, published in 2020, with relative samples including 1462 cases [12] and 1744 cases [13], focused on the techno stressors of higher education students.

However, as a limitation, the local case studied is a recent research, and that is why, it has been chosen to obtain concrete measures and a multivariate analysis that focuses on confirming the empirical validity of the RED-TIC scale before being able to conclude the relation to underlying variables. At this point, we distanced ourselves with other recent studies that seek to test theory through an analysis with partial least square structural equation modelling (PLS-SEM) [47] in K-12 teachers [24] and in lecturers and professors [28]. However, this study is in line with articles that use confirmatory factorial analysis (CFA) to analyze technostress of university students [9,10]. On the other hand, while technostress studies in teachers are scarcer, it is interesting to note that the results of the constructs and procedures validation used are also consistent with recently published research on teachers [22,36].

Regarding differences by technostress dimensions and manifestations, in the context of the COVID-19 pandemic and under a teleworking or teleteaching scheme, the results showed that female teachers suffer higher fatigue and anxiety with the use of technology as an educational means. Such manifestations of technostress, because of these emerging psychosocial risks present at work, associated with the use of ICTs, are also observed in Salanova's research [10]. On the other hand, it is important to emphasize that, according to the latest psychosocial risk assessment, through the application of the SUSESO/ISTAS 21 questionnaire, in work centers in Chile during 2019, the results of which were published in 2020, in a scenario prior to COVID-19 pandemic, most of the psychosocial risk variables considered show differences according to gender. Thus, women in this country are more exposed to these risks with significant differences in relation to men in 13 out of 19 subdimensions, which correspond to emotional psychological demands, influence,

development possibilities, sense of work, clarity of role, role-playing conflict, leadership quality, relationship with superiors, relationship with peers, esteem, contract insecurity, job insecurity, and double presence [48]. This reinforces the idea that female gender would have reason to be more stressed, consistent with this study where the level of technostress, simultaneously techno anxiety and techno fatigue, is 7%, greater than that of men reaching 6.4%. The need to reconcile domestic and professional tasks due to the establishment of telework and the closure of schools, with assistance in educational tasks for children could be related to these results. According to the study by Lambert et al. [49], work–family conflict influences levels of work stress in women. Additionally, La Torre et al. [50] state that women experience greater techno-overload, techno-invasion, techno-complexity, and role overload than men.

On the other hand, the proportion of techno anxiety (11.0%), which surpasses Techno fatigue (7.2%), tends to be coincident with the findings of Estrada et al. [30] prior to COVID-19 pandemic and teleworking resulting from the quarantine of confinement, but the results of both manifestations have a higher distance, and the total level of techno-stresses is reduced in this sample greater than 6.8%. García-Gonzalez's study [51] also shows coincidences, although this research focuses on instrument validation, more than in technostress measuring and moderating variables comparison. It is important to consider that the vast majority of the teachers who answered the survey have formal education, which, according to Tarafdar et al. [52], would be related to lower technostress levels.

In relation to future lines of research and deepening, it is relevant to design educational public policies, including other levels of school and members of educational communities, such as students, administrators, and other education-assistant professionals. In the same manner, it is important to delve into the effects of techno-inhibitors and techno-creators on technostress in education in an empirical way [28,36] and, in reality, compared to other countries. Similarly, it is necessary to delve into the moderating variables and their effects on techno-inhibitors and techno-creators [52,53], and to explore what are the main conditions that predispose female gender people to present greater manifestations of technostress, in the teleteaching context, compared to those of the male gender [54].

5. Conclusions

This research, when measuring the levels of technostress in a national sample of teachers of different levels of primary and secondary education, has allowed to account for differences in dimensions that show manifestation of technostress. At the same time, as the results warn, statistically significant differences have been appreciated when the gender variable is introduced. In this way, in the case of Chilean primary and secondary school teachers, it is advised that female teachers show a higher technostress than their male gender pairs, a condition that is also consistent with other contemporary studies that have analyzed these differences.

In this way, the results of this research acquire a relevant importance to strengthen knowledge on the subject, especially when in the case of teachers, keys are collected for the formulation of strategies and measures that allow an effective and sustainable integration of ICTs in the educational field, an integration that undoubtedly transcends the juncture that has installed COVID-19 pandemic.

For contemporary educational systems, the integration of information and communication technologies (ICTs) into education has become an urgent necessity both for universal access to knowledge and for pedagogical and didactic resources associated with information and communications technologies. This implies a transformation in how teaching work is organized and how teachers' skills are developed and consolidated when using and incorporating ICTs, without the increasing of stress associated with their use. In this sense, the findings of this research are a concrete contribution to the design of educational policies, generating the beginning of a way to study other factors, in addition to those related to the use of ICT, to generate conditions that optimize work [55].

Specifically, this research infers the demands and resources of work with technological means in the educational field, where teachers from primary and secondary schools develop daily warning of the risks of stress and pathological exhaustion. This confirmed that work in primary and secondary schools, especially in urban areas, relates to greater manifestations of stress, especially in the case of female teachers.

In this regard, the establishment of public policies focused on mitigating those stressful factors, beyond human-ICT interaction, is recommended. According to Ayyagari et al. [56], these factors are associated with tasks (work overload, work schedule, and exposure to risks and dangers), role characteristics (ambiguity, conflict, and overload), interactions within the organization (interpersonal relationships and style of leadership), career (job insecurity and career advancement), organizational factors (climate and structure), work–home interface (work–home conflict and invasion of privacy), and characteristics related to the physical work environment. To which, Tarafdar et al. [57] add that the attitude towards ICT, the workload, the complexity of the work, digital literacy, and user participation affect the perception of technostress.

Finally, in practical terms, the results of this research contribute to analyzing the effective implementation of the Chilean Educational Reform, in particular, Law 20.903 [58], which creates the System of Professional Teacher Development and sets the criteria to guide the training of teachers and the conditions of professional practice. Additionally, in article 1 of this law, it is stated as a purpose to contribute to the continuous improvement of the teaching professional performance and the systematic reflection of professional practice. Thus, contributing to an explicit demand of the Chilean Teachers Association, to identify manifestations of risk in the mental health of teachers and based on these findings, this research propose actions and strategies that attend and prevent emotional or mental illnesses. Additionally, in theoretical terms, this research gather evidence that allows the development and promotion of didactic and pedagogical adjustments that, while safeguarding the working conditions of the teaching activity, allow the consolidation of an educational model that combines the advantages of face-to-face teaching with classes supported by virtual resources, both synchronous and asynchronous.

Supplementary Materials: The following are available online at https://www.mdpi.com/article/10.3390/ijerph18105458/s1, Table S1: TSPTW.xlsx.

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Institutional Review Board Statement: The absence of any involvement of therapeutic medication, no formal approval of the Institutional Review Board of the local Ethics Committee was required. Nonetheless, all subjects were informed about the study and participation was fully on a voluntary basis. Participants were ensured of confidentiality and anonymity of the information associated with the surveys. The study was conducted according to the guidelines of the Declaration of Helsinki.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The analyzed dataset has been anonymized and included as Supplementary Materials.

Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

Technostress theoretical constructs by NTP730. This appendix presents the RED-TIC scale, originally published in Salanova et al. [59] as a Technical Note on Prevention (NTP730) and adapted for the first time for its use to the context of Chile by Vega et al. [29].

Factor: Theoretical Constructs	Variable	Components
Skepticism	r_1	S1. With the time passage, technologies interest me less and less
	r_2	S2. Every time I feel less involved in the use of ICT
	r_3	S3. I am more skeptical about the technology's contribution in my work
	r_4	S4. I doubt the working meaning with these technologies
Fatigue	r_5	F1. I find it difficult to relax after a workday using them
	r_6	F.2 When I finish working with ICT, I feel exhausted
	r_7	F3. I'm so tired when I just work with them that I cannot do anything else
	r_8	A3. I doubt when using technologies for fear of making mistakes
Anxiety	r_9	A1. I feel tense and anxious when working with technologies
	r_10	A2. It scares me to think that I can destroy a lot of information by the improper use
	r_11	A3. I doubt when using technologies for fear of making mistakes
	r_12	A4. Working with them makes me feel uncomfortable, irritable, and impatient
Inefficacy	r_13	I1. In my opinion, I am inefficient using technologies
	r_14	I2. It is difficult to work with information and communication technologies
	r_15	I3. People say that I am inefficient using technologies
	r_16	I4. I am unsure of finishing my tasks well when I use ICT

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Validation of the Multidimensional Fatigue Inventory with Coronary Artery Disease Patients

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Abstract: Background: Fatigue is a common distressing symptom in patients with coronary artery disease (CAD). The Multidimensional Fatigue Inventory (MFI) is used for measuring fatigue in various clinical settings. Nevertheless, its multidimensional structure has not been consistent across studies. Thus, we aimed to psychometrically evaluate the MFI in patients with CAD. Methods: In sum, 1162 CAD patients completed questionnaires assessing their subjective fatigue level (MFI-20), mental distress symptoms (HADS, STAI), and health-related quality of life (SF-36). Participants also completed exercise capacity (EC) testing. Results: Confirmatory factor analysis of the four-factor model, showed acceptable fit (CFI = 0.905; GFI = 0.895; NFI = 0.893, RMSEA = 0.077). After eliminating four items, confirmatory factor analysis testing showed improvement in the four-factor model of the MFI-16 (CFI = 0.910; GFI = 0.909; NFI = 0.898, RMSEA = 0.077). Internal consistency values were adequate for the total score and four MFI-16 subscales: General fatigue, physical fatigue, reduced activity, and mental fatigue with Cronbach's α range: 0.60–0.82. The inadequate value (Cronbach's $\alpha = 0.43$) was received for the subscale of reduced motivation in both MFI-20 and MFI-16. Correlations between the MFI-16 and HADS, STAI, SF-36, and EC measures were statistically significant (all p's < 0.001). Conclusions: The Lithuanian version of the modified MFI of 16 items showed good factorial structure and satisfactory psychometric characteristics, except for reduced motivation subscale.

Keywords: coronary artery disease; mental exertion; physical performance; psychometric properties; multidimensional fatigue inventory; fatigue; reliability and validity; rehabilitation

1. Introduction

Despite the strides made in medicine, coronary artery disease (CAD) remains the most frequent cause of mortality, accounting for almost one third of all deaths globally [1] and impairing not only the individual's personal life, but also their career and work [2]. Fatigue, which is characterized as a subjective experience of persistent and extreme exhaustion, a lack of energy, and tiredness [3–5] is one of the most frequent and stress-provoking symptoms reported by individuals with heart-related conditions [6–9]. In CAD patients, the prevalence of moderate to severe fatigue reaches 39% during cardiac rehabilitation (CR), remaining up to 28% after one year [10]. Up to date, mental fatigue is considered as a risk factor for developing heart diseases [11], while unusual fatigue is a strong predictor of a longer prehospital delay [12], poor health related outcomes, and an increased risk for mortality [13], which is also considered as one of the key prodromal factors in those after acute coronary syndrome (ACS) [14]. Fatigue in those with heart diseases is also common and distressing symptom that raises concerns within the field of occupational health [2].

Extensive literature of previously published studies suggests strong associations between fatigue and mental distress [7,8,15–21] as well as poor health-related quality of life (HRQoL) [9] in patients with CAD. Findings in post-ACS patients showed significant associations between fatigue, anxiety and depressive symptoms [7,15,17–19]. A study by Eckhardt et al. [22] reported that symptoms of depression were a sole predictor of fatigue intensity. In fact, some authors suggest that there are great conceptual similarities between the construct of depression and fatigue [17,23,24]. Furthermore, previous scientific literature has also drawn the attention towards fatigue and its effect on HRQoL of patients with various clinical conditions [25,26], including heart related conditions [9]. Staniute and colleagues [9] reported that greater limitations due to emotional and physical issues, decreased vitality, poorer social functioning, the perception of worse general health and lower overall HRQoL were significantly linked to greater levels of fatigue. In another study by Burkauskas et al. [8] it was noted that specifically mental, but not other type of fatigue characteristics, was independently associated with worse cognitive functioning in CAD patients during CR, drawing the attention to consider not only physical fatigue and exercise capacity (EC), but also mental fatigue as a risk factor for worse health related outcomes.

Considering that almost one third of CAD patients who completed CR program [10] remains significantly fatigued, it is important to detect the presence of fatigue and its characteristics in those individuals early and accurately as well as adapt the CR program accordingly. Optimal treatment of those with fatiguing illnesses requires measuring severity, frequency, duration, the nature and type of fatigue, as this may help to individualize and monitor the progress of therapy focused on reducing symptoms of fatigue [5]. To date, there are at least 25 standardized unidimensional and multidimensional scales designed to assess fatigue in various clinical populations [27,28]. Nevertheless, well-validated instruments in those with heart related conditions, including CAD, are still lacking.

Multidimensional Fatigue Inventory (MFI), created by Smets and colleagues in 1995 [5], was originally intended as the 20-item self-report method to evaluate five domains of fatigue in oncology patients, including general, physical, and mental fatigue, as well as reduced activity and motivation. The MFI is considered as one of the four most valid instruments, meeting the quality assurance requirements and was found to be the most appropriate tool for assessing fatigue in patients with cancer [27].

Furthermore, recent studies suggest the MFI as a useful tool to measure the level of fatigue not only in cancer-related but also in other clinical populations, including patients with hepatitis B infection [29], Hodgkin's lymphoma patients [30], those with a chronic fatigue syndrome [31], idiopathic Parkinson's disease patients [32], fibromyalgia patients [33], individuals with schizophrenia spectrum disorders [34], a major depressive episode [35], multiple sclerosis [36], acquired brain injury [37], pospoliomyelitis syndrome [38], and overall in those that are critically chronically ill and follow intensive care [39]. There were also some attempts to measure validity and reliability of the MFI in 204 patients after myocardial infarction (MI) [40] in a Swedish population, as well as in 201 CAD patients in Brazil [41], suggesting adequate validity and reliability. However, in a larger and more diverse CAD population, the MFI validation studies are very sparse, especially the ones that explore the MFI factorial structure. Nevertheless, the psychometric studies on various self-reported instruments [42,43] in those with heart related conditions are of great importance, as it helps to evaluate the usefulness of the measures and confidently apply research evidence in a clinical work [44].

It is important to note that previous literature has detected several issues regarding the MFI adaptation. Inadequate reliability of the MFI reduced motivation scale was reported in French-Canadian version [45], Swedish version [46], and English version [47,48] of the MFI. Further, in several articles some complications with factorial structure were addressed: the studies of the American [47] and French-Canadian [45] versions of the MFI reported different item loading from the original MFI version of Smets et al. [5], thus did not support the originally proposed structure solution. In the most recent study by Hinz et al. [49] completed in several countries reported incomplete factorial validity of the MFI and the adaptation of the modified MFI was not suggested. These issues suggest that the MFI

could be further improved and analyzed in the adaptation process of Lithuanian MFI version by applying factor analysis.

The goal of our research was to evaluate psychometric characteristics of the MFI, including the dimensional structure, reliability and validity of the MFI as well as to investigate the dimensional structure in a large sample of Lithuanian CAD patients. In this current study we hypothesized that in CAD patients after ACS (1) The internal reliability of the total fatigue score and the four MFI scales (i.e., general fatigue, physical fatigue, reduced activity, and mental fatigue) will be satisfactory (2) the MFI scores will be associated with mental distress (HADS and STAI) and HRQoL (SF-36), suggesting good convergent validity of the MFI.

2. Materials and Methods

2.1. Study Participants

For this cross-sectional study, a sum of 1287 consecutive patients with CAD were invited to take part as the study participants from February 2010 to March 2020. This study was conducted as part of the larger ongoing research exploring biopsychosocial and environmental risk factors affecting the course and progression of CAD. Inclusion criteria were (1) a current diagnosis of CAD after recent ACS; (2) attendance of an in-patient cardiovascular rehabilitation (CR) program at the Hospital Palangos klinika, Neuroscience Institute, Lithuanian University of Health Sciences, Palanga, Lithuania. The patients were admitted to the CR program within one week following ACS treatment and gave written informed consent. Exclusion criteria were (1) the unstable cardiovascular condition (n = 62), (2) a severe comorbid illness (n = 33), and (3) unwillingness to participate in the study (n = 30). In total, after exclusion criteria were considered, 1162 participants remained in the final study sample (76% men, 24% women, mean age 57 ± 9 years). All the study patients received standard diagnostic and treatment procedures for the secondary prevention of CAD, based on the established guidelines elsewhere [50–53]. The study and its consent procedures were approved by the Regional Biomedical Research Ethics Committee (project identification code: Kardiogen no. 5, 13 April 2007, No. BE-2-21; 15 January 2009, No. P1-38/2007; 12 September 2009, No. P2-38/2007; 20 April 2010, No. P3-38/2007; 24 October 2012, No. P1-110/2012.) This study is also in accordance with the principles of the Declaration of Helsinki.

2.2. Study Procedure

Within two days of admission for CR, all study patients were assessed for (1) socio-demographic information, such as gender, age, and education, and (2) clinical characteristics such as New York Heart Association (NYHA) functional class, history of ACS, and angina pectoris class. Further, usual echocardiography testing to assess the left ventricular ejection fraction was performed on all participants of this study. They also performed EC testing. In order to assess HRQoL, the Short Form (36) Health Survey (SF-36) was used [54]. Patients also independently completed questionnaires, assessing their subjective fatigue level (the Multidimensional Fatigue Inventory, MFI-20) [5,7].

Additionally, depressive and anxiety symptoms (Hospital Anxiety and Depression scale, HADS) [55], state and trait anxiety (The Spielberger State-Trait Anxiety Inventory, STAI) [56] were measured in 200 randomly assigned patients. The number of a sample size was reduced to 200 patients for this analysis involving HADS and STAI due to financial limitations regarding licensing fees of these scales. We employed Lithuanian versions of self-rating scales with good psychometric properties, measured in previous studies [9,57–59].

2.3. Measures

2.3.1. Multidimensional Fatigue Inventory, MFI-20

Fatigue severity was measured by employing subscales from the MFI-20 original version [5,7]. The MFI, consisting 20 items covers five subscales: (1) General fatigue, (2) physical fatigue, (3) mental

fatigue, (4) reduced activity, and (5) reduced motivation. Each domain consists of four items with possible answers on a five-point (1 = "yes, that is true"; 5 = "no, that is not true") Likert scale. The domain of General fatigue is composed of the general statements about fatigue and reduced functioning, covering physical as well as psychological aspects of fatigue. Physical fatigue concerns physical feelings related to fatigue. Mental fatigue relates to cognitive functioning, such as concentration difficulties. Reduced activity subscale evaluates the impact of psychological and physical factors on the activity level. The lack of motivation to start an activity is reflected by the subscale of reduced motivation. The total score ranges from 4 to 20 on each subscale, and 20 to 100 for total fatigue score with higher score indicating higher fatigue levels.

2.3.2. 36-Item Short Form Medical Outcome Questionnaire, SF-36

The SF-36 is comprised of eight subscales that measure HRQoL on eight domains: (1) Physical and (2) social functioning, (3) role limitations due to physical problems, (4) role limitations due to emotional problems, (5) mental health, (6) energy/vitality, (7) pain, and (8) general health perception. Each of the SF-36 domains is rated on scales from 0 to 100, with a higher total score suggesting better HRQoL [54]. Cronbach α coefficients of all eight domains ranges from 0.56 to 0.85, suggesting adequate internal reliability.

2.3.3. Exercise Capacity Testing, EC

The research cardiologist (J.Br.) measured patients' EC with a standardized computer-driven bicycle ergometer (Schiller AT-102). Every three minutes the workload was increased by 25 watts (W) [50]. The peak of workload (PW) in watts (W) or MET (1 MET = 3.5 mL of oxygen uptake per kilogram of body weight per minute) at the moment of the termination of the exercise test reflected individual's EC. Detailed procedures of EC has been reported in our study elsewhere [60].

2.3.4. Hospital Anxiety and Depression Scale, HADS

The self-administered HADS is composed of 14 items, which help to evaluate person's symptoms of anxiety (HADS-A) and depression (HADS-D) [55]. Total scores on both of the subscales is between 0 and 21. The higher total score suggests the worse symptoms of anxiety and depression [61]. Previous studies suggest good psychometric parameters of the HADS in Lithuanian CAD patients [17,62]. In our study, the internal consistency of the HADS was good (Cronbach $\alpha = 0.74$; the HADS-A Cronbach $\alpha = 0.84$).

2.3.5. Spielberger State-Trait Anxiety Inventory, STAI

The STAI was employed to assess state anxiety (STAI-S, 20 items) and trait anxiety (STAI-T, 20 items) [56]. The higher total score on each subscale represents the higher levels of state and trait anxiety. Having good psychometric characteristics in patients with CAD, STAI has been widely used for research purposes in Lithuania [63–65]. In our study population, the STAI showed good internal consistency (The STAI-S Cronbach's $\alpha = 0.92$; the STAI-T Cronbach's $\alpha = 0.89$).

2.4. Statistical Analysis

For statistical procedures, we used The SPSS for Windows statistical package (SPSS Inc., Chicago, IL, USA) (version 17.0). The sample size was determined based on the previous reports by Comrey and Lee [66] as well as MacCallum et al. [67] for sample size in factor analysis. The authors [66,67] suggested that in order to assure adequate recovery of population, minimal sampling error, and stable sample factor analysis solutions, as large as the sample size of ≥1000 participants is preferable, even though the 200–500 sample size in some cases might be acceptable.

Descriptive statistics were generated to define our study population with regards to clinical and sociodemographic characteristics. Floor and ceiling effects were used to demonstrate the response

distribution and served as a measure of feasibility. If 15% or more respondents achieve the lowest or highest level of the score on a measure, there may be a significant floor or ceiling effect [68]. We further used skewness statistics, kurtosis statistics, and Shapiro–Wilk tests to evaluate the normality of distribution in the variables.

The internal validity of the five MFI subscales has been calculated using corrected-to-total correlations, inter-item correlations, and α-coefficients of Standardized Cronbach. If estimates of a magnitude were higher than 0.7, we considered it as acceptable [69]. The value of the corrected-to-total correlations should be higher than 0.20 and correlations lower than 0.15 are unacceptable [70].

Further, we evaluated convergent validity of the target instrument, while comparing MFI with other related measures administered in the study. Pearson or Spearman correlation coefficients were employed to measure linear associations between the scales of the MFI, the HADS, the STAI, SF-36, and EC measures. Due to financial limitations, to measure the associations between the MFI and the HADS, the STAI, a sample of randomly assigned 200 patients was evaluated.

We used confirmatory factor analysis (CFA) to evaluate whether the original factor structure of the MFI is confirmed for the current sample. The fitness of model with the data was measured by calculating the absolute and comparative fit indices (CFI). Absolute fit indices include chi-square goodness-of-fit (GFI), non-normal fit index (NFI), and root mean square error of approximation (RMSEA). Further analyses resulted in the deletion of 4 items and development of a shortened MFI 16-item version, that helped to improve the factorial structure, while leaving the original number of subscales.

3. Results

3.1. Sample Characteristics

The final sample was comprised of 1162 CAD patients, 276 women (24%) and 886 men (76%); the average age of participants was 57 ± 9 years. Table 1 represents socio-demographic, clinical, mental distress characteristics, scores of fatigue, and HRQoL of all study patients. Overall, 87% of participants met the criteria for NYHA functional class I-II, while 13% remained within the group of NYHA functional class III. In sum, 37% of study patients had unstable angina pectoris, and 63% were admitted after recent acute MI.

Table 1. Sociodemographic and clinical characteristics of all patients.

Characteristic	N = 1162	
	Mean	**SD**
Age	57.34	9.09
	N	**Percent**
Gender:		
Male	886	76.2
Female	276	23.8
Education:		
Up to 8 years	86	7.4
High school graduate	577	49.7
College/university degree	499	42.9
Diagnosis:		
Unstable angina pectoris	430	37.0
Acute myocardial infarction	732	63.0
NYHA class:		
I	86	7.4
II	921	79.3
III	155	13.3

Table 1. *Cont.*

Characteristic	N = 1162	
	Mean	**SD**
HF class:		
A	111	9.6
B	817	70.3
C	234	20.1
Arterial hypertension	951	81.8
Left ventricular ejection fraction ≤40%	115	9.9
	Mean	**SD**
Left ventricular ejection fraction	51.35	8.45
Exercise capacity workload (W)	72.90	26.95
	N	**Percent**
Medication Use:		
Nitrates	267	23.0
Beta-blockers	1027	88.4
ACE inhibitors	941	81.0
Diuretics	169	14.5
Benzodiazepines	162	13.9
	Mean	**SD**
State Trait Anxiety Inventory:		
State anxiety	37.27	10.51
Trait anxiety	42.8	9.52
	N	**Percent**
Anxiety symptoms (HADS-A):		
Total score <8	140	70.0
Total score ≥8	60	30.0
Depressive symptoms (HADS-D):		
Total score <8	175	87.5
Total score ≥8	25	12.5
	Mean	**SD**
MFI-20 score		
General fatigue	10.76	3.97
Physical fatigue	11.75	4.34
Reduced activity	12.33	3.90
Reduced motivation	9.91	3.43
Mental fatigue	9.77	4.02
Total Fatigue Score	54.52	16.18
SF-36		
Physical functioning	68.98	19.73
Role limitation due to physical problems	30.16	37.27
Role limitation due to emotional problems	52.70	43.72
Social functioning	66.84	26.24
Mental health	68.28	19.11
Energy/vitality	59.09	20.70
Pain	51.04	27.52
General health perception	53.15	18.86

HADS-A—Anxiety subscale of the Hospital Anxiety and Depression Scale; HADS-D—Depression subscale of the Hospital Anxiety and Depression Scale; NYHA—New York Heart Association; SF-36—Medical Outcomes Study 36-Item Short Form Health Survey; MFI-20—Multidimensional Fatigue Inventory; W—Watts; HF—heart failure.

3.2. Reliability of MFI 20-Items, MFI-20

The results of three reliability tests of all MFI-20 domains are presented in Table 2. The item redundancy was not detected. Inter-item average of correlations for general fatigue domain was 0.46 (range 0.38–0.58); for physical fatigue domain was 0.53 (range 0.44–0.60); for reduced activity domain was 0.40 (0.30–0.47); for reduced motivation domain was 0.24 (0.15–0.35); for mental fatigue domain was 0.49 (0.35–0.68); and for total score was 0.35 (0.10–0.68). The internal consistency values were reasonable for the MFI-20 total fatigue score and four of the five domains: General fatigue, physical fatigue, reduced activity and mental fatigue Cronbach's α range: 0.72–0.92. An inadequate value was found for the domain of reduced motivation (Cronbach's $\alpha = 0.55$). With regards to the inter-item correlations, a mean value of ≥0.20 was found for the MFI-20 four of the subscales but the lowest correlation was present between items of reduced motivation subscale (0.24, range 0.15–0.35). Item-total correlations were ≥0.20 for all the subscale of MFI-20 (range: 0.28–0.37 to range 0.60–0.68).

Table 2. MFI-20 scale item characteristics and internal consistency reliabilities.

Fatigue Characteristics	Mean	SD	Inter-Item Correlation		Corrected-to-Total Correlation	Coefficient α (If Item Deleted)	Standardized Cronbach's α
			Mean	Range	Range	Range	
General Fatigue	10.76	3.97	0.46	(0.38–0.58)	0.52–0.65	0.67–0.75	0.77
Physical Fatigue	11.75	4.34	0.53	(0.44–0.60)	0.60–0.68	0.76–0.79	0.82
Reduced Activity	12.33	3.90	0.40	(0.30–0.47)	0.47–0.57	0.63–0.69	0.72
Reduced Motivation	9.91	3.43	0.24	(0.15–0.35)	0.28–0.37	0.45–0.52	0.55
Mental Fatigue	9.77	4.02	0.49	(0.35–0.68)	0.46–0.70	0.69–0.73	0.79
Total Fatigue Score	54.52	16.1	0.35	(0.10–0.68)	0.32–0.72	0.91–0.92	0.92

MFI-20—Multidimensional Fatigue Inventory.

3.3. Convergent Validity: Relationships of the Subscales of the MFI-20 to Mental Distress Factors, Functional Impairment, and Exercise Capacity

Table 3 displays correlations between MFI-20 total score and fatigue subscales and subscales measuring anxiety and depression symptoms (HADS-A, HADS-D), state and trait anxiety (STAI-S, STAI-T), functional impairment (SF-36) and EC. In overall sample, the strongest correlations were found between the MFI general fatigue ($r = -0.51$, $p < 0.001$), physical fatigue ($r = -0.49$, $p < 0.001$), reduced motivation ($r = -0.43$, $p < 0.001$), total fatigue score ($r = 0.551$, $p < 0.001$), and the SF-36 subscales measuring energy/vitality. In 200 participants, The MFI reduced motivation ($r = 0.50$, $p < 0.001$), mental fatigue ($r = 0.61$, $p < 0.001$), and total fatigue score ($r = 0.58$, $p < 0.001$) were strongly associated with the STAI Trait anxiety, suggesting excellent convergent validity.

Table 3. Convergent Validity: Pearson Correlation Coefficients between the MFI-20, the HADS, the STAI, the SF-36, and EC testing in overall sample.

Clinical Characteristics	MFI-20					Total Fatigue Score
	General Fatigue	Physical Fatigue	Reduced Activity	Reduced Motivation	Mental Fatigue	
	r ($p < 0.001$)					
HADS						
Anxiety symptoms	0.416	0.363	0.323	0.319	0.451	0.466
Depressive symptoms	0.551	0.509	0.484	0.525	0.533	0.563
STAI						
State anxiety	0.587	0.499	0.434	0.507	0.567	0.541
Trait anxiety	0.553	0.446	0.424	0.496	0.613	0.582

Table 3. *Cont.*

Clinical Characteristics	MFI-20					Total Fatigue Score
	General Fatigue	Physical Fatigue	Reduced Activity	Reduced Motivation	Mental Fatigue	
	r ($p < 0.001$)					
SF-36						
Physical functioning	−0.459	−0.446	−0.386	−0.355	−0.299	−0.475
Role limitation due to physical problems	−0.290	−0.304	−0.273	−0.229	−0.172	−0.310
Role limitation due to emotional problem	−0.278	−0.248	−0.243	−0.257	−0.269	−0.315
Social functioning	−0.376	−0.341	−0.300	−0.288	−0.296	−0.391
Mental health	−0.418	−0.365	−0.323	−0.360	−0.426	−0.461
Energy/vitality	−0.514	−0.494	−0.434	−0.405	−0.412	−0.551
Bodily pain	−0.295	−0.294	−0.241	−0.207	−0.182	−0.298
General health	−0.484	−0.486	−0.401	−0.410	−0.344	−0.518
Exercise capacity	−0.307	−0.316	−0.279	−0.317	−0.193	−0.331

MFI-20—Multidimensional Fatigue Inventory; HADS—the Hospital Anxiety and Depression Scale; STAI—State Trait Anxiety Inventory; SF-36—Medical Outcomes Study 36-Item Short Form Health Survey.

3.4. Floor and Ceiling Effects

We explored the possibility for the floor and ceiling effects in all the MFI-20 subscales as well as for total fatigue score. For the general fatigue subscale, n = 81 patients (7%) had the lowest possible test score, n = 21 patients (2%) had the highest test score. For the physical fatigue subscale, n = 72 patients (6%) had the lowest test score, n = 54 (5%) the highest test score. For the reduced activity, n = 41 patients (3%) had the lowest and n = 42 patients (4%) had the highest possible score. For the reduced motivation, n = 66 patients (6%) had the lowest test score, while n = 4 patients (0.3%) had the highest test score. For the mental fatigue, n = 150 patients (13%) had the lowest possible test score, n = 17 (1.5%) had the highest possible test score. For the total fatigue score, n = 16 patients (1.4%) had the lowest test score, n = 1 (0.1%) the highest test score.

3.5. Factor Analysis of the MFI-20

We completed a principal components factor analysis using oblique rotation on the MFI-20. The results are presented in Table 4. In summary, the factor analysis solution was complex. In all four factors, the multiple loadings of items had factor-loading values of >0.50. The first factor explained 39% of the variance in the MFI-20, and was comprised of general fatigue and physical fatigue. The second factor was composed of solely all four mental fatigue items that explained 9% of the variance of the MFI-20. However, two of the reduced motivation items and one reduced activity item fell on the third factor, which explaining 6% of the variance of the MFI-20. The fourth factor was loaded by two of the reduced activity items, which explained 5% of the variance in the MFI-20.

Factor 1 (general/physical), factor 2 (mental fatigue), factor 3 (reduced motivation), and factor 4 (reduced activity) were defined by the authors of the original MFI [5]. General fatigue and physical fatigue were two distinct domains on the original MFI instrument. Surprisingly, confirmatory factor analysis testing of the four-factor model showed acceptable fit (CFI = 0.905; GFI = 0.895; NFI = 0.893, RMSEA = 0.077). However, of these 20 items, the four items (3, 9, 17, and 18) were difficult to categorize to one specific factor. In other to enhance the factorial structure of the MFI, a second principal components factor analysis with an oblique rotation was completed on the 16 items.

3.6. Factor Analysis of the 16-Item MFI, MFI-16

After removing the four items (3, 9, 17 and 18), the factor analysis with multiple loadings of items had factor-loading values >0.50 across four factors. Detailed results are presented in Table 5.

In short, similarly as with previous factor analysis, the first factor was dominated by general fatigue and physical fatigue that was comprised of eight items. The second factor was composed of all four mental fatigue items. Two of the reduced activity items fell under the third factor, while the fourth factor was loaded by two of the reduced motivation items. Of the 16 items of the MFI-16, the first factor explained 39.7% of the variance, while the second, third and fourth factors explained 10.2%, 6.9%, and 6.4% of the variance respectively.

Confirmatory factor analysis testing of the four-factor model from 16 items of the MFI-20 showed acceptable fit (CFI = 0.910; GFI = 0.909; NFI = 0.898, RMSEA = 0.077) (Table 5).

Table 4. Factor analysis of the Multidimensional Fatigue Inventory (MFI) 20-item responses.

Fatigue Characteristics and Items	Factors			
	1	2	3	4
General Fatigue				
I feel fit	0.529			
I feel tired	0.726			
I feel rested	0.526			
I tired easily	0.723			
Physical Fatigue				
Physically I feel I am in a bad condition	0.642			
Physically I feel I am in an excellent condition	0.619			
Physically I feel I am in a bad condition	0.737			
Physically I can take on a lot	0.658			
Reduced Activity				
I feel very active			0.609	
I think I do a lot in a day				0.658
I think I do very little in a day				0.774
I get little done	0.607			
Reduced Motivation				
I feel like doing all sorts of nice things			0.630	
I dread having to do things				
I have a lot of plans			0.594	
I don't feel like doing anything				
Mental Fatigue				
When I am doing something, I can keep my thoughts on it		0.706		
I can concentrate well		0.750		
It takes a lot of effort to concentrate on things		0.772		
My thoughts easily wander		0.626		
Alpha	0.90	0.79	0.66	0.60

Note: Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization. Factor loadings less than 0.5 were not listed in the table. Kaiser–Meyer–Olkin index = 0.937, *p*-value for Bartlett's Test of Sphericity is less than 0.001. Cumulative percent of explained variance is 59.3%.

Table 5. Factor analysis of Multidimensional Fatigue Inventory (MFI) 16-items responses.

Fatigue Characteristics and Items	Factors			
	1	2	3	4
General Fatigue				
I feel fit	0.588			
I feel tired	0.739			
I feel rested	0.579			
I tired easily	0.739			

Table 5. *Cont.*

Fatigue Characteristics and Items	Factors			
	1	2	3	4
Physical Fatigue				
Physically I feel I am in a bad condition	0.660			
Physically I feel I am in an excellent condition	0.673			
Physically I feel I am in a bad condition	0.757			
Physically I can take on a lot	0.716			
Reduced Activity				
I think I do a lot in a day			0.745	
I think I do very little in a day			0.796	
Reduced Motivation				
I feel like doing all sorts of nice things				0.555
I have a lot of plans				0.732
Mental Fatigue				
When I am doing something, I can keep my thoughts on it		0.736		
I can concentrate well		0.790		
It takes a lot of effort to concentrate on things		0.772		
My thoughts easily wander		0.638		
Alpha	0.89	0.79	0.60	0.43

Note: Extraction Method: Principal Component Analysis; Rotation Method: Varimax with Kaiser Normalization. Factor loadings less than 0.5 were not listed in the table. Kaiser–Meyer–Olkin index = 0.919, *p*-value for Bartlett's Test of Sphericity is less than 0.001. Cumulative percent of explained variance is 63.2%.

3.7. Reliability of MFI-16

The summary of the results of three reliability tests for the all MFI-16 domains is presented in Table 6. Inter-item correlations averaged 0.46 (range 0.38–0.58) for general fatigue, 0.53 (range 0.44–0.60) for physical fatigue, 0.43 for reduced activity, 0.27 for reduced motivation, 0.49 (0.35–0.68) for mental fatigue, and 0.35 (0.12–0.68) for total fatigue score. The internal consistency values were reasonable for the MFI-16 total fatigue score and four of the five subscales: General fatigue, Physical fatigue, Reduced activity, and Mental fatigue Cronbach's α range: 0.60–0.89. Cronbach's $\alpha = 0.43$ was received for the domain of reduced motivation, suggesting inadequate internal reliability. In terms of the inter-item correlations, a mean value of ≥0.20 was calculated for the MFI-16 four of the subscales but the lowest correlation was present between items of reduced motivation subscale (0.24). Item-total correlations were ≥0.20 for all the subscales of MFI-16.

Table 6. Multidimensional Fatigue Inventory (MFI) 16-items characteristics and internal consistency reliabilities.

Fatigue Characteristics	Mean	SD	Inter-Item Correlation		Corrected-to-Total Correlation	Coefficient α (If Item Deleted)	Standardized Cronbach's α
			Mean	Range	Range	Range	
General Fatigue	10.76	3.97	0.46	0.38–0.58	0.52–0.65	0.67–0.75	0.77
Physical Fatigue	11.75	4.34	0.53	0.44–0.60	0.60–0.68	0.76–0.79	0.82
Reduced Activity	6.45	2.26	0.43	-	0.43	-	0.60
Reduced Motivation	5.26	2.07	0.27	-	0.27	-	0.43
Mental Fatigue	9.77	4.02	0.49	0.35–0.68	0.46–0.70	0.69-0.73	0.79
Total Fatigue Score	43.99	13.03	0.35	0.12–0.68	0.14–0.58	0.83-0.90	0.89

3.8. Convergent Validity: Relationships of the Factors of the MFI-16 to Mental Distress Factors, HRQOL, and Exercise Capacity

To evaluate convergent validity in the overall sample, we measured the associations between the MFI-16 and other related constructs. Specifically, Table 7 displays the significant associations between the factors of MFI-16 and subscales measuring anxiety and depressive symptoms (HADS-A, HADS-D), state and trait anxiety (STAI-S, STAI-T), functional impairment (SF-36) and EC. In total sample, the strongest correlations were found between Factor 1 (general/physical fatigue) (r = −0.53, $p < 0.001$), Factor 3 (reduced activity) (r = −0.28, $p < 0.001$) and the SF-36 subscales measuring energy/vitality. In 200 patients, Factor 2 (mental fatigue) (r = 0.61, $p < 0.001$) and Factor 4 (reduced motivation) (r = 0.41, $p < 0.001$) were most strongly correlated with the STAI-T (trait anxiety) and HADS-D (depressive symptoms), suggesting excellent convergent validity. The total fatigue score was most strongly associated with depressive symptoms (r = 0.56, $p < 0.001$) and trait anxiety (r = 0.58, $p < 0.001$).

Table 7. Convergent validity: Pearson Correlation Coefficients between the factors of Multidimensional Fatigue Inventory (MFI) 16—items, the HADS, the STAI, the SF-36, and exercise capacity in the overall sample.

Clinical Characteristics	Factors				Total Fatigue Score
	1	2	3	4	
	r ($p < 0.001$)				
HADS					
Anxiety	0.410	0.451	0.304	0.177	0.461
Depressive symptoms	0.558	0.533	0.374	0.424	0.561
STAI					
State anxiety	0.570	0.567	0.342	0.381	0.539
Trait anxiety	0.524	0.613	0.333	0.407	0.576
SF-36					
Physical functioning	−0.478	−0.299	−0.237	−0.244	−0.461
Role limitation due to physical problems	−0.315	−0.172	−0.180	−0.155	−0.299
Role limitation due to emotional problem	−0.277	−0.269	−0.161	−0.150	−0.302
Social functioning	−0.378	−0.296	−0.197	−0.216	−0.388
Mental health	−0.413	−0.426	−0.217	−0.246	−0.458
Energy/vitality	−0.532	−0.412	−0.282	−0.326	−0.549
Bodily pain	−0.311	−0.182	−0.180	−0.121	−0.294
General health	−0.512	−0.344	−0.264	−0.329	−0.514
Exercise capacity	−0.329	−0.193	−0.185	−0.232	−0.315

HADS—the Hospital Anxiety and Depression Scale; STAI—State Trait Anxiety Inventory; SF-36—Medical Outcomes Study 36-Item Short Form Health Survey; Factor 1—General/Physical fatigue; Factor 2—Mental fatigue; Factor 3—Reduced activity; Factor 4—Reduced motivation.

4. Discussion

The purpose of our research was to measure reliability and validity of the MFI as well as to investigate the dimensional structure in the sample of CAD patients after recent ACS. We hypothesized that (1) the internal consistency of a total score and the four MFI domains (i.e., general fatigue, physical fatigue, reduced activity, and mental fatigue) will be satisfactory, and (2) the subjective fatigue (as measured by the MFI) will be linked with mental distress (as measured by HADS and STAI). Both of the hypothesis were met after the completion of the statistical analysis.

The multidimensional structure of the MFI has been found to be comprised of four factors, including general/physical fatigue, mental fatigue, reduced activity, and reduced motivation. The four-factor model used in our study was in line with the original results of Smets et al. [5]. Nevertheless, several issues with the factorial structure were identified. Two items of the original MFI-20 loaded on unexpected

dimensions, while the other two did not meet the criteria for factor-loading values >0.50 across the four factors. These inconsistent loading were also reported in previous studies [45,47], suggesting the possibility for further modifications. Respecting the original four factor structure suggested by the MFI-20 authors [5], in the current study, we eliminated the following items (items 3, 9, 17, and 18). After the noted modifications, MFI-16 was an improved version in terms of the factorial structure and confirmatory support was reached, showing acceptable fit. The MFI 16-item four-factor model was further employed to evaluate the internal consistency of all factors.

In terms of factor loadings, even though several previous studies have reported five-factor model of MFI [30,31] or incomplete factorial validity [49], in our study we found that the domains of General fatigue and the domain of Physical fatigue were highly correlated and fell under the same factor. The four-factor model of the MFI appears to be more common in scientific literature and is in accordance with the original study by Smets et al. [5], as well as with other more recent studies [30,37,45,46,71]. It is previously suggested that due to subjective patients' experience, it might be hard to distinguish between general and physical aspects of fatigue [46]. Nevertheless, the decision whether it is better to merge these two subscales or keep them as separate subscales remained an open question even for the original authors [5]. Based on our study results, the option to merge the General and Physical fatigue subscales of the MFI is recommended when measuring fatigue in those with CAD. However, the five subscales can also be retained, until more data is gathered as suggested by original authors [5].

Furthermore, in our study, we tested the reliability of the MFI-20 and modified version the MFI-16 while using inter-item correlations, corrected item-to-total correlations and Cronbach's α values. Inter-item correlations and corrected-to-total correlations suggested adequate reliability. All factors showed moderate to acceptable [69] Cronbach α coefficients ranging from 0.60 to 0.82, except for reduced motivation factor (Cronbach $\alpha = 0.43$). The lower Cronbach α coefficient for reduced motivation factor is consistent with previous findings [45–48], thus the results of a current study might not be caused due to cultural differences but rather reflects the psychometric properties of the MFI-20. Nevertheless, further investigation for reduced motivation subscale is necessary to address this issue. Overall, the current study suggests adequate reliability for the MFI, except for one subscale of reduced motivation.

Further, the current study has also shown that convergent validity of Lithuanian MFI-20 as well as modified MFI-16 is good: Each subscale and factor was correlated with closely related constructs of mental distress (anxiety and depressive symptoms (HADS-A, HADS-D), state and trait anxiety (STAI-S, STAI-T)), HRQoL as presented by all SF-36 subscales, as well as the level of objective EC (all p's ≤ 0.001). Our findings are in line with the previous research by Smets et al. [72] Fillion et al. [45], Lin et al. [31] in terms of showing high correlations with previously mentioned mental distress and HRQoL scales.

Additionally, we have also investigated floor and ceiling effect for the MFI. Our findings yielded plausible results as no ceiling or floor effects were detected. Similarly, in a recent study by Antonio et al. [41] it was found that 2.5% of the CAD patients reported lowest point on total fatigue score, while none has scored the highest score. In our study we expanded the knowledge and further explored not only floor and ceiling affects for a total fatigue score but also for separate domains, where participants number with the lowest scores ranged from 3 to 13% and with the highest scores ranged from 0.3 to 5%. Thus, in none of the domains participants number topped 15% indicating a significant floor or ceiling effect [68].

Several ideas may explain the inconsistent factorial structure of the MFI-20 items and the need to eliminate four items in order to improve the dimensional structure. First, all our patients had been in the CR for only two weeks, thus questions like "I get little done" (question 17) or "I feel very active" (question 3) might have been answered based on the changed context of physical settings, rather than internal state and health condition. Secondly, due to cultural differences and subjective understanding of fatiguing experience, questions like "I dread having do things" (question 9) or "I don't feel like doing anything" might have been attributed to somewhat different concept than reduced motivation, possibly to symptomatology of CAD.

From occupational health perspective, up to 91% of the CAD patients after CR [73] returns to the workplace, while successful vocational reintegration is essential to those individuals and their psychosocial functioning [74]. Up till now, occupational therapists have been using various instruments, including those that assess anxiety and depressive symptoms as well as health related outcome measures of former CAD patients [74]. The MFI could serve as a useful instrument for evaluating and monitoring different fatigue characteristics in individuals with CAD that could further assist in tailoring individualized work conditions, workload or daily schedule that may help them to better adapt to their health changes at work.

4.1. Study Limitations

Despite of our consistent findings, several limitations should be noted. First, test-retest reliability was not evaluated, precluding us from making interpretation on replicability of the given results more than once in the same population. Secondly, the study was completed in a large cohort of Lithuanian CAD patients, thus generalizability for other cultural cohorts should be assumed and interpreted with caution. Finally, even though we achieved the original four factor structure, to meet this assumption, the adjustment had to be completed and the original 20-item MFI was reduced to 16-items. Despite the potential limitation, our study included a large sample size of CAD patients, suggesting high confidence of generalizability of the results in Lithuanian patients with CAD.

4.2. Future Directions

Even though the MFI is a commonly used instrument, its structure still struggles to find perfect suitability among the various diseases and cultural adaptations. In order to address these issues, we developed a shorter MFI version of 16 items with good factorial structure and sound psychometric qualities. Nevertheless, further studies in various clinical samples are warranted to further address the issues related to the MFI psychometric properties, especially factorial structure, and internal consistency of reduced motivation subscale. Considering the validity of the MFI, the improvements in the future studies can be made in terms of random selections of the CAD patients as well as studies in more diverse cultural cohorts, allowing the clinicians and researchers in related fields to draw more confident conclusions for the generalizability of the study results.

5. Conclusions

This is the first study showing the MFI as an adequate instrument to evaluate the level of fatigue in Lithuanian clinical settings. Nevertheless, the modified MFI version of MFI-16 can be considered as psychometrically improved instrument to measure the multidimensional construct of fatigue, as it was found to have a sound and complete factorial structure in CAD patients. MFI-16 may assist in early detection and characterization of fatigue in cardiac patients undergoing cardiovascular rehabilitation after recent acute coronary event. This may help to tailor individualized treatment program and to not only reduce the levels of fatigue but also positively affect patients' health related quality of life and emotional state, including depressive and anxiety symptoms.

This latest questionnaire is tailored to CAD patients, and clinicians should find it useful to test the fatigue of these patients. However, the subscale of reduced motivation should be considered with caution due to possible threat to internal consistency.

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Presenteeism and Productivity: The Role of Biomarkers and Hormones

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Abstract: Purpose. This study aimed to assess whether self-reported productivity despite presenteeism may be affected by biomarkers and hormones and how these physiological indicators can interact with each other to explain the presenteeism dimensions. Methods. This pilot study included 180 healthy participants with a mean age of 41.22 years (SD = 13.58), 76.11% of whom were female. The dependent variable included a self-reported measure of productivity loss due to presenteeism: the Stanford Presenteeism Scale 6. This study also includes physiological indicators such as biomarkers (C-reactive protein (CRP) and blood glucose) and hormones (cortisol and TSH thyroid hormone). Results. Multiple linear regression analyses revealed that CRP moderated the relationship between cortisol levels and productivity despite presenteeism. Moreover, the increase of TSH moderated the relationship between cortisol, glycemia, and employees' capacity to complete work tasks while sick. Conclusions. The results highlight TSH's moderating role in decreasing employees' capacity to fulfill tasks when these individuals have high levels of glycemia and cortisol in their blood. These findings have practical and theoretical implications based on a fuller understanding of how biomarkers and hormones explain productivity despite presenteeism.

Keywords: biomarkers; hormones; cortisol; glycemia; presenteeism; productivity

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1. Introduction

Presenteeism refers to working while one is sick and can cause significant productivity losses associated with poor health, emotional exhaustion and workplace epidemics from virus transmission such as the current SARS CoV-2 [1]. However, the presenteeism literature has been very critical regarding the measurement of presenteeism with recent studies, suggesting the poor psychometric evidence of the current self-reported measures [2]. Therefore, as mentioned in previous studies, an ideal measure of presenteeism should include both psychological and physical conditions that affect productivity while being ill [2,3]. In fact, there is a call to include physiologic measures of stress (e.g., cortisol) with classical self-reported instruments of presenteeism/productivity losses due to presenteeism. With

this in mind, we are strongly convinced that the current study may provide important contributions to evaluate productivity while one is ill and the development of health promotion programs [2].

The excessive and accumulative exposure to stressors at work may conduct to increased morbidity (e.g., diabetes, inflammations). In fact, previous research shows that stress activities increase cortisol production [4,5], hyperglycemia [6], and systemic inflammation [7]. Therefore, the present research aimed to investigate how presenteeism may be associated with biological variables by detecting interactions between biomarkers and hormones (e.g., cortisol and TSH) and presenteeism's effect on job performance. Due to the scarcity of studies [2], we aimed to explore associations between all the analyzed biomarkers and then find possible interactions.

The presenteeism literature has considered two different approaches: (i) the frequency of presenteeism, and (ii) productivity loss associated with presenteeism. In the current study we will consider the latter perspective. To this end, the Stanford Presenteeism Scale 6 (SPS-6) was used to measure productivity despite sickness presence (presenteeism) [8]. This methodological approach considers two dimensions: one related to psychological illness and avoidance distraction, and another related to physical illness and completed work. Presenteeism refers to attendance behavior in the workplace, when employees cannot fulfill their functions adequately due to physical or psychological problems [9,10]. The literature suggests that several health conditions explain productivity despite illness [11]. For example, in a study conducted with a sample of 296 nurses, lower-back pain and breath infections were among the most prevalent physical diseases [8,12]. Regarding psychological diseases, this study also showed that stress and anxiety were the most prevalent health conditions in nurses.

Cortisol is mostly used as a marker of different stress types [4,5,13,14]. Studies associating perceptions of daily experiences with physiological processes have confirmed relationships between negative experiences, stress, and physiological endeavors involving increased cardiovascular activity [14] and higher cortisol levels [4,14]. Despite its pertinence, studies examining the impact of cortisol levels on job performance considering multicultural perspectives have been scarce in the literature. Previous studies have shown that immunological activity depends on positive mood reactivity and that stress activities increase cortisol production [4,5,15]. Moreover, researchers have found evidence that low levels of cortisol in conjunction with high levels of CRP, a marker of systemic inflammation, influence individuals with depression by increasing their stress sensitivity and negative affect reactivity [7]. Another study revealed that CRP is correlated with disease severity in patients with chronic spontaneous urticaria [16]. However, despite the significant correlations found in previous studies, some inconsistency has been reported in the association between stress and CRP [17].

Another significant biomarker in this context is glycemia, which is related to cognitive decline—a process subject to biological constraints [18] and thus, more related to the avoidance distraction dimension of presenteeism. Hyperglycemia is known to cause a gradual decrease in cognitive functions and has been associated with increased absenteeism [19,20] and burnout [6]. Both reflect adverse implications on job outcomes. Moreover, there is also literature suggesting that higher values of CRP and hyperglycemia have been used as blood parameters to detect long-term diseases such as diabetic foot osteomyelitis [21]. These findings provide interesting clues about the possibility that having higher levels of CRP and glycemia could reinforce the detrimental role of cortisol in decreasing workers' productivity when they go to work while they are ill. In other words, the presence of an interaction effect implies that the negative effect of blood cortisol levels on productivity while one is ill varies as a function of low versus high levels of CRP and glycemia. Taking into account the aforementioned evidence, individuals with high levels of cortisol who are also diagnosed with high CRP and glycemia have a higher tendency to reduce their capacity to concentrate and accomplish assigned tasks at work while they are ill. Hence, the following hypotheses were formulated for the present study:

Hypotheses 1 (H1). *Blood CRP levels will moderate the relationship between blood cortisol levels and productivity while one is ill (presenteeism). The negative relationship between these variables (i.e., cortisol and productivity) will be stronger for workers who have higher CRP and glycemia levels.*

Hypotheses 2 (H2). *Blood glycemia levels will moderate the relationship between blood cortisol levels and productivity while one is ill (presenteeism). The negative relationship between these variables (i.e., cortisol and productivity) will be stronger for workers who have higher CRP and glycemia levels.*

Studies which used a pool of variables have revealed that thyroid-stimulating hormone (TSH) in subclinical hypothyroidism has a role in psychological consequences [21,22]. The thyroid gland produces stimulating hormones that help control and regulate the amount of energy used in the body (i.e., metabolism). The increased amount of TSH stimulates the thyroid gland to produce the hormone thyroxine (T4) and triiodothyronine hormone (T3), which accelerate the metabolism and contribute to symptoms such as irritability, weight loss, an increased heart rate, excessive perspiration, and heat intolerance [23]. Thyroid clinical symptoms have been associated with tiredness, weight gain, excessive sleepiness and physical weakness [24], which may affect productivity at work. Thyroid hormones have an important role in the glucose metabolism [25] with studies suggesting interactions between the hypothalamic–pituitary–adrenal axis and insulin [26]. Thyroid hormone imbalance appears in combination with metabolic disorders, such as diabetes, which may worsen health conditions and affect employees' productivity. A recent study conducted with a sample of 13,292 participants revealed that a group with high levels of glucose was associated with high presenteeism productivity losses when compared to a group with low blood glucose [27]. Based on these assumptions, we expect that increased levels of both blood glucose and TSH influence sick workers' ability to complete their tasks. Apparently, not only do high levels of glycemia contribute to the negative affect of cortisol on productivity while individuals are ill (H2), but they also hinder the negative relationship between TSH and employees' capacity to perform tasks during sickness disease. Therefore, the following hypothesis was postulated for the present study:

Hypotheses 3 (H3). *Individuals with high levels of TSH that interact with high blood glucose will have greater difficulty in presenting higher levels of productivity while they are ill.*

Figure 1 shows the proposed relationship amongst the studied variables.

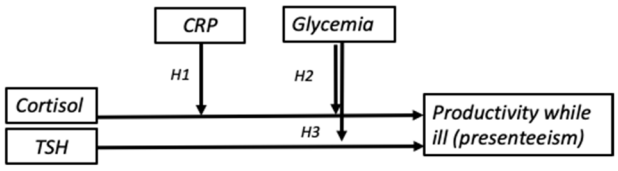

Figure 1. Research model diagram.

2. Methods

2.1. Participants and Procedures

The participants were 108 active Brazilian employees who were users of a university laboratory in Brasília (Brazil) and 72 Portuguese employees from a Portuguese company that provides health care services. In total, our sample comprises 180 active employees, of whom 137 were female. Their mean age was 41.22 years (standard deviation [SD] = 13.58). Regarding education and employment, 50.6% of the sample had a high school diploma and 37.1% a university degree. Eighty-four participants (46.7%) were removed from the analysis because they did not report health problems (e.g., anxiety, depression, migraine, arterial hypertension, lower-back pain, allergies, dermatitis . . .) in the six months prior to this study (which was a requisite for presenteeism, according to the Stanford Presenteeism Scale). Moreover, exclusion criteria included hypothyroidism, hyperthyroidism or diabetes

which had already been diagnosed, medicament use to control glycemia, depression, infection, and hormone replacement procedures that could affect medical exams. The final sample was comprised of 97 participants, 60 from Brazil and 37 from Portugal.

In order to test if higher levels of CRP and glycemia explain a negative relationship between cortisol and workers' productivity, blood samples were taken from the participants, who then filled out a questionnaire in two locations, one in Brazil and another in Portugal. The Brazilian sample was collected in the Community Treatment Center (CAC) of the University Center located in the Southern Commercial Sector of the city of Brasília, in Brazil's Federal District. This center usually serves the underserved population, and most of the sample was composed of healthcare employees: attendants, secretaries, caregivers (i.e., housemaids, nannies, caregivers of the elderly, cleaners). Our sample also included plumbers, bricklayers, among others. The CAC is a university laboratory that serves the surrounding community. In this case, the recruitment procedure was the following: we offered participants the opportunity to participate in a research about the relation between blood markers and psychological factors. We provided complementary exams for free when participants did not have prescriptions for them (e.g., cortisol, TSH). We offered this to up to 6 participants per day, due to the number of available slots for the cortisol test.

The Portuguese sample was collected in a company that provides external services in Portugal (Lisbon) in the areas of occupational safety and health (e.g., nurses, doctors and administrative staff). The research was supported by the company's executive board that accepted to participate in the study and invited all employees (100 in total) to do so as well. Before agreeing to participate, the patients were informed of the study's objectives, and they were asked to sign an informed consent term. Those who agreed to participate filled out the questionnaire while waiting to be called to give blood samples. Due to financial constraints, we could only count measures of CRP in the Brazilian sample. The questionnaires were answered using paper and pen.

The blood samples were taken in the morning before the workday, following a 20 min rest, and after participants fasted for 8 h. Three separating gel vacuum tubes were used, except for the full blood count. Each tube held 4 mL of blood and contained the following biological reagents: plasma cortisol, with an obligatory rest of 20 min before the sample was taken; thyroid hormone, fasting glycemia, and full blood count measures of CRP.

To maintain the confidentiality and anonymity of the data, the laboratory gave us a protocol number. This number was matched with the medical exam results when they arrived by e-mail.

2.2. Instruments

The SPS-6 (Stanford Presenteeism Scale—6) was included in the current study. The presenteeism literature shows that the SPS- 6 is one of the most used instruments to measure productivity despite illness and revealed very good psychometric properties in a previous study developed with Portuguese-speaking samples [28]. The original version of this instrument [29] includes six items that evaluate two factors directly related to presenteeism: completed work and concentration that were computed (mean score) at a higher-level factor named "productivity despite illness (Presenteeism)" [30]. The Portuguese version [28] was adopted. We tested its standard assumptions with normality tests (skewness and kurtosis/error), revealing a normative interval $|1.7|$. Due to demographic differences (e.g., mean age differences between samples), measurement equivalence across groups was computed [31–33] (Table 1), which allowed the analysis with the complete sample, as the instrument demonstrated suitable equivalence across countries. The Cronbach alphas were 0.74 and 0.80, omegas were 0.74 and 0.81, and the model showed adequate fit for a second-order general factor of productivity despite illness ($\chi^2 = 14.43$; df = 7; $\chi^2/df = 2.06$; CFI = 0.96; TLI = 0.91; SRMR = 0.06), which presented a general omega reliability score of 0.77 [34]. Only participants who reported illness in the last six months were eligible to answer the items. The demographic data includes age, gender, and education.

Table 1. Equivalence measurement of SPS6 across countries.

	χ^2 (Diff)	DF (Diff)	CFI (Delta)	RMSEA (Delta)
Configural Invariance	19.34	16	0.98	0.06
Configural loading—metric invariance	(1.35)	(4)	(.01)	(0.03)
Configural intercept	(10.81)	(4)	(0.04)	(0.05)
Configural means	(6.28)	(2)	(0.03)	(0.01)

Note. Brazil $N = 60$; Portugal $N = 37$.

2.3. Statistical Analysis and Reference Values

The reference values for each biochemical marker were normal CRP levels (below 3.0 mg/l), glycemia (70–99 mg/dl), cortisol (4.3–22.4 g/dl), and TSH (0.55–4.78 mcUI/mL). In most cases, the samples were processed using enzymatic with hexokinase to conduct glycemia test; immunoturbidimetry to test CRP; and electrochemiluminescence to test hormones. Questionnaire and laboratory data were collected gathered on the same day.

We tested normality and homoscedasticity assumptions. CRP and Cortisol data were normally distributed, whereas glycemia and TSH revealed some non-normal parameters. For TSH, we found one potential outlier higher than 2SD (TSH = 75.4), whom we opted to delete from the database. The Levene test was non-significant for all markers.

Before testing the hypotheses, comparative tests between the samples were conducted and, in general, no significant differences were found except for glycemia, cortisol, and level of education. The Brazilian sample revealed higher glycemic levels ($M_B = 101.90$; SD = 26.72; $M_P = 84.89$; SD = 10.38, $p < 0.05$), and lower education levels (77.77% of Brazilian and 40.00% of Portuguese participants had a high school degree or lower). The Portuguese sample revealed higher levels of cortisol ($M_B = 13.43$; SD = 5.82; $M_P = 17.48$; SD = 7.16, $p < 0.05$). Although there were differences between the samples ($p < 0.05$), all were within the standard norms [35]. We used the IBM SPSS Software (IBM, New York, USA) and the PROCESS Macro (University of Calgary, Alberta, Canada) [36]. Therefore, hypotheses 1 and 2 were tested through a multiple moderation analysis where the effect of cortisol could also be a function of two variables simultaneously, such as both CRP and glycemia (Model 2 in PROCESS), while Hypothesis 3 was tested using a simple moderation analysis (Model 1 in PROCESS). All the variables were mean-centered prior to analysis.

2.4. Ethical Approval

All procedures performed in this study were in accordance with the institutional and/or national research committee's ethical standards and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Approved in CAAE: 51340715.2.0000.0023.

3. Results

Table 2 presents the means, standard deviations, and Pearson's product–moment correlations among the studied variables with the final sample.

Table 2. Means, standard deviations, and Pearson correlations among variables.

Variables	Mean	SD	1	2	3	4
1. Cortisol	15.04	6.66				
2. CRP	2.72	3.28	−0.20			
3. TSH	3.02	7.71	0.08	−0.02		
4. Glycemia	95.34	23.36	−0.06	0.02	−0.04	
5. Productivity Despite Illness (SPS6)	3.61	0.77	0.21 *	0.17	−0.28 **	0.75 **

Note. * $p < 0.05$, ** $p < 0.01$. SD = Standard Deviation.

In Table 3, the results showed evidence of a moderation effect between cortisol and CRP and between cortisol and glycemia in terms of productivity despite illness [$F(1,40) = 6.10$; $p = 0.02$, and $F(1,40) = 5.94$; $p = 0.02$, respectively]. It is important to notice that

presenteeism is a trick variable because increasing its level is worse for individuals and organizations. Thus, there is a loss in performance when Cortisol, CRP and TSH levels are increased.

Table 3. Multiple regression analyses and moderation effects explaining the relationships between both biomarkers and hormones and productivity despite illness.

Direct Effects and Moderations	*b*	SE	*t*	*p*	CI (Lower)	CI (Upper)
Cortisol –> SPS6	0.00	0.03	0.15	0.88	−0.05	0.06
CRP –> SPS6	0.03	0.04	0.73	0.47	−0.05	0.10
Cortisol×CRP –> SPS6	−0.02	0.01	−2.47	0.02	−0.03	−0.00
Glycemia –> SPS6	0.01	0.01	2.42	0.02	0.00	0.02
Cortisol × Glycemia –> SPS6	−0.00	0.00	−2.44	0.02	-0.01	−0.00
Conditional effect for low CRP and Glycemia	0.15	0.04	3.86	<0.01	0.07	0.24
Conditional effect for medium CRP and Glycemia	0.00	0.03	0.15	0.88	−0.05	0.06
Conditional effect for high CRP and Glycemia	−0.16	0.07	−2.17	0.04	−0.30	−0.01
TSH –> SPS6	−0.11	0.07	−1.62	0.11	−0.24	0.02
Glycemia –> SPS6	0.01	0.00	1.50	0.14	−0.00	0.01
TSH × Glycemia–> SPS6	−0.01	0.00	−2.11	0.04	−0.02	−0.00
Conditional effect for low Glycemia	0.08	0.11	0.74	0.46	−0.13	0.29
Conditional effect for medium Glycemia	−0.11	0.07	−1.61	0.11	−0.24	0.03
Conditional effect for high Glycemia	−0.30	0.12	−2.57	0.01	−0.53	−0.07

Notes. SPS6—Productivity despite illness. *B*—unstandardized beta values; SE = Standard Errors; *t* = *t*-value; *p* = *p* value; CI = Confidence Intervals.

Our findings showed that, for high levels of CRP (i.e., +1SD > 3.29) and glycemia (i.e., +1SD > 27.09), the relationship between cortisol and productivity despite illness became significantly negative (Figure 2). In addition, our results also revealed (see Figure 3) that employees with high levels of TSH and high glycemia values (i.e., +1SD > 21.54) showed lower levels of productivity despite their illness (F (1,92) = 4.48; $p = 0.04$).

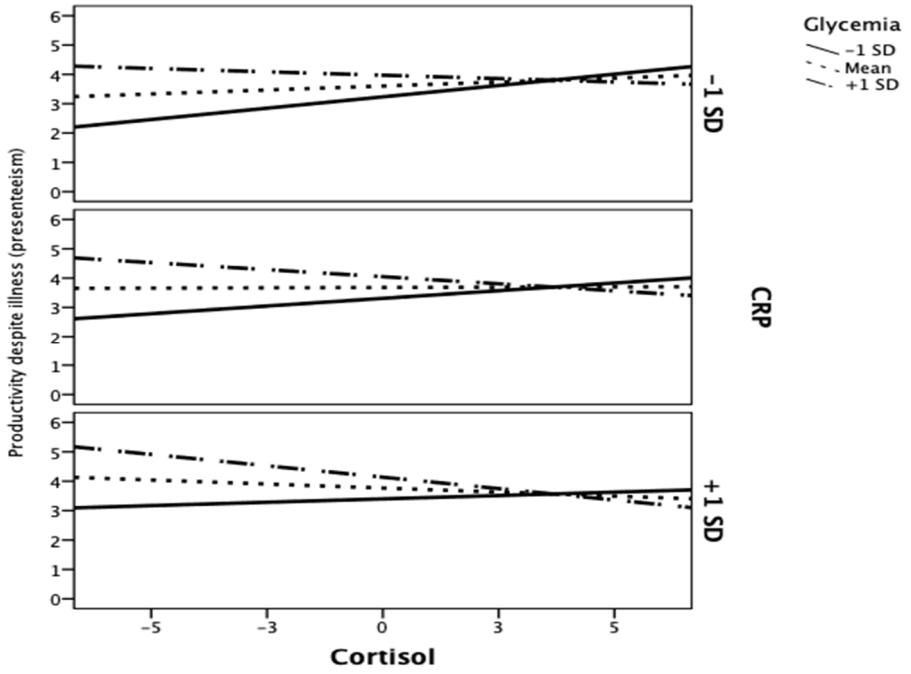

Figure 2. Interaction of Cortisol and CRP and Cortisol and Glycemia levels predicting productivity despite illness (presenteeism).

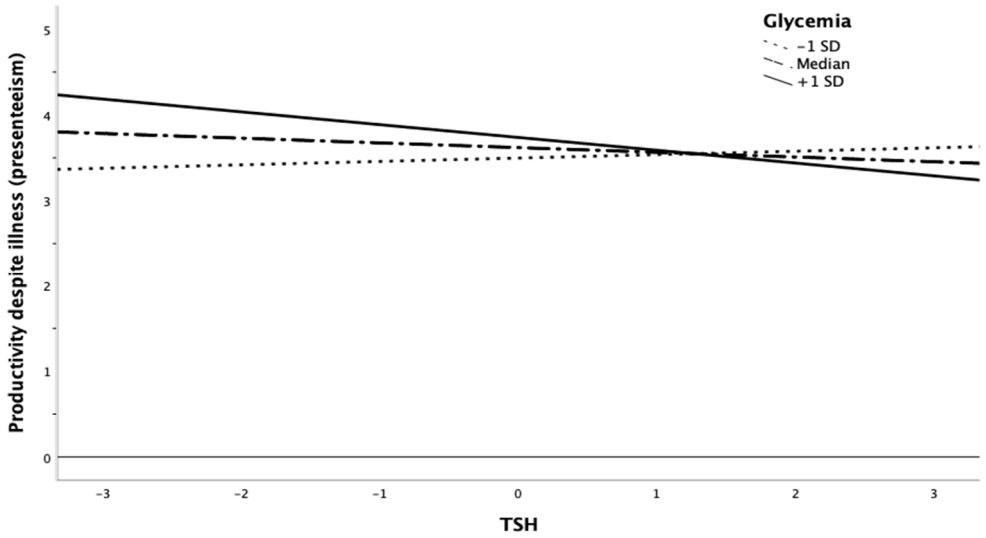

Figure 3. Interaction of TSH and glycemia predicting productivity despite illness (presenteeism).

4. Discussion

This study aimed to combine a self-reported measure of productivity despite illness (i.e., the SPS-6) with physiological indicators such as biomarkers and hormones [2,3]. The findings presented confirm the hypotheses and provide initial support for an association between hormones (i.e., cortisol and TSH), biomarkers (i.e., CRP, and blood glucose), and the general SPS-6 dimension of productivity despite illness.

These findings shed light on the presenteeism and occupational and public health literature that could also be interpreted through blood markers. Also, it can explain some inconsistencies previously detected in the link between stress and CRP. In line with prior studies [17], increased cortisol levels (i.e., the primary stress hormone) were significantly associated with CRP. These results corroborate and extend previous studies [7] by showing that the relationship between cortisol and negative work outcomes is conditioned upon high CRP levels and glycemia. In other words, the current findings suggest that high levels of productivity while employees are sick exist when they develop high levels of cortisol, present signs of systemic inflammations (i.e., high CRP) and high levels of glycemia, which are usually connected to the first stages of stress [37].

Moreover, our results emphasize the TSH role in strengthening the relationship between glycemia and workers' capacity to develop their work while they are sick. The present findings also contribute to the literature by considering the negative impact that high blood glucose has on individuals' cognitive functions and job performance [18,38] and by showing that high levels of TSH moderate these effects. Thus, the current results indicated that high TSH may increase the detrimental effects of high glycemia on workers' capacity to perform their tasks.

It is reasonable to suppose that TSH alone is associated with poor results of workers' capacity to perform their tasks, since individuals with high TSH levels tend to generate irritability, fatigue, depression and impaired memory [37]. The interesting point is that the combination of high levels of TSH and glycemia can be problematic for individual performance. In other words, our results show that high TSH and glycemia may explain a detriment on employees' capacity to perform tasks at work while they are sick.

This study presents various limitations. Therefore, its generalizability is limited and cause–effect paths should be interpreted cautiously. Also, hypothesis 1 was only tested in Brazil for the moderating variable CRP. The research was cross-sectional in nature, and it relied on a small sample, which means replications with more diverse and larger samples (e.g., other countries and patients) are needed. The existing literature has shown that CRP is a sensitive, dynamic molecule that rapidly increases stimulation [39]. Future

studies should consider longitudinal analyses to study possible cause–effect inferences and possible non-linear effects between the variables under study.

Despite these limitations, our findings contribute to the literature by showing that the stress models gain new support because inflammatory effects (i.e., high CRP and glycemia) strengthen the impact of cortisol on productivity losses associated with presenteeism. Our findings support the stress response models that are explained by the hypothalamic–pituitary–adrenal (HPA) axis. Inadequate HPA axis response to stress and inadequate cortisol reactions have been associated with inflammatory disorders, which in turn, affect performance at work. This research focused on the importance of biomarkers and hormones when explaining productivity losses associated with presenteeism. By combining current psychometric instruments with emerging physiologic approaches, the results provide valuable new dimensions in the study of presenteeism and potential improvements in workplace productivity [2].

Practical Implications

This study also contributes to practice by bringing knowledge from the occupational and health sector to human resource departments. Findings suggest that data from biomarkers and hormones may help decision-makers find strategies to reduce several work demands and increase the required resources to reduce stress (cortisol), inflammations (CRP), sugar consumption (glycemia), or thyroid problems. Specifically, managers should consider reducing long working hours [40], developing practices to increase general well-being, such as physical exercise [41] or providing neurofeedback training [42]. Moreover, in light of our findings, we propose that a tight collaboration between occupational doctors and HR managers may be the best solution to provide employees with personalized solutions based on their needs. For example, the development of digital platforms and behaviour change intervention toolkits could provide individual counseling with regards to food choice and health-related behavior at work and in leisure time. Taking into account that different sources of stress may affect different profiles of employees (e.g., blue vs. white collars; youth vs. senior employees), managers should develop customized interventions to control stress and decrease the levels of cortisol and glycemia. For example, managers should provide annual onsite biometric screenings, health webinars with virtual group lectures in real time, digital workshops with interactive education content. These strategies can be developed periodically (e.g., each semester) so that each employee may find the best strategies and behavior to reduce their health risks [43].

5. Conclusions

This study also provides an important contribution to the literature as it offers insightful information from the area of occupational and health to human resource departments. Specifically, data from biomarkers and hormones may aid decision-makers in finding strategies to reduce work demands and increase necessary resources to reduce stress (cortisol), inflammations (CRP), sugar consumption (glycemia), or thyroid problems.

In the future, other direct measures could be used as alternatives to traditional models used to evaluate workers' productivity. This innovative approach approximates existing research on presenteeism in occupational health and medicine, thereby offering a new paradigm in analyses of biomarkers and hormones with significant human resource management implications.

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Data Availability Statement: Data can be made available upon request.

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Article

On the Dynamics of the Psychosocial Work Environment and Employee Well-Being: A Latent Transition Approach

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Abstract: The current study investigates employee well-being in stable versus changing psychosocial working conditions, using the Job Demand-Control theoretical framework. It thereby addresses a gap in the literature dealing with how the dynamics of the work environment may affect different aspects of well-being, such as job satisfaction, work stress, mental health complaints, and overall quality of life. The study was carried out on a large heterogeneous sample of employees in Switzerland (N = 959) and was based on two measurement points. Latent profile and latent transition analyses were used to analyse the data. The findings revealed three commonly encountered and temporally quite stable patterns of job characteristics (i.e., latent profiles), defined by low, average, or high job control and average job demands. The average demand-low control combination was the most precarious, whereas a combination of average demands and high control was the most beneficial and it clearly outperformed the balanced average demands-average control pattern. Furthermore, our results partially supported the claim that employee well-being is contingent on the dynamics (i.e., transition scenarios) of the psychosocial work environment. They particularly highlight the central role of job resources in preventing the deleterious effects on well-being, which may occur even in relatively mild situations where job demands are not excessive.

Keywords: job characteristics; employee well-being; work stress; latent profiles

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1. Introduction

Psychosocial working conditions refer to important job characteristics in terms of content and work organisation [1]. They may be classified into job demands, such as heavy workload, and job resources, such as autonomy or opportunities to develop and apply one's skills [2,3]. Major theoretical models consider them the building blocks of employees' psychological experiences at work with lasting implications for health and well-being [4,5].

Notably, job demands and resources do not act in isolation—they are thought to interact in creating a (un)favourable work environment. This leads to an implication that different combinations of job characteristics should be considered when investigating their role in employee outcomes [5]. Moreover, adopting a temporal perspective is crucial when assessing the work environment. Being persistently versus temporarily exposed to a certain set of conditions should produce different effects on employees (see Frese & Zapf [6]), and these potentially differing effects are not yet fully understood. The majority of existing studies rely on a momentary estimation of working conditions that are then assumed to have long-term outcomes. Hence, even longitudinal investigations tend to overlook the changing nature of the work environment per se, ignoring whether a given combination of job demands and resources is persistent and how this may affect employee well-being.

In the current study, we aimed to address this gap by employing a longitudinal person-centred approach. First, we aimed to identify the most salient combinations of key job characteristics suggested in the Job Demand-Control model (i.e., job demands, decision authority (autonomy), and skill discretion) that are likely to be encountered by employees at work [1,2]. As a result, this allowed us to classify employees into latent profiles in terms of their working conditions. Second, we tested the stability and change of latent profile membership over a one-year period. Ultimately, we compared a set of health and well-being outcomes cross-sectionally across the profiles and longitudinally across the profile transition scenarios in order to investigate how exposure to a certain set of working conditions affects employee well-being.

2. Theoretical Background

2.1. Psychosocial Working Conditions

Most theoretical models define psychosocial work environment by job demands and job resources. The Job Demand-Control model [3,7] is one such model and it offers several foundational assumptions about the nature and impact of working conditions on employee well-being. It posits that job demands and job control are the key characteristics of the work environment. Job demands pertain to psychological stressors that cause strain and include aspects, such as workload, time pressure, role conflict, and the like [3,8]. Job control pertains to key job resources that help dealing with job demands. It consists of two separate dimensions referring to the possibility to use one's skills at work and the freedom to decide how to accomplish the tasks [7,9]. One important tenet of the JDC model is that psychological job demands and job control jointly predict employee well-being depending on how they are configured together [7,10–12]. This suggests that a combination of demands and control rather than isolated job characteristics should be considered in order to understand how and when the psychosocial work environment affects employee outcomes. For instance, a combination of high demands and low control defines high-strain jobs and is considered conducive to ill-being (i.e., the stressor–strain hypothesis), whereas high demands accompanied by high control denote active jobs that are thought to result in positive outcomes [9,13,14]. To date, the above-mentioned assumptions have been mostly investigated focusing on additive and multiplicative effects. Additive effects refer to the main effects model, where job demand and job control variables autonomously predict employee outcomes cross-sectionally or over time. Multiplicative effects are tested in a moderation model. In this case, job control is set to buffer the effects of job demands, thereby inspecting high versus low control conditions [2,8,15]. Over the recent decades, studies testing the assumptions of the JDC model have produced abundant findings, also revealing several important shortcomings. The most notable criticism emerging from the literature is that empirical evidence about the joint impact of job demands and job control appears to be rather inconsistent. While there is quite some support for their additive effects on a range of well-being variables, the evidence about their multiplicative effects in reducing strain is much more scarce [5,10,16]. Hence, research still seems to fail to comprehensively depict the co-occurrence of job demand and control characteristics, which is a major setback in understanding their blended role in employee well-being. One reason for that may be that previous studies have either only partially managed to capture different combinations of job demands and job control or they have not aimed to do that at all. This also results in a lack of knowledge about the temporal stability of these combinations and the impact it may have on employee well-being. At this point, it may therefore be necessary to step beyond a cross-sectional and variable-centred approach in order to properly address these gaps.

2.2. A Person-Centred Methodological Approach to Job Characteristics

2.2.1. Exploring Job Demand-Control Combinations

Studies investigating the role of job characteristics in employee well-being have for the major part used a conventional variable-centred approach. A variable-centred

approach focuses on isolating characteristics on which individuals differ and then studies the correlation of these characteristics in a given sample. Hence, such analyses rely on the properties of separate variables. Whereas by adopting a person-centred approach, one gains the possibility of studying a configuration of multiple variables of interest within the person, which then becomes the centre of analysis [17]. As a result, an advantage of person-centred analytic methods, such as latent profile analysis (LPA), is that they allow for identifying unobserved subgroups of individuals based on the similarity of their scores [18], which represent qualitatively and quantitatively distinct configurations of input variables [19]. This is clearly beneficial for research on job characteristics, as it may help overcome some of its known issues and shortcomings. Notably, it helps to capture naturally emerging combinations (i.e., latent profiles) of job demands and control in the investigated sample, which is not easily done otherwise. By linking these profiles to well-being outcomes, such analyses then enable the researcher to test the combined effects of different job characteristics, thus offering a more holistic insight into the impact the work environment has on employees.

This line of investigation is gradually finding its way with quite promising results. For instance, Van den Broeck et al. [20] have distinguished four job demands and resources profiles, demonstrating that employees in demanding jobs were more at risk of high burnout and low engagement. De Spiegelaere et al. [21] succeeded in identifying five distinct job characteristics profiles in the electricity sector and showed that low-strain and active jobs were related to the best scores of work engagement and innovative work behaviour. Mäkikangas et al. [22] adopted a multi-level LPA to identify healthy and unhealthy (i.e., high-strain) departments, whereas yet another study conducted by Keller et al. [23] replicated a bipolar low stressors-high resources and low resources-high stressors profile solution across four samples and linked it to employee well-being. These and similar findings convey a very important message for further research on the topic. By pointing out the unobserved heterogeneity among employees in terms of their job characteristics, they unequivocally suggest that such heterogeneity may exist in any sample and it is crucial to unravel it in order to understand how workplace ill- and well-being evolves.

This implication has laid the foundations for the current study, in which we adopted a person-centred approach to investigate the emerging patterns of key job characteristics in the general working adult population. Drawing on the JDC model's assumptions about different job types that are situated on a quadrant combining the job demand and job control axes [3,7], we aimed to corroborate this theoretical distinction empirically. Encouraged by the above-mentioned findings on the existence of job characteristics profiles, we thus expected to identify more than one unobserved subpopulation displaying distinct patterns of job demands and both dimensions of job control as a starting point of our study. This led to our first hypothesis:

Hypothesis 1 . *Distinct patterns (i.e., latent profiles) of job demands, decision authority, and skill discretion should emerge denoting a differing degree of favourability of the psychosocial work environment, based on the JDC quadrant.*

2.2.2. Adopting a Temporal Perspective

After establishing cross-sectional combinations of job demands and job control, we subsequently aimed to extend these analyses into a longitudinal framework. Despite a steep increase in longitudinal investigations over the recent years, they often have their primary focus on the dynamics of selected outcome measures rather than job characteristics as such. For instance, some studies have examined the development of employee well-being related processes over time [24–26], unravelling their changes in the light of various job demands or resources. On the flipside, the dynamic nature of the work environment per se and the lasting impact it may have on the individual still needs to be better understood. Persistent exposure to (un)favourable work environment should have different implications on employee well-being compared to a temporary one (see Frese & Zapf [6]), which is a sound reason to explore these aspects more in detail. The current study thus aims to test how

stability and change in the constituent characteristics of the work environment occur and what role it may play in employee outcomes. In doing so, we join rare previous attempts to address similar questions. In this regard, Igic et al. [27] have recently provided interesting evidence for the formation of different constellations of growth trends in job resources and demands over a period of 10 years. Whereas a study of Bujacz et al. [28] explored psychosocial working conditions patterns among highly skilled workers and observed some fluctuations in their prevalence over six years. To advance on the topic, we aimed to examine the longitudinal development of such patterns within a general population over a one-year period, which is long enough to capture change versus non-change in the working conditions and yet short enough to spot its imminent implications for well-being. To do so, it was necessary to identify so-called transition scenarios that denote stability and change of employee membership in the identified job characteristics profiles from one time point to another in a second step of the current study. Although some shifts are likely to occur [28], based on the build-up logic of Karasek and Theorell [7], one may also expect the emergence of pretty much stable patterns, especially given quite a short time lag. The above authors claimed that strain tends to generate further strain, which then implies that stressful (or vice versa, resourceful) job experiences may reinforce themselves, embedding the person in the same type of work environment over time. Hence, whilst we considered both types of transition patterns plausible, we expected a different degree of salience in them.

Hypothesis 2 . *The most salient transition scenario will denote stability (i.e., staying in the same job characteristics profile), accompanied by less salient transition scenarios that denote moving from one profile to another one year later.*

2.2.3. Linking Well-Being Outcomes

Ultimately, we sought to unravel how the different profiles of job demands, decision authority, and skill discretion relate to employee well-being concurrently and over time. Previous person-centred research has shown some evidence that less favourable work environment types (e.g., high-strain jobs) relate to lower well-being [20,21,23]. However, such findings provide only a partial picture examining one-time effects of a given work environment or focusing on rather specific outcome indicators, such as rumination or job satisfaction [27,28]. To address this gap, we considered a broader set of balanced positive and negative aspects of employee well-being in the current study that cover both work and general life domains, are substantiated by the theory, and are suitable to be examined both as instant and as longer-term outcomes of the job characteristics profiles and transitions thereof. Job satisfaction denotes a positive emotional state resulting from the evaluation of one's job experience [29]. It is one of the most important work-related outcomes frequently investigated within the JDC model. In the current study, we focused on global job satisfaction that refers to the evaluation of the job situation as a whole. Work stress refers to perceiving one's work environment as taxing [30] and it is another highly relevant outcome representing a negative aspect of work-related well-being. Furthermore, the inclusion of a health indicator was substantiated by a strong emphasis on health outcomes in the JCD research that includes aspects, such as physical symptoms, subjective health, mental health, and unhealthy habits [2]. In the current study, we particularly focused on mental health that refers to anxiety and depressive symptoms among employees. The last outcome, quality of life, is a positive indicator of general well-being [31]. In the current study, it refers to an evaluation of the overall quality of one's life at present.

In theory, favourable work environments that include high levels of job resources, such as decision authority and skill discretion, promote positive outcomes such as job satisfaction. Whereas a deterioration in employee well-being is thought to occur in unfavourable settings where job demands are not compensated by job resources, thus causing psychological strain [12,13]. Hence, we expected such effects to reflect in the levels of work stress and mental health complaints. Moreover, assuming that workplace experiences may spillover to

non-work domains [32], we also expected the quality of life to be related to the favourability of the work environment that one is exposed to. Based on the above, our hypothesized instant effects are as follows:

Hypothesis 3. *Favourability of the work environment is concurrently linked to employee well-being: unfavourable job characteristics profiles entail lower levels of well-being (in terms of job satisfaction, work stress, mental health, and quality of life) compared to more favourable profiles at any given time point.*

Besides that, drawing on Frese and Zapf [6], we expected corresponding longitudinal effects to occur. These authors have described several ways in which the stressor–strain relationships evolve over time. Remarkably, they maintain that the quality of employee functioning in the workplace (e.g., in terms of well-being) may not simply follow the presence or absence of a stressor—it may as well show accumulation effects, where ill-being increases over time due to a prolonged exposure to taxing work environment and may not instantly decline after the stressor (or unfavourable job characteristics) is removed. This served as the basis for our last set of hypotheses:

Hypothesis 4 . *The dynamics of employee well-being over a one-year period, as expressed in the levels of job satisfaction, work stress, mental health, and quality of life, are contingent upon the job characteristics profile transition scenario.*

Hypothesis 4a. *Stable exposure to an unfavourable work environment (i.e., staying in the same profile) results in the accumulation of ill-being, whereas stable exposure to a favourable work environment results in heightened well-being.*

Hypothesis 4b . *Changes in the work environment (i.e., transitioning to a different profile) have asymmetrical effects on employee well-being, so that moving into a less favourable profile relates to a decrease in well-being, whereas leaving an unfavourable profile does not necessarily result in instant positive effects.*

3. Methods

3.1. Procedure

The present study was based on the data obtained from a longitudinal "Professional Paths" survey conducted at the Swiss National Centre of Competence in Research—Overcoming Vulnerabilities: Life Course Perspectives (LIVES). This survey benefits from a large heterogeneous adult sample randomly drawn from the national register of inhabitants that is managed by the Swiss Federal Statistics Office (SFSO) (for more details on the sampling strategy see Maggiori et al. [33]). Participant recruitment was handled by a polling institute. The participants were invited to complete the survey by means of the invitation letter sent by post. The participation was voluntary, and the data were collected anonymously, with a six-digit code identifying each participant. At the end of each wave, participants received a compensation of 20 CHF. They could choose to either donate it to a non-profit organization or to receive a gift card in this amount.

3.2. Sample

3.2.1. Sample Characteristics

The data from two waves collected in 2016 and 2017 were used in the present study, with a one-year lag between the measurements. The final sample consisted of 959 employed adults (50.6% female; mean age at T1 = 46.67, *SD* = 8.21), reflecting the German- and French-speaking Swiss population in terms of age, gender, and linguistic region. With regard to education, 37% of participants held a higher education degree (n = 358), 47% had an upper secondary or vocational education diploma, or its equivalent (n = 448), 3% had compulsory education (n = 31), and the remaining sample indicated other type of education or did not respond to this question. Approximately 95% of the participants were employed on a permanent basis in their main job (n = 917 at T1 and n = 914 at T2). The household

income, measured as an ordinal variable, ranged from (1) less than 40,000 CHF to (8) over 160,000 CHF per year.

3.2.2. Selection Criteria

To be included in the sample, the participants had to have participated in both waves of the study and have at least partially responded on the variables of interest. Furthermore, a criterion of being professionally active was applied when composing the final sample. Only data from participants who held a remunerated employment contract during both measurement occasions were included in the analyses. Holding the same job at both time points, however, was not a prerequisite. The majority of participants (n = 886) stayed with the same employer, whereas a small fraction (n = 73) changed their job.

3.2.3. Sample Attrition

At Time 1, the initial valid sample consisted of 1172 employed adults. At Time 2, the valid sample decreased to 959 employed adults. Some participants were eliminated because they became unemployed or professionally inactive (n = 40), the rest dropped out from the study (n = 173). We compared the dropout and the final sample and found no significant differences in participants' age, gender, or type of contract. However, the dropout sample reported lower household income, $\Delta M = 0.45$, $p = 0.010$ and showed a different distribution in the level of education, $\chi^2(2) = 6.56$, $p = 0.038$, containing a higher percentage of less educated participants than the main sample. With regard to psychological variables, no differences were detected, except for lower quality of life among the dropouts as measured at Time 1, $\Delta M = 0.20$, $p = 0.001$.

3.3. Measures

Job characteristics were assessed with 14 items from the Job Content Questionnaire (JCQ) [34]. The items were rated on a four-point scale (1 = strongly disagree, to 4 = strongly agree) and were subdivided into three subscales measuring decision authority (3 items, Cronbach's $\alpha_{T1} = 0.82$, $\alpha_{T2} = 0.83$), skill discretion (6 items, Cronbach's $\alpha_{T1} = 0.75$, $\alpha_{T2} = 0.72$), and psychological demands (5 items, Cronbach's $\alpha_{T1} = 0.61$, $\alpha_{T2} = 0.61$). Whilst the latter falls in the lowest acceptable range of reliability [35], it is comparable to a number of studies that showed similar psychometric properties of this subscale [36–38].

To evaluate job satisfaction, a one-item measure was used. It was developed for the aims of the Professional Paths survey and asked the participants to evaluate the overall satisfaction with their current job using a four-point response scale (1 = not satisfied at all, to 4 = very satisfied).

Work stress was assessed with the General Work Stress Scale (GWSS) [30]. It consists of nine items measuring subjectively experienced work stress (e.g., "Does your work make you so stressed that you wish you had a different job?"). The responses were recorded on a 5-point scale (1 = never to 4 = always). Cronbach's $\alpha_{T1} = 0.90$, $\alpha_{T2} = 0.91$.

Quality of life was measured with a one-item scale. The participants were asked to rate their health overall quality of life on a five-point response scale (1 = very bad to 5 = very good).

Mental health complaints were measured with a six-item subscale from the General Health Questionnaire (GHQ-12) [39]. The participants had to rate depression and anxiety symptoms they had experienced recently (e.g., "Have you recently lost sleep over worry?"). The items had to be rated on a four-point response scale (1 = not at all, to 4 = much more than usual), Cronbach's $\alpha_{T1} = 0.87$, $\alpha_{T2} = 0.88$.

Because this is a two-wave study, multi-item scales were checked for longitudinal invariance and satisfied the requirement of metric invariance across the two time points.

3.4. Data Analyses

3.4.1. Latent Profiles and Latent Profile Transition

The analyses were conducted in three steps. First, separate series of LPA [40] were performed to examine unobserved subgroups of employees with regard to their job characteristics at Time 1 and Time 2. This was done as a prerequisite for the longitudinal LPA and latent transition analyses conducted in steps 2 and 3 and allowed for determining the optimal latent profile solution at each time point. The mean scores from the JCQ subscales of decision authority, skill discretion, and psychological demands were used as indicators for the LPA. In each series, we took the one-profile model as a baseline, increasing the number of profiles until the optimal solution was reached, as per guidelines in the literature [41]. Decision about which profile solution should be retained was based on their fit statistics as well as on the interpretability of profiles. The following fit statistics were inspected: the Akaike Information Criterion (AIC), the Bayesian Information Criterion (BIC), the sample-adjusted BIC (SaBIC), Lo–Mendell–Rubin likelihood ratio test (LMR), the Bootstrap Likelihood Ratio Test (BLRT), and entropy. Lower values of the AIC, BIC and SABIC indicate a better fitting model. A non-significant value of the LMR and BLRT tests, obtained after comparing a *k*-profile model with a *k*-1 profile model, indicates that a more parsimonious model should be kept. Entropy informs about the classification accuracy, values closer to one indicating a better solution.

In step two, we selected the most optimal set of latent profiles obtained at each time point and estimated them simultaneously without modelling a transition yet. In this step, we applied a sequential procedure aimed at testing the equivalence of Time 1 and Time 2 profile solutions with regard to their means and variances. To this end, we gradually imposed model constraints starting with an unconstrained model, then constraining the means in the corresponding profiles across the two time points, and ultimately adding variance constraints.

In step three, a latent transition analysis (LTA) [41,42] model was tested based on the best fitting model from step two. It is a longitudinal extension of latent profile analyses, which allows for the investigation of latent profile membership stability and change over time by regressing Time 2 profiles on Time 1 profiles. To account for occasional missing data, full-information maximum likelihood (FIML) estimation was used in both LPA and LTA.

3.4.2. Covariates and Outcomes

Participants' background characteristics were modelled as covariates of latent profile membership in LPA using the auxiliary variable command. We used the R3STEP command in Mplus (for more details see [43]), allowing to directly examine the covariates without imposing bias to the profile solution [44]. Furthermore, cross-sectional outcome analyses were conducted using the BCH command [44,45]. It yields a comparison of the mean levels of outcomes across the job characteristics profiles identified in LPA.

Finally, longitudinal analyses were carried out based on profile transition scenarios. To this end, transition scores from the LTA were saved to a data file. Based on these scores, a change in employee well-being outcomes in each latent profile transition scenario was inspected using repeated measure analyses with two time points. To test the role of employer change in profile transitions, we combined their scenarios into two groups, the first group encompassing all employees who transitioned to a different profile and the second group encompassing all employees with stability scenarios. Then, a Chi-Square test of independence was used to inspect the frequency of job changers across these two groups.

4. Results

Descriptive statistics are provided in Table 1 and inform about the means, standard deviations and inter-correlations of the main study variables at both time points. Additionally, Table A1 in the Appendix A displays correlations between background variables and latent profile indicators (i.e., job characteristics).

4.1. LPA Results

The results of job characteristics latent profile analyses conducted in the first step are summarized in the upper part of Table 2 and provide a comparison of the alternative latent profile solutions at Time 1 and Time 2.

As seen in Table 2, the three-, four-, and five-profile solutions had quite good fit statistics at both time points. The LMR and BLRT tests were significant in all cases. However, the most notable decrease in the information criteria, such as BIC and SABIC, was observed when switching from two to three profiles at Time 1 as well as Time 2 (see Figures A1 and A2 in the Appendix A), suggesting a three-profile solution. Furthermore, despite that the four- and five-profile solutions (and a six-profile solution at Time 2) had slightly higher entropy than the three-profile solution, they contained a negligible profile at both time points that was not well interpretable. Based on these results, as well as on the interpretability of the profiles, the three-profile solution was chosen as the optimal one.

To inspect the comparability of the profiles, in the next step we gradually increased the constraints, beginning with a configural model with freely estimated means and variances across the two time points, proceeding to a model where profile means were constrained to equality over time, and ultimately, to a model where both means and variances were set to be equal over time. Mean equality refers to so-called structural similarity, whereas constraining the variances helps to establish the similarity of dispersion, thus increasing the comparability of Time 1 and Time 2 latent profile solutions [46]. The results are provided in the lower section of Table 2 and show that the models did not differ considerably with regard to the information criteria and entropy. Hence, the most parsimonious three-profile model with constrained means and variances was retained for further analyses.

As shown in Figure 1, we labelled the first profile the "low resources" profile. It characterizes employees with low decision authority (i.e., autonomy), low opportunities for skill utilization, and average psychological job demands. The "average" profile refers to employees with average scores on all three job characteristics, whereas the "high resources" profile consists of employees who reported high decision authority and skill discretion. Covariate analyses showed that age and contract type did not predict profile membership. Regarding gender, women had lower odds of being classified into the high resources profile (at Time 2 only) as compared with the low resources profile. Other advantageous background characteristics, such as higher level of education and higher household income, were associated with higher odds of being classified into a more favourable profile (see Tables A2 and A3 in the Appendix A for more details).

4.2. LTA Results

A latent transition analysis was run based on the above-described constrained three-profile solution. In the current study, the LTA had nine possible transition scenarios. Detailed information on transition probabilities and final counts for each scenario is provided in the Appendix A (see Tables A4 and A5). According to the results, profile membership proved to be quite stable over time at ~80% rate and we found no evidence that employer change would play a role: the proportion of job changers was similar among those who stayed in the same profile and those who transitioned to a different one over time, $\chi^2(1) = 0.001$, $p = 0.980$. Three salient job characteristics stability scenarios were identified, denoting stable low resources ($n = 92$), stable average ($n = 463$), and stable high resources ($n = 219$) scenarios. Concerning latent profile change, four transition scenarios were retained for further analyses, denoting the average-to-high ($n = 50$), high-to-average ($n = 79$), low-to-average ($n = 22$), and average-to-low ($n = 26$) transitions. Extreme transition scenarios (i.e., moving between the high and low resources profile) were very scarce and they were excluded from outcome analyses for this reason.

Table 1. Descriptive statistics and correlations between the main study variables.

Variables	M (*SD*)	1	2	3	4	5	6	7	8	9	10	11	12	13
1. T1 JCD-skill	3.04 (0.46)													
2. T1 JCD-auto	3.10 (0.61)	0.54 ***												
3. T1 JCD-dem	2.61 (0.44)	0.18 ***	−0.05											
4. T1 Jobsat	3.27 (0.58)	0.26 ***	0.31 ***	−0.25 ***										
5. T1 Wstress	1.87 (0.62)	−0.02	−0.17 ***	0.41 ***	−0.47 ***									
6. T1 QL	4.28 (0.65)	0.20 ***	0.26 ***	−0.11 **	0.24 ***	−0.31 ***								
7. T1 MH	1.66 (0.57)	−0.08 *	−0.14 ***	0.26 ***	−0.32 ***	0.61 ***	−0.40 ***							
8. T2 JCD-skill	3.05 (0.44)	0.75 ***	0.43 ***	0.17 ***	0.19 ***	−0.02	0.21 ***	−0.09 **						
9. T2 JCD-auto	3.10 (0.60)	0.44 ***	0.67 ***	−0.04	0.22 ***	−0.19 ***	0.23 ***	−0.16 ***	0.53 ***					
10. T2 JCD-dem	2.61 (0.42)	0.17 ***	−0.02	0.62 ***	−0.17 ***	0.31 ***	−0.10 **	0.22 ***	0.19 ***	−0.04				
11. T2 Jobsat	3.24 (0.59)	0.21 ***	0.29 ***	−0.19 ***	0.48 ***	−0.35 ***	0.24 ***	−0.29 ***	0.29 ***	0.38 ***	−0.23 ***			
12. T2 Wstress	1.87 (0.64)	<0.01	−0.15 ***	0.32 ***	−0.31 ***	0.69 ***	−0.27 ***	0.49 ***	−0.03	−0.23 ***	0.40 ***	−0.49 ***		
13. T2 QL	4.25 (0.68)	0.21 ***	0.24 ***	−0.06	0.22 ***	−0.26 ***	0.61 ***	−0.32 ***	0.25 ***	0.25 ***	−0.13 ***	0.35 ***	−0.36 ***	
14. T2 MH	1.73 (0.64)	−0.09 **	−0.14 ***	0.16 ***	−0.23 ***	0.42 ***	−0.29 ***	0.56 ***	−0.13 ***	−0.21 ***	0.23 ***	−0.39 ***	0.59 ***	−0.45 ***

Note. T1 = Time 1. T2 = Time 2. JCD-skill = skill discretion. JCD-auto = decision authority. JDC-dem = psychological demands. Jobsat = job satisfaction. Wstress = work stress. QL = quality of life. MH = mental health complaints. *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$

Table 2. Latent profile solutions and their fit statistics.

Model Estimation Steps	AIC	BIC	SaBIC	LMR (*p*)	BLRT (*p*)	Entropy	Smallest Profile (%)
LPA Time 1							
1-profile solution	4117.309	4146.504	4127.448	-	-	1.000	100
2-profile solution	3882.880	3931.539	3899.779	0.007	<0.001	0.570	34.9
3-profile solution	3700.847	3768.969	3724.506	<0.001	<0.001	0.847	11.3
4-profile solution	3635.454	3723.040	3665.873	0.031	<0.001	0.901	1.8
5-profile solution	3603.149	3710.199	3640.328	0.039	<0.001	0.802	2.0
6-profile solution	3572.382	3698.895	3616.320	0.162	<0.001	0.802	1.0
LPA Time 2							
1-profile solution	3944.652	3973.847	3954.792	-	-	1.000	100
2-profile solution	3738.577	3787.236	3755.476	0.007	<0.001	0.509	43.2
3-profile solution	3514.577	3582.699	3538.235	<0.001	<0.001	0.882	12.5
4-profile solution	3423.185	3510.771	3453.604	<0.001	<0.001	0.932	1.2
5-profile solution	3374.967	3482.017	3412.146	<0.001	<0.001	0.930	1.0
6-profile solution	3330.157	3456.670	3374.095	0.007	<0.001	0.940	0.9
LPA Time 1−Time 2 tests of equivalence							
3-3 profile model unconstrained	7215.424	7351.669	7262.741	-	-	0.864	11.3–12.5
3-3 profile model means constrained	7208.188	7300.640	7240.297	-	-	0.863	12.3–11.9
3-3 profile model means and variances constrained	7205.127	7282.981	7232.166	-	-	0.863	12.4–11.8
LTA Time 1 -> Time 2							
3->3 model means and variances constrained	6741.817	6839.135	6775.616	-	-	0.865	13.0–12.5

Note. LMR and BLRT are not available in single profile models and models with two time points.

4.3. Outcome Analyses Results

Cross-sectional results are provided in Table 3 and show the mean levels of employee well-being across the latent profiles at any given time point.

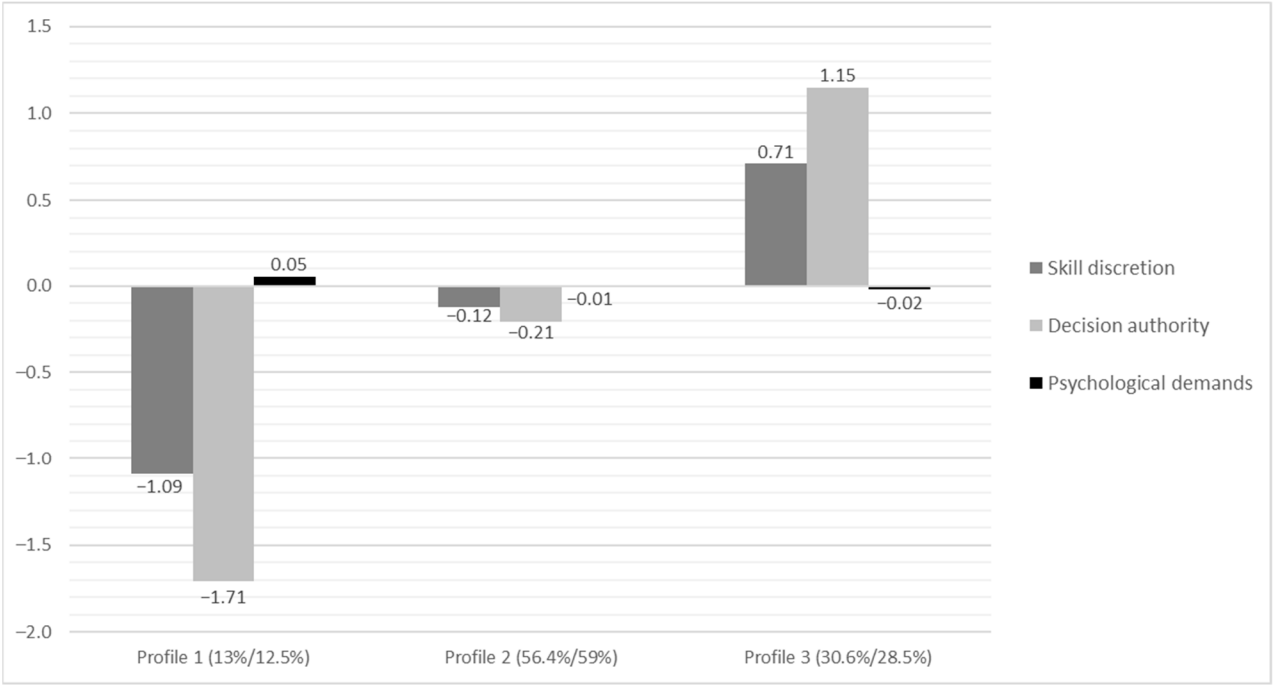


Figure 1. The final three-profile solution after imposing invariance constraints over time in LTA. For easier interpretation, the graph is based on z scores. Profile 1 = Low resources profile. Profile 2 = Average profile. Profile 3 = High resources profile. Percentages before the slash indicate the size of the profiles at Time 1. Percentages after the slash indicate the size of the profiles at Time 2.

Table 3. Cross-sectional differences in employee well-being across the job characteristics profiles.

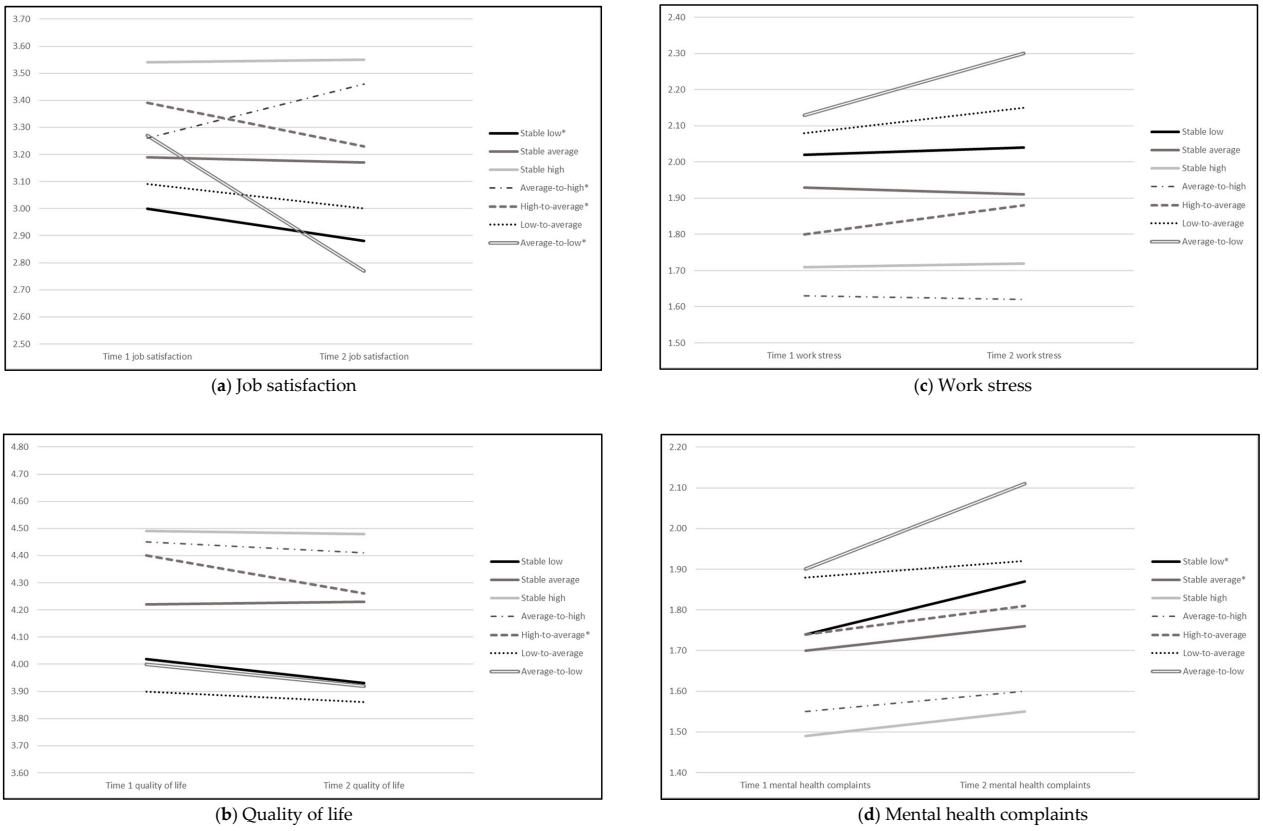
	Job Characteristics Profiles			
Well-Being Indicators	**Low Resources**	**Average Resources**	**High Resources**	**Overall Test**
T1 Job satisfaction	2.95	3.19	3.52	88.98 ***
T2 Job satisfaction	2.82	3.17	3.58	153.46 ***
T1 Work stress	2.10	1.91	1.71	30.26 ***
T2 Work stress	2.13	1.91	1.67	42.10 ***
T1 Mental health complaints	1.82 ^{n}	1.70 ^{n}	1.54	18.13 ***
T2 Mental health complaints	1.96	1.78	1.54	37.87 ***
T1 Quality of life	3.90	4.25	4.47	48.87 ***
T2 Quality of life	3.84	4.24	4.45	49.23 ***

Note. The overall test assesses the overall between-profile differences (*** $p < 0.001$). It is based on a Chi-Square test with 2 degrees of freedom. All pairwise between-profile differences are significant ($p < 0.05$), except for the difference in mental health complaints between the low and average resources profiles, marked with "n".

Almost all pairwise-comparisons showed significant mean differences. The high resources profile was associated with the highest scores in positive well-being indicators (i.e., job satisfaction and quality of life) and the lowest scores on ill-being (i.e., work stress and mental health complaints). By way of contrast, employees with the most precarious low resources profile reported the lowest scores of well-being as compared with more favourable average or high resources profiles at both time points.

The results of repeated measure analyses are provided in Figure 2 and they inform about the change in employee well-being over time due to the transition scenario. Looking from a temporal perspective, our findings suggest that staying in a favourable profile was related to persistently higher levels of well-being but not to accumulation of it, as seen in the

case of the stable-high-resources scenario. Some accumulation of ill-being may be implied in the stable-low-resources scenario, as we observed a significant decrease in job satisfaction and a significant increase in mental health complaints, even though the latter was slightly increasing in the entire sample, across all transition scenarios. Moreover, transitioning to a different profile was only related to changes in positive but not negative indicators of well-being. Job satisfaction was the most malleable outcome, with a significant decrease in its levels as employees transitioned to a less favourable profile (i.e., high-to-average and average-to-low transition scenarios) and an increase in its levels in the average-to-high transition scenario. The low-to-average transition did not result in a significant improvement of job satisfaction and even showed a slight decline. A significant decrease in the levels of quality of life, another positive outcome, was mostly associated with the high-to-average transition scenario. Other profile change scenarios, however, were not related to a corresponding change in this outcome over time.



(**a**) Job satisfaction

(**c**) Work stress

(**b**) Quality of life

(**d**) Mental health complaints

Figure 2. Change in employee well-being across profile transition scenarios. Asterisks in the legend indicate a significant change in a given aspect of well-being from Time 1 to Time 2 in the marked transition scenarios.

5. Discussion

5.1. Interpretation of the Job Characteristics Profiles

The current study provides an insight into the ways vulnerability and flourishing at work take place by unravelling the dynamic relationship between the work environment and employee well-being. In line with Hypothesis 1, the findings revealed three patterns of job characteristics characterized by high, average, and low job control resources and average job demands. This indicates sample heterogeneity with regard to their typical working conditions and could be expected both from a theoretical and from an empirical point of view. The JDC model adopts a typological approach towards the work environment, defining it by different combinations of job demands and job control. Our findings corroborate this approach in the sense that we did observe varying levels of key job characteristics—job control resources in particular—across the identified profiles. The observed set of profiles,

however, did not exactly match the four job types discussed in the JDC research [3,9,14], which may be due to the fact that some types of jobs are less prevalent in the world of work and may not always emerge [8]. Such mismatch seems to be quite common: previous person-centred studies have identified anywhere from two [23] to five [21] work environment profiles, and these variations are natural because latent profiles always reflect the characteristics and experiences of a specific sample.

Notably, whilst we used a large and rather heterogeneous sample, descriptive statistics revealed the overall quality of their working conditions to be higher than average. This means that the emergence of a large enough sub-group with extreme vulnerabilities (i.e., high strain) was less likely among our participants. Such around-average trends shown not only here but can be also found in large-scale European data. For example, the sixth European Working Conditions Survey indicated the Swiss work intensity index to be slightly below and skills and discretion index to be very close to the overall European average [47]. This lends a useful explanation for the shape of the profiles obtained in the current study—they all had average levels of job demands and were mostly differentiated based on the levels of decision authority (i.e., autonomy) and skill discretion. In other words, we did not observe the typical "high-strain" and "active" combinations with a highly expressed demands dimension but rather see a milder variant of them in the low resources and high resources profiles correspondingly, whereas the largest "average resources" profile seems to represent the above-mentioned Swiss standard with both job demands and job control expressed around the midpoint.

As expected in Hypothesis 2, the majority of participants remained in the same working conditions over the studied period, with similar probability rates for staying in the most and least favourable profiles. This adds to existing findings [28] and is in line with theoretical assumptions suggesting that job types have an underlying dynamic that promotes the continuity of a given job pattern [7]. Stated otherwise, for someone in a high-strain job (or low resources job in our case), a lack of resources may not allow for adequately meeting the job demands, which will further reinforce the resource–demand imbalance, thereby establishing a strain pattern. A similar rationale applies to so-called active jobs (or high resources jobs in our case): resourceful employees get more activated, which fosters their job resources and increases the probability of maintaining a favourable working conditions pattern over time. Such reasoning closely approximates the principles of conservation of resources [48], which maintain that resource dynamics are inherent in the stress experience. Resource depletion and elevated levels of stress are reciprocally interlinked, enclosing people in a loss cycle, which explains why they cannot easily switch from an unfavourable to a more favourable pattern. Whereas in the case of resource availability, the opposite dynamic should be promoted, making it easier to maintain favourable conditions over time.

At this point, it is notable that job change was unrelated to transitioning to a different working conditions pattern. However, background variables such as male gender, higher level of education, and higher initial financial status were all found to increase one's chances of having a more favourable type of job, such results implying that socio-economic status may play a role in determining the quality of one's job and, in a way, the quality of employment in general.

5.2. Interpretation of Findings on Well-Being Outcomes

The main contribution of the current study is that it unravels the impact that different patterns of job characteristics may have on employee outcomes. Our results have largely supported Hypothesis 3 showing that, from a cross-sectional perspective, the more resourceful the work environment, the more it relates to higher employee well-being with obvious differences across the profiles (see Table 3 for the summary of findings). The high resources job characteristics profile is particularly distinguishable as it was associated with significantly higher well-being on all aspects, at both times points, and as compared to both the low resources and the adjacent average resources profile. In turn, the low resources

pattern showed stark differences from the opposite-end high resources pattern and, in most cases, from the average resources pattern. These findings, first of all, serve as a sound validation of the three-profile solution as such, showing that the profiles discriminate well between the outcomes. Second, they hint at the importance of increasing access to job resources, since such remarkable differences in employee well-being across the profiles seem to be due to variations in the job control dimension. Third, they suggest that even average job demands may create a precarious work environment if the resources are not sufficient.

Our longitudinal results bring more light to such considerations, addressing the call for more research on the temporal dynamics of stressor–strain reactions at work [6,14,49,50]. As summarized in Figure 2, most changes were found in job satisfaction, which provides an illustrative case of how degrading versus improving working conditions may trigger a corresponding change in well-being. Such findings can be thought to reflect the first phase of several exposure time models encompassing an increased initial reaction to the stressor. Although Frese and Zapf's work [6] mostly concentrates on stressor–strain reactions, the current study provides some evidence of the reversed dynamic as well, linking resource increase to flourishing at work. Remarkably, in addition to the changing scenarios, our results also showed a decline in job satisfaction in the stable and most unfavourable "low resources" scenario, but we did not observe a corresponding accumulation of well-being in the favourably stable scenarios. It is an intriguing finding that conforms to Hypothesis 4 and suggests that positive and negative effects may be not symmetrical. From a theoretical point of view, it falls in line with Karasek and Theorell's [7] reasoning that strain creates more strain, thus even stable but unfavourable working conditions can result in a degrading well-being.

Such tendencies, however, do not apply universally to all investigated outcomes. Quality of life showed to be less malleable, which may be attributable to the nature of the construct. Compared to job satisfaction, which denotes an immediate reaction to existing psychosocial working conditions, it represents a more distal and static outcome covering multiple areas, not just work [31]. Therefore, fluctuations in job control may have been not strong enough to cause significant changes in the overall quality of life or the time lag may have been too short to observe them.

Furthermore, the aspects of ill-being either were not subject to change (i.e., work stress) or their change seemed to make part of an overall growth trend observed within the population (i.e., mental health complaints). While somewhat unexpected, one explanation for such findings lies in the contents of our identified profiles. Notably, they varied in the levels of job control resources but not demands, and this variation in positive job characteristics possibly targets positive aspects of well-being in the first place. Whereas according to the JDC logic [3,8], one would expect strain reactions to occur due to an increase in job demands, which remained virtually the same across different scenarios in our case. It is, however, important to note that degrading working conditions (i.e., average-to-low transition scenario) found some resonance in both aspects of ill-being, but this trend did not reach the significance level, likely due to the tiny fraction of the sample (n = 26) that was exposed to it.

5.3. Implications and Limitations

The current study gives an additional vantage point for discussing the makeup of an optimal work environment. While in theory the most beneficial active job profile is conceptualized by the combination of high resources and high demands, already Karasek and Theorell [7] have noted that demand levels should be high but not excessive. Some empirical studies have even concluded that low-demands and high-control jobs may produce more desirable effects than high-demands and high-control jobs [50,51], thus launching a debate in the literature about which combination is the most favourable. In this context, our "high resources" profile is particularly intriguing as it may indicate a perfect job demands–resources match, and the current findings on elevated well-being associated with it seem to point in that direction.

This further touches upon the role of job resources versus job demands in employee well-being. A lot of attention within the JCD literature has been given to high psychological demands that are inherent in high-strain jobs. While there is no doubt about the deleterious consequences of such work environments [16,21,52], they represent quite an extreme end. To elaborate on the very same inquiry, it may be crucial to examine various intermediate variants as they can inform about which job characteristics are indispensable for separating a favourable work environment from an unfavourable one. Given the rather schematic (i.e., high vs. low) approach towards the job characteristics, such questions have rarely been tested in the JDC literature. We had a unique opportunity to do it here, and our study adds to the existing literature by showing that even milder variants of these theoretical job types can account for substantial differences in well-being.

From a practical point of view, the current findings have demonstrated that the psychosocial work environment can be perceived as quite dynamic and it immediately affects employee outcomes, especially job satisfaction. The fact that it can either deteriorate or improve over quite short periods of time, even when staying with the same employer, indicates the importance of preventive and reactive HR interventions in keeping the right balance between demanding and resourceful job characteristics on a regular basis. Our analyses have clearly shown that even a slight difference in job resources may matter much. It is remarkable that the average resources profile, which seems to be the most common in the population and overall is quite well-balanced, still does not produce sustainable well-being and was found to be significantly less optimal than the high resources profile. This particularly encourages investing in various job resources in organizations and teaching employees how to capitalize on them. In today's turbulent world of work, job demands that are determined by external labour market factors may be difficult to adjust or remove, whereas the advantage of psychosocial job resources is that they are often at organization's and supervisor's disposal and this can help make a difference in the way a work environment is experienced and affects employees' well-being.

As in every study, our findings are not exempt from limitations that are important to note and address in future investigations. First, we consider it essential to expand and upgrade the measurement of psychosocial job characteristics. In the current study, the psychological job demands subscale performed quite poorly and it may have been one of the reasons why we did not observe much variation in job demands across the identified profiles. While using a well-known measure increases the comparability of findings, a few concerns have been raised in the literature with regard to inconsistent reliability of its scores [37], as well as a lack of precision of the construct [53,54]. Future research should focus on these aspects to better capture the variety of job demands. It would be particularly useful to separate between hindrance and challenge demands as they are known to have a different impact on employee outcomes [55]. Additionally, one may be interested in expanding the list of characteristics that are pertinent in today's organizations (e.g., management regimes, level of perceived responsibility, work/time arrangements, specialised skills) and consider integrating objective indicators among them, as self-report measures portray the reality from a subjective perspective only.

Second, although the current study identified several vulnerability scenarios (e.g., transition from average to low resources), they were encountered by a rather small proportion of the sample, which complicates their comparison with substantially larger non-vulnerable groups. Dropout analyses have also shown that the dropouts had somewhat lower quality of life compared to the remaining sample. This means that vulnerable participants tended to quit the study, lowering the chances of identifying big enough groups of employees with a vulnerability profile. Future studies may specifically address this issue by using targeted sampling procedures. This would allow for a better insight into the way vulnerabilities evolve among the most fragile members of the working population.

Third, there is room for advancement in the investigation of stability and change in the work environment. Whilst the present study revealed several interesting scenarios, we do not know the pre-history of the pattern observed at Time 1, that is, for how long the

person had been exposed to it. This drawback may explain why our results on changes in well-being were quite inconsistent. To circumvent this issue and to further inspect the stressor–strain models delineated by Frese and Zapf [6], future studies may consider using samples where change has an a priori set starting point, such as newcomers [50] or those whose organizations undergo a stressful period. It would be as well pertinent to focus on longer time lags as, for example, in Igic et al. [27]. Such investigations would offer an opportunity to explore the "entrapment" patterns from a career development perspective that are of particular importance in turbulent times.

Finally, since the current study was focused on well-being outcomes, we only tested standard background characteristics as covariates of the job characteristics patterns encountered by our participants. A logical next step would be to go beyond the socio-demographic predictors by including personal and psychosocial context variables as they may better reveal personal and structural resources that help people escape precarious settings and have more satisfying working lives.

6. Conclusions

The current study has identified three patterns of job characteristics denoting salient low, average, and high job control resources and average job demands. While such combinations do not fully correspond to the job types described in the JDC model, they can be considered milder variants of them. According to the findings, people tended to stay embedded in their job type over time, irrespective of whether they had changed employer or not, only one fifth of the sample transitioning from one pattern to another. Cross-sectional comparisons clearly demonstrated the high resources pattern to be the most beneficial, whereas the low resources pattern showed detrimental effects. Longitudinal findings were less consistent, but they also suggest that an average demands-high resources (but not average resources) work environment may be the one leading to sustainable well-being. In contrast, both deteriorating working conditions and prolonged exposure to a resource-deprived work environment showed harmful signs, especially touching upon job satisfaction. Such findings connect the dynamics of the work environment to the dynamics of well-being. Their key message is that vulnerability scenarios at work may be determined by the level of job control resources solely, and they seem to occur in relatively mild situations where job demands are not necessarily excessive.

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Ethics Statement: IRB approval is not required for non-medical research with human subjects in Switzerland. The study was conducted in compliance with the ethical guidelines and procedures of the University of Lausanne and following the Psychologists' Code of Conduct. Before each measurement wave, participants received an invitation letter detailing the aims and procedure of the research study, asking them to take part in the survey, and ensuring confidentiality and informing about their right to withdraw at any moment.

Informed Consent Statement: Not applicable (consent to participate is implied by participants' actions to undertake the survey).

Data Availability Statement: The archiving of the Professional Paths survey data is currently in progress. The 2016 and 2017 datasets that were used in the current study are archived at FORSBASE repository https://forsbase.unil.ch/ (accessed on 31 March 2021).

Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

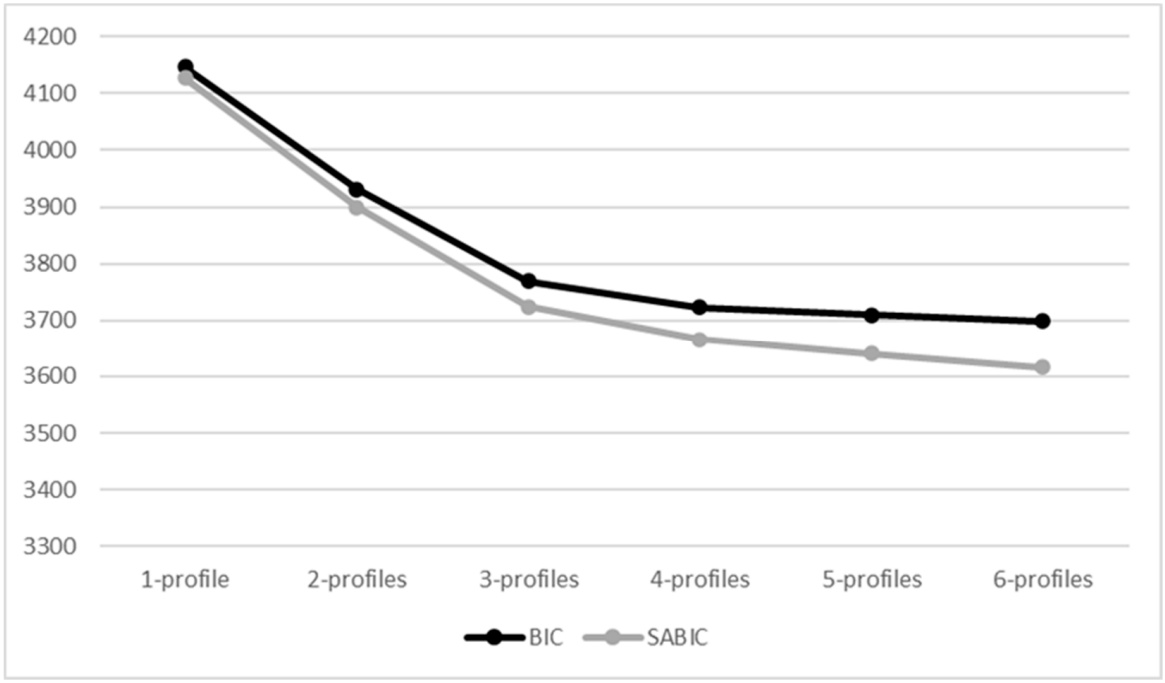

Figure A1. BIC and SABIC plots based on Time 1 LPA.

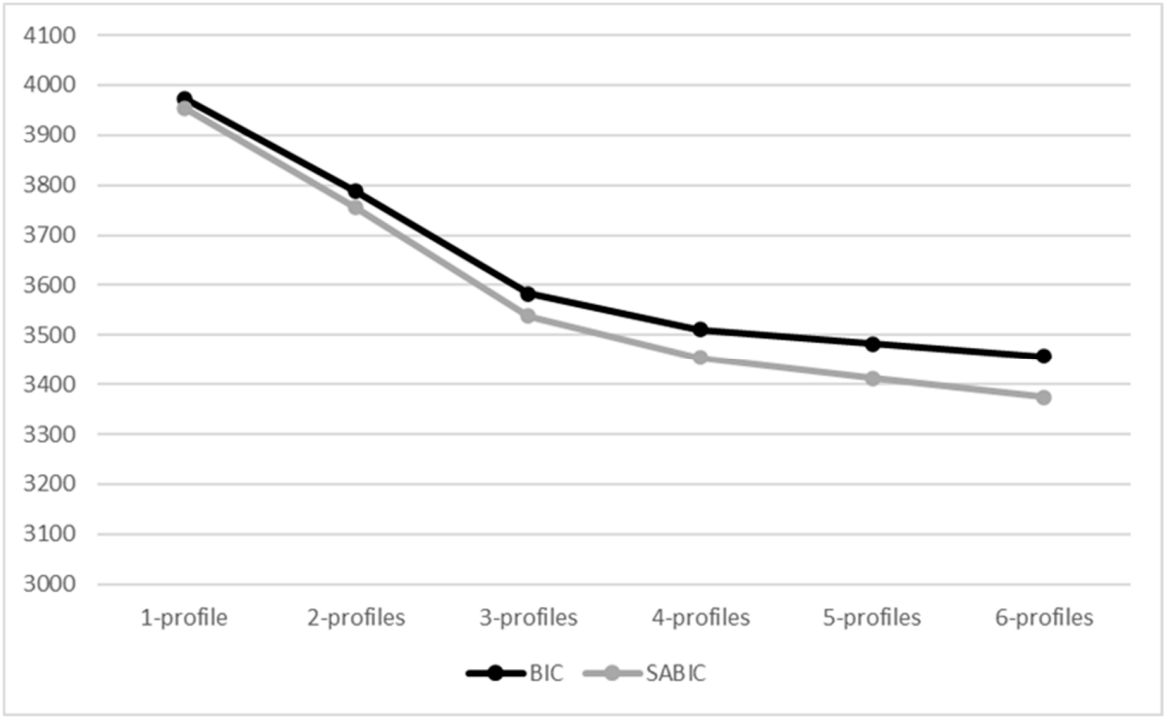

Figure A2. BIC and SABIC plots based on Time 2 LPA.

Table A1. Correlations between demographic variables and latent profile indicators.

Variables	T1 Latent Profile Indicators			T2 Latent Profile Indicators		
	JCD-Skill	JCD-Auto	JCD-Dem	JCD-Skill	JCD-Auto	JCD-Dem
Age	0.04	0.08 *	−0.05	0.05	0.06	−0.05
Gender	−0.04	−0.08 **	−0.06	−0.05	−0.07 *	−0.04
Education	0.36 ***	0.19 ***	0.08 *	0.34 ***	0.20 ***	0.09 *
T1 Contract type	−0.02	0.06	0.02	0.01	0.06	0.08 *
T1 Household income	0.25 ***	0.19 ***	0.11 **	0.25 ***	0.14 ***	0.10 **
T2 Contract type	−0.01	0.05	−0.03	0.01	0.06	0.07 *
T2 Household income	0.28 ***	0.18 ***	0.12 ***	0.28 ***	0.15 ***	0.10 **

Notes. T1 = Time 1. T2 = Time 2. JCD-skill = skill discretion. JCD-auto = decision authority. JDC-dem = psychological demands. Gender: 0 = male; 1 = female. Contract type: 0 = temporary; 1 = permanent. Education and household income measured in an increasing order. *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

Table A2. Covariates of the latent profile membership at Time 1.

Covariates	Compared Profiles	Odds Ratio	95%CI
Age	ns	ns	ns
Gender (female)	ns	ns	ns
Education (high)	2 vs. 1	2.55	[1.646;3.963]
	3 vs. 1	4.44	[2.726;7.238]
	3 vs. 2	1.74	[1.243;2.434]
Contract type (permanent)	ns	ns	ns
Household income (high)	2 vs. 1	1.39	[1.213;1.587]
	3 vs. 1	1.50	[1.305;1.730]

Notes. Profile 1 = low resources; Profile 2 = average resources; Profile 3 = high resources. ns = no significant results observed. Gender: 1 = male; 2 = female. Contract type: 1 = temporary; 2 = permanent. Education and household income measured in an increasing order. Only significant results indicating higher odds (i.e., OR > 1) of a given covariate in one profile versus another are shown, when the 95%CI do not include 1.

Table A3. Covariates of the latent profile membership at Time 2.

Covariates	Compared Profiles	Odds Ratio	95% CI
Age	ns	ns	ns
Gender (female)	1 vs. 3	1.70	[1.059;2.713]
Education (high)	2 vs. 1	1.78	[1.187;2.662]
	3 vs. 1	3.67	[2.347;5.734]
	3 vs. 2	2.06	[1.499;2.840]
Contract type (permanent)	ns	ns	ns
Household income (high)	2 vs. 1	1.17	[1.053;1.299]
	3 vs. 1	1.30	[1.160;1.462]
	3 vs. 2	1.11	[1.025;1.209]

Notes. Profile 1 = low resources; Profile 2 = average resources; Profile 3 = high resources. ns = no significant results observed. Gender: 1 = male; 2 = female. Contract type: 1 = temporary; 2 = permanent. Education and household income measured in an increasing order. Only significant results indicating higher odds (i.e., OR > 1) of a given covariate in one profile versus another are shown, when the 95% CI do not include 1.

Table A4. Transition probabilities.

Time 2: Time 1:	Profile 1	Profile 2	Profile 3
Profile 1	0.736	0.223	0.041
Profile 2	0.048	0.860	0.092
Profile 3	0.006	0.249	0.745

Note. Profile 1 = Low resources. Profile 2 = Average. Profile 3 = High resources.

Table A5. Final counts for each profile transition scenario.

Time 2: Time 1:	Profile 1	Profile 2	Profile 3
Profile 1	92	22	6
Profile 2	26	463	50
Profile 3	2	79	219

Note. Profile 1 = Low resources. Profile 2 = Average. Profile 3 = High resources.

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Article

Exploring the Engaged Worker over Time—A Week-Level Study of How Positive and Negative Work Events Affect Work Engagement

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Abstract: Although work events can be regarded as pivotal elements of organizational life, only a few studies have examined how positive and negative events relate to and combine to affect work engagement over time. Theory suggests that, to better understand how current events affect work engagement (WE), we have to account for recent events that have preceded these current events. We present competing theoretical views on how recent and current work events may affect employees (e.g., getting used to a high frequency of negative events or becoming more sensitive to negative events). Although the occurrence of events implies discrete changes in the experience of work, prior research has not considered whether work events actually accumulate to sustained mid-term changes in WE. To address these gaps in the literature, we conducted a week-level longitudinal study across a period of 15 consecutive weeks among 135 employees, which yielded 849 weekly observations. While positive events were associated with higher levels of WE within the same week, negative events were not. Our results support neither satiation nor sensitization processes. However, a high frequency of negative events in the preceding week amplified the beneficial effects of positive events on WE in the current week. Growth curve analyses show that the benefits of positive events accumulate to sustain high levels of WE. WE dissipates in the absence of a continuous experience of positive events. Our study adds a temporal component by highlighting that positive events affect work engagement, particularly in light of recent negative events. Our study informs research that has taken a feature-oriented perspective on the dynamic interplay of job demands and resources.

Keywords: affective events; work engagement; sensitization-satiation effects; job demands-resources model; experience sampling; growth curve modeling

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1. Introduction

From a psychological perspective, organizational life can be understood in terms of a chain of events [1]. Despite calls to take issues of time more seriously [2–5], researchers in the field of occupational health psychology have only recently begun to consider the dynamics of relevant phenomena, such as employee strain and engagement [6], through the lens of work events [7]. Work engagement has been described as "a positive, fulfilling, work-related state of mind that is characterized by vigor, dedication, and absorption" [8]. Furthermore, work engagement has attracted considerable research interest within the last 15 years [9–11]. In particular, job characteristics have been identified as major drivers of work engagement [6,10,11], and empirical evidence has consistently shown that work engagement is determined by the interplay of different types of job characteristics (e.g., resources such as autonomy and demands such as workload) [12]. However, to fully understand the experience of work and how it relates to employee outcomes (e.g., engagement),

it is advisable to go beyond generalized perceptions of how a job usually is (i.e., job characteristics measured by surveys in terms of job demands and resources). More specifically, there is a need to consider dynamic aspects (i.e., day-to-day fluctuations in job characteristics) [12,13] as well as factors that are more proximal to employee experiences over time [14]. Therefore, a focus on enacted job characteristics—that is, events and activities in the job as they happen [14]—is warranted. Work events differ from job features in that they are "discrete and bounded in space and time" [1]. Therefore, the study of work events (versus job characteristics) would provide the opportunity to add a temporal component to the research on job characteristics [6] and to examine work events as more proximal antecedents of work engagement [13,14]. In other words, the study of work events rather than job characteristics would provide the opportunity to specify and examine how the different situations that employees experience at work combine to affect work engagement over time. For instance, over the course of a workweek, employees are likely to experience a series of positive events (e.g., praise from a supervisor after successfully finishing an important task) and negative events (e.g., an episode of interpersonal conflict with colleagues). Although the occurrence of each of these events is individually associated with short-term fluctuations in work engagement in its own right [15], it is likely that the last week's work events carry over to affect work engagement during the current workweek [16]. Furthermore, different work events may interact to predict work engagement. Put another way, receiving praise from one's supervisor in the current week's team meeting may foster work engagement, but the events of the previous week (e.g., positive feedback from the same supervisor or interpersonal conflict with colleagues) may alter the impact of this current event [see 1]. Hence, it is worthwhile to consider work events embedded within a chain of events over time [17]. To account for the richness of the work experience [18], we drew on a taxonomy of work events that encompasses a broad range of relevant positive and negative work events [7]. This taxonomy was derived from qualitative research [7] and can be considered exhaustive with regard to the most relevant work events from the perspective of employees. The taxonomy provides an integrative framework covering a broad range of work events that have been considered in the literature to date (see [7] for a literature review). In the present study, we leverage this taxonomy to determine which specific type of work event is most relevant to work engagement, aside from the effects of positive and negative work events in general terms.

Above, we have outlined that an event-oriented approach permits specifying the order of what happens and interactions among current events and recent events. Recently, Wickham and Knee [16] have proposed applying experience sampling data to analyze such interactions between current events and recent events to describe psychological processes of sensitization and satiation over time. For instance, in the case of sensitization, last week's conflict makes the current week's conflict seem worse. That is, employees become more vulnerable or susceptible to work events with each episode. Conversely, in the case of satiation, last week's conflict makes this week's conflict seem less threatening. In other words, employees become less vulnerable or susceptible to work events with each episode. We adopt this approach to examine sensitization and satiation to the study of both positive and negative events predicting work engagement. Furthermore, a positive event like praise from the supervisor may yield particularly strong effects on work engagement after a negative event has occurred [17,19,20]. Hence, we extend the sensitization-satiation perspective and scrutinize the interplay of positive events and negative events from one week to the next week. Interestingly, experiencing a set of events in a given order (e.g., conflict with colleagues after praise from the supervisor) may not be equivalent to the reverse order and is likely to result in different levels of work engagement. However, theory and empirical research on job characteristics and work engagement so far have largely focused on the situational features of work [12] and have rarely considered temporal issues in depth. Put another way, research on job demands and resources usually does not distinguish between experiencing a specific resource prior to or after being confronted with high levels of a specific job demand. Accordingly, in this study, we aim to account for the order of positive

and negative events and examine competing hypotheses. Given that job characteristics are linked to work events as more proximal precursors of work engagement [13,14], our event-oriented temporal approach has implications beyond the study of work events per se. In this sense, the different types of work events correspond to immediate situational consequences of a broad range of job characteristics [13,14]. Hence, our research informs researchers interested in the interplay of job demands and job resources and may contribute to reconcile inconsistent findings on this interplay as well.

On a related note, it is important to gain insights into how frequent exposure to positive and negative events may accumulate to affect work engagement over longer periods of time [6,21,22]. These insights are important as they pave the way to connect transient processes to longer-term processes underlying employee well-being [21]. In the study of work events, researchers have rarely gone beyond considering the cross-sectional associations or short-term effects of events over a couple of hours (see [7] for a review). Hence, we know little about sustained effects due to the accumulation of negative or positive events over time. However, if work events do not have longer-term implications for individual outcomes, one may question their practical relevance [21]. Conversely, studying accumulation effects may contribute to gain insights in how mundane events in the daily grind of work add up and lead to potentially profound changes in work engagement over time. We therefore conducted a week-level diary study over a period of four months, which fits these aims best: capturing meaningful events shortly after they happen, but, at the same time, monitoring mid-term changes in work engagement by applying an intensified longitudinal design.

Our study contributes to the literature in at least two ways. First, we add a temporal perspective to the research on relationships between job characteristics and work engagement by considering sensitization and satiation to positive and negative events. This approach is important because it allows us to specify the order of events and the interplay of current and recent events. Second, we extend the sensitization-satiation perspective and examine whether positive and negative events combine to affect work engagement from one week to the next. In this sense, we follow the call for applying experience sampling data for analyzing the effects of work events within the context of a history of preceding events [1,15].

1.1. What Happens in the Short Run: Work Events as Antecedents of Work Engagement

In recent years, evidence on antecedents of work engagement at the intraindividual level has started to accumulate [12]. However, links between work events and work engagement have rarely been considered explicitly. According to Weiss and Cropanzano [13], affective events are "things [that] happen to people in work settings" to which "people react emotionally" (p. 11). From the perspective of the conservation of resources theory [23], positive events signal the availability of resources or opportunities for resource gain [24]. Given that positive work events refer to experiences that either overlap in content with or are triggered by resources such as rewards or reinforcement [12,25,26], we assume that positive events at work are positively related to work engagement. Accordingly, positive work events, such as praise from supervisors, predict work engagement within [19,27] and between individuals [26]. By contrast, negative events can be considered factors that detract attention and may inhibit engagement in focal tasks [28]. So far, empirical evidence on negative events and work engagement has been mixed. One study has favored significant negative links between negative events and work engagement at the day-level [15,19]. By contrast, other researchers found negligible lagged associations with work engagement [29]. Their results suggest no lagged main effects of previous-day positive event intensity on work engagement the next day. Moreover, in some studies negative events paradoxically even yielded beneficial lagged effects on job satisfaction [17] and work engagement [19]. More specifically, given these inconsistencies, we need to account for what happens in the aftermath of the focal events. Events probably do not affect employee well-being in isolation, and it is unlikely that "participants in diary studies ... become a tabula rasa once they have completed the diary report for a given interval" [16]. Therefore, the present

study incorporates a temporal component and considers work events embedded in a series of events that may happen to an employee over time [1,17]. For one, we take into account that the effects of recent events on work engagement may carry over from one week to the next and affect work engagement. Second, we consider how past events affect the impact of current work events. Given that there are contrasting views on what the interplay of work events may look like, we formulate competing hypotheses. Prototypical patterns of interactions are depicted in Figure 1. Panel A refers to prototypical patterns of work engagement that may arise from the interaction of current × lagged positive events. Panel B describes prototypical patterns for interactions of current × lagged negative events. Finally, Panel C illustrates how positive events and negative events may combine over time to affect work engagement. Given that we aim to extend the perspective beyond prior-day-level research, we focus on links and interactions at the week-level, which is a time frame rarely applied to work events. This approach appears to be adequate, because the seven-day week is a salient unit for structuring time [30]. Furthermore, week-to-week associations tap into less transient and more profound effects over time [31].

1.2. Temporal Patterns of Positive Events

While the concurrent association between positive events and work engagement is well-established [15,19,26,27,29], the carryover effects of positive events on work engagement have rarely been considered (see [29] for the only exception). However, [29] was focused on negative event intensity and several features of their design (e.g., events sampled on three consecutive days only, time frame of focal measures referred to the day level), their measures (e.g., affective reaction to events versus frequency of events as predictor), and their focal analyses (e.g., coefficients for positive events when controlling for several other aspects) prevent us from drawing strong conclusions regarding lagged effects of positive events per se. Basically, there are two perspectives: First, positive events experienced in the course of the previous workweek may linger on to affect work engagement in the current week, for instance by means of positive reflection (e.g., about successfully finishing a project) [32] or capitalization on the same event through social sharing with others [33]. Second, positive events from the previous workweek may change the way current positive events are perceived and experienced. To investigate these temporal processes, Wickham and Knee [16] have suggested applying interactions of current events (concurrent) and more recent events (lagged) to experience sampling data. As illustrated in Figure 1A, there are two prototypical patterns of the interaction. On the one hand, employees may get used to high frequencies of positive events. For instance, research on the hedonic treadmill suggests that individual standards may change, and positive events will be taken for granted when positive events have occurred frequently before [34]. That is, in light of many positive events in the previous week, current-week high frequencies of positive events have a reduced impact on work engagement. Throughout this manuscript, we label this pattern the satiation effect (right side of Figure 1A) (Wickham and Knee [15]). On the other hand, positive events in the past may contribute to benefits even more from current positive events, as positive events broaden awareness for positive events that might follow [35]. Throughout this manuscript, we label this pattern the intensification effect (right side of Figure 1A). Positive events may even trigger behaviors of the individual that provoke positive events in the future [36]. Given that there are competing theoretical views and that prior empirical results do not allow for firm conclusions, we state two competing hypotheses for satiation versus intensification effects:

Hypothesis 1. *Concurrent positive events in week n and lagged positive events in week n-1 interact to predict work engagement in week n. Lagged positive events (a) amplify (intensification) or (b) alleviate the effect of concurrent positive events (satiation).*

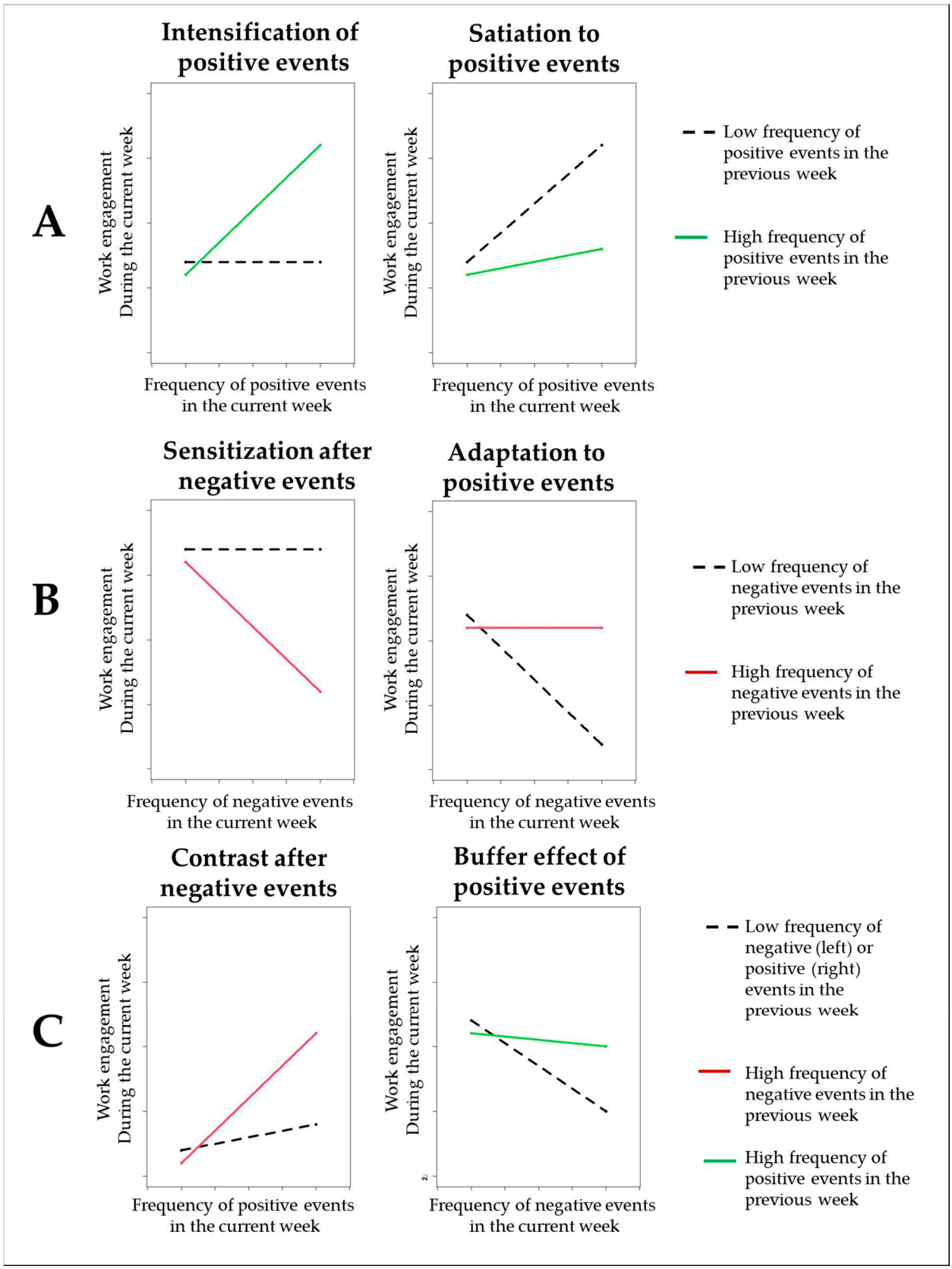

Figure 1. Prototypical ways of how work events may interact to predict work engagement. (Panel **A**) refers to the interplay of positive events over time. (Panel **B**) refers to the interplay of negative events over time. (Panel **C**) refers to the interplay of positive and negative events over time.

1.3. Temporal Patterns of Negative Events

The rationale regarding sensitization and satiation effects presented above can also be applied to negative events. The prototypical patterns of work engagement are illustrated in Figure 1B. Negative work events in the previous workweek may affect employees even after a couple of days have passed [29,37]. So, negative events in the current workweek may shift attention to negative cues in the environment and make employees react more sensitively to negative events during the next workweek [22,38]. In line with this perspective, Farmer and Kashdan [39] found that individuals reacted more sensitively to negative social events on a given day when negative events had preceded the day before. A prototypical pattern of work engagement is depicted on the left side of Figure 1B. Throughout this manuscript, we label this pattern the sensitization effect.

By contrast, from the perspective of the allostatic load model [40], it is also plausible that employees will adapt to negative events and will not mind negative events when they re-occur. This may be because employees might become more proficient in dealing with negative events [41] or become more resilient due to having been challenged before [42]. Throughout this manuscript, we label this pattern adaptation [43]. In sum, negative events in the previous workweek, may make employees either more susceptible to the detrimental effects of negative events (sensitization) or may contribute to adapting to negative events (adaptation, see right side of Figure 1B). Again, we state two competing hypotheses:

Hypothesis 2. *Concurrent negative events in week n and lagged negative events in week n-1 interact to predict work engagement in week n. Lagged negative events (a) amplify (sensitization) or (b) reduce the effect of concurrent negative events (adaptation).*

1.4. The Interplay of Positive and Negative Events over Time

Beyond sensitization and satiation effects, our study addresses the question of whether experiencing positive events in the aftermath of negative events results in different levels of work engagement than experiencing positive events after a period of few positive events. Above we have discussed that positive events in the previous week may broaden awareness of and strengthen the impact of current positive events. In a similar way, negative events in the past may also change the way current positive events are perceived. For instance, experience-sampling research on work events and after-work fatigue—a state of tiredness and reduced functional capacity—suggest that employees benefit most from positive events in the face of negative events and in the face of chronically high job demands [20]. Other researchers have argued that work engagement results from a shift in affect in the aftermath of negative events – that is, down-regulation of negative affect and up-regulation of positive affect [19]. Empirically, these authors found that negative events enhance, rather than impair work engagement, when followed by high levels of positive affect. Given that prior research is mute on the triggers of affective shift and the beneficial effects on work engagement, we consider positive work events to be predictors, because positive events have consistently been linked to positive affective outcomes [7]. Positive events in the aftermath of negative events may be particularly beneficial for work engagement because positive events create a contrast effect at the backdrop of prior negative events [20,44,45]. Accordingly, and in line with the contrast after a negative-events perspective, we expect that negative events in the past and current positive events interact to predict work engagement. A prototypical pattern of work engagement is depicted on the left side of Figure 1C. Throughout this manuscript, we label this pattern the contrast effect. More specifically, we expect that positive events in the aftermath of negative events will have a particularly strong effect on work engagement:

Hypothesis 3. *Concurrent positive events in week n and lagged negative events in week n-1 interact to predict work engagement in week n. Lagged negative events amplify the effect of positive events (contrast effect after negative events).*

To gain a more complete picture of how positive and negative events interact over time, we need to consider whether positive events in the past change the impact of current negative events. We argue, that positive events in the previous workweek may also contribute to build up personal resources [24,25] that change the way current negative events affect work engagement. For instance, a high frequency of positive events in the previous workweek is associated with positive affect [7] and may therefore replenish coping resources [46]. In this sense, positive events likely strengthen self-efficacy [47] and self-regulation capacity [48] as personal resources (see, for instance [49]). Hence, after experiencing positive events in the previous workweek, employees may be well-equipped to face negative events in the current week. In line with this idea, Kuba and Scheibe [15] found that habitual acceptance as a personal resource buffers the detrimental effects of negative events on work engagement at the day-level. Given that positive events likely feed personal resources and that resources, in turn, attenuate the detrimental effects of negative events on work engagement, we assume that positive events in the previous workweek attenuate the impact of negative events in the current week. Throughout this manuscript we label this pattern the buffering effect. A prototypical pattern of work engagement is depicted on the right side of Figure 1C.

Hypothesis 4. *Concurrent negative events in week n and lagged positive events in week n-1 interact to predict work engagement in week n. Lagged positive events attenuate the effect of current negative events (buffering effect).*

1.5. What Happens in the Long Run: Sustained Effects of Work Events over Time

Recently, Ilies and Aw (2015) have reviewed the theory and empirical evidence on intraindividual models of well-being and noted that we need to connect transient processes (as reflected in fluctuations in well-being from day to day) to longer-term processes (as reflected in changes in well-being over periods of weeks, months, or years). If applied research provides evidence that, for instance, positive events are associated with sustained changes in work engagement over longer periods of time, these findings would underscore the practical relevance of these concepts in organizations from a practitioner's point of view, whereas associations at the day- or week-level may reflect fluctuations around characteristic average levels that might be largely stable over time (see also [34]), sustained effects address the issue of whether work events indeed yield chronically beneficial effects [21]. Given that prior intraindividual research has not considered this aspect empirically, we examine whether frequent exposure to positive and negative events is associated with mid-term changes in work engagement over time at the interindividual level.

Drawing on the conservation of resources theory [23], it has been suggested that work engagement results from resource abundance [50,51]. According to Halbesleben and colleagues [25], positive aspects in organizational settings like social support, justice, and trust act as signals that the "investment of resources will help the individual realize his or her goal of achieving more resources." (p. 1347). Given that positive events tap into these kinds of signals, we assume that a high frequency of such signals over time is associated with gains in work engagement. The frequent experience of positive events over time should accumulate to feed higher levels of work engagement. In other words, trajectories of work engagement should be more positive (steeper increase) when positive events occur frequently compared to when positive events occur infrequently.

Hypothesis 5. *Trajectories in work engagement differ between persons dependent upon the frequency of positive events over time. Higher (lower) frequencies of positive events are associated with steeper (flatter) increases in work engagement.*

Given the pioneering nature of our study with regard to mid-term trajectories of work engagement dependent upon accumulation of work events, we do not state a formal hypothesis on the effects the frequency of negative events over time might have. However, we do investigate the concurrent effects of the frequency of negative events within

our focal analyses on the accumulation of positive events. Our analyses, therefore, also provide insights into the relative importance of positive versus negative events for work engagement in the long run.

2. Materials and Methods

2.1. Procedure

Drawing on the rationale outlined above, we conducted a week-level diary study across a period of four months. Participants filled in a general survey containing demographics and other variables assumed to be largely stable across time. After registering for the study and filling out the general survey, participants received emails inviting them to complete short diary questionnaires across a period of 15 consecutive weeks with two questionnaires per week. The procedure and materials of this study have not undergone examination by an ethics committee, as the measures and procedures of our study followed the protocols of standard self-report experience sampling research in applied psychology, and we did not touch sensitive topics (e.g. sexual orientation). Our study fully complied with the standards of the Department of Psychology at the University of Hagen, which included strict guidelines to guarantee the anonymity of the self-reported data. Individuals interested in participating in our study were informed about the general aims and the protocol of the study before their participation. All participants gave their informed consent for inclusion before they participated in the study. The study was conducted in accordance with the Declaration of Helsinki. Our protocol did not include any form of deception of participants. Participation was voluntary, and participants had the opportunity to quit whenever they wanted.

2.2. Sample

Our 135 participants were employees who were enrolled in a psychology distance-learning program at a German university that offers these courses primarily for individuals who study besides their regular jobs and occupations. Participants received course credit for filling out the general survey and the diary questionnaires. Credit was commensurate with the number of completed weekly surveys and participants who completed ten or more surveys received some extra credit.

Seventy-seven percent of our participants were female. The average age was 35.41 years (SD = 9.93), ranging from 18 to 61 years. Tenure within the organization ranged from less than one year to 28 years (M = 6.79, SD = 7.34). Participants came from diverse industries, mainly from healthcare (19%), the service sector (16%), education (10%), and commerce (9%). Participants had either full-time or part-time jobs and worked, on average, 32.18 h per week (SD = 9.92); 75% had a permanent contract, and 29% had a leadership position. In total, we received 849 observations (person-weeks) for Friday from 135 persons (on average 6.3 weeks per person, 42% of the theoretically possible 2025 observations) suited for use in our growth curve models. Our analyses of short-term lagged effects from one week to the next week, however, relied on matched observations from two consecutive weeks. Given that participants had missing data for single or several weeks over the course of 15 weeks, our analyses of the short-term effects were based on a sample of 490 matched observations from 101 employees. Descriptive information and zero-order correlations for the full sample and the matched sample at the intraindividual level and at the interindividual level are presented in Tables 1 and 2, respectively.

Table 1. Correlations Among Study Variables at the Intraindividual Level.

	Variable	*ICC*	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1.	Goal attainment, problem-solving, task-related success	0.40		**0.60**	**0.28**	**0.39**	**0.45**	−0.06	0.05	**0.07**	−0.04	−0.06	0.01	**0.74**	−0.01	**0.38**
2.	Perceived competence in or through social interactions	0.47	**0.62**		**0.25**	**0.41**	**0.56**	−.02	−0.07	0.03	−0.05	**−0.16**	**−0.12**	**0.77**	**−0.10**	**0.45**
3.	Work-related good news	0.30	**0.28**	**0.23**		**0.27**	**0.36**	−0.03	0.03	0.04	**0.09**	−0.02	−0.02	**0.56**	0.03	**0.23**
4.	Passively experienced positive events	0.46	**0.40**	**0.40**	**0.27**		**0.54**	−0.02	**−0.09**	**−0.07**	**−0.15**	**−0.18**	**−0.25**	**0.76**	**−0.20**	**0.45**
5.	Praise, appreciation, positive feedback	0.44	**0.50**	**0.60**	**0.35**	**0.56**		−0.02	**0.07**	−0.02	0.04	**−0.10**	**−0.09**	**0.82**	−0.02	**0.43**
6.	Technical difficulties, problems with work tools and equipment	0.45	−0.07	0.00	−0.05	0.02	0.00		**0.07**	0.05	**0.18**	**0.26**	**0.15**	−0.04	**0.46**	**−0.13**
7.	Hindrances in goal attainment, obstacles in completing work tasks, overload	0.39	**0.12**	−0.02	0.03	−0.08	**0.13**	0.01		**0.36**	**0.44**	**0.33**	**0.23**	0.00	**0.67**	−0.04
8.	Problems in interactions with clients or patients	0.41	0.05	0.00	0.00	−0.06	−0.03	0.00	**0.39**		**0.20**	**0.30**	**0.22**	0.01	**0.54**	0.04
9.	Ambiguity, insecurity, loss of control	0.45	−0.04	−0.03	**0.10**	**−0.13**	0.08	**0.18**	**0.44**	**0.18**		**0.45**	**0.37**	-0.04	**0.71**	**−0.15**
10.	Conflicts and communication problems	0.43	−0.07	**−0.16**	0.00	**−0.16**	−0.06	**0.27**	**0.35**	**0.37**	**0.43**		**0.51**	**−0.15**	**0.74**	**−0.13**
1.	Managerial and internal problems, organizational climate	0.49	0.05	**−0.10**	0.03	**−0.23**	−0.04	**0.10**	**0.27**	**0.26**	**0.33**	**0.46**		**−0.14**	**0.64**	**−0.15**
12.	Positive events	0.53	**0.75**	**0.77**	**0.54**	**0.76**	**0.84**	−0.02	0.05	−0.02	−0.01	**−0.13**	**−0.10**		**−0.09**	**0.54**
13.	Negative events	0.57	0.02	−0.08	0.03	**−0.17**	0.03	**0.43**	**0.69**	**0.55**	**0.70**	**0.74**	**0.63**	-0.05		**−0.15**
14.	Work engagement	0.61	**0.31**	**0.42**	**0.18**	**0.37**	**0.36**	**−0.12**	−0.04	0.07	**−0.17**	**−0.09**	**−0.11**	**0.45**	**−0.13**	
15.	Work engagement (lagged)	–	**0.42**	**0.48**	**0.24**	**0.46**	**0.42**	**−0.13**	−0.01	**0.09**	**−0.17**	−0.08	−0.08	**0.56**	**−0.11**	**0.67**

Note: Correlations above the diagonal are week-level correlations in the full sample (k = 849). Correlations below the diagonal are week-level correlations in the matched sample (k = 490). Correlations in bold type are significant at $p < 0.05$. Bold is necessary to mark significant correlations.

Table 2. Means, Standard Deviations, and Correlations Among Study Variables at the Interindividual Level.

	Variable	*M*	*SD*	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1.	Gender [a, b]	0.77	0.42		−0.06	0.02	0.03	0.02	0.00	0.09	−0.07	−0.12	−0.05	0.04	−0.01	−0.03	0.04	−0.06	0.02
2.	Age in years [b]	35.75	10.38	−0.01		−0.06	0.13	0.04	0.06	−0.04	−0.01	0.00	−0.04	**−0.28**	−0.15	−0.14	0.04	−0.16	0.11
3.	Goal attainment, problem-solving, task-related success	3.17	0.87	0.15	−0.04		**0.53**	**0.38**	**0.44**	**0.37**	**−0.13**	**−0.19**	0.07	−0.14	−0.14	−0.10	**0.69**	−0.16	**0.45**
4.	Perceived competence in or through social interactions	3.37	0.86	0.12	0.10	**0.72**		**0.39**	**0.51**	**0.64**	−0.05	**−0.22**	0.09	**−0.19**	**−0.23**	**−0.22**	**0.82**	**−0.21**	**0.48**
5.	Work-related good news	1.53	0.75	−0.03	0.03	**0.41**	**0.40**		**0.41**	**0.49**	−0.05	**−0.17**	0.07	−0.04	−0.05	−0.11	**0.67**	−0.09	**0.50**
6.	Passively experienced positive events	2.59	1.11	0.05	0.07	**0.49**	**0.59**	**0.36**		**0.61**	−0.08	−0.17	0.02	**−0.29**	**−0.23**	**−0.34**	**0.80**	**−0.27**	**0.67**
7.	Praise, appreciation, positive feedback	2.47	1.03	0.05	0.04	**0.45**	**0.68**	**0.51**	**0.72**		−0.12	**−0.22**	−0.02	−0.10	**−0.26**	**−0.20**	**0.83**	**−0.23**	**0.63**
8.	Technical difficulties, problems with work tools and equipment	1.76	0.98	−0.02	−0.07	−0.16	**−0.32**	0.01	−0.18	−0.19		**0.28**	**0.18**	**0.27**	**0.43**	**0.34**	−0.11	**0.61**	**−0.23**
9.	Hindrances in goal attainment, obstacles in completing work tasks, overload	1.85	1.1	−0.10	−0.07	**−0.21**	**−0.29**	−0.10	**−0.24**	−0.14	**0.36**		**0.42**	**0.48**	**0.42**	0.15	**−0.25**	**0.67**	−0.13
.	Problems in interactions with clients or patients	1.56	0.82	0.00	−0.05	−0.06	−0.14	0.04	−0.19	−0.17	0.16	**0.46**		**0.21**	**0.30**	**0.18**	0.06	**0.53**	−0.06
11.	Ambiguity, insecurity, loss of control	1.9	0.98	−0.03	**−0.27**	−0.15	**−0.29**	0.00	**−0.37**	−0.19	**0.45**	**0.56**	**0.30**		**0.58**	**0.52**	**−0.21**	**0.76**	**−0.22**
12.	Conflicts and communication problems	1.6	0.83	−0.07	−0.18	−0.16	**−0.40**	0.01	**−0.34**	**−0.31**	**0.59**	**0.55**	**0.39**	**0.67**		**0.67**	**−0.25**	**0.83**	**−0.26**
13.	Managerial and internal problems, organizational climate	1.63	0.92	−0.09	−0.15	−0.11	**−0.33**	−0.06	**−0.47**	**−0.28**	**0.38**	**0.28**	**0.24**	**0.65**	**0.65**		**−0.26**	**0.71**	**−0.27**
14.	Positive events	2.63	0.68	0.09	0.05	**0.77**	**0.86**	**0.64**	**0.82**	**0.86**	**−0.22**	**−0.25**	−0.14	**−0.27**	**−0.32**	**−0.33**		**−0.26**	**0.72**
15.	Negative events	1.72	0.59	−0.08	−0.19	**−0.20**	**−0.40**	−0.03	**−0.41**	**−0.29**	**0.68**	**0.72**	**0.55**	**0.83**	**0.88**	**0.74**	**−0.35**		**−0.29**
16.	Work engagement	2.42	1.05	0.01	0.09	**0.50**	**0.61**	**0.45**	**0.70**	**0.66**	**−0.27**	−0.12	−0.10	**−0.28**	**−0.27**	**−0.33**	**0.75**	**−0.32**	

Note: Correlations above the diagonal are person-level correlations in the full sample (n = 135). Correlations below the diagonal are person-level correlations in the matched sample (n = 101). Correlations in bold type are significant at $p < 0.05$. [a] 0 male, 1 female; [b] for gender and age n = 131 (full sample) and n = 99 (matched sample). Bold font indiciates significant correlations.

2.3. Measures

We applied short versions of validated scales adapted to the purposes of our study. Participants rated aspects on 5-point Likert scales to indicate the frequency of experiences during the recent workweek. Unless stated otherwise, response options ranged from 1 ("never during this week") to 5 ("several times a day").

2.3.1. Positive Work and Negative Work Events during the Workweek

We measured work events within the recent workweek on Friday afternoon using eleven items from the work-events checklist, which covers the work-events clusters identified by Ohly and Schmitt [7]. The work-event checklist consists of 13 items, two of which refer to events not directly related to the job (negative events: bad news in employees' private lives and health problems). Given the focus and theoretical rationale of the present study, we confined analyses to a set of eleven items, which were explicitly job-related. However, we included the off-job events in the supplemental analyses. Five items tapped into positive events during the current workweek. Sample items are "Did you get confronted with positive but unexpected news or information (e.g., a promotion or a new work order)?" and "Did you receive a positive feedback or a thank from anyone (e.g., supervisor, colleagues or customers)?" We applied six items to capture negative events within the recent workweek. Sample items are, "Did you experience any conflicts or communication problems with colleagues?" and "Did you experience a situation that negatively affected the working climate and the cooperation among the employees/colleagues in your department/your company (e.g., dismissal of a colleague, issues dealing with the supervisor, unsuccessful team meetings)?" Multilevel McDonald's Omega for positive events is 0.69 at the intraindividual level and 0.83 at the interindividual level. Multilevel McDonald's Omega for negative events is 0.58 at the intraindividual level and 0.73 at the interindividual level. Although reliability is important for measures in general, it is less so with regard to factual information such as the one we assessed ((How often) Did the event occur?). Given that work events are formative rather than reflective constructs coefficient alphas or omegas are not optimal for judging reliability [52]. For instance, experiencing high levels of conflict does not necessarily imply high levels of ambiguity or organizational changes at the same time. Keeping this in mind, the reliability of the work-events measures seems to be adequate.

2.3.2. Work Engagement during the Workweek

We applied a brief three-item measure to capture work engagement based on the UWES-9 items (Utrecht Work Engagement Scale) [53]. Preliminary analyses based on cross-sectional data from the baseline survey of the present study using the UWES-9 items (Utrecht Work Engagement Scale) [53] suggested that all items loaded on one factor (see [54] on the structure of the UWES) and, in our study, the three highest loading items captured engagement as reliable as the UWES-9 in our baseline survey (r UWES9-UWES3 = 0.97). We applied the following items: "During this week, I was enthusiastic about my job" (dedication dimension); "During this week, I was immersed in my work" (absorption dimension); and "During this week, I got carried away when I was working" (absorption dimension). We calculated multilevel alphas for work engagement following procedures introduced by [55], implemented in R by [56]. Alphas for work engagement were 0.84 at the intraindividual level and 0.96 at the interindividual level. Given that alpha has been criticized for several reasons, we report MacDonald's Omega as an alternative measure of reliability [57]. Omegas were 0.84 and 0.96 at the intraindividual level and at the interindividual level, respectively. Applying the factor analytic procedure outlined below, we found that the three items yielded standardized loadings ranging from 0.75 to 0.82 at the intraindividual level and 0.89 to 0.99 at the interindividual level. The consistently high to very high factor loadings provide evidence that our measure of work engagement is reliable and taps into a single construct.

2.4. Analytic Strategy

We examined the reliabilities of the focal measures by means of multilevel confirmatory factor analysis applying the lavaan library in R [58]. We estimated models applying the robust maximum likelihood estimator (MLR), which is recommended for non-normally distributed data [59]. We applied the semTools library in R [60] to estimate multilevel reliabilities inferred from the focal confirmatory factor analysis models.

In focal analyses, we applied multilevel modeling [61] to account for the dependence of repeated observations. We applied the "nlme" package for R [62]. As weekly observations were nested within persons, we specified two-level models. Work engagement yielded an intraclass correlation coefficient (ICC(1)) of 0.61. In our focal analyses, predictors at the week-level (Level-1) were centered around the person-mean [63]. Given that we expected relationships between predictors and criteria to vary across persons, we specified random effects for all focal predictors. We controlled for the Level 2-effects of our focal predictors [16,64,65] and entered the person-means of positive and negative events for each person to predict the intercept of work engagement. The person-mean of positive or negative events captures the amount of work events experienced over the period of 15 weeks. Including the person-mean of positive and negative work events at Level 2 offers the advantage of being able to differentiate between differences at the interindividual level and the focal short-term effects at the intraindividual level [66]. Our model is equivalent to what Kreft et al. call a CWC_2 model [67]. That is, a model applying predictors centered within context (CWC) and including the cluster-mean (2).

To analyze the mid-term effects of frequent exposure to work events over time, we specified growth curve models using multilevel modeling. We followed the steps recommended by [68] for growth curve modeling using a multilevel modeling approach in R. We specified linear changes (decrease or increase) in work engagement over time as a random slope of time in weeks predicting these outcomes. Significant random effects indicate that employees differ in the rate of change in the respective outcome variable. We also probed quadratic and cubic trajectories for exploratory purposes. We then added the person-means of positive and negative work events as cross-level moderators, which tests whether differences in the trajectory of work engagement (slope of time) can be explained by the amount of positive and negative events experienced by each person over time. Whereas the person-means as covariates depict differences in characteristic average levels of work engagement due to frequent exposure to work events, the trajectories can be interpreted as increases or decreases in weekly work engagement over time.

3. Results

In a first step, we examined whether each type of positive and negative work events had occurred or not (once or several times versus not at all during the workweek) and how frequently these events had occurred over the course of the 15 weeks. With regard to positive events we found that positive events occurred more frequently than negative events. Positive events ranged from more than 335 occurrences (work-related good news) to more than 828 occurrences (goal attainment, problem-solving, and task-related success). Negative events ranged from more than 327 occurrences (problems in interactions with clients) to more than 460 occurrences (ambiguity, insecurity, and loss of control). Average frequencies for each type of event are displayed in Table 1 for descriptive purposes. Whereas positive events occurred on average several times a week, negative events occurred on average less than once a week during the period studied.

In the second step, we ran multilevel factor analyses to examine the reliability of the focal measures. We specified a three-factor model (positive events, negative events, work engagement) homologous across levels of analysis. That is, we specified a three-factor model at the intraindividual level and a three-factor model at the interindividual level [66]. We compared the model fit of a three-factor model to alternative models, such as a single-factor model and a two-factor model with work events and engagement loading on distinct factors. We found that the three-factor model achieved an acceptable fit as reflected in

Comparative Fit Index (CFI) = 0.945, Tucker-Lewis Index (TLI) = 0.932, Root Mean Square Error of Approximation (RMSEA) = 0.035, and Standardized Root Mean Square Residual (SRMR) $_{within}$ = 0.053 and SRMR $_{between}$ = 0.081. The three-factor model fit the data better than the alternative models (Delta $\chi^2 > 144.55$, $p < 0.001$).

3.1. Short-Term Effects of Work Events

Addressing the first set of hypotheses, we specified Model 1, in which work engagement (in week *n*) was regressed on the main effects of concurrent (week *n*) and lagged work events (week *n*−1), the interactions among positive events (satiation or intensification) and among negative events (adaptation or sensitization). We found that models, including auto-regressive and heteroscedasticity specification, did not improve model fit [68] and did not alter the pattern of results. Therefore, we omitted these specifications from the focal models. Results are depicted in Table 3. We found a positive relationship between positive events during the workweek and work engagement in the same week ($\gamma = 0.74$, t = 12.52, $p < 0.001$) at the intraindividual level. Concurrent negative events were unrelated to work engagement ($\gamma = 0.07$, t = 0.86, $p > 0.10$). We did not find evidence for the lagged main effects of work events from week n−1 to week n. That is, neither positive nor negative events carried over to affect work engagement from one week to the next. Furthermore, concurrent positive events did not interact with lagged positive events ($\gamma = -0.07$, t = −0.61, $p > 0.10$). Hence, in contrast to Hypothesis 1, we found neither sensitization nor satiation effects of positive events. In a similar way, concurrent negative events did not significantly interact with lagged negative events to predict work engagement ($\gamma = -0.07$, t = −0.07, $p > 0.10$). Hence, in contrast to Hypothesis 2, we found neither sensitization nor satiation effects of negative events. Repeated exposure to positive events does not change the way positive events affect work engagement in the next week. The same holds for negative events.

Table 3. Results from Multilevel Analysis Predicting Work Engagement.

Parameter	Model 1			Model 2		
	γ	*SE*	*t*	γ	*SE*	*t*
Level 2 (person-level)						
Intercept	2.44	0.07	33.62	2.43	0.07	33.50
Person-mean positive events	1.21	0.13	9.64 ***	1.21	0.12	9.70 ***
Person-mean negative events	−0.12	0.13	−0.92	−0.13	0.13	−0.97
Level 1 (week-level)						
Time	0.00	0.01	0.33	0.00	0.01	0.43
Positive events (lagged week n−1)	0.03	0.06	0.49	0.03	0.06	0.57
Negative events (lagged week n−1)	0.02	0.08	0.24	−0.02	0.08	−0.20
Positive events (week n)	0.74	0.06	12.52 ***	0.72	0.06	12.12 ***
Negative events (week n)	0.07	0.08	0.86	0.06	0.08	0.77
Interactions						
Positive events x lagged positive events	−0.07	0.11	−0.61	−0.09	0.12	−0.76
Negative events x lagged negative events	−0.02	0.20	−0.07	−0.05	0.20	−0.24
Positive x lagged negative events				0.40	0.15	2.69 **
Negative events x lagged positive				0.10	0.17	0.59
Variance components						
Level 2 intercept variance	0.32			0.33		
Positive events slope variance	0.01			0.02		
Negative events slope variance	0.02			0.01		
Lagged negative events slope variance	0.06			0.06		
Level 1 intercept variance	0.26			0.25		
Deviance (*df*)	920.43		(21)	913.27		* (23)
AIC	962.43			959.27		
BIC	1050.51			1055.74		

Note. *SE* = standard error. *df* = degrees of freedom. * $p < 0.05$. ** $p < 0.01$. *** $p < 0.001$. Deviance = (−2 Residual Log Likelihood). AIC = Akaike information criterion. BIC = Bayesian information criterion.

Addressing Hypotheses 3 (contrast after negative events) and 4 (buffering effect), we examined the interactions of lagged negative events x current positive events and of lagged positive events x current negative events. In line with Hypothesis 3, we found that lagged negative events and concurrent positive events interact to predict work engagement ($\gamma = -39$, t = 2.36, $p = 0.008$). The pattern of the interaction is depicted in Figure 2 and suggests that frequent negative events in the last week amplify the positive association between positive events and work engagement in the current week (Simple slopes: γ low negative events = 0.60, t = 7.70, $p < 0.001$, γ high negative events = 0.86, t = 11.41, $p < 0.001$). Gains in work engagement at the week-level due to positive events are greatest in weeks when many negative events have preceded in the week before. In contrast to Hypothesis 4, lagged positive events did not change the effects of concurrent negative events ($\gamma = 0.11$, t = 0.67, $p > 0.10$). In sum, our results are compatible with the basic idea of a contrast effect after negative events. However, we did not find evidence for sensitization or satiation effects across weeks.

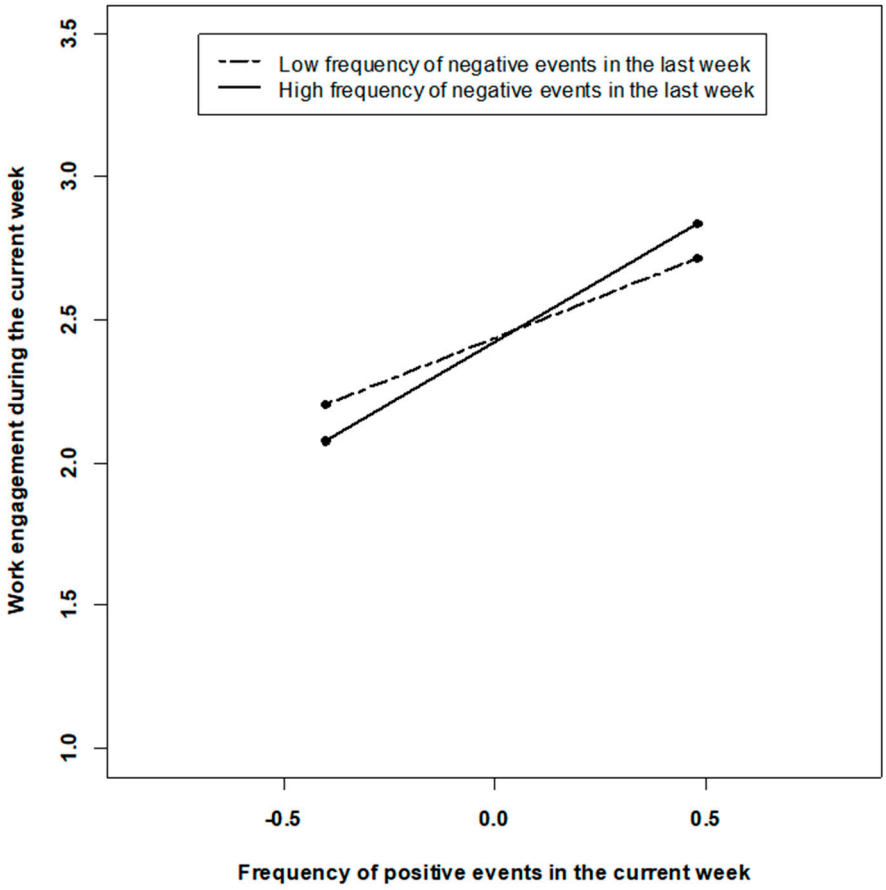

Figure 2. Interaction of current positive and lagged negative events at the week-level.

3.2. Mid-Term Changes in Work Engagement Due to Work Events

Results from linear growth curve models predicting changes in work engagement over time are shown in Table 4 (Growth Model 1). In a first step, we found a significant negative effect of time ($\gamma = -0.01$, t = −2.05, $p = 0.04$), indicating that, on average, work engagement slightly decreased over the period of four months. Given that we found significant slope variance, we considered the frequency of positive and negative events over time as cross-level moderators in Growth Model 2. In line with Hypothesis 5, positive events were predictive of the slope of time ($\gamma = 0.03$, t = 1.97, $p = 0.04$). In contrast, negative events did not contribute to explain slopes in work engagement over time ($\gamma = -0.02$, t = −1.13, $p > 0.10$). The trajectories of work engagement over time dependent upon accumulation of positive events are depicted in Figure 3. Inspection of the slopes reveals

that lower frequencies of positive events over time are related to steeper decreases in work engagement over time, whereas work engagement remains constant when a high frequency of positive events occurs. Further inspection of simple slopes using tools developed by [69] suggests that work engagement decreases when the frequency of positive events over time is close to the grand-mean or below and that work engagement might even increase when very high frequencies of positive events are present (region of significance $-0.01 > w > 1.57$) (simple slopes: γ low positive events = -0.03, t = 2.97, $p < 0.01$, γ high positive events = -0.00, t = 0.04, $p > 0.10$). Besides the trajectories over time, the person-mean of positive events was also predictive of the intercept ($\gamma = 0.98$, t = 8.36, $p < 0.001$). That is, differences in individual "characteristic average levels" [21] of work engagement were attributable to the frequency of positive events over time. Work engagement was higher for individuals who experienced positive events more frequently over the period of four months.

Table 4. Growth Curve Modeling Analysis Predicting Trajectories of Work Engagement Over Time.

Parameter	Growth Model 1			Growth Model 2		
	γ	*SE*	*t*	γ	*SE*	*t*
Level 2 (person-level)						
Intercept	2.48	0.06	38.36	2.47	0.06	38.63
Person-mean positive events	1.11	0.10	11.58 ***	0.98	0.12	8.36 ***
Person-mean negative events	−0.18	0.11	−1.70	−0.11	0.13	−0.91
Level 1 (week-level)						
Time	−0.01	0.01	−2.05 *	−0.01	0.01	−2.20 *
Cross-level interactions						
Person-mean positive events x time				0.03	0.01	1.97 *
Person-mean negative events x time				−0.02	0.02	−1.13
Variance components						
Level 2 intercept variance	0.34			0.33		
Time slope variance	0.00			0.00		
Level 1 intercept variance	0.39			0.39		
Deviance (*df*)	1857.86	*** (8)		1850.93		* (10)
AIC	1873.86			1870.93		
BIC	1911.82			1918.37		

Note: SE = standard error. df = degrees of freedom. * $p < 0.05$. *** $p < 0.001$. Deviance = (−2 Residual Log Likelihood). AIC = Akaike information criterion. BIC = Bayesian information criterion.

3.3. Additional Analyses

We ran several additional analyses to scrutinize the robustness of our results, address potential alternative explanations, and explore additional issues related to the link between work events and work engagement. First, to rule out systematic bias due to missing data, we reran Models 1–4 using subsamples of participants, who had provided either at least 8 ($n = 51$) or 10 ($n = 39$) out of 15 weekly reports. The pattern of results did not differ from those of our focal analyses. That is, all main and interactions effects remained significant. These findings suggest that the number of missing observations did not systematically affect the focal results, implying that the focal effects are robust. Models using a subsample of participants who provided at least 12 reports per person yielded convergence problems in Model 2 due to the low number of participants ($n = 20$) and fall below the threshold for minimum sample sizes at Level 2. Detailed results of the supplemental analyses will be provided by the first author upon request.

Second, in our focal analyses, we have combined different types of positive events to a global measure of positive events and then applied the same strategy to negative events. This approach serves to draw comparisons with prior research that has distinguished between positive versus negative events in general terms. However, in the present study, we applied an 11-item work-events checklist that also included two items referring to off-the-job events, namely health-related problems and negative news in employees' private lives.

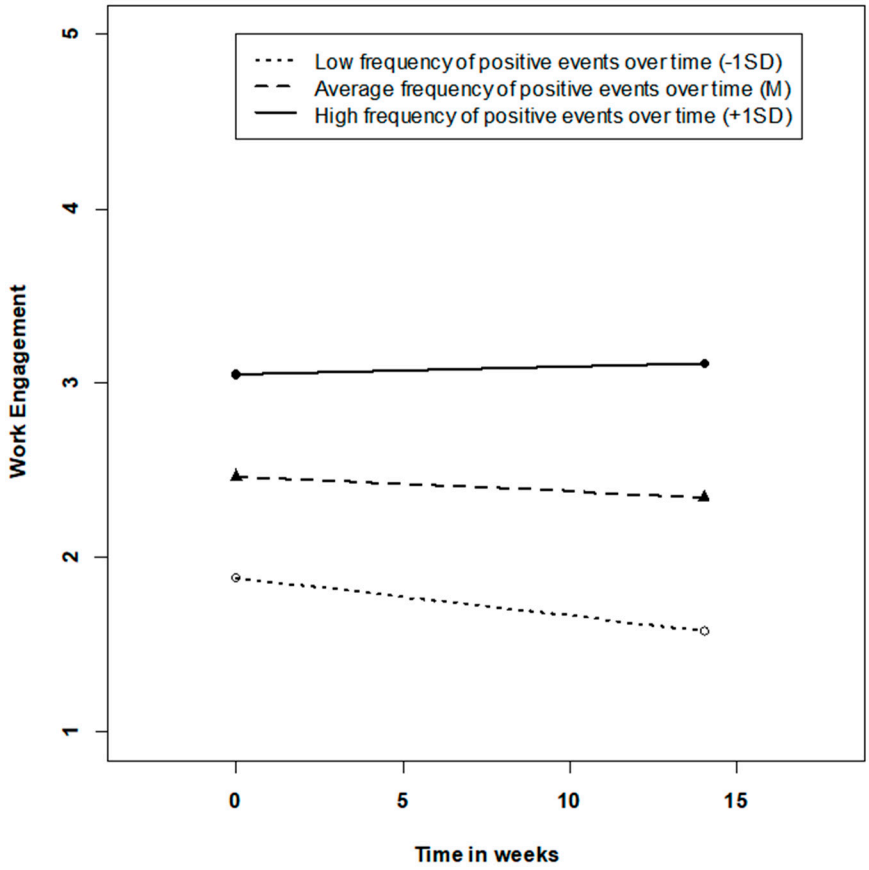

Figure 3. Trajectories of work engagement over 15 weeks dependent upon the accumulation of positive events over time.

This allows for a more fine-grained analysis of the relative strength of the association between work events and work engagement. Whereas prior research only indicates that positive events tend to be beneficial for work engagement, the present study aimed to determine which types of events may be most relevant for work engagement at the week-level and hence, which classes of events are actual drivers of work engagement. Following a similar analytic strategy as in prior research on the comprehensive work-events taxonomy [7], we ran multilevel models and regressed work engagement at the week-level on all types of work events. We applied the full sample for these analyses and specified random intercepts and fixed slopes for each type of work event because the sample sizes at both levels of analysis did not permit specifying eleven random slopes within the same model. The results are displayed in Table 5. In essence, we found almost all types of positive work events uniquely contribute to explain the variance in week-level work engagement. More specifically, goal attainment events ($\gamma = 0.23$, t = 6.69, $p < 0.001$); passively experienced positive events ($\gamma = 0.16$, t = 5.59, $p < 0.001$); and episodes of praise, appreciation, and positive feedback ($\gamma = 0.20$, t = 6.45, $p < 0.001$) were positively related to levels of work engagement. Furthermore, perceived competence through social interactions was significantly related to higher levels of work engagement at the week-level too ($\gamma = 0.07$, t = 1.97, $p = 0.049$), albeit the coefficient was a bit lower than for other work events. By contrast, negative events were unrelated to week-level work engagement, except for episodes of ambiguity, insecurity, and loss of control. Interestingly, the coefficient for this type of negative work event was positive rather than negative ($\gamma = 0.07$, t = 2.11, $p = 0.034$. Hence, this type of negative event contributes to enhance, rather than diminish, work engagement, when considered in concert with all other types of work events. As the other negative work events, negative off-job events did not yield significant associations with work engagement. The consistent

evidence across all types of positive (negative) events supports our approach of forming composite scores for positive and negative events, respectively.

Table 5. Results from Multilevel Analysis Predicting Work Engagement by Specific Positive and Negative Events Within the Same Week.

Parameter	Model 3		
	γ	*SE*	*t*
Level 1 (week-level)			
Intercept	2.37	0.08	28.38
Time	0.00	0.01	0.46
Goal attainment, problem-solving, task-related success	0.23	0.03	6.70 ***
Perceived competence in or through social interactions	0.07	0.03	1.97 *
Work-related good news	0.05	0.03	1.58
Passively experienced positive events	0.16	0.03	5.59 ***
Praise, appreciation, positive feedback	0.20	0.03	6.45 ***
Technical difficulties, problems with work tools and equipment	0.00	0.03	0.17
Health complaints	−0.01	0.02	−0.30
Private issues	−0.02	0.03	−0.51
Hindrances in goal attainment, obstacles in completing work tasks, overload	−0.04	0.03	−1.52
Problems in interactions with clients or patients	0.03	0.04	0.80
Ambiguity, insecurity, loss of control	0.07	0.03	2.12 *
Conflicts and communication problems	−0.01	0.04	−0.25
Managerial and internal problems, organizational climate	0.03	0.03	0.10
Variance components			
Level 2 intercept variance	0.77		
Time slope variance	0.00		
Level 1 intercept variance	0.27		
Deviance (*df*)	1693.77		(19)
AIC	1731.77		
BIC	1821.91		

Note: *SE* = standard error. *df* = degrees of freedom. * $p < 0.05$. *** $p < 0.001$. Deviance = (−2 Residual Log Likelihood). AIC = Akaike information criterion. BIC = Bayesian information criterion.

Third, our study provides the opportunity to assess whether associations between positive work events and work engagement within the same week are due to common method bias only. More specifically, we leveraged the matched sample and ran an alternative version of Model 2 regressing work engagement in week n on positive and negative work events in week *n*, lagged positive and negative work events in week n−1 controlling for work engagement in week n-1. In other words, we controlled for prior levels of the outcome variable when predicting week-level work engagement. Finding significant associations between our focal predictors and work engagement under these circumstances would facilitate the interpretation of results as work events predicting changes in work engagement rather than both phenomena co-occurring at the same time. The results are presented in Table 6. In essence, we found the same pattern of results as in our focal analyses. That is, the main effect of positive work events at Level 1 ($\gamma = 0.72$, t = 12.19, $p < 0.001$) and the interaction at Level 1 remained significant ($\gamma = 0.37$, t = 2.43, $p = 0.015$). Not surprisingly, previous week's work engagement was positively linked to current week's work engagement ($\gamma = 0.27$, t = 6.29, $p < 0.001$). Of note however, the inclusion of work engagement from the previous week resulted in a significant lagged effect of positive events in week n-1 on work engagement in week n ($\gamma = -.19$, t = –2.85, $p = 0.005$).

Table 6. Results from Multilevel Analysis Predicting Work Engagement in Week n Controlling for Work Engagement in Week $n-1$.

Parameter	Model 4		
	γ	*SE*	*t*
Level 2 (person-level)			
Intercept	1.78	0.12	14.75
Person-mean positive events	0.90	0.11	8.16 ***
Person-mean negative events	−0.09	0.10	−0.91
Level 1 (week-level)			
Time	0.00	0.01	0.27
Positive events (lagged week $n-1$)	−0.19	0.07	−2.85 *
Negative events (lagged week $n-1$)	−0.05	0.08	−0.60
Positive events (week n)	0.73	0.06	12.19 ***
Negative events (week n)	0.03	0.08	0.37
Work Engagement (lagged week $n-1$)	0.27	0.04	6.29 ***
Interactions			
Positive events x lagged positive events	−0.05	0.12	−0.45
Negative events x lagged negative events	0.02	0.21	0.08
Positive x lagged negative events	0.37	0.15	2.43 *
Negative events x lagged positive	0.08	0.18	0.46
Variance components			
Level 2 intercept variance	0.17		
Positive events slope variance	0.01		
Negative events slope variance	0.04		
Lagged negative events slope variance	0.07		
Level 1 intercept variance	0.27		
Deviance (*df*)	889.48		(24)
AIC	937.48		
BIC	1038.14		

Note: *SE* = standard error. *df* = degrees of freedom. * $p < 0.05$. *** $p < 0.001$. Deviance = (−2 Residual Log Likelihood). AIC = Akaike information criterion. BIC = Bayesian information criterion.

Fourth, we probed whether positive and negative events interact *within the same week* to predict work engagement. This perspective would be in line with the perspective of prior research on work events that has not accounted for the order of events (e.g., [20]). Moreover, this kind of concurrent work-events interaction corresponds to the perspective taken in experience-sampling research on job demands and resources. We specified an alternative version of Model 2 including the interaction of positive x negative events within the same week. In essence, when analyzing the full sample, we found evidence for a positive link between positive events and work engagement at the week-level ($\gamma = 0.69$, $t = 13.35$, $p < 0.001$) and that positive and negative events interact to predict work engagement ($\gamma = -0.31$, $t = -2.76$, $p = 0.006$). An inspection of the simple slopes confirmed that negative events alleviate the link of positive events and work engagement within the same week. However, an analysis of concurrent interactions across two consecutive weeks in the matched sample (including all combinations of positive events, negative events, lagged positive events, and lagged negative events) revealed no interactions of concurrent positive and negative events within the same week ($\gamma = -13$, $t = -0.83$, $p = 0.41$). The results of these supplemental analyses suggest that the pattern of interaction of concurrent positive and negative events is opposite to the pattern of interaction when taking into account the order of events. Negative events alleviate the link between positive events when measured concurrently with positive events. However, negative events amplify the link between positive events and work engagement when measured prior to positive events.

Finally, we complemented our growth modeling analyses and examined whether positive and negative events accumulate in the long run to explain interindividual differences in work engagement. To infer accumulation, we estimated so-called emergent or compositional effects leveraging multilevel modeling procedures [61,67,70,71]. In the case

of intensified longitudinal data, emergent effects refer to between-person differences in the outcome variable that can be attributed to between-person differences in the predictor variable over time. We estimated the emergent effects of positive (negative) events by subtracting the within-person from the between-persons effect, that is, holding constant the momentary weekly level of positive (negative) events, respectively. The emergent effect reflects the expected difference in work engagement between two persons who have the same frequency of positive (negative) events in a given week but who differ by one unit of the overall level of positive (negative) events. We expected that even if two persons report similar levels of positive (negative) events in a particular week, their work engagement might differ depending on the frequency of work events experienced over four months. We found a positive emergent effect of positive events (γ = 0.38, t = 3.67, $p < 0.001$) and a negative emergent effect of negative events (γ = -.64, t = -4.01, $p < 0.001$). That is, experiencing positive events more frequently over time is associated with higher levels of work engagement. Experiencing negative events more frequently over time is associated with lower levels of work engagement.

4. Discussion

In this study, we have examined how positive and negative events dynamically interact to predict fluctuations in work engagement from week to week. Notably, we have added a temporal component [19], which might resolve inconsistent findings in prior research. Furthermore, our study is among the first to explicitly consider whether the accumulation of work events is predictive of the mid-term trajectories of work engagement over a period of four months. Our approach complements prior research on job demands and resources as more distal feature-oriented antecedents of work engagement, such as time pressure or autonomy [12,72], and provides a more nuanced picture of the interplay of positive and negative events over time.

First, our results extend prior research, which has reported that negative events may, under certain circumstances, be beneficial for work engagement, dependent upon what happens afterwards [19]. The present study contributes to clarify the dynamics underlying these seemingly paradoxical effects [17]. Specifically, our results suggest that the occurrence of positive events is tightly related to high levels of work engagement and that current positive events affect work engagement particularly in the light of recent negative events. High levels of work engagement result from a contrast that evolves when experiencing positive events in the aftermath of negative events. The amplifying effect of recent negative events on the association between current positive events and work engagement is consistent with research on the affective-shift model of work engagement [19] and is also in line with the interplay of job demands and job resources as postulated in job demands-resources theory [6]. However, taking into account the order of positive and negative events provides a more differentiated picture. Whereas recent negative events interacted with current positive events, recent positive events did not interact with current negative events to predict work engagement. So, the timing of positive and negative events may play a crucial role. In this sense, our results illustrate the value of studying the experience of work through the lens of work events and taking the order of events into account. Our results suggest that, for instance, experiencing support after struggling with overload results in different levels of work engagement than facing overload in the aftermath of support. In feature-oriented research on job demands and resources, researchers usually do not account for this distinction. The results suggest that we need to consider these temporal aspects to avoid inconsistent results in the future. Our supplemental analyses show that, while negative events alleviate the link between positive events and week-level work engagement, negative events amplify the link between positive events and work engagement, when negative events precede positive events. In this sense, our study may help explain why interactions of demands and resources have emerged in some studies but have not been found in other studies applying feature-oriented approaches to the interplay of job characteristics measured concurrently. One reason for these inconsistencies may be

that measures applied in feature-oriented research neglect the temporal order of relevant events and result in mixed findings, depending on which timeframe employees have in mind when thinking about time pressure, organizational constraints, perceived progress towards goal attainment, or praise from their supervisor.

Given that we did not find sensitization or satiation effects either for positive or for negative events, obviously, gains in work engagement do not result from a contrast between currently low frequencies of negative events versus high frequencies of negative events in the previous week (adaptation). In the same way, the positive events of the previous week do not alter the impact of this week's positive events on work engagement (intensification), but negative events of the previous week do. Importantly, whereas positive events yielded strong direct short-term associations with work engagement, negative events merely acted as the background for positive events, which amplifies the gains due to positive events—a pattern similar to the effects of positive events on fatigue in the face of high job demands [20]. Furthermore, our analysis of lagged effects from one week to the next suggests that work events apparently do not directly carry over from the previous week to the next week. Associations of positive and negative events with work engagement found in prior day-level research [15,19], therefore, seem to reflect short-lived effects, which fade out rather quickly within a couple of hours [3]. Admittedly, our measures of work events were focused on mundane, rather than exceptional, work events and therefore, may underestimate how long the beneficial or detrimental effects may actually last. The impact of work events varies as a function of event strength and event duration [1,73]. For instance, the impact of novel or highly disruptive events like psychological contract breach [37] may not fade out after a couple of hours or days but will likely take longer [1]. Our supplemental analyses on the unique links of work events with work engagement within the same week suggest that almost all types of positive events quite consistently covary with work engagement.

Second, we rigorously tested whether work events yield sustained—and hence, practically meaningful—significant changes in employee engagement [21]. More specifically, our approach taps into accumulation effects over time. Given that knowledge about accumulation effects and the timing of both positive and negative events is scarce, our results add to current theoretical perspectives [1,73]. We found that, on average, work engagement tends to decrease, and frequent exposure to positive events over time is associated with slower rates of change over time or constantly high levels of work engagement. For a high frequency of positive events, a flat linear trend results, a pattern described as a "passageway trajectory" in the literature (cf. [25]). The general downward trend is in line with the notion that work is associated with investment and thereby, the consumption of resources over time. Our results are in line with research that has provided evidence for "some downward pressure on the general upward trend" [25]. This downward trend is also consistent with declining trajectories in variables related to work engagement. For instance, the organizational socialization [74,75] and voluntary turnover literature [76] literature suggests that there may be slow declining trajectories after being very enthusiastic as a newcomer, for instance, due to the accumulation of minor events. Interestingly, our results imply that this downward trend may be compensated for by a high frequency of positive events. By contrast, in our study, negative events did not accumulate to affect work engagement over time. This finding has important implications for understanding the role of positive events for building and sustaining high levels of engagement. Sustained high levels of work engagement over time are dependent upon being fed by frequent positive experiences. In the absence of continuous reinforcement [25], work engagement is likely to fade and decline quite substantially within the daily grind. In this sense, particularly positive events can be considered key drivers to maintaining and fostering engagement.

4.1. Practical Implications

From a practical perspective, our findings suggest that single mundane work events have short-term effects on employee work engagement. Positive events have the potential

to foster work engagement, and this effect is more pronounced in the aftermath of negative events. However, the frequent occurrence of mundane positive events accumulates to sustain the level of work engagement over periods of several weeks or months. According to our results, in the face of adversity, creating opportunities for positive events afterwards is superior to avoiding the occurrence of additional negative events. Supervisors might acknowledge their followers' progress towards goal accomplishment as an element of routine communication [77] to foster positive events. Our suggestion coincides with facets of transactional leadership, such as contingent reward and proactive forms of management by exception [78], and stresses the importance of these leadership behaviors in daily job routine. In more general terms, organizations might develop structures and routines that facilitate positive events at work to happen. For instance, adequate job design [79] and optimal employee training are likely to contribute to experiencing successful task completion and positive feedback from others. Beyond goal attainment and successful mastery of job tasks, team meetings have a high potential to act as opportunities for positive social exchange that might feed work engagement (see [7]).

4.2. Strengths and Limitations

The key strength of the present study is that we applied an intensified longitudinal design over a period of four months and rigorous methods for analyzing data. A series of robustness checks and supplemental analyses were conducted to qualify our core results. However, the present study relied on self-reported data only. Furthermore the week-level design implied that retrospective reports referred to overall assessments of the entire workweek, an approach that may come at the cost of retrospective bias [80]. On the other hand, we aimed to extend the analysis beyond very short day-level periods, because we intended to capture the impact of rare but potentially powerful events, [29] and we intended to link transient processes to longer-term processes [21]. For instance, quits by colleagues or significant positive team events (e.g., an informal gathering for the celebration of a colleague's birthday) do not usually occur within a few days but may be important aspects of organizational life [1]; such events are likely to be overlooked in episodic or day-level studies. The relatively low prevalence of negative events of less than one occurrence of each type of negative event per week on average (see Table 1) suggests that the mid-term time-frame of several weeks to months is in line with the relatively rare occurrence of work events that are strong enough to yield sustainable effects over time. Moreover, the results of our supplemental analyses suggest that the associations between positive work events and work engagement within the same week are not purely a result of method-variance [81]. The results held when we controlled for prior levels of work engagement. Although, researchers have recently suggested that affective events may be the results of affective experiences, rather than the other way around [82], the idea of work events affecting affective states, such as work engagement, is consistent with the basic tenets of affective events theory [13]. The results of the present study are compatible with this more traditional view.

Because responses were anonymous, participation was voluntary, and respondents held a wide variety of jobs, we think that our sampling strategy is largely comparable to other psychological studies. However, our sample is not representative of the general working population, so it is unclear how the study findings generalize to other samples. Moreover, we have a high percentage of missing data. We obtained weekly reports for roughly half of the theoretically possible number of observations. This limitation is due to the high number of repeated observations within our ambitious design (fifteen diary surveys in total), which covered a period of almost four months. However, our random coefficient modeling approach does not hinge on listwise deletion and is able to handle missing data. On average, each participant still provided more than six (and nearly five lagged) observations covering periods of at least two months. Furthermore, our supplemental analyses suggest that our results are not dependent upon the number of

missing observations. Taken together, we believe that our results are valid despite the missing data.

Although, our study is among the first to study events based on the work events taxonomy by Ohly and Schmitt [7], we have not distinguished between different clusters of work events (e.g., goal attainment versus praise or perceived competence) in our focal analyses. Consequently, rather than doing a fine-grained analysis of interactions among the five specific positive and six specific negative work-related event clusters identified, our study is meant to provide insights on the general patterns of how positive and negative events (irrespective of their specific content) interact to predict work engagement (for a similar approach, see [19]).

On a related note, several authors [1,73] have argued that the strength of events varies as a function of novelty, disruption, and criticality and should be considered to understand the impact of particular events with regard to individual level or organizational level outcomes. We did not monitor and incorporate these kinds of event characteristics in this study as our focus was on the dynamic interplay of the quantity of work events over time. However, we consider our study a first step towards a better understanding of the dynamics of work events *per se*.

4.3. Implications for Future Research

Although our study has addressed several gaps in the literature, a couple of unresolved issues remain to be considered in future research. While some researchers have found negative events to predict lower levels of work engagement [14] (see also Table 3 in [18]), we did not find that negative events had any direct or lagged effects, on average. This inconsistency may have been due to differences in the ways work events were measured (open answer format versus event checklist) or differences in the time lags applied (day-level versus week-level) [3]. For instance, Bone and colleagues [24] provided evidence that the impact of work events on employee health may differ quite substantially depending upon whether data are analyzed at the episodic or at the day-level. Accordingly, it may not be straightforward to generalize results from day-level research to longer time frames [83]. In the present study, it was not clear whether negative events had no affect on work engagement whatsoever or whether their effects simply faded out before work engagement was assessed at the end of the workweek [3]. Day-level data collected over a period of several weeks would allow researchers to gain a clearer picture of how long it takes until the effects of work events unfold or fade out [84]. A combination of day-level and week-level perspectives would further close the gap between transient processes and the longer-term processes discussed above [21]. As noted above, tracking indicators of event strength alongside event frequency could further reconcile contradictory findings and integrate the research on work events into event system theory [1].

On a related note, work events are discrete by definition and are meant to fundamentally and sustainably change the experience of work. Significant work events may even be triggers of transition processes, rather than predictors of minor short-term fluctuations in work engagement [13]. In this sense, future experience sampling research might apply discontinuous growth modeling approaches to account for the discrete nature of (rare but potentially powerful affective) events [76] and study shifts in work engagement, in addition to day-level fluctuation [85].

Furthermore, Koopmann, et al. [86] found that regulatory focus mediates the short-term effects of positive and negative events on employee strain. Drawing on this research and further advancing discontinuous perspectives, future research may also explore the role of shifts of regulatory focus in work engagement fluctuations. Although we have illustrated the dynamic interplay of positive and negative events using examples of events, which may refer to the same task (e.g., struggling with obstacles in a certain task in one week and successfully finishing the task in the consecutive week), we did not track whether the positive events in one week actually were related to the negative events in the preceding workweek. Future research might scrutinize whether compensatory effects are dependent

upon a link between the positive and lagged negative events. Furthermore, personality traits, such as positive affectivity, might influence the relationships between positive and negative events, their interplay, and work engagement [19], which needs to be taken into account in future studies.

We have addressed how the repeated occurrence of positive and negative events might accumulate over weeks to months, although our analysis of sensitization and satiation effects across two consecutive weeks yielded no support for a build-up of such effects in the short run. However, we found that the frequent occurrence of positive events is associated with sustained higher levels of work engagement. By contrast, we found emergent effects of both positive and negative events on work engagement at the interindividual level. That is, reporting more positive (negative) events over time is associated with higher (lower) levels of work engagement, even when controlling for momentary levels of positive (negative) work events. Illies and colleagues [21] have emphasized that it is important to explain how transient processes are linked (and lead) to longer-term consequences in terms of employee well-being. Our results suggest that the occurrence of positive and negative events is associated with meaningful differences in work engagement over time. However, we can neither rule out third variables that might explain this link, nor can we establish causality with the correlational data at hand. Future research may take an episodic approach to accumulation effects [87] and leverage linear and discontinuous growth modeling [88] to study build-up effects in a more rigorous way. Our results suggest that positive and negative events yield practically relevant effects and predict interindividual differences in work engagement on the long run (emergent effect) [70,89,90]. Hence, positive and negative events are probably a good starting point to study accumulation effects with regard to work engagement.

5. Conclusions

Our study adds a temporal component to the research of work events and work engagement. More specifically, we provide evidence that recent negative events amplify the beneficial effects of current positive events on work engagement. Hence, studying the experience of work through the lens of work events over time [1] improves our understanding of the contingencies and the dynamic interplay that determine work engagement. Furthermore, this study links transient processes to longer-term processes underlying engagement and shows that positive events accumulate to feed continuously high levels of work engagement over periods of several months. Overall, our study provides insights into how work events combine to affect work engagement over time. Notably, our results on mid-term changes in work engagement underscore the practical relevance of work events for employee well-being. We hope our study contributes to provide insights into the vital worker and will inspire further research on what happens at work through the lens of work events in the future.

Author Contributions: O.W., C.J.S. and A.S. planned the study together and prepared the focal materials. A.S. and S.O. provided the work events checklist. O.W. set up the electronic surveys, was in charge of communication with participants, collected the data, and was in charge of data preparation for analysis and all analyses. O.W. wrote the original draft. C.J.S., A.S. and S.O. commented on earlier versions of the manuscript. O.W. prepared all materials presented in this manuscript. O.W. handled the paper during the review process. All authors have read and agreed to the published version of the manuscript.

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Institutional Review Board Statement: Ethical review and approval were waived for this study, because an ethics review board still had to be founded at the Faculty of Social and Cultural Sciences of the University of Hagen when this study was planned and conducted. The measures and procedures of our study followed the protocols of standard self-report experience sampling research in applied psychology, and we did not touch sensitive topics (e.g. sexual orientation). Our study fully complied with the standards of the Department of Psychology at the University of Hagen, which included strict code of conduct and guidelines to guarantee the anonymity of the self-reported data.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

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Article

Healthy Leadership and Workplace Health Promotion as a Pre-Requisite for Organizational Health

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Abstract: (1) Background: Increasing stress levels at the workplace constitute a concerning organizational trend, challenging not only employees but also organizations alike, as it is in most instances associated with increasing workloads. In consequence, employees have started to demand that organizations begin to accept responsibility for their health and well-being. The present contribution seeks to investigate, to which extent individuals are able to deal with stress and whether their employers and respective supervisors (leaders) accept responsibility for their health, for instance, by leading by example. In addition, the existence and support generated by the organization in form of Workplace Health Promotion (WPHP) is inquired. (2) Methods: Semi-structured qualitative interviews with 40 (full and part-time) employees from two European countries were conducted. (3) Results: The study with employees from Austria and Germany (n = 40) confirmed that employees have started to recognize the potential of the workplace as an environment, where individual health can be enhanced. Yet, the results showed that only a few companies have already put some WPHP measures into practice. Likewise, the implementation of healthy leadership is rather limited to date. (4) Conclusions: At present, companies are still more likely to delegate responsibility for employee health and well-being to their staff, having not fully realized the potential of healthy leadership and organizational health promotion. There is great potential to increase WPHP measures on the employer side, through both healthy leadership and supporting WPHP measures.

Keywords: organizational health; healthy leadership; workplace health promotion; qualitative study

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1. Introduction

Increasing stress levels at the workplace constitute a concerning organizational trend [1–4]. The 2020 Trends Report on Well-Being at Work concluded that work is taking its toll on people and their health, respectively [5]. For some years already, work has been listed amongst the top three sources of stress [6]. In most instances, work-related stress was found to also have effects on individuals' health, leading to sleep deprivation or mental health issues amongst others [3,7] and negatively affecting employees' private lives [1,2]. In consequence, the Stress Awareness Month 2020 was dedicated to identifying and alleviating Work-Related Stress and Anxiety [8]. In most instances, employees' stress stems from the high workloads they have to deal with on a regular basis [9]. Present-day work demands have found that 40% of people work more than 50 hours per week; an additional 74% claims to be sleep-deprived [10]. As this work overload contradicts the so-called "healthy job"—defined as the demands on employees being appropriate in relation to their abilities and resources [11]—it comes as no surprise that 43% of US employees think their employers should also be concerned with their health [12].

With the literature excessively documenting the detrimental aspects of employment, such as stress and burnout [13], organizations have been increasingly encouraged to show concern for their employees' health and well-being. A growing concern for individual health in the workplace is grounded in positive organizational behavior, defined as "the

study and application of positively-oriented human resource strengths and psychological capacities that can be measured, developed, and effectively managed for performance improvement in today's workplace" ([14], p. 57). This approach induces organizations not only to change their behaviors [15] but also recognizes the relevance of human capital as an organization's most valuable asset in an ever-changing environment [14]. Previous research has addressed the benefits of healthy workers for companies, such as higher job satisfaction, higher employee engagement, and better job performance [16–22], together with healthy leadership [23,24], which can be defined as the "health-specific influence of leaders on employee health and wellbeing" ([25], p. 2). In response to social movements and global initiatives concerned with improving health and well-being on a population level (e.g., see Sustainable Development Goals (SDGs) by the United Nations [26]; see also, Reference [27]), organizations have started to allocate resources towards individual health [28–30] in the form of Workplace Health Promotion (WPHP) measures. Especially against the background of a growing mediatization, which leads to blurring boundaries between employees' private and professional lives and to an always-on mentality among many employees, individual health is repeatedly put to the test [31]. In consequence, the maintenance of a sound work-life-balance is becoming more and more important, as is the introduction of flexible work solutions, such as the ability to work from the home office, to work flexible hours during the day, or to access the company email account from home, which can improve individual well-being in the long run. While companies make more efforts related to their employees' health, each individual also has responsibility for his/her own health. Healthy leadership can only be successful if both employers and employees work in concert to improve employee health and create a healthy work environment. However, the roles of who bears more responsibility are not yet clearly defined. In our study, we want to analyze whether employees perceive to have the responsibility for their health mainly themselves or whether they see their employers as responsible for their health as well. To date, this aspect is absent from research to the largest part.

Changes in Human Resources' orientation are, first and foremost, conditioned by a paradigm shift, which stresses the necessity to invest in competitiveness (and skilled employees) instead of boosting productivity [32–34]. Since human resources are hard to copy, they constitute an organizations' rarest and most valuable resource [35] and are part of the organization's movement towards sustainability [36]. In the current "war for talent", where companies are trying to get and keep qualified and capable employees, it is increasingly important that employers make employees feel that they care about them and that their health is not just a personal matter but also something that the company pays attention to.

In the following, focusing on an employees' perspective, we aim (1) to analyze whether employees feel mainly responsible for their own health or whether they see the responsibility for their health to also lie with their employer and (2) to investigate the strategies employees use to establish a sound work-family-balance. While these are the main goals of our study, we also want (3) to explore whether, from an employees' perspective, companies have already started to implement healthy leadership and (4) to determine which WPHP measures have already been implemented by companies, on the one hand, and how they are perceived by employees, on the other hand.

2. Theoretical Background

2.1. Organizational Health

Occupational health as a subject area was first introduced in the 1990s and accounted for the valuable contribution of psychologists to creating a healthy workplace [37]. In general, occupational health focuses on the creation of "healthy workplaces in which people may produce, serve, grow, and be valued, [and in which they] use their talents and gifts to achieve high performance, high satisfaction, and well-being" ([38], p. 3). While the term well-being is not easy to define, it usually refers to an individuals' optimal functioning, as well as personal growth and development [39,40]. These concerns for

individual well-being and health arose out of increasing psychosocial hazards individuals were confronted with on a daily basis [41], such as increasing work demands and poor work–life balance [42] or even work–life conflict [43,44], which impeded their work's success and health. An overview over occupational health research themes showed that work-related stress and work–life balance were the most commonly researched areas [42]. Work–family balance—which is often used interchangeably with work–life balance—can be defined as "satisfaction and good functioning at work and at home with a minimum amount of role conflict" ([45], p. 349). Responsibility for health can be assigned to the management or be extended to an organization's employees [46,47]. The first aspect recognizes the organization as a place where individual health can be improved. In this context, the workplace is seen as an environment "for promoting and maintaining improved levels of health over time" ([48], p. 141). In the second instance, employers are seen to be in the position to assist their employees in successfully juggling the different domains of their lives without any difficulties and tensions. Both forms of health support have been found to benefit the organization in the long run [49–51]. Thus, both the individual and the employer are responsible for enabling and maintaining a good work–family balance. To date, little research has been done on who is more responsible for employee health, the employee or the employer. This is a research gap that our study intends to fill.

In recent years, the term occupational health has been substituted by organizational health [52]. Bauer and Jenny [53] offer the following reasons for this shift: (1) employee health is more and more subject to the organizational context, (2) employee health has implications for the organization as a whole, and (3) both concepts are reciprocally linked and continue to influence one another. They offer a generic organizational health framework that is made up of the following elements: employees, employees in leadership positions, work processes, social processes, and the organizational environment [52,53]. Stress has been identified as an environmental cause of ill health [54], which can be overcome if the organizational parameters were changed. This assumption is supported by the person–environment fit model [55], which perceives the environment as essential in shaping individual responses to work situations. Thereby, the fit between the person (and its needs respectively) with the environment is seen as crucial [56]. Constituting an "ultimate competitive advantage" [57], organizational health describes an organization's ability to operate effectively, grow sustainably, and adapt smoothly to change [58]. In addition, it is conceptualized as an organization's ability "to align, execute, and renew itself faster than the competition to sustain exceptional performance over time. It comprises core organizational skills and capabilities, such as leadership, coordination, or external orientation, that traditional metrics don't capture" ([57], p. 3).

2.2. Criteria and Strategies of Healthy Organizations

Organizational health comprises a number of areas, such as a company's psychological and financial health. According to Cacace et al. [59], psychologically and financially healthy organizations are characterized as follows:

(1) Healthy organizations set a clear direction for their future and how they conduct themselves.
(2) Healthy organizations are executed well and have a culture of high performance.
(3) Healthy organizations create a strong connection between employees and the company by showing appreciation and by bringing meaning to work.

These criteria correspond with two recent industry studies, according to which a shift in employee preferences can be observed: "What employees really want isn't more money but better benefits. They want to work at a place that is really organizationally healthy" [60,61]. This suggests that individuals' health and well-being is subject to their experiences of the workplace, as well as work-related aspects [62]. A healthy organizational environment consists of psychosocial factors that can enhance rather than harm individual health [63,64] and is expected to benefit the organization as a whole [64]. A healthy psychosocial environment, and encompasses all (environmental) social structures that have

a bearing on individual health, such as work demands, control, and social support [65,66]. Moreover, workplace health and wellness programs are a common employee benefits [67] and describe the employer-provided efforts to "enhance awareness, change behavior, and create environments that support good health practices" ([68], p. 297). Employers believe that these programs reduce medical spending and increase the productivity [69].

The literature has defined a number of strategies and factors that influence organizational health and suggests that

(1) a balance between job demands, resources, job design, social relationships, and support, as well as change, need to be achieved [70,71];
(2) organizational offerings need to be tailored to employee needs [72]; and
(3) organizational health must be reflective of organizational climate. Thereby, organizational climate encompasses leadership and management practices, as well as organizational structures and processes [64,73].

Strategies to enhance organizational health mainly concern healthy leadership [74,75] and workplace health promotion [76]. Both aspects will be discussed in more detail in the following sections.

2.3. Healthy Leadership

Organizational health is linked to the concept of organizational politics [77], and as such, it has also increasingly been linked to positive leadership [14,74,75]. Leadership is conceptualized as a process in the course of which a person influences and directs others in an attempt to accomplish certain objectives or common goals [78]. Leaders have to ensure that organizations develop [79] and can motivate employees to follow their example [80,81]. As workplace health requires far-reaching organizational adaptations and changes, the management assumes responsibility for the process [82].

According to Hänsel & Kaz and Boehm et al. [23,24], healthy leadership is a new promising management approach, whereby an employer raises awareness for the topics of health and well-being at work. Following Rudolph, Murphy & Zacher [25], healthy leadership can be defined as the "health-specific influence of leaders on employee health and wellbeing", whereby—as it is the case within the healthy leadership literature—health and well-being are understood to encompass physical, mental, and social well-being and not just the absence of disease [83]. Similar constructs are health-specific [84], health-focused [85], health-oriented [86], and health-promoting leadership [87,88] (for an overview of the different concepts, please see the review by Reference [25]). The objectives of a healthy leadership are to build trust, manage problems, and reduce the work-related pressure employees face [89]; healthy leaders are, furthermore, concerned with protecting, enhancing, and restoring the health of their employees [24]. The healthy leadership concept is based on two elements: (1) The employer him-/herself must live a healthy life ([23], p. 2); since the leader of a company often has high responsibilities, which results in a lot of stress and anxieties, a leader always sets an example for the employees and serves as a role model [90]. Applying the motivational theory of role modeling to the organizational health context, managers can serve as role models and, thus, have the ability to motivate individuals in both setting and achieving goals [91]. (2) Employers should implement Workplace Health Promotion measures to develop a health-promoting workplace that motivates employees to participate in such a development [92], which will be discussed in the next section and the empirical study.

2.4. Workplace Health Promotion

Increasingly, the workplace is recognized as a place in which employees' health can be improved [93]. The concept of workplace health describes "the ability of the workforce to participate and be productive in a sustainable and meaningful way" ([82], p. 79). This increasing interest in workplace health is reflective of a growing concern for and interest in employee health and well-being as a means to reduce concerning retention rates [94,95]. In occupational health psychology, the term Workplace Health Promotion (WPHP) has

been increasingly used [96,97]. As an organizational strategy, WPHP is part of the broader concept of organizational health [57].

Following the Practices for the Achievement of Total Health (PATH)-Model, healthy workplace practices can result in both employee and organizational health; thereby, both components are dependent upon each other [76]. A similar reasoning is offered by the heuristics model of occupational health, which postulates that individual and organizational behaviors can benefit employee well-being and organizational performance [98]. The health development model emphasizes that health and well-being are continuously produced and reproduced through interactions with individuals' immediate environments [99]. All models are based on the assumption that health—a process that can be influenced by both the individual and the organization—can be maintained through concrete health-enhancing measures.

As part of a modern change management that focuses on the workforce and their individual needs respectively, companies are required to listen actively, create a healthy work environment, provide benefits that correspond with personal needs, and engage their employees pro-actively in order to make their business thrive and convince employees that their business is the best place to work [100]. Workplace health promotion is a promising way of achieving and strengthening identification [101]. WPHP comprises aspects beyond workplace safety and health promotion—namely, personnel management and staff development [102]. A recent survey produced evidence that WPHP measures are one of the top three priorities amongst employees of all ages [103].

Organizations can affect health in a variety of ways—for instance, through material, behavioral, and physical mechanisms [104]. In the process of WPHP, work context factors are of relevance [105,106] and have been found to influence employee health and well-being [107]. These, for instance, concern ergonomics (i.e., the extent to which an appropriate amount of movement and posture is possible in the workplace); physical demands (i.e., the amount of physical effort required to perform the job); work conditions (i.e., pleasant physical conditions in the workplace, including temperature, low safety risks, and low noise levels); and equipment (i.e., the degree to which a job requires a variety of equipment). Investments in WPHP have been found to pay off in the long run, resulting in increasing productivity and lower turnover rates [16,48,108–110].

3. Empirical Study

3.1. Study Purpose

The focus of the empirical study concerned healthy leadership and employee well-being in the digital workplace. Based on the previously outlined generic organizational health framework by Bauer and Jenny [52,53] and the strategies and factors to enhance organizational health and respective WPHP measures introduced before, the empirical investigation seeks to investigate how individuals cope with stress. In addition, we seek to explore whether their supervisors (leaders) lead by example by following a healthy lifestyle, while also inquiring the existence and support generated by the organization (in the form of WPHP).

Besides individual strategies of dealing with this dichotomous approach to health, the empirical study aims to determine whether employees feel that companies increasingly step up and recognize the workplace as a place where individual health can be enhanced. As such, it is proposed that organizations draw from their health promotive capacities.

In detail, the study examines, from an employees' perspective, (1) whether employees themselves perceive to be in charge of their health and (2) the strategies they utilize to manage the often contradictory requirements of their private and professional lives (work-family-balance), (3) whether companies have already established a healthy leadership and whether their leaders model healthy lifestyles, as well as (4) whether employers have already implemented WPHP measures. If this is the case, we also seek to uncover how employees evaluate the respective WPHP measures. Hence, the relevance of individual as well as organizational strategies to optimize individual and organizational health is scrutinized.

3.2. Method

Semi-structured qualitative interviews with 40 (full and part-time) employees from two European countries (Austria and Germany) were conducted over the course of two months. We used purposeful sampling in order to recruit interview partners that could provide in-depth and detailed information on healthy leadership and workplace health promotion [111]. For this purpose, we identified a set of qualifying criteria each participant had to meet to be considered for the study. The interview partners were selected if they fulfilled the following criteria: they (a) were employed either full-time or part-time, (b) have been with their employer for six months at the minimum, and (c) indicated to be interested in their health. Moreover, we ensured to recruit an equal amount of females and males, as well as representatives from different industries and management levels (leadership vs. non-leadership positions). In order to recruit interview partners, we turned to a German and Austrian corporate database. Each interview was conducted face-to-face and fully transcribed afterwards; the transcripts served as the basis for our qualitative content analysis. All interview transcripts were analyzed using QCAmap. The respondents (female: 27; male: 13; age range: 22 to 57 years) worked in a variety of industries, such as tourism, banking, IT, and security. About half of the participants (n = 19) did not have a management position. The average interview time was 35 min.

A qualitative research approach was chosen, as, instead of confirming existing research findings, the main focus of the chosen method is to get new insights [111]. The interview guideline consisted of four broad categories: (1) Importance and Definition of Health, (2) Health in the Workplace, (3) Workplace Health Promotion and Healthy Leadership, and (4) Work-Life Balance. Sample questions for each category can be found in Table A1 in Appendix A.

Semi-structured interviews were used in order to give the interview partners freedom to elaborate on selected aspects [112–114]. Interview material was analyzed via a content analysis, as proposed by Mayring [115,116]. According to Mayring ([115], p. 114), the advantage of a qualitative content analysis is "systematically analyzing texts by processing the material step by step using category systems that have been developed based on theory". In the process of the analysis, material is divided into units and summarized to answer the previously introduced research questions.

The fully transcribed interviews were saved in text format. All interviews were uploaded to QCAmap and analyzed using both a deductive and inductive approach. The analysis was deductive in that it tried to find support for the previously introduced topics, investigating the extent to which previous research findings are supported. We did so by assigning interview passages to pre-defined categories based on the literature—the categories were also reflected in our interview guideline. The analysis was, however, also inductive, as we tried to identify aspects that have not been thematized by previous research to date. In addition to inductive/deductive coding, we also were able to report the frequency of elements. A summary of the most important themes together with exemplary quotes can be found in Appendix A (see Table A2).

The content analysis was conducted by two independent coders. The individual coders were trained by the authors on how to code variables along the specific categories. The codebook was refined on several occasions to account for the additional insights that emerged during the training process. When coders had reached acceptable levels of reliability [117], they coded one-third of the interviews. Based on this sample, Krippendorff's alpha was calculated for each coding category to ensure acceptable levels of intercoder reliability [117] and ranged from 0.82 to 1.0. All discrepancies were discussed and resolved before the final analysis was conducted.

4. Results

4.1. Individual vs. Organizational Responsibility for Health

In a first step, we asked participants about the relevance they attribute to their health and, also, who they think should be responsible for their health. To the largest part, individuals attested that they were in charge of their health. Exemplary statements read as follows: "I am responsible for my health, I would say" (male, 28, IT industry), "I am solely responsible for my health" (female, 23, hospitality industry), and "I pay a lot of attention to my health and try to improve it on multiple occasions" (male, 28, IT industry). While "everyone is responsible for their own health" (40, male, sales director), there was also agreement that individuals are able to improve their health and well-being more readily, "because these days, you have many opportunities to take care of yourself" (female, 23, education). One respondent, nonetheless, remarked that his health was subject to environmental influences, including the workplace (male, 28, engineering).

When inquired as to how participants took care of themselves at work, several measures were listed, such as "getting up and moving around in-between work. Taking the steps instead of the elevator" (male, 54, public service), "take enough breaks, eat on a regular basis" (female, 24, education), or "go outside for a bit" (female, 24, education). One interviewee even mentioned that he learned how to "sit in front of the computer for 8 h, or how can I practically strengthen my eyes" (male, 54, public service). In one company, exercise was not an individual but a team effort: For example, the employees said "Let's go up a few floors" or "Let's take some exercise. That's convenient" (female, 31, public service).

4.2. Work–Life Balance

Strategies to establish a healthy work–life balance entailed, for example, flexible working hours (male, 28, IT industry). In the context of work flexibilization, the largest proportion of employees indicated that separating their private from their professional lives was quite challenging, opting for an *integration*. One employee stated that "with the modern technologies, it is very hard to separate work from home" (male, 47, service industry). Respondents attested that work presented a central component of their private lives, forcing them to integrate work-related aspects into their homes on a regular basis. Conditioned by the omnipresence and broadening scope of new technologies, the two spheres are "more and more connected because with these new tools, like mobiles, where you get your emails, and it gets more complicated to really disconnect" (male, 40, sales director). This also held true for an employee from the banking industry, who observed his own inability to "escape it. Your work will influence your private life and your family will feel that you are not content and preoccupied with job-related matters" (male, 53, banking).

One interviewee described it as a "balancing act, since the company is always very present in the private sphere. One does additional tasks. But it is exactly the other way around as well: it is possible to organize and do private things in the workplace" (male, 47, engineer), while one extreme case even forced an employee to attend to job-related matters during his honeymoon, attesting to his inability "to separate the two areas" (male, 28, engineering); another employee held a more relaxed attitude towards the subject matter: "Of course, it happens that I go for a drink with my work colleagues after work and that we talk about work. But I also think, yes, that's just part of it, because that's everyday life, work is part of your everyday life and you talk about it, too." (male, 22, IT).

However, not all employees are content with integrating their professional lives into their private lives; instead, they decide to take pro-active action to ensure that the two spheres do not mix. This is commonly referred to as *adaptation*. Since "it is very important for me to separate these two" (male, 24, lawyer), individuals have to take action themselves to guarantee a break from work. While individuals can, allegedly, "at a certain level, [. . .] adjust your life around the company" (male, 40, sales director), for others, it is not as easy. One interviewee, who is a sales manager, remarked: "It was quite difficult to draw a line in the beginning, because you just go into the stores in a different way. So that's

certainly the problem, that somehow you always know that you are in a market where an employee of yours works. But you learn to live with it" (male, 47, sales director). Another employee shared: "Until January, I actually worked from Monday to Friday, and my life has been sacrificed to the employer—no let's say my life belonged to my employer. And now, through teleworking, I have 2 days a week when I can do things for myself, when I have time for the family and that's very important for me" (male, 54, public service).

In some instances, a *separation* of the two areas is possible. In these instances, even employers ensured employees' ability to disconnect from work, e.g., by not grating them the possibility to access work-related information from home. A female respondent expressed appreciation for this regulation, claiming that "you leave the office and only think about work when you come back the next morning" (female, 39, IT industry). This, however, did not constitute the norm, as others were forced to take matters into their own hands. For example, one employee postulated in order for his work not to interfere with family time: "I got myself a private cell phone" (male, 40, sales director). Another said: "I try not to work at home" (female, 24, education). This notion is shared by another interviewee: "At first, I couldn't keep my work and private life separate, because I was doing a lot of work at home. But now I know, that if I go to the office, I do my job and if I go home, I don't do a lot of work at home, so it helps me, to keep it separate" (female, 39, IT industry).

4.3. Healthy Leadership

Mixed results were reported with regard to the extent organizations in general or managers in particular expressed concerns for employee health. While some respondents claimed that health was not an organizational issue, announcing that "in my company, health doesn't play any role" (female, 28, service industry), or "my employer does not play any role in my health" (42, female, public service), other employees reported more positive experiences. In line with the observation that "my environment can also influence my health" (male, 28, engineering), one female respondent, who works in education, stated: "At my workplace, it is great. We have an own department that deals with health promotion and management. And there are many offers I can choose from, provided I take advantage of them" (female, 24, education).

At times, managers take a hands-on approach to health as well. One employee claimed: "My boss is one of those people, who puts a carafe of water on my table when I cannot get any. So he most certainly takes care of his employees" (female, 23, manufacturing). Another respondent stated that their work canteen offered healthy food, and "our boss often joins us for a healthy meal" (female, 30, manufacturing). In other cases, the whole department attends gym classes together, and that also includes the top management (male, 28, sales). One interviewee shared a very positive example: "My superior offers weekly appointments where you can come to her with concerns, but you can also talk with her about stress and she helps us when she recognizes that we can't deal with the situation ourselves" (female, 31, public service). Through healthy leadership, managers can positively shape responses to organizational offerings and lead through their own behaviors, thus functioning as role models.

4.4. Workplace Health Promotion (WPHP)

Albeit both employees' concern for their health and calls for employers to take responsibility for individual health are on the rise, notions of how health in the workplace can be improved are quite diverse (male, 28, engineering). Sixty percent of all respondents indicated to have benefitted from corporate initiatives and showed appreciation for what they had been offered so far. Corporate WPHP measures, for instance, involved the provision of free fruits and vegetables (female, 22, hospitality), free health checks and vaccinations (female, 24, education), comfortable chairs and a pleasant office atmosphere (female, 39, IT industry), and gym classes/memberships either free of charge or at a reduced fee (female, 24, education).

When inquired about the relevance of WPHP measures related to a work–life balance, employees did not fail to express the importance of separating their private lives from their work lives. While respondents claimed it was definitely easier to keep the two areas apart for some industries (male, 32, hospitality; female, 42, service industry), personal efforts alone would not suffice but need to be complemented by corporate measures (male, 40, sales director). While employers only stepped up in selected cases, ensuring that e.g., employees were unable to access the work content from home (female, 39, IT industry), or even offering an employee some additional flexibility after he had become a parent (e.g., extra parental leave or home office time) (male, 28, engineering), similar corporate steps were also reported by a service industry worker, who reckoned: "They give you extra vacation up to two days a year so you can do good social things like helping in the kindergarten. They also give you an extra day for your birthday which you can use flexibly—meaning you have plus/minus a week to take it" (male, 47, service industry). An alternative would be appointing a deputy in chief, who then attends to matters (male, 53, banking). These incentives, however, do not present the norm yet. Overall, employees feel like there is room for improvement, stating that they would appreciate small steps, such as the opportunity of telecommuting (male, 28, engineering).

5. Discussion and Implications

Our study showed that employees attach a great importance to their health and confirmed that present-day conceptualizations of organizational health have to take shifting priorities on part of employees into account (see also, References [118,119]). These changes also correspond to the changes brought about by Work Culture 4.0 [120] and Work 4.0, respectively [121], which are not only conditioned but also enabled by digital technology. Our research again confirmed that ICT are a double-edged sword (see also, Reference [31]). Against the background of an increased workload and rising instances of workplace stress [5,6], our study showed that organizations have started to invest in workplace health promotion.

The study further confirmed that employers have begun to recognize the potential of the workplace as an environment, where individual health can be enhanced [81,93]. Several employees reported that the first steps towards a healthy leadership have already been taken in their company. As part of healthy leadership [23], managers' responsibility and capability in advancing organizational health by leading by example were confirmed by our study. Corporations cannot only encourage individuals to take a proactive role in their health, but through healthy leadership, they can also positively shape responses to their offerings and lead through their own behaviors, thus functioning as role models [90]. Several participants acknowledged that employers or executives in a leading position take on a role model function, as proposed by Morgenroth et al. [91].

Likewise, our study validated that social relations with other team members or employees hold a health-enhancing capacity. Referring to social capital theory, strong support from or social relations with leaders and other peer group members can increase individuals' feelings of support and empowerment [122]. Thereby, social support can take different forms, such as instrumental support (i.e., receiving help), emotional support, informational support (i.e., receiving advice and guidance), and appraisal support (i.e., receiving feedback [123]). Social support from within the organization thus presents an effective means to help buffer the negative effects associated with workplace stress [124]. As such, it becomes a valuable source to increase job performance, further fostering the development of a positive organizational climate [125,126].

As Bauer and Jenny [53,54] rightfully observed, the workplace as an environment, and individual health are reciprocally linked, as employee health is influenced by the organizational context, which, in turn, is influenced by employee health. Linking our study findings to the generic organizational health framework introduced by Bauer and Jenny [53,54], our results substantiate previous claims that organizations must take a holistic approach towards health, offering initiatives that involve employees, managers, and processes (work

and social), as well as the organizational environment altogether. Organizations should implement health-enhancing measures for employees, e.g., by prioritizing employee health and well-being and making it an integral part of their supportive organizational culture and supportive leadership [34]. Although our study showed that ergonomic measures that concern the workplace infrastructure, layout and design, agreeable work conditions and appropriate equipment are very important and appreciated by employees, it is even more important to help employees achieve a good work–family balance. Employers should thrive to reduce the burden posed on employees by redesigning work tasks and implementing more flexible solutions. The increasing workload and corresponding developments (e.g., burnout, stress, etc. [13]) compel organizations to not only prioritize their profits but, also, their employees' well-being and health. These calls are also in line with the United Nation's SDGs, which emphasize the need for organizations to invest in decent working conditions and have already been thematized by selected workplace theories. For instance, the quality of work life (QWL [127]) is used to describe employees' broader experiences of the workplace environment. It requires organizations to recognize that employees do have a life outside of work, further evoking them to optimize working conditions and contextual factors to improve employees' experiences of the workplace [128].

One striking result brought about by the present survey, however, was that one solution does not fit the requirements of an ever more diverse workforce; instead, individuals' needs and preferences have to be accounted for. As the workplace is undergoing some rapid changes, employees' motives are shifting too, which might be conditioned by the broader set of skills required in the digital workplace [129]. Hence, it is important to also involve employees in these far-reaching change processes [130]. In order for employers to tap into the pulse of time and thematize changing employee expectations in the workplace, employee concerns need to be determined in advance; if taken up and implemented in the form of comprehensive organizational measures, both employees and employers can have a mutually beneficial relationship in a supportive work environment [131].

This also suggests that employees' preferences and motives need to be evaluated against the background of changing lifestyles and values [119]. However. not only employees' wishes are undergoing some changes; likewise, organizational notions of human resources are subject to change. As already mentioned above, the "war for talent" conditioned a paradigm shift, emphasizing the need to attract qualified employees, develop them, and keep them in the company [32]. As good human resources are difficult to replace, they represent one of the rarest and most valuable resources of an organization [35] and are part of the organization's movement towards sustainability [33,36].

Based on our study findings, and in line with developments witnessed during COVID-19, flexibility and the option of remote work have been found to benefit employees tremendously in combining their private and personal lives. Amidst the turmoil brought about by the health crisis—and the consecutive labor disruptions—organizations have started to implement solutions that do not require employees to work in physical proximity. According to PwC [132], 83% of the US companies surveyed claim to have been successful in implementing remote work. Yet, employers are not convinced that remote work will present a permanent solution, as, in order to keep up a strong organizational culture, employees are expected to be present in the physical workplace. Nonetheless, remote work and hybrid workplace solutions are expected to be a permanent scenario in the future [133].

Right now, as our study with employees has demonstrated, employer concern for employee health and well-being is an add-on rather than a given; and while corporate efforts are slowly surfacing—and will presumably be intensified in response to COVID-19—steps towards a truly supportive organizational culture that is based on an understanding of employees' needs have to be taken more proactively. While notions of organizational health are subject to environmental conditions and, as such, likely to change [134], organizational health efforts need to be made a part of everyday organizational practices [135,136]. Our study confirms that employers have started to recognize the potential of the workplace as an environment, where individual health can be improved sustainably. Some have even

tapped into the concept of a healthy leadership, recognizing the possibility of mangers to "lead by example". The role of managers in ensuring individual health becomes even more crucial if organizational health measures are absent, as managers' commitment can positively effect employee satisfaction and engagement [34]. This supports the notion that, as leaders, they can serve as a role model [90], motivating employees to follow their example [92].

If organizations attempt to implement a "culture of health and well-being", which is supported by "the institutional, social and physical environment" [137], a more profound understanding of employees and their individual life situations is needed. Yet, results show that only a few companies have already implemented WPHP measures, if only to a certain degree. At present, companies are still more likely to delegate responsibility for employee health and well-being to their staff, having not fully realized the potential of healthy leadership, which puts individuals first. Overall, there is a great potential to increase WPHP measures on the employer side, through both healthy leadership and supporting WPHP measures.

6. Conclusions

Our study provided useful insights into employees' perceptions of who is responsible for their health, as well as insights into healthy leadership tendencies and WPHP measures, which have already been established by companies in Germany and Austria. Yet, there are several limitations to the study presented in this paper, which offer directions for future research.

Our study looked at employees' perspectives only; therefore, it would also be of interest to incorporate the employers' perspectives. It would be also interesting to extend the study to other countries and to compare the establishment of healthy leadership and WPHP measures in different countries. For example, a recent industry survey showed that most U.S. American companies claim to only invest in very basic health strategies, meaning they only offer healthcare benefits or health initiatives but do not really pursue a healthy leadership approach [10].

In addition, future researchers could take possible moderators into account, such as cultural differences. The GLOBE researchers House et al. [138] identified several leadership styles in different countries, and so, it would be interesting to analyze in which country a healthy leadership is already being used or also expected by employees. Likewise, it would be fruitful to uncover how healthy leadership can be combined with other leadership types, such as supportive leadership [139], virtuous leadership [34], ethical leadership [140], or relation-oriented or transformational leadership qualities [90]. The cultural dimension of individualism and collectivism [141] could also be an important moderator for employees' preferences regarding who assumes responsibility for their health. Besides cultural differences, individual differences could influence employee preferences and expectations regarding individual vs. organizational health efforts (e.g., health status, tenure with the company, internal locus of control, or personality traits such as neuroticism or a proactive personality; additionally, see Reference [4] for a discussion on the role of psychological capital in mitigating occupational stress).

Our study was conducted prior to the COVID-19 pandemic. As the pandemic is likely to increase economic and job uncertainty and, with it, has detrimental effects on employees' psychological well-being [142,143], another direction for future research would be to replicate our study once again in the present in order to analyze whether and how COVID-19 has impacted the healthy leadership and WPHP measures; when doing so, it would be worthwhile to also scrutinize employees' and employers' perceptions of the healthy organization.

For our study, we chose a qualitative approach. Future researchers might want to use additional methods, e.g., it would be interesting to conduct a quantitative survey or expert interviews with executives from different companies.

We asked participants about their perceptions of already established WPHP measures and also inquired desired measures; however, the results could not be explored in detail in this paper, as it would exceed the scope of our paper. A selected set of recommended measures, however, is reported in Table A1 in Appendix A.

Future researchers might also want to focus on sociodemographic factors, especially those that influence individuals' work–life balance such as gender, children in the household, or relationship status.

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Data Availability Statement: Interview data is available upon request.

Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

Table A1. Interview guideline with sample questions for each section (note: original items have been translated).

Survey—Sample Questions	
(1) Importance and Definition of Health	- What does health mean to you? - Who is responsible for your health?
(2) Health in the Workplace	- How can you influence or enhance your health in the workplace? - To which extent does your employer play a role in your health? - Does your employer consider your health?
(3) Workplace Health Promotion and Healthy Leadership	- Through new technologies individual stress at work has increased. How do you deal with these heightened stress levels? - Are there any health enhancing measures offered by your employer? - Does your employer (or direct supervisor) support you in dealing with stress in the workplace? If yes, how?
(4) Work–Life Balance	- How would you describe the relationship between your work and your private life? - What do you do to maintain a Work-Life-Balance (WLB)? - Does your employer support you in maintaining a WLB?

Table A2. Main themes and subthemes that emerged from the data analysis with sample quotes.

Individual vs. Organizational Health Efforts	
Individual efforts (90%)	- *"I am responsible for my health, I would say"* (male, 28, IT industry) - *"I am solely responsible for my health"* (female, 23, hospitality industry) - *"I pay a lot of attention to my health and try to improve it on multiple occasions"* (male, 28, IT industry) - *"Everyone is responsible for their own health"* (40, male, sales director) - *"You can easily improve your well-being because, nowadays, you have many opportunities to take care of yourself"* (female, 23, education)
Organizational efforts (10%)	- *"Mainly myself. But my environment can also be responsible for my health"* (male, 28, engineering)

Table A2. *Cont.*

Improving Health in the Workplace	
Personal Health Improvement in the Workplace	- *"As an individual I can improve my own health in the workplace . . . I have to make sure to take enough breaks, I eat frequently, when I 'm hungry, maybe not only do sedentary activities but walk around and take breaks. Or go outside for a bit"* (female, 24, education) - *"I can relax by getting up and moving around in-between work. Taking the steps instead of the elevator. And not to get stressed that much"* (male, 54, public service) - *"From time to time, we also have workshops or classes, where we are trained on different health topics at work. Like, how do I sit in front of the computer for 8 hours, or how can I practically strengthen my eyes' ability to concentrate".* (male, 54, public service) - *"From time to time there are certain events, where exercising is encouraged. [...] For example, the employees go and say: "Let's go up a few floors" or "Let's take some exercise. That's convenient."* (female, 31, public service) - *"As a balance for my everyday working life, I am trying to spend enough time in nature and to get enough sleep."* (male, 32, factory worker; male, 36, hospitality) - *"Some fresh air and short breaks help."* (male, 36, hospitality)
Corporate Health Programs	- *"Once a month, we have the opportunity to do a free health check, where you can check how fit you are, blood pressure and they give us small exercises depending to the job you are doing, for example for relaxation tips"* (male, 54, public service) - *"Yes, they offer vacancies and once a year there is another health check where they test your urine, your lungs, blood. For food they offer us a daily discount of five Euros in selected restaurants where they offer only freshly cooked meals. So, they help us eating healthy. In a gym near the company we can attend free courses for example for your posture."* (male, 22, hospitality; male, 22, IT industry) - *"There are always some offers, for instance skiing or hiking. That's also health-promoting, because sport is good for your body."* (male, 22, hospitality) - *"Yes, there is the 'Employees move employees' project, but also excursions or a gymnastics group. The menu plan for the cafeteria was developed with a dietician and there are always whole-grain products. Every Friday there is also a special juice for the employees, which is made from oranges, lemons and apples. So the company makes sure that the employees are healthy."* (female, 31, public service) - *"There is also a canteen inside the building which has been renovated recently. It is now not just for eating but also for relaxing during your breaks with areas which include couches. To stay social and mentally healthy you can for example go as a group to a homeless shelter and cook there."* (female, 31, public service)
Work–Life Balance—Forms	
Integration	- *"With the modern technologies, it is very hard to separate work from home"* (male, 47, service industry) - *"Home and work are more and more connected because with these new tools, like mobiles, where you get your emails, and it gets more complicated to really disconnect"* (male, 40, sales director) - *"You cannot escape it. Your work will influence your private life and your family will feel that you are not content and preoccupied with job-related matters"* (male, 53, banking) - *"I was called during an emergency during my honeymoon. So, as you can see, I am unable to separate the two areas"* (male, 28, engineering) - *"It's a relative broad balancing act between private life and professional life, since the company is always very present in the private sphere. One does additional tasks. But it is exactly the other way around as well: it is possible to organize and do private things in the workplace."* (male, 47, engineer) - *"Of course, it happens that I go for a drink with my work colleagues after work and that we talk about work. But I also think, yes, that's just part of it, because that's everyday life, work is part of your everyday life and you talk about it, too. Nevertheless, I'm distancing myself from it when I'm not at the office."* (male, 22, IT)
Adaptation	- *"At a certain level, [. . .] adjust your life around the company"* (male, 40, sales director) - *"It's a smooth transition. It was quite difficult to draw a line in the beginning, because you just go into the stores in a different way. So that's certainly the problem, that somehow you always know that you are in a market where an employee of yours works...."* (male, 47, sales director) - *"Until January, I actually worked from Monday to Friday, and my life has been sacrificed to the employer- no let's say my life belonged to my employer. And now, through teleworking, I have 2 days a week when I can do things for myself, when I have time for the family and that's very important for me."* (male, 54, public service)

Table A2. *Cont.*

Work–Life Balance—Forms		
Separation	-	*"It is very important for me to separate these two"* (male, 24, lawyer)
	-	*"You leave the office and only think about work when you come back the next morning"* (female, 39, IT industry)
	-	*"I got myself a private cell phone"* (male, 40, sales director)
	-	*"At first, I couldn't keep my work and private life separate, because I was doing a lot of work at home. But now I know, that if I go to the office, I do my job and if I go home, I don't do a lot of work at home, so it helps me, to keep it separate."* (female, 39, IT industry)
	-	*"I try not to work at home."* (female, 24, education)
Work–Life Balance—Responsibilities		
Personal Responsibility	-	*"It is definitely easier to keep the two areas of work and home apart for some industries"* (male, 32, hospitality; female, 42, service industry)
Corporate Measure	-	*"I am unable to access work content from home"* (female, 39, IT industry)
	-	*"My company supported me by granting me extra parental leave or home office time"* (male, 28, engineering)
	-	*"They give you extra vacation up to two days a year so you can do good social things like helping in the kindergarten. They also give you an extra day for your birthday which you can use flexibly – meaning you have plus/minus a week to take it"* (male, 47, service industry)
	-	*"My company appoints a deputy. When I'm gone, he/she is in charge to attend to matters"* (male, 53, banking)
Healthy Leadership		
Leader as a healthy role model	-	*"At my workplace, it is great. We have an own department that deals with health promotion and management. And there are many offers I can choose from, provided I take advantage of them"* (female, 24, education).
	-	*"My boss is one of those people, who puts a carafe of water on my table when I cannot get any. So, he most certainly takes care of his employees"* (female, 23, manufacturing).
	-	*"Our boss often joins us for a healthy meal"* (female, 30, manufacturing).
	-	*"The whole department attends gym classes together, and that also includes the top management"* (male, 28, sales)
	-	*"My superior offers weekly appointments where you can come to her with concerns, but you can also talk with her about stress and she helps us when she recognizes that we can't deal with the situation ourselves."* (female, 31, public service)
Leader shows no concern	-	*"In my company, health doesn't play any role"* (female, 28, service industry)
Workplace Health Promotion (WPHP)		
WPHP measures	-	*provision of free fruits and vegetables* (female, 22, hospitality)
	-	*free health checks and vaccinations* (female, 24, education)
	-	*comfortable chairs and a pleasant office atmosphere* (female, 39, IT industry)
	-	*gym classes/memberships either free of charge or at a reduced fee* (female, 24, education)
Potentials	-	*increased opportunity of telecommuting* (male, 28, engineering)
Appreciation for Measures	-	*"In my work, the offerings are great. We have health promotion management and there are many measures, which influence my health positively, provided that I take advantage of them"* (female, 31, public service)
Seeking Employee Feedback	-	*"We have certain benefits, for instance we have get a massage once a month. There is also a project on workplace stress. There is always an evaluation and the employee gets asked what stresses him the most and what is very good in his opinion"* (male, 54, public service)
Personal Initiative	-	*"My employer allows me or us to take part in health programs at any time, but only out of my own initiative"* (female, 31, public service)
Desirable measures	-	*"I would like to have the opportunity to build more back muscles, since I am sitting for a long time in front of the computer because of my work. And this sedentary position does not benefit my posture."* (female, 43, office manager)
	-	*"I think it would be enough if the working hours were changed and our schedule became more flexible."* (male, 22, health service)
	-	*"I think, if my employer would offer a timeframe for exercise, everyone can organize one's time, and promote health at the same time."* (male, 54, public service)

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How and When Job Crafting Relates to Employee Creativity: The Important Roles of Work Engagement and Perceived Work Group Status Diversity

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Abstract: Creative employees are treasured assets for organizations. However, relatively little is known about what specific actions employees can take to manage their own creative process. Taking a motivational perspective, this study examined how job crafting behaviors positively link to employee creative performance through work engagement, and whether perceived work group status diversity moderates this relationship. We conducted a weekly diary study in which 55 employees from a Chinese energy company were asked to fill in diaries over four consecutive weeks (176 observations in total). Results of the multilevel analyses showed that weekly job crafting behaviors were positively related to weekly creative performance through increasing weekly work engagement. In contrast to our expectation, we found that weekly job crafting behaviors were more positively related to weekly creative performance when perceived work group status diversity was high. In summary, our study suggests that job crafting behaviors are effective actions employees can take to manage their creative processes through increasing work engagement. In addition, we stress that status diversity in existing work environments is an important contextual factor that shapes the job crafting process.

Keywords: job crafting; work engagement; perceived work group member status diversity; creativity; diary study

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1. Introduction

For gaining competitive and sustainable advantages in today's dynamic business environment, creative employees are treasured assets for organizations [1,2]. To date, many studies have identified which personality traits and personal abilities could be associated with creative outcomes [3]. For example, research suggests that extrovert and flexible individuals tend to be more creative [4]. Employees with high growth needs and a learning orientation show higher levels of creative outcomes [5,6]. This literature also indicates that managers and organizations should build work environments that support employee creativity by setting creativity work goals, leading in a transformational manner, and rewarding employees when they achieve creative outcomes [5,7,8].

However, creativity is not only a matter of who is creative and how organizational contexts support employee creativity but also a matter of what actions employees themselves can take to enhance their creative process. It is surprising that relatively little is known about what specific actions employees actually take and how these actions contribute to creative performance. Although a limited number of studies identified some behavioral processes associated with creativity such as help/feedback-seeking behaviors [9,10], networking [11], and social learning [12], we recognize that these studies tended to take a resource- or information-based perspective. That is, these studies posit that individual help/feedback-seeking behaviors positively link to creativity through obtaining a broader base of resources and information [9,10]. However, few studies take a motivational perspective to understand the creative process. The question remains whether certain self-initiated

actions and strategies may enhance creative performance. This might be an important omission as research suggests that actions and strategies driven by one's intrinsic motivation are vital and beneficial to maintaining positive states at work and fostering work achievements [13,14].

Accordingly, this study proposes that job crafting, referring to the self-initiated changes employees make in their job demands and resources [15], may positively relate to employee creativity. The job crafting literature indicates that job crafting has significantly positive effects [1,16,17]. For example, job crafting is able to help employees to achieve goals, to take control, to find meaning in work, and to fulfil the need for connection [18]. Moreover, research shows that via job crafting, employees can experience positive emotions and reach an engaged state with vigor, dedication, and absorption at work [19,20]. Previous studies found that engaged employees are often intrinsically motivated to invest efforts to push work forward and come up with new ideas [21,22]. Therefore, we further propose that work engagement may be a motivational mediator transmitting job crafting behaviors into improved creative performance.

Nevertheless, the motivational process by which job crafting links to creativity may be contingent on certain conditions. In addition to personal conditions such as personality traits, capabilities, and/or personal resources [23], another important contextual factor is one's work environment. The reason is that work environments consist of different colleagues and supervisors with whom employees regularly interact. This may enable or restrict the opportunities for employees to see what paths are available in how they craft their jobs [24]. Nowadays, work environments are more diverse than they used to be [25]. It is found that the working employees of contemporary organizations not only have heterogeneous knowledge, skills, and functional backgrounds but also present different levels of social status, power, and influence [12,26,27]. Although previous literature recognized that work group functional/informational diversity can facilitate information elaboration and offers individuals a resource-rich environment [28,29], surprisingly, few studies considered that work environments may also contain members' social status differences, which may affect employees' job crafting processes. For example, in a status-diverse work group, most decisions and regulations may be set up by authority figures [30,31]. With less autonomy, employees likely are less motivated to modify their job boundaries and activate thought–action processes [32]. Given its importance, this study incorporated the important role of perceived member status diversity in work environments.

To summarize, our study aimed to investigate how job crafting behaviors positively relate to employee creativity through work engagement and to what extent perceived member status diversity affects this positive relationship. We conducted a weekly diary study to address these questions. Using a diary method, this study was able to capture whether the weekly fluctuation in job crafting is related to weekly fluctuations in creativity and work engagement. Our study aimed to contribute to the literature in two ways. First, we contributed to the creativity literature by underscoring that job crafting is a potent action strategy that employees can use to manage their creative process and to achieve creative outcomes. Using a weekly diary design, we advanced the understanding of how job crafting links to employee creative performance through work engagement on a weekly basis. We uncovered how work engagement serves as a motivational mediator transmitting the benefits of job crafting into improved creative achievements. Second, we highlighted a boundary condition of the job crafting–creativity relationship. This study took a workplace diversity lens and uncovered an important contingent factor—perceived work group member status diversity—and how it may influence employees' motivational processes. Our study thus provides a more nuanced insight into whether job crafting can be a successful strategy in a less favorable work environment.

2. Theory and Hypothesis Development

2.1. Job Crafting and Creativity

Creativity, in this study, refers to the generation of domain-specific, novel, and useful outcomes [6,8]. Therefore, we take creativity as a form of work outcomes at work, rather than a personality trait. We argue that job crafting strategy is positively related to employees' creative outcomes. Job crafting is defined as a behavioral process by which employees redesign their jobs in order to fit their abilities and preferences, thus enhancing personal outcomes [24]. Building upon the job demands-resources model and job crafting theory [24], job crafting involves several proactive behaviors including seeking resources, seeking challenges, reducing demands, and optimizing demands [33–35]. Via job crafting, employees deliberately seek job resources that facilitate work outcomes and/or optimize those job demands that make them feel exhausted and stressful. Job crafting can not only enlarge the pool of cognitive resources but also stimulate the need for personal growth [18]. For example, seeking resources that accord with employees' own needs can stimulate intrinsic as well as extrinsic motivation, which yields positive work outcomes [15,17,35]. Seeking challenges can foster mastery experiences, which in turn promote well-being and willingness to spend effort at work [17,35]. Optimizing demands, rather than simply reducing demands, leads to efficient work and a benefit with a secondary, self-serving gain (e.g., time) by using knowledge and skills to create and execute an alternative, more efficient path to that goal [33]. Therefore, it can be expected that job crafting motivates employees to invest efforts to push work forward and to come up with new ideas for improving work processes. Prior empirical studies and meta-analyses provide evidence of the link between job crafting and creativity [23,36]. For example, Demerouti and colleagues found that job crafting was positively related to employee creativity via increasing work engagement and flourishing [37]. Gordon and her team found that seeking resources was positively related to task performance and creativity [38]. Lin, Law, and Zhou found that job crafting was positively related to creativity and organizational citizenship behavior [39]. Taken together, we hypothesized that:

Hypothesis 1. *Job crafting is positively related to creativity.*

2.2. Work Engagement as A Mediating Mechanism

Previous studies tended to take social network or information exchange perspectives (i.e., a sociological perspective) to explain the mechanism of resource-seeking behaviors (e.g., job crafting) on work-related outcomes [10,40]. However, the understanding of the job crafting process may not be complete. The job crafting process is not only rooted in how different information is processed but also in how employees are intrinsically motivated to enact their jobs. Therefore, this study used a motivational processing perspective (i.e., a psychological perspective) to underpin the relationship between job crafting and creativity.

The motivational processing perspective is framed on the job demands-resources model and self-determination theory [41–43]. That is, job crafting can be seen as a motivational process by which employees proactively adjust their job resources and demands, which increases the likelihood that the workplace satisfies one's basic psychological needs (i.e., autonomy, competence, and relatedness) [44]. By being proactive, employees find motivating challenges and engage in effective problem solving, which enhances their engagement [45]. Moreover, the job demands-resources theory also posits that job resources play a key role in facilitating engagement because they can act as intrinsic or extrinsic motivators [46]. Hence, job crafting, as a bottom-up approach to mobilize resources, can be expected to facilitate work engagement. Empirical evidence showed that job crafting was positively related to work engagement and meaningful work [47], and daily job crafting is positively related to daily work engagement through momentary need satisfaction and momentary engagement [44,48]. Meta-analyses also confirmed that job crafting is a promising tool to stimulate work engagement [23,49].

Subsequently, work engagement can be expected to drive creativity. Work engagement refers to feelings of energy and enthusiasm about one's work and consists of three dimensions: vigor, dedication, and absorption [20]. Based on a motivational processing perspective, engaged employees are intrinsically motivated to pursue their goals [19], are flexible in their thinking, and invest considerable effort in their work [21,22,50]. Work engagement provides employees with intrinsic task motivation, which is a necessary component for reaching creative solutions [51]. That is, those who are engaged will be motivated to use the skills and expertise needed to perform creatively [21]. Additionally, engaged employees often experience positive emotions, which widen their momentary thought–action repertoire process and generate personal resources [19]. These positive emotions facilitate creativity by fostering the thirst for exploring and assimilating new information [52]. When employees reach a high level of work engagement, positive work-related outcomes can subsequently emerge. For example, Bakker and Xanthopoulou in a study of a school principals and teachers dyad reported a mediating role of work engagement in the job resources–creativity relationship [21]. Similarly, Demerouti and colleagues found a positive link between work engagement and supervisor rated creativity in a study among employees of various sectors in the Netherlands [37]. Further, in a study among eldercare nurses in Japan, Toyama and Mauno demonstrated that work engagement mediated the relationship between emotional intelligence and creativity [53]. Taken together, we hypothesized that:

Hypothesis 2. *Work engagement mediates the positive relationship between job crafting and creativity.*

2.3. The Moderating Role of Perceived Work Group Member Status Diversity

We further propose that it is also important to understand what conditions affect the relationship between job crafting and creativity. Research suggests that employees' work environments form an important contextual factor that affects the relationship between job crafting and creativity [23,49]. Work environments have become more diverse than they used to be [25]. Besides knowledge/informational diversity in work environments, we recognize that work environments also include status diversity in which members may present different social status, power, and privilege [29,54–56]. The level of perceived status diversity in the work environment may have consequences for the motivational process by which job crafting links to creativity. Hence, it is important to consider the context of perceived work group member status diversity.

Status diversity in work environments tends to be seen as an unfavorable condition [54]. The literature on work group diversity indicates work group member status diversity tends to imply the vertical differences among group members concerning decision-making authority, power, and pay [54]. Research suggests that marked differences in group member status diminished group performance by distracting members from key tasks and interrupting the flow of information [54]. Based on the job demands-resources theory, work environments characterized by a higher level of member status diversity tend to restrict access to critical job resources. The reason may be that some crucial resources such as challenging opportunities, supervisory feedback, prior experience, and high-quality relational networks are controlled by a limited number of high-status members. As a result, lower-status members may have difficulty in accessing crucial resources and may have less motivation to access job resources that are controlled by higher-ranking members [57,58]. Hence, we argue that perceived job crafting opportunities become less available when working in a highly status-diverse work environment, impeding the motivational process.

Besides the fewer perceived opportunities for job crafting, employees likely have less autonomy to modify their job requirements and to seek new resources to facilitate their work processes when working in highly status-diverse work environments [27,29,55]. This is because most decisions and regulations may be set up authoritatively [30,31]. With less autonomy, employees would be less motivated to think creatively and to activate thought–

action processes [32]. Hence, the relationship between job crafting and creativity may become weaker when employees perceive a highly status-diverse work environment. Prior studies and meta-analysis underscored the negative consequences of a status-diverse work environment such as job dissatisfaction, exhaustion, inequality, and resource-seeking barriers. Oedzes and his colleagues found that higher status-diverse work environment related negatively with team creativity when leaders exhibited little empowering behavior [59]. Similarly, Mullen, Johnson, and Salas demonstrated that individuals positioned at the lower levels of an informal hierarchy are often reluctant to share ideas and refrain from voicing their views in the presence of more influential authority figures [60]. Hence, we hypothesized that:

Hypothesis 3. *Perceived work group member status diversity weakens the positive relationship between job crafting and creativity, such that this relationship becomes weaker when perceived work group member status diversity is high (vs. low).*

Therefore, based on our proposed hypotheses, we frame a conceptual model for visualization (see Figure 1).

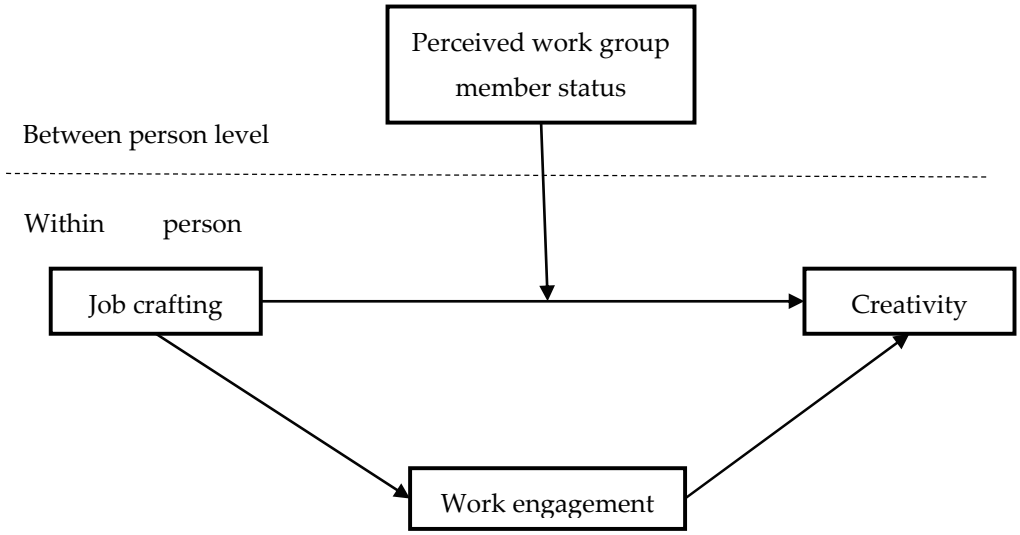


Figure 1. Conceptual model.

3. Methods

3.1. Procedure and Participants

This study used a weekly diary study design. Although data collection can be practically difficult, research shows that diary design with repeated measures has more methodological advantages than cross-sectional and multi-wave designs [61–63]. For example, diary methods are a useful method of capturing the short-term dynamics of experiences, feelings, and behaviors within and between individuals in the work context. Diary studies provide researchers with the opportunity of capturing "life as it is lived" [64] (p. 597). Furthermore, diary studies are less susceptible to retrospective bias [65], which is known to threaten the validity of general survey measures.

In this study, participants were required to complete a survey questionnaire every week for four weeks and a general questionnaire at the start. Participants were employees of a medium-sized Chinese energy company. The second author informed the employees that the research was a weekly survey over four consecutive working weeks. Participants volunteered to fill in the anonymous questionnaire. The first author sent out the online questionnaire link to participants each Thursday and inspected the accomplishments by the end of every Friday. Each participant had a personal identification code, which enabled us to link each weekly entry. Finally, 44 out of 53 participants (i.e., 176 usable responses) were

obtained, yielding an 83% response rate across weeks and individuals. We also conducted a power analysis to test whether 44 participants with repeated measures (i.e., 176 data points) had significant statistical power [66]. Results showed that repeated measures including examining within–between interactions in the equations should at least yield 36 sample size if statistical power is expected to be above 95%. This result was actually in line with the review article of Ohly and colleagues, indicating that sample size (person level) should be at least 30 to avoid biased estimates [61].

The final sample consisted of male (63.6%) and female (36.4%) participants. Their average age was 39.25 years, the standard deviation (SD) was 8.41, and average tenure was 13 years. A total of 41.5% of the respondents had a bachelor's degree or above.

3.2. Measures

The questionnaires were in Chinese, and we conducted back-translation to ensure their validity. Unless otherwise stated, all measures used a 5-point Likert scale (1 = strongly disagree, 5 = strongly agree). Among them, we measured job crafting behaviors, work engagement, and creativity (i.e., within-person variables) over four consecutive weeks; while we only measured perceived work group member status diversity (i.e., the between-person variable) once in the general questionnaire together with demographic information. The questionnaires are shown in Appendix A.

Weekly job crafting was measured with 14 items [33,34], including 6 items for seeking resources (e.g., This week, I asked colleagues for advice. Cronbach's alpha (α) ranged from 0.79 to 0.89 over four weeks), 3 items for seeking challenges following the scale validated by Petrou and colleagues [34] (e.g., This week, I asked for more responsibilities. α ranged from 0.79 to 0.93), and 5 items to measure optimizing demands using the scale of Demerouti and Peeters [33] (e.g., This week, I improved work processes/procedures to make my job easier. α ranged from 0.89 to 0.94).

Weekly creativity was measured with 4 items using the scale of Welbourne and colleagues [67]. An example item is "This week, I implemented new ideas during work". The Cronbach's alpha for each week ranged from 0.88 to 0.94.

Weekly work engagement was assessed with a 7-point Likert scale (1 = strongly disagree, 7 = strongly agree) [20]. We adapted the 3-item scale of Schaufeli and Bakker [20]. An example item is "This week, I felt bursting with energy." The Cronbach's alpha for each week ranged from 0.81 to 0.87.

Perceived work group member status diversity was defined as the vertical differences among group members concerning decision-making authority, power, and pay [54]. We used Harrison and Klein's (2007) measure. An example item is "Are there significant differences in socioeconomic status and power among group members?" [54].

Finally, we measured gender and tenure as control variables due to their interference influences [68,69].

3.3. Analytical Approach

To examine the mediating effect, a bias-corrected bootstrapping analysis is recommended [70]. As our data include two levels, person-level and week-level, we used the MLMED macro to examine within-level mediation and between-level mediation [71]. To examine the moderating effects, we used the MLwiN program to conduct a multilevel regression. All week-level variables were centered on the person-mean avoiding multicollinearity and spurious regression. We first established a null model including only the intercept. In model 1, we entered the two control variables gender and tenure. In model 2, the main effects were entered, i.e., the predictors including specific dimensions of job crafting separately. In model 3, we entered the two-way interactions, i.e., predictors and the moderator (i.e., perceived work group member status diversity). Because our predictors were within-person variables but the moderator a between-person variable, we conducted a cross-level moderation analysis. In our multilevel regression, random effects of the

slopes were examined. To test the improvement of each model over the previous one, the differences of its log-likelihood statistic $-2\times$log and its chi-square (χ^2) were computed.

4. Results

4.1. Preliminary Analysis

First, we conducted a multilevel confirmatory factor analysis (CFA) to analyze if the five indicators at the within-person level (i.e., weekly seeking job resources, weekly seeking job challenges, weekly optimizing job demands, weekly work engagement, and weekly creativity) were distinct constructs. Results of CFA with all five within-person level variables as separate constructs showed acceptable fit indices with χ^2 = 110.602 (with degree of freedom (df) as 67), comparative fit index (CFI) as 0.955, Tucker–Lewis index (TLI) as 0.939, standardized root mean square residual (SRMR) as 0.045, and root mean square error of approximation (RMSEA) as 0.062. These results indicated that the constructs are sufficiently distinct from one another. Moreover, this model was significantly better than the model collapsing seeking resources, seeking challenges, and optimizing demands into one factor (χ^2 = 336.075 (df = 74); CFI = 0.729; TLI = 0.667; SRMR = 0.126; RMSEA = 0.144; $\Delta\chi^2$ (7) = 225.473, $p < 0.001$).

Additionally, to justify the multi-level analysis, the intraclass correlation coefficient (ICC) was calculated, which examines the between-person and within-person variance components of the week-level constructs. The between-person variance of seeking resources, seeking challenges, optimizing demands, and creativity was 44.8%, 61.8%, 51.2%, and 35.8%. Thus, our variables varied both within and between persons, indicating that multilevel analysis was indeed appropriate.

Table 1 shows the descriptive statistics. Means, standard deviations, and correlations of each variable are summarized.

Table 1. Mean, SD, and within-level (below the diagonal) and between-level (above the diagonal) correlations of the study variables (N = 176).

Variable	Mean	S.D.	1	2	3	4	5	6	7	8
1.Work Engagement	4.648	1.247	1	0.589 **	0.600 **	0.595 **	0.522 **	−0.088	−0.107	−0.050
2.Creativity	3.608	0.765	0.529 **	1	0.563 **	0.671 **	0.572 **	−0.239 **	−0.294 **	−0.133
3.Seeking Resources	3.217	0.848	0.226 **	0.253 **	1	0.686 **	0.637 **	0.107	−0.052	−0.137
4.Seeking Challenges	2.947	1.003	0.573 **	0.483 **	0.243 **	1	0.481 **	−0.018	−0.268 **	−0.131
5.Optimizing Demands	3.697	0.865	0.509 **	0.429 **	0.199 **	0.534 **	1	0.100	−0.094	−0.206 **
6.Perceived work group member status diversity	3.590	1.054	−0.070	−0.175 *	0.078	−0.013	0.070	1	−0.065	−0.127
7.Gender	1.360	0.482	−0.085	−0.215 **	−0.038	−0.196 **	−0.065	−0.065	1	0.124
8.Tenure	12.800	10.005	−0.039	−0.097	−0.100	−0.096	−0.143	−0.127	0.124	1

**. Correlation is significant at the 0.01 level (2-tailed); *. Correlation is significant at the 0.05 level (2-tailed).

4.2. Hypothesis Testing

In testing H1, we found that weekly seeking challenges and weekly optimizing demands were positively related to weekly creativity (b = 0.201, $p < 0.01$; b = 0.234, $p < 0.01$) (see Model 2 in Tables 4 and 5). However, weekly seeking resources was not (b = −0.091, $p > 0.05$; b = −0.026, $p > 0.05$) (see Model 2 in Table 6). Hence, H1 was partially supported. The results indicated that weekly job crafting behaviors such as seeking challenges and optimizing demands were positively related to weekly creativity.

To test H2, we examined both within-person (i.e., week-level) mediation and between-person (i.e., person-level) mediation. For the week-level mediating effects of work engagement, we found b = −0.118, CI = [−0.204, −0.048] for seeking resources; b = 0.182, CI = [0.099, 0.279] for seeking challenges; and b = 0.175, CI = [0.092, 0.273] for optimizing demands (see Table 2). For the person-level mediating effects of work engagement, Table 3 shows that b = 0.201, CI = [0.049, 0.387] for seeking resources, b = 0.144, CI = [0.023, 0.293] for seeking challenges, and b = 0.189, CI = [0.055, 0.364] for optimizing demands. Results were statistically significant as the CI did not include zero. Thus, H2 was supported. Our results indicated that weekly job crafting behaviors were positively related to weekly creativity through increasing weekly work engagement. This mediating effect did not only exist within persons but also between persons.

Table 2. Results of the indirect effects of job crafting approaches on creativity through work engagement (within-level).

Variables → Mediator → Outcomes	Effect	SE	z	*p*	MCLL	MCUL
Seeking resources → work engagement → creativity	−0.118	0.041	−2.911	0.004	−0.204	−0.048
Seeking challenges → work engagement → creativity	0.182	0.046	3.962	0.000	0.099	0.279
Optimizing demands → work engagement → creativity	0.175	0.046	3.777	0.000	0.092	0.273

N = 176; unstandardized regression coefficients are reported; bootstrap sample size = 5000 bias corrected; LL = lower limit, UL = upper limit; significance level of confidence is at 95%.

Table 3. Results of the indirect effects of job crafting approaches on creativity through work engagement (between-level).

Variables → Mediator → Outcomes	Effect	SE	z	*p*	MCLL	MCUL
Seeking resources → work engagement → creativity	0.201	0.087	2.318	0.021	0.049	0.387
Seeking challenges → work engagement → creativity	0.144	0.069	2.097	0.036	0.023	0.293
Optimizing demands → work engagement → creativity	0.189	0.080	2.376	0.018	0.055	0.364

N = 176; unstandardized regression coefficients are reported; bootstrap sample size = 5000 bias corrected; LL = lower limit, UL = upper limit; significance level of confidence is at 95%.

Regarding H3, we found that the interaction between perceived work group member status diversity and weekly seeking challenges on weekly creativity was significant (b = 0.126; $p < 0.05$) (see Model 3 in Table 4). It was also significant for weekly optimizing demands (b = 0.143; $p < 0.05$) (see Table 5), but not significant for weekly seeking resources (b = −0.080; $p > 0.05$) (see Table 6). For the significant interactions between seeking challenges and optimizing demands approaches, we conducted simple slope analyses [72]. The simple slope analyses results showed that weekly seeking challenges and weekly optimizing demands were positively related to weekly creativity when perceived work group status diversity was high (b = 0.382, $p < 0.05$ for seeking challenges; b = 0.424; $p < 0.05$ for optimizing demands), while they were not significantly related to weekly creativity when perceived work group status diversity was low (b = 0.116, $p > 0.05$ for seeking challenges; b = 0.122; $p > 0.05$ for optimizing demands). As Figure 2a,b shows, weekly seeking challenges/optimizing demands was positively related to weekly creativity when perceived work group status was high. These results were in contrast with H3. Hence, H3 was not supported. Our results indicated that perceived status diversity strengthened the positive relationship between weekly job crafting behaviors and weekly creativity.

Table 4. Multilevel estimates of weekly seeking challenges, perceived work group member status diversity on weekly creativity.

	Model 1			Model 2			Model 3		
	Estimate	**SE**	**Sign**	**Estimate**	**SE**	**Sign**	**Estimate**	**SE**	**Sign**
Constant	4.124	0.252	**	4.124	0.252	**	4.083	0.24	**
Control only									
Gender	−0.327	0.168		−0.327	0.168		−0.285	0.159	
Tenure	−0.005	0.008		−0.005	0.008		−0.007	0.008	
Subjects									
Seeking challenges				0.201	0.064	**	0.249	0.074	**
Status diversity							−0.144	0.074	
Interactions									
Seeking challenges x status diversity							0.126	0.061	*
-2LL	369.432			359.871			346.915		
d.f.	2			1			2		
-2LL differences	4.426			9.561	*		12.956	*	
Individual level variance	0.193	0.061	**	0.199	0.061	**	0.187	0.056	**
Week level variance	0.358	0.044	**	0.333	0.041	**	0.292	0.040	**

**. Correlation is significant at the 0.01 level (2-tailed); *. Correlation is significant at the 0.05 level (2-tailed); N = 176 data points; "status diversity" refers to "perceived work group member status diversity"; "-2LL" refers to -2*loglikelihood.

Table 5. Multilevel estimates of weekly optimizing demands, perceived work group member status diversity on weekly creativity.

	Model 1			Model 2			Model 3		
	Estimate	**SE**	**Sign**	**Estimate**	**SE**	**Sign**	**Estimate**	**SE**	**Sign**
Constant	4.124	0.252	**	4.124	0.252	**	4.062	0.239	**
Control only									
Gender	−0.327	0.168		−0.327	0.168		−0.278	0.159	
Tenure	−0.005	0.008		−0.005	0.008		−0.006	0.008	
Subjects									
Optimizing demands				0.234	0.070	**	0.273	0.076	**
Status diversity							−0.142	0.074	
Interactions									
Optimizing demands x status diversity							0.143	0.059	*
-2LL	369.432			358.664			343.321		
d.f.	2			1			2		
-2LL differences	4.426			10.768	*		15.343	**	
Individual level variance	0.193	0.061	**	0.200	0.061	**	0.187	0.056	**
Week level variance	0.358	0.044	**	0.330	0.041	**	0.295	0.039	**

**. Correlation is significant at the 0.01 level (2-tailed); *. Correlation is significant at the 0.05 level (2-tailed); N = 176 data points; "status diversity" refers to "perceived work group member status diversity"; "-2LL" refers to -2*loglikelihood.

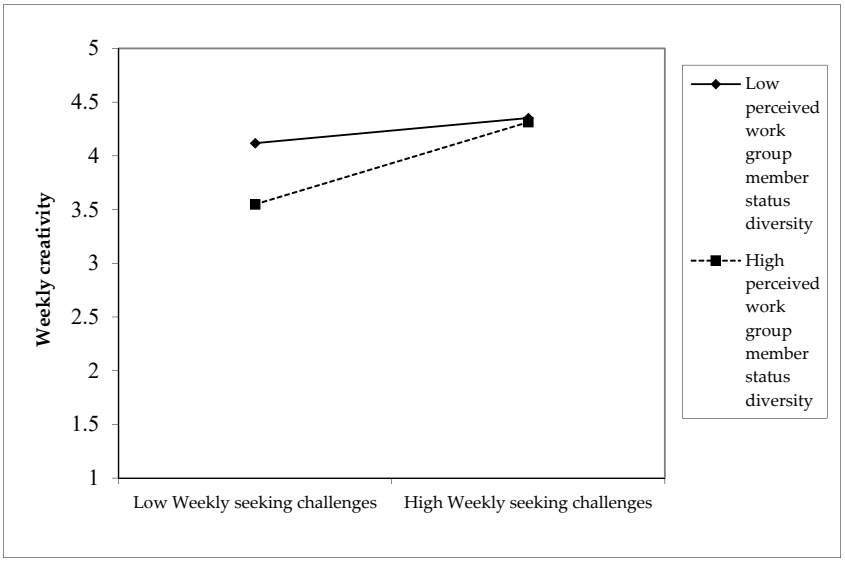
Table 6. Multilevel estimates of weekly seeking resources, perceived work group member status diversity on weekly creativity.

	Model 1			Model 2			Model 3		
	Estimate	**SE**	**Sign**	**Estimate**	**SE**	**Sign**	**Estimate**	**SE**	**Sign**
Constant	4.124	0.252	**	4.124	0.252	**	4.170	0.243	**
Control only									
Gender	−0.327	0.168		−0.327	0.168		−0.344	0.161	*
Tenure	−0.005	0.008		−0.005	0.008		−0.007	0.008	
Subjects									
Seeking resources				−0.091	0.077		−0.136	0.084	
Status diversity							−0.146	0.074	*

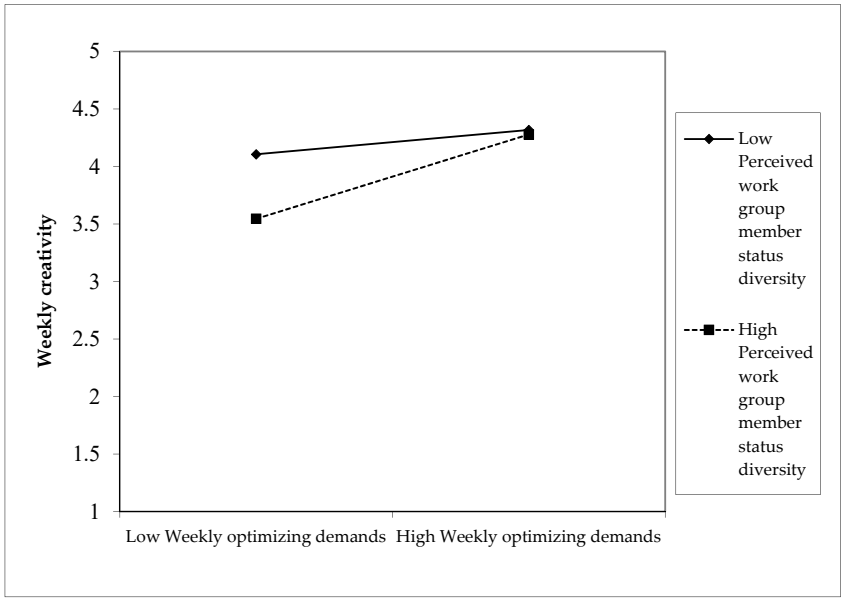
Table 6. *Cont.*

	Model 1			Model 2			Model 3		
	Estimate	**SE**	**Sign**	**Estimate**	**SE**	**Sign**	**Estimate**	**SE**	**Sign**
Interactions									
Seeking resources x status diversity							−0.080	0.059	
-2LL	369.432			368.057			362.462		
d.f.	2			1			2		
-2LL differences	4.426			1.375			5.595		
Individual level variance	0.193	0.061	**	0.194	0.061	*	0.172	0.056	**
Week level variance	0.358	0.044	**	0.355	0.044	**	0.350	0.043	**

**. Correlation is significant at the 0.01 level (2-tailed); *. Correlation is significant at the 0.05 level (2-tailed); N = 176 data points; "status diversity" refers to "perceived work group member status diversity"; "-2LL" refers to -2*loglikelihood.



(**a**)



(**b**)

Figure 2. (**a**) The interaction of perceived work group status diversity and weekly seeking challenges on weekly creativity, (**b**) the interaction of perceived work group status diversity and weekly optimizing demands on weekly creativity.

5. Discussion

In this study, we took a motivational processing perspective to advance the understanding of how and when job crafting behaviors positively relate to employee creativity. Our results showed that employees who engaged in weekly job crafting behaviors also reported more creative performance on a weekly basis. Moreover, weekly work engagement mediated this positive relationship. Surprisingly, we found that weekly job crafting behaviors were more positively related to weekly creative performance when perceived work group member status diversity was high. Taken together, our study suggests that job crafting is a potent way to sustain a higher level of creativity at work. Using a weekly diary design, we shed light on how job crafting is related to employee creative performance on a weekly basis. We stressed the mediating role of work engagement transmitting the benefits of job crafting into improved creative performance. We also added to the job crafting literature by uncovering an important contingency—perceived work group member status diversity. We provided an insight into a compensating effect of job crafting on creative outcomes when working in a status-diverse work environment.

5.1. Theoretical Contributions

This study mainly contributes to the literature in two ways. First of all, although prior studies uncovered factors affecting employees' creativity, most of them have focused on identifying the personality characteristics and traits associated with creative outcomes [4–6]. This study contributes to the creativity literature by taking a behavioral lens to examine the means (i.e., job crafting) that can enhance employees' creativity. Although researchers have proposed that various cognitive and behavioral processes occur in creativity [8], empirically, little is known about the specific strategies that employees use to manage their creative processes and how these strategies operate in the work context on a weekly basis. This study demonstrated that the job crafting strategies—seeking challenges and optimizing demands—were positively related to creativity. This study provides insights into how creativity can be improved by specific job redesign strategies.

This study established the mediating role of work engagement. Whereas prior studies took social network or information exchange perspectives to explain the mechanism of resource-seeking behaviors (e.g., job crafting) on work-related outcomes [10,40], we proposed a motivational perspective. Our results suggest that job crafting enables employees to become engaged in their work (i.e., vigor, dedication, and absorption), which, subsequently, facilitates thinking of novel solutions and performing creatively.

Second, this study further answers the question of under what conditions job crafting is more positively related to creativity. Although prior studies uncovered several important boundary conditions of job crafting such as personal traits and abilities, job autonomy, perceived organizational support, and organizational change context [35,73,74], this study took a workplace diversity lens to explore a contingency to job crafting. We examined perceived status diversity. Work group status diversity represents a vertical disparity in terms of decision-making authority, power, and pay [54]. A highly status-diverse work environment is often seen as an unfavorable work environment [57,58]. However, we found that weekly job crafting behaviors were more positively related to weekly creativity when perceived work group member status diversity was high, which was not in line with our hypothesis. Job crafting behaviors seem more beneficial to creative performance when employees work in an environment in which members' social status is highly disparate and power is distributed across their ranks. We argue that this reverse result can be attributed to a compensating effect of job crafting [23]. Job crafting is a bottom-up job redesign process by which employees proactively adjust their job resources and demands in order to restore fit between themselves and environments [24,35,75,76]. Hence, when work environments are not optimal for individual employees, they can adapt via job crafting (i.e., by seeking challenges and/or optimizing demands). Prior research suggested that the positive association between job crafting and work attachment would be stronger when employees experience tough times at work [77], and that job crafting can act as a strategy of employees

to respond to organizational change [35]. Our finding is in accordance with prior evidence supporting the role of job crafting in disadvantageous work conditions. Therefore, we contribute to the creativity and workplace diversity literature by uncovering the beneficial effect of job crafting on creativity when working in an unfavorable environment.

Notably, we also have an unexpected finding on the mediating effects of work engagement. We found that seeking resources was negatively related to work engagement, and further decreased creativity within weeks (i.e., on the week level) (see Table 2), but this relationship was positive on the person level. This finding implies that the seeking resources strategy is generally beneficial for employees' creativity through increasing work engagement, but seeking resources might produce detrimental effects within a short period of time. We think that this could be a case when employees seek resources that are not relevant to work tasks, or when employees need more time and energy to understand and use the resources, and thus may be distracted from their work goals [34]. Hence, when employees seek such resources, they may become less engaged during the work and in turn decrease the level of creativity.

5.2. Practical Implications

Our study also has several practical implications for organizations and management practitioners. First, we suggest that job crafting as a bottom-up job redesign strategy including seeking resources, seeking challenges, and optimizing demands is an effective approach to enhancing employees' work engagement and creativity. Moreover, job crafting behaviors play a more beneficial role when employees work in an unfavorable environment. Therefore, organizations and managers may want to empower employees to redesign their jobs and to adjust their job resources and demands. For example, emerging studies demonstrate that job crafting training and interventions are an effective tool to enhance employee job crafting behaviors [78,79].

Second, although our results showed that job crafting strategy is effective when employees work in a status-diverse work environment, the work group diversity literature still indicates that work environments characterized by hierarchies, status disparity, and authorities are not favorable for knowledge sharing, decision quality, collective performance, and individual well-being [54,57,58]. Hence, we suggest that organizations should attempt to create a relatively fair and inclusive work environment. Idea generation and implementation need favorable work environments [28,80].

5.3. Limitations and Future Research

Our study has potential limitations, which represent future research directions. First, all constructs in our study were self-reported, which may raise the question of whether common method bias may explain the results [17,78,81]. However, we used a diary study, and the literature indicates that common method bias is less likely to be a serious concern when interaction effects are observed [82] and when constructs are measured over time [83]. Second, although perceptions are important for understanding what people feel, think, and do, future research may include more objective indicators of proactive behaviors [84] and workplace diversity (e.g., a Gini index to measure work group status diversity) [85–87]. Third, we also hold concerns on the generalizability of our study. We collected data from an energy company in China, which represents a single industry and a single culture. Future studies are necessary to obtain confidence that our findings are generalizable to other industrial settings and other cultures. Last but not least, we suggest that future studies can look into team level creativity. Doing so can allow researchers to gain insights into how different employees interact and collaborate with one another and in turn enhance collective creative outcomes [88].

6. Conclusions

This study sheds light on how and under what conditions job crafting behaviors relate to employee creative performance. Using a weekly diary study design, our study

uncovered how job crafting positively links to creativity through work engagement on a weekly basis. Our study highlights an important contingency—perceived member status diversity in work environments—that affects the relationship between job crafting and creativity. Our study indicates that job crafting is a potent action to manage the creative process and can be a useful compensating strategy when working in a status-diverse work environment (i.e., when work environments are less favorable). Our study suggests that it is important for researchers and practitioners to pay more attention to the beneficial role of job crafting on a weekly basis and the context of member status diversity in existing work environments.

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Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The data are not publicly available due to privacy and ethical considerations.

Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

General Information

The questions in this section of the questionnaire concern your personal situation. Please write down your answer on the dotted line or check the box that represents the answer of your choice.

Q01	What is your age?	___years
Q02	What is your gender?	0 = Female 1 = Male
Q03	What is your highest education qualification?	1 = Vocational Training 2 = HO 3 = Bachelor's 4 = Master's 5 = PhD 6 = Other
Q04	What is your tenure in this company?	_____years
Q05	To what extent do you agree there are significant differences in socioeconomic status among group members?	1 = strongly disagree 2 = disagree 3 = neither disagree nor agree 4 = agree 5 = strongly agree

Weekly Questionnaire

Job Crafting						
In the following, we ask for your opinion about some questions of job crafting. Please circle the answer of your choice.						
Question number	To what extent do you agree or disagree with the following statements?	Never	Sometimes			Often
Week-level seeking resources						
Q01	I ask others for feedback on my job performance.	1	2	3	4	5
Q02	I ask colleagues for advice.	1	2	3	4	5
Q03	I ask my supervisor for advice.	1	2	3	4	5
Q04	I try to learn new things at work.	1	2	3	4	5
Q05	I contacted other people from work (e.g., colleagues, supervisors) to get the necessary information for completing my tasks.	1	2	3	4	5
Q06	When I have difficulties or problems at my work, I discuss them with people from my work environment.	1	2	3	4	5
Week-level seeking challenges						
Q07	I ask for more tasks if I finish my work.	1	2	3	4	5
Q08	I ask for more responsibilities.	1	2	3	4	5
Q09	I ask for more odd jobs.	1	2	3	4	5
Week-level optimizing demands						
Q10	I simplified work processes/procedures to make my job easier.	1	2	3	4	5
Q11	I thought of solutions in order to carry out work more easily.	1	2	3	4	5
Q12	I improved work processes/procedures to make my job easier.	1	2	3	4	5
Q13	I looked for ways to make my work more efficient.	1	2	3	4	5
Q14	I tried to change them when certain work processes/procedures slowed down.	1	2	3	4	5

Creativity/Innovation						
Considering all your job duties and responsibilities, how would your supervisor or manager rate your behaviors at work this week? Please circle the answer of your choice.						
Question number	**This Week, I . . .**	**Strongly Disagree**		**Agree**		**Strongly Agree**
Q15	Came up with new ideas	1	2	3	4	5
Q16	Worked to implement new ideas	1	2	3	4	5
Q17	Found improved ways to do things	1	2	3	4	5
Q18	Created better processes and routines	1	2	3	4	5

Work Engagement								
Think of this week; to what extent do you agree with the following statements?								
Question number	**This Week . . .**	**Strongly Disagree**			**Agree**			**Strongly Agree**
Week-Level Vigor								
Q19	I felt bursting with energy.	1	2	3	4	5	6	7
Q20	My job inspired me.	1	2	3	4	5	6	7
Q21	I got carried away when I was working.	1	2	3	4	5	6	7

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Article

How and When Does Psychological Wellbeing Contribute to Proactive Performance? The Role of Social Resources and Job Characteristics

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Abstract: Are psychologically healthy employees more proactive at work? Surprisingly, responses to this question are lacking as empirical research has overlooked the wellbeing–proactive performance relationship. Drawing insights from the conservation of resources theory and the motivational fit perspective, this study proposes that leader-member exchange and team-member exchange act as social resources that convey the benefits of psychological wellbeing to subsequent proactive performance. Moreover, job complexity and task interdependence—two job characteristics that enhance the motivational potential of social resources—are expected to amplify these positive indirect relationships. Data from a three-wave, time-lagged study conducted among employees (N = 318) from French-Canadian organizations were used to test our hypothesized model. The results indicated that leader-member exchange mediated a positive relationship between wellbeing and proactive performance and that the contribution of wellbeing to proactive performance via leader-member exchange was increased when job complexity was higher. We also found a negative indirect relationship between wellbeing and proactive performance via team-member exchange when team interdependence was lower. Theoretical and practical implications of this research are discussed.

Keywords: psychological wellbeing; proactive performance; leader-member exchange; team-member exchange; job characteristics

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1. Introduction

The relationship between employee wellbeing—a psychological state reflecting a positive experience at work [1,2]—and work performance fascinates organizations [3,4] and researchers [5–9]. Over the years, this relationship has been investigated through various analytical perspectives and operationalizations of performance [9,10]. Yet, surprisingly, prior research has neglected proactive individual performance, a set of self-initiated, future-focused behaviors oriented toward improving work efficacy [11,12]. In this research, we focus on the contribution of psychological wellbeing at work, defined as a domain-specific, psychological gestalt resulting from individuals' positive evaluations of and affective reactions to their work [9]. Essentially a work-related experience rather than an assessment of one's physical health [1], this conceptualization captures how people feel psychologically fulfilled at their job [13], as indicated by their overall level of serenity, harmony and involvement feelings.

Examining the psychological wellbeing–proactive performance relationship is an important issue because proactive behaviors represent a sine qua non condition for enhancing individual and organizational effectiveness in today's uncertain environment [14]. As the successful enactment of proactive behaviors requires energy and a significant amount of resources, psychological wellbeing appears as a major driver that provides the necessary

energy enabling the individual to acquire more specific resources supporting proactive behaviors in the face of work challenges [12,15,16]. In that sense, psychological wellbeing can be considered as an energizing resource for proactive performance [17].

The literature linking psychological wellbeing to performance has reported small and variable effects for wellbeing [4,7,9]. This suggests that intervening variables (e.g., mediators and moderators) may come into play for elucidating how and when psychological wellbeing can result in a higher level of proactive performance. Along that line, the current study aims to investigate the mediating role of social exchanges with supervisors and coworkers as mechanisms through which employees who feel well at work access the social resources needed to improve their proactive work performance [18,19].

Furthermore, the wellbeing literature suggests that different situational features can moderate the relationship between employee wellbeing and performance in general [9,10]. However, the scope of these findings is limited because previous research has not addressed the "social processes" through which wellbeing is expected to influence performance. The effect of social resources, such as having developed constructive social exchanges with supervisors or coworkers, would then depend on employees' job characteristics (e.g., job complexity, social embeddedness/coordination requirements). To the best of our knowledge, such a model (i.e., a moderated mediation model) has been scarcely examined. Exploring such a model would help identify the role of social resources and the associated boundary conditions linking psychological wellbeing to proactive performance. In addition, social processes are considered important in the proactive behavior literature but are controversial [20,21]. Constructive social exchange relationships offer a large pool of resources that help employees engage in proactive endeavors, yet some of these resources (e.g., instrumental or emotional support) may not always be relevant for the accomplishment of one's job or can come with some restrictive forces for change brought by social cohesion [22,23]. This is a potential explanation for why social exchanges with supervisors and coworkers had weak and inconsistent relations with proactive performance in Cai et al.'s review [20]. The authors suggested that the value of social processes for the enactment of proactive performance is influenced by moderators.

Taken together, the arguments developed in the wellbeing literature and in the proactive behavior literature highlight the value of integrating social exchange processes and situational characteristics to uncover the mechanisms and boundary conditions that influence the strength of the relationship between psychological wellbeing and proactive performance. However, few theoretical perspectives currently exist to support these claims. Accordingly, to address this important yet overlooked issue, this study integrates two theoretical frameworks, namely the conservation of resources (COR) theory [17] and the motivational fit perspective [24], to propose and test the moderated mediation model of wellbeing and proactive performance (Figure 1). This model posits that psychological wellbeing boosts proactive performance by enabling employees to invest their resources in high-quality social exchanges with supervisors—i.e., leader-member exchange (LMX)—and coworkers—i.e., team-member exchange (TMX). Hence, the relationship between psychological wellbeing and proactive performance would be mediated by LMX and TMX (see Appendix A). Moreover, we propose that the contribution of psychological wellbeing to proactive performance through LMX and TMX would depend on two job characteristics: job complexity and task interdependence, respectively. The development of high-quality social exchange with the leader would be of higher value when the employee has a complex job, while investment in positive exchanges with coworkers would facilitate proactive performance mostly when there is task interdependence among coworkers.

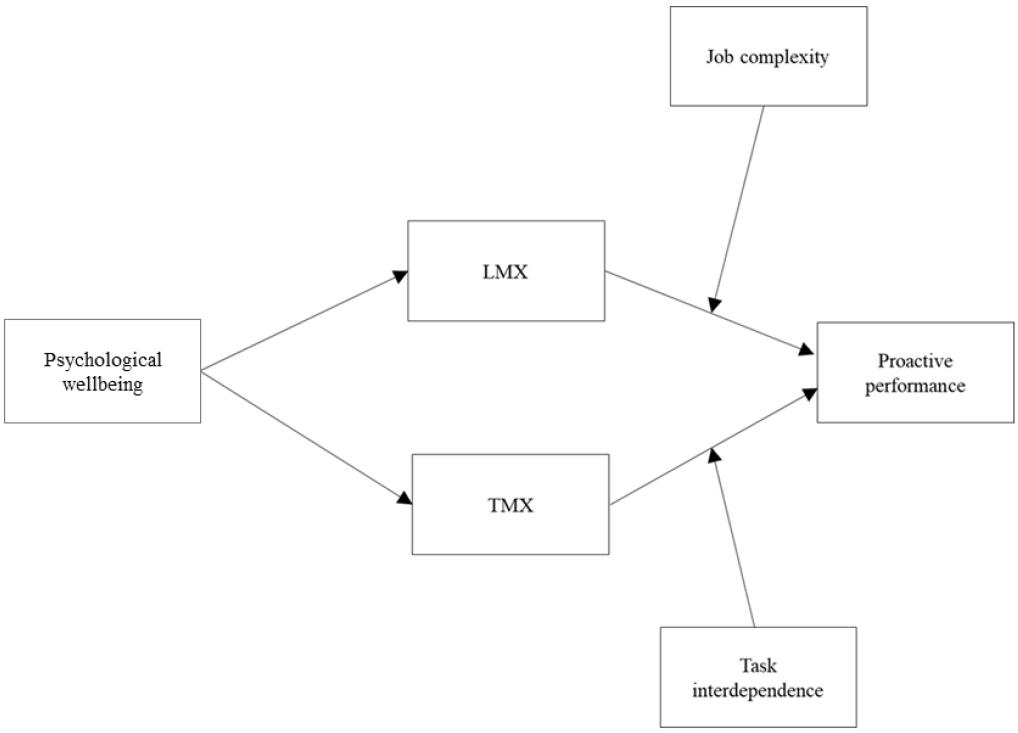

Figure 1. Conceptual model. LMX = leader-member exchange; TMX = team-member exchange.

The present study intends to contribute to the literature in three important ways. First, we examine a more complex perspective of how psychological wellbeing relates to proactive performance (i.e., through mediated moderation relationships) than is previously carried out in the literature. This approach is essential to address the lack of consistency in the strength of the relationship between employee wellbeing and performance as reported in previous studies, and thus provides a more accurate picture of how individuals experiencing wellbeing can achieve their proactive potential. Second, by identifying LMX and TMX as mediators, our study addresses the need for identifying the social exchange mechanisms that connect employee wellbeing to performance [9] and highlight the role of the social pathways through which psychological wellbeing fosters proactive performance [20]. Third, by assessing the moderating role of job complexity and task interdependence, our study extends the wellbeing and proactivity literatures, which have overlooked the conditions that alter the effects of employee wellbeing and social exchange processes on proactive performance [4,20]. This way, our study brings to light that the characteristics of jobs matter in determining the extent to which psychologically healthy individuals involved in high quality social exchanges can behave proactively to improve individual and organizational outcomes.

1.1. Mediating Role of Social Exchange Processes: The COR Perspective

Through the lens of the COR theory, psychological wellbeing can be considered as a resource [25]. The main proposition of the COR theory is that individuals strive to protect their resources and make resource investments enabling them to secure valued resources or to gain additional resources [17,26]. As such, wellbeing at work is a valued resource for employees. It is valued for intrinsic reasons (e.g., pleasure) [27] as well as for giving instrumental capacities (e.g., flexibility, openness) to pursue actions in a given context [28–30]. According to the COR theory, wellbeing at work is a personal resource that enables resource investments and resource acquisition to optimize one's adjustment and performance [31]. This process of resource acquisition can be fulfilled through developing functional interpersonal relationships at work.

Indeed, the COR theory argues that the acquisition of social resources is sought after by people to perform effectively in their work context [32]. The theory proposes that resource acquisition is easier when people already possess a substantial level of resources. Higher levels of resources, such as psychological wellbeing, would place people in a resource gain perspective [32]. Employees with a higher level of wellbeing would be more confident and open with others, interact more frequently with them, and be more inclined to achieve satisfactory social relationships [1,2,4,18]. Feeling serene, socially fitting and involved in their work, psychologically healthy individuals would be better able to see the resources available from others as well as the benefits of further developing a positive social context to continue to obtain resources in the future. This would be achieved because they would be more self-congruent and in line with their work environment [33,34]. In contrast, when people possess fewer resources, they would focus on resource protection instead of resource investment. Individuals experiencing a low level of wellbeing may be susceptible to a resource loss spiral, as they may tend, for instance, to act in a more defensive way with others, to isolate themselves, and to limit their investments to preserve their current (and limited) resources [35,36]. Accordingly, we posit that wellbeing is a personal resource that supports the development of social resources at work, as captured by LMX and TMX constructs.

According to Graen and Uhl-Bien [37], LMX refers to the quality of the relationship between an employee and the supervisor. High LMX is characterized by mutual trust, open exchange of information, and mutual support. Similarly, TMX is defined as the quality of exchanges between an employee and coworkers, including the reciprocal exchange of ideas, honest feedback, and mutual assistance [38]. From a COR theory perspective, LMX and TMX are meaningful social resources because they represent general resources that are useful to work adjustment rather than specific resources to achieve a particular goal. These general resources are relevant when it is not possible to forecast the specific situational requirements or the behaviors that are necessary for meeting such requirements. Proactive performance typically emerges in this type of context [11]. Indeed, the change-related (i.e., uncertain) nature of such behaviors prevents employees from knowing in advance all potential setbacks they could face and the specific resources they need to take proactive initiatives. Employees feeling well at work can invest in the development of these general resources, which could eventually be mobilized to obtain the specific supports needed for enacting their proactive endeavors. This investment strategy is consistent with the COR theory tenets suggesting that individuals orient their efforts to stay well-adjusted to their environment and to leave their behavioral options open to meet the different types of challenges that arise.

The role of social resources in the accomplishment of proactive performance has recently gained attention because "to affect the environment and initiate changes, employees need to seek support from, cooperate with, and build allies with others [20] p. 209". Indeed, social interactions (e.g., networking) and proactive behaviors are linked [39]. These social interactions can involve the supervisor, coworkers, or more distal organizational representatives. Yet, because supervisors and coworkers are more accessible [40], it is easier for employees to develop exchange relationships with them to constitute ongoing resources. As such, LMX and TMX are general resources reflecting functional vertical (e.g., LMX) and horizontal (e.g., TMX) exchange relationships that can be leveraged for enacting proactive performance. While interactions between LMX and TMX have been found to predict performance in teams [41], our research model assumes that different resources (i.e., that are not completely interchangeable) are available through LMX and TMX. Therefore, these mechanisms are complementary rather than compensatory and their effects are expected to be influenced by specific boundary conditions.

LMX as Mediator. Developing positive exchange relationships with one's supervisor is instrumental to performance [42]. According to meta-analyses, LMX is positively related to various performance outcomes including task performance and citizenship behavior [43,44]. Similarly, Chiaburu et al. [45] found LMX to be positively related to

proactive performance. These authors suggested that LMX provides a supportive context that fosters employees' willingness to be proactive. Indeed, proactive behaviors can be enacted while performing one's work role creatively [46]. These behaviors, disruptive of the status quo, can be considered as risky as their success is not guaranteed. The supervisor can have a unique role, owing to his or her formal authority, by promoting a supportive context for employees who engage in proactive initiatives. Indeed, supervisors have more power than coworkers to make decisions, reward certain behaviors, and support employee initiatives [47,48]. LMX relationships are therefore important for employees given the required efforts and potential drawbacks entailed in the proactive process.

Employees need personal resources to be able to figure out how new ways of doing things can be implemented. Studies by Fredrickson [49] indicate that positive feelings, those typically accompanying wellbeing, can facilitate creative thinking. To move from envisioning new ways of doing things to the emission of proactive behaviors, commitment and support from supervisors are crucial [20,50]. Quality relationships with supervisors as fostered by higher employee wellbeing would increase the receptivity of supervisors to proactive behaviors. Employees would feel more secure to propose innovations when they feel the supervisor provides tangible support [51]. High LMX also means that employees may obtain feedback from the supervisor when their initiatives fail and there is a need to take corrective actions [52]. Research by Li et al. [53] indicates that high-quality interactions with supervisors explain why people predisposed to proactivity are more inclined to engage in proactive behaviors. In sum, although LMX does not always have positive implications for performance [22], previous research suggests that LMX can act as a social resource that facilitates the enactment of proactive performance.

Although LMX has not been considered as a mediator between psychological well-being and proactive performance in previous research, indirect support can be found for this relationship. For example, a cross-lagged study [54] indicated that employees' positive feelings at work facilitated the development of LMX three months later. Further, LMX has been found to mediate the relationship between subordinates' positive feelings and various performance outcomes [43]. According to Martin et al.'s meta-analysis [42], trust in supervisors' support is the key mechanism linking LMX to extra-role behaviors such as proactive performance. Thus, the following hypothesis is proposed (Hypothesis 1).

Hypothesis 1 *LMX will mediate a positive relationship between psychological wellbeing and proactive performance.*

TMX as Mediator. Horizontal relationships complement vertical relationships in facilitating proactive performance. Coworkers may offer socio-emotional and informational resources that are useful to proactive behaviors [20,55,56]. Indeed, Vough et al. [21] noted that individuals interact with and rely on others in many ways to accomplish their proactive goals, suggesting that interpersonal interactions may facilitate proactive performance. First, exchange relationships with coworkers provide different perspectives that facilitate the generation of new ideas [57], which can fuel the process of envisioning proactive behaviors to improve the work context [50]. Coworkers could further provide a sounding board to test new ideas before voicing them more formally. Getting access to support from coworkers is a key enabler to promote new ideas in a work context, especially if other members of the group are expected to be impacted by the proposed changes [21]. It gives a security base that motivates people to implement their ideas despite obstacles and pursue their efforts even when conflicts arise [23,58]. High-quality relationships with coworkers also lend credibility that proactive behaviors are performed for the common good [59]. Thus, TMX can make coworkers open to proactive behaviors from others in the group. Gong et al.'s study [60] found that the quality of information exchanges and trust in the social environment were key to explain why proactive minded employees displayed proactive behaviors. Therefore, in accordance with the COR theory, many resources can be expected to be developed in a context where psychologically healthy workers develop a high quality TMX. These resources would energize proactive behaviors.

Although TMX has not been studied as a mediator between psychological wellbeing and proactive performance, some studies on social support, where coworkers were involved [35,61], have documented the social mechanisms intervening between wellbeing and performance. Daniels and Guppy [35] found that accountants with higher contentment at work were more likely to receive subsequent help and support. Further, Tsai et al. [61] found in two samples of sales agents that people with a positive mood were more likely to help others and to subsequently receive help from them in return; these positive relationships with coworkers in turn predicted higher persistence in work behaviors and higher performance. Thus, the following hypothesis is proposed (Hypothesis 2).

Hypothesis 2 *LMX will mediate a positive relationship between psychological wellbeing and proactive performance.*

1.2. Moderating Role of Job Characteristics: The Motivational Fit Perspective

The motivational fit perspective [24] provides insights that help understand how boundary conditions can alter the contribution of LMX and TMX in the psychological wellbeing–proactive performance relation. This framework suggests that the factors that prompt individuals to engage in a given behavior are unlikely to release their motivational potential unless the situation allows for their expression [62,63]. Cai et al. [20] applied the motivational fit perspective to proactivity and suggested that when the social processes do not fit the characteristics of the job, its influence on proactive behavior is reduced. In support of this idea, a few studies found social processes to interact with job characteristics to predict proactivity. For example, Leung et al. [64] showed that when perceived support for innovation was high, role conflict was positively related to innovative performance. Similarly, Volmer et al. [65] found that high levels of job autonomy enhanced the benefits of LMX for employee involvement in developing new ideas.

Based on the above premises, we argue that the motivational fit perspective can be integrated with the COR theory to determine the boundary conditions for the wellbeing–social resources–proactive performance relations. Indeed, the COR theory can be viewed as a motivational theory that explains how employees build resources through social investments and, thereby, improve their functioning [25]. The motivational fit perspective would suggest that the relationship between social investments and proactive behavior is stronger when there is a fit between the work situation and the motivational potential underlying social investments. As such, this perspective complements the COR theory by disclosing the boundaries upon which the COR-based predictions on the consequences of the resource building process are most applicable. Job complexity and task interdependence are job characteristics that can align the work situation with the motivational potential of LMX and TMX, respectively, and moderate their effects on proactive performance. We discuss these ideas in the next sections.

Job Complexity as a Moderator of LMX. While LMX is a general asset for work performance, it is particularly relevant in complex jobs, where few generic solutions are available to accomplish tasks involving uncertainty [66,67]. Job complexity and autonomy have both been identified as situational characteristics that can strengthen the link between employee wellbeing and performance [9]. While these characteristics often coexist in the real world, they capture different realities. According to Morgeson and Humphrey's model [67], complexity is a "knowledge demand" while autonomy is a basic "motivational" characteristic of jobs. We selected the former in our model because it raises the demand for (i.e., reason to) performing proactive behaviors in a job [12]. Further, compared to job autonomy, job complexity is a job requirement that is less dependent on the quality of the relationship with the supervisor [37], making the motivating potential of this job characteristic distinguishable from the motivating potential of LMX.

LMX may be helpful for performing proactive behaviors when tasks are complex, involving intensive knowledge work. In these jobs, proactive behaviors are needed to accomplish work duties because solutions are less readily available [68]. Typically, the ex-

tensive knowledge needed in complex jobs means that employee–supervisor relationships must be personalized. Therefore, high-LMX employees may benefit from individualized interactions that help explore new ideas and identify those specific resources needed to implement them. Likewise, they would have access to continued feedback to adjust their proactive endeavor in order to be successful [51]. As a result, they would be more motivated to expand efforts in initiating change-oriented actions aimed at improving the work context. In contrast, when tasks are simpler, proactive behaviors are less required for achieving performance goals [68]. Further, less extensive support is required from supervisors for assisting employees with the demands of jobs with low complexity. For example, Scott and Bruce [69] found that LMX was more predictive of innovative behavior in complex jobs (e.g., engineering and scientists vs. technicians). In sum, strong, rather than weak, levels of job complexity would make the work situation congruent with LMX, thereby optimizing the motivational power of this social resource in enhancing proactive performance. Accordingly, we hypothesize the following (Hypothesis 3):

Hypothesis 3 *Job complexity will moderate the positive relationship between LMX and proactive performance such that this relationship will be stronger (vs. weaker) when job complexity is higher (vs. lower).*

Task Interdependence as a Moderator of TMX. As argued by Srivastava and Singh [56], "the importance of team-member exchange quality is greater in work situations in which success is contingent upon strong social exchange relationships between team members" [p. 2]. On one hand, perceived embeddedness in a group has been identified as a boundary condition of the collective wellbeing–performance relationship [70]. Further, Chiaburu and Harrison's meta-analysis [71] indicated that the correlation between co-worker support and performance is stronger when the job is socially intense (i.e., extent to which cooperation among co-workers is required). One way to capture this phenomenon is via task interdependence. Task interdependence refers to the degree to which an employee must share resources (e.g., material, information, or expertise) with coworkers to achieve expected performance [72]. High levels of interdependence mean more opportunities to collaborate with and influence others and to facilitate the performance of others in the group.

TMX implies that an individual has access to supportive resources from coworkers (e.g., information, emotional support). However, support from coworkers may not always be relevant for bringing improvements in job performance, particularly if coworkers do not sufficiently understand the work context and the job mission of the focal employee. This could lead to suboptimal strategies to tackle the challenge at hand that may distract the employee with thoughts that are not useful for pursuing proactive efforts. Further, as discussed earlier, these supportive resources can sometimes come with disadvantages (e.g., social forces limiting change-oriented behaviors) that undermine proactive performance.

We propose that high levels of task interdependence can make the resources offered by coworkers (e.g., TMX) more relevant to proactively implement new ideas at work. In jobs with interdependent tasks, employees would benefit more from coworkers' support to implement their ideas because coworkers may use their own experience and knowledge to provide useful and contextualized resources to assist others. Further, in a highly interdependent environment, coworkers would develop a cohesion around the mission and tasks to perform rather than staying focused on the maintenance of supportive relationships. In the context of interdependent tasks, collaboration and cohesion within a group (i.e., the motivating potential of TMX) would lead to more initiatives and creative performance [19]. In contrast, in jobs with low task interdependence, TMX may be less instrumental to performance outcomes as coworkers are less familiar with each other's work. Being less knowledgeable about others' jobs, these coworkers could offer advice that is not applicable or relevant for the employee pursuing proactive efforts. Finally, the development of supportive relationships in the context of a low task interdependence could orient group members towards meeting individuals' emotional needs. In such situations, a high TMX could be associated with some restrictive forces toward changes to preserve the group's

supportive role. Thus, TMX would not be favorable to proactive behaviors in a context of low task interdependence. In sum, high TMX is more likely to manifest its motivational potential for enhancing proactive behavior among employees with task-interdependent jobs. Therefore, we hypothesize the following:

Hypothesis 4 *Task interdependence will moderate the positive relationship between TMX and proactive performance such that this relationship will be stronger (vs. weaker) when TMX is higher (vs. lower).*

1.3. Overall Moderated Mediation Model

So far, we have predicted that psychological wellbeing relates positively to proactive performance via LMX and TMX (Hypotheses 1 and 2). In addition, we have proposed that job complexity (Hypothesis 3) and task interdependence (Hypothesis 4) moderate the LMX–proactive performance and TMX–proactive performance relationships, respectively. Combining the mediating roles of LMX and TMX and the moderating roles of job complexity and task interdependence results in a moderated mediation model [73,74]. The indirect relationships between psychological wellbeing and proactive performance via LMX and TMX should be stronger when job complexity and task interdependence are higher. Wellbeing would foster LMX, which would be more instrumental to support proactive behaviors when workers have complex jobs. Likewise, wellbeing would enable TMX, which would be more instrumental for engaging in proactive endeavors when tasks are interdependent. These predictions are summarized in the following hypotheses (Hypotheses 5 and 6).

Hypothesis 5 *Job complexity will moderate the positive indirect relationship between psychological wellbeing and proactive performance via LMX such that this indirect relationship will be stronger (vs. weaker) when job complexity is higher (vs. lower).*

Hypothesis 6 *Task interdependence will moderate the positive indirect relationship between psychological wellbeing and proactive performance via TMX such that this indirect relationship will be stronger (vs. weaker) when task interdependence is higher (vs. lower).*

2. Materials and Methods

2.1. Participants and Procedure

Participants were recruited from 16 organizations located in the Quebec province, Canada. Cold calls were made to organizations listed in the provincial directory of knowledge-based organizations and to secondary references following these calls until we reached the target of a thousand potential participants for our multi-wave research project. Organizations' representatives were contacted by the researchers and agreed to participate in a research project on employee wellbeing, performance and innovation. Organizations were operating in a variety of industries, including engineering, architecture, insurance, legal services, human resources, and aeronautics. The study involved three waves of data collection between 2015 and 2018. A time-lagged design was used where psychological wellbeing and control variables were measured at Time 1, LMX and TMX were measured at Time 2, and proactive performance was measured at Time 3 through supervisor reports. A time lag of three months between measurements was used, which provided enough time for temporal effects to be observed between wellbeing and the mediators, and between the mediators and proactive performance. The overall time span of six months can be considered optimal for detecting relationships between attitudes and behavior, while effects tend to decline over longer periods of time [75,76]. All measures were collected during work hours with online questionnaires using a Secure Sockets Layer protocol (hosted by Survey Monkey). Participants were presented with the study objectives, the ethical guidelines, and means available to obtain additional information. After providing their consent to participate, they accessed the survey through a personalized link provided in the email

invitation. This link allowed the identification of the participants' names and matching data across the three measurement waves. The project received approval from the University's ethical committee (CERAS-2015-16-054-D).

At Time 1, 1038 employees participated in the survey, of which 941 provided complete responses. At Time 2, we contacted employees that had participated in the first-wave survey. Of these, 615 provided usable responses and did not change supervisors. These employees did not differ from those who participated only at Time 1 on wellbeing (t (939) = −0.52, ns). Further, they were not different on demographic characteristics (sex, age, education, tenure). At Time 3, supervisors rated employees' proactive performance through online questionnaires containing the names of the employees to be assessed. Supervisors' ratings were obtained for a total of 318 employees. These ratings were then matched by the research team with the responses obtained from employees. When comparing the final sample to the initial pool of respondents, they did not differ on wellbeing (t (939) = −1.23, ns), LMX (t (939) = −1.85, ns), and TMX (t (939) = −0.03, ns). Further, they were not different on demographic characteristics (sex, age, education, tenure). Therefore, attrition in participation should not represent a threat affecting the study results. In the final sample, most participants were women (55%), were aged between 25 and 45 years (64%), had a university degree (58%), and reported a tenure of more than 5 years (52%).

2.2. Measures

Psychological wellbeing at work. Wellbeing was measured with Gilbert et al.'s instrument [1]. This questionnaire is composed of 25 items measuring serenity, social harmony, and feelings of engagement at work (e.g., "I feel good, at peace with myself;" "I got along well with my colleagues;" "I found my work exciting and I wanted to enjoy every moment of it"). Participants were asked to indicate the extent to which they had experienced each wellbeing item in the previous month at work (1 = almost never; 5 = almost always). Previous studies indicated that the psychological wellbeing construct can be represented as a global, second-order factor [77]. Therefore, we averaged scores on items across the three components to create a global score of psychological wellbeing. Previous studies found global wellbeing to be reliable (αs = 0.91 and 0.92) [77,78].

Job complexity. Morgeson and Humphrey's scale [67] was used to measure job complexity. Employees answered three items from a French version of this scale [79] to indicate their perception of job complexity (e.g., "The tasks on the job are simple and uncomplicated"—reverse coded). Previous studies indicated that this scale is reliable (α = 0.88) [79].

Task interdependence. The 5-item scale developed by Aubé et al. [80] was used to measure task interdependence (e.g., "I have to work closely with my colleagues to do my work properly"). Previous studies have indicated that this scale is reliable (α = 0.91) [81].

LMX. LMX was measured with the French version [82] of Graen and Uhl-Bien's instrument [37]. This 7-item scale measures the extent to which the employee perceives having high quality exchanges with the supervisor. This scale includes items targeting employee contribution (e.g., "I have enough confidence in my supervisor that I would defend and justify his/her decision if he/she were not present to do so") and supervisor contribution (e.g., "How well does your supervisor recognize your potential?"). Participants answered items using a 5-point scale (1 = rarely/not a bit/not at all/none/strongly disagree/extremely ineffective; 5 = very often/a great deal/full/very high/strongly agree/extremely effective). Previous studies have reported good reliability for this scale (α = 0.92) [82].

TMX. TMX was measured with Seers et al.'s scale [38]. A translation-back-translation procedure was performed to create a French version of this measure. This 10-item scale measures the extent to which employees perceive having high quality exchanges with coworkers. This scale targets employee contribution (e.g., "In busy situations, how often do you volunteer your efforts to help your colleagues") and coworkers' contribution (e.g., "How well do your colleagues recognize your potential?"). Participants answered items using the same 5-point scale as for LMX. Previous studies have indicated that this scale is composed of two highly

correlated dimensions that can be merged to create an overall score [38,83,84]. Therefore, we computed a global score by averaging across all items. Reliability for this scale ($\alpha = 0.84$) was similar to reliabilities reported in previous studies ($\alpha = 0.81$–0.84) [38,83,84].

Proactive performance. The 3-item French version [85] of Griffin et al.'s scale [11] was used to measure proactive performance in core tasks. Supervisors assessed whether employees displayed proactive behaviors in their core tasks (e.g., "Comes up with ideas to improve the way in which your core tasks are done"). Supervisors indicated the extent to which (1 = totally disagree; 5 = totally agree) the employee had performed the behaviors in the past three months. Prior studies reported good reliability for this scale (αs = 0.91–0.94) [11,85].

Control variables. We controlled for age, education level, and organizational tenure as people with more work experience and knowledge (resulting from higher education, tenure, or age) may engage in more innovative thinking to find proactive solutions to work problems [86]. We also controlled for gender since men might be advantaged in obtaining resources for proactive behaviors as organizations tend to be more favorable to men than to women in providing resources [87]. Furthermore, we included a measure of self-reported proactive performance at Time 1 (3 items; $\alpha = 0.78$) [85] to control for the potential effects of proactive behaviors on the quality of social interactions [88]. The inclusion of this variable as a control also helped account for the potential impact of proactive dispositions on exchange relationships [43]. Finally, we controlled for job autonomy (9 items; $\alpha = 0.86$) [67] as a potential moderator of the relationship between LMX and proactive performance (see Appendix B).

3. Results

3.1. Confirmatory Factor Analysis

Prior to testing the hypotheses, we conducted confirmatory factor analyses (CFAs) with Mplus 7.11 [89] to assess the discriminant validity of our variables. For TMX (i.e., a two-dimensional construct), psychological wellbeing (i.e., a three-dimensional construct) and job autonomy (i.e., a three-dimensional construct comprising work scheduling autonomy, decision-making autonomy, and work method autonomy), the scores on the corresponding dimensions were used as indicators of their latent construct to ensure an adequate sample-size-to-parameter ratio. As can be seen in Table 1, the hypothesized eight-factor model (self-reported proactive performance, job autonomy, psychological wellbeing, job complexity, task interdependence, LMX, TMX, and proactive performance) displayed a good fit ($\chi^2_{[349]} = 417.87$, $p < 0.01$, comparative fit index (CFI) = 0.94, root mean square error of approximation (RMSEA) = 0.05, standardized root mean square residual (SRMR) = 0.05) and outperformed any simpler representations of the data ($p < 0.01$). Accordingly, these findings support the distinctiveness of the study variables (see also Appendix C). Descriptive statistics and correlations are presented in Table 2.

Table 1. Confirmatory Factor Analysis Results: Fit Indices.

Model	χ^2	*df*	$\Delta\chi^2$	Δdf	CFI	RMSEA	SRMR
Hypothesized eight-factor model	417.87 *	349	–	–	0.94	0.05	0.05
Six-factor models							
Combining job complexity and task interdependence	1367.85 *	356	949.98 *	7	0.78	0.09	0.11
Combining job complexity and job autonomy	1154.59 *	356	736.72 *	7	0.83	0.08	0.09
Combining task interdependence and job autonomy	1109.36 *	356	691.49 *	7	0.84	0.08	0.07
Combining LMX and TMX	855.67 *	356	437.80 *	7	0.89	0.07	0.06
One-factor model	3629.37 *	377	3211.50 *	28	0.31	0.16	0.15

Note: N = 318. CFI = comparative fit index; RMSEA = root mean square error of approximation; SRMR = standardized root mean square residual; LMX = leader-member exchange; TMX = team-member exchange. * $p < 0.01$.

Table 2. Descriptive Statistics and Correlations.

Variable	*M*	*SD*	1	2	3	4	5	6	7	8	9	10	11	12
1. Gender	1.45	0.50	–											
2. Age	2.97	1.08	−0.13 *	–										
3. Educational level	3.70	0.94	0.21 **	−0.07	–									
4. Organizational tenure	4.53	1.18	−0.08	0.46 **	−0.05	–								
5. Psychological wellbeing	4.17	0.44	−0.04	0.01	−0.12 *	−0.14 **	(0.92)							
6. Job complexity	4.55	1.51	0.09	0.12 *	0.27 **	0.20 **	−0.12 **	(0.92)						
7. Task interdependence	5.33	1.16	0.15 **	−0.14 *	0.27 **	−0.06	0.08	0.13 *	(0.85)					
8. Job autonomy	5.30	1.12	0.25 **	−0.03	0.25 **	0.02	0.20 **	0.18 **	0.27 **	(0.86)				
9. SRPP	4.09	0.61	−0.07	−0.02	−0.06	−0.14 *	0.42 **	−0.03	0.07	0.17 **	(0.78)			
10. LMX	3.71	0.73	−0.01	−0.05	−0.11	−0.10	0.42 **	−0.08	0.16 **	0.21 **	0.18 **	(0.87)		
11. TMX	3.45	0.62	0.09	−0.07	0.07	0.03	0.39 **	−0.09	0.29 **	0.11	0.25 **	0.39 **	(0.84)	
12. Proactive performance	3.75	0.77	−0.01	−0.13 *	−0.06	−0.15 **	0.23 **	−0.01	0.07	0.07	0.10	0.25 **	0.08	(0.86)

Note: N = 318. SRPP = self-reported proactive performance; LMX = leader-member exchange; TMX = team-member exchange. For Gender: 1 = female, 2 = male. For Age: 1 = ≤ 25 years, 2 = 26–35 years, 3 = 36–45 years, 4 = 46–55 years, 5 = 56–65 years, 6 = ≥ 66 years. For Educational level: 1 = primary school, 2 = secondary school, 3 = college, 4 = undergraduate, 5 = graduate. For Organizational tenure: 1 =< 6 months, 2 = 6 months-1 year, 3 = 1–2 years, 4 = 2–5 years, 5 = 5–10 years, 6 = 10–15 years, 7 = >15 years. * $p < 0.05$; ** $p < 0.01$.

3.2. Hypotheses Testing

Because employees were nested in 16 organizations, we performed a series of hierarchical linear modeling (HLM) analyses using HLM 6.02 software [90] to test our hypotheses. We first ran a null model to determine if there was significant between-organization variance in LMX, TXM and proactive performance. Results indicated significant between-organization variance in LMX, (χ^2 = 46.50, df = 15, $p < 0.01$, intra-class correlation $[ICC]_{[1]} = 0.09$), TMX (χ^2 = 38.68, df = 15, $p < 0.01$, $[ICC]_{[1]} = 0.07$), and proactive performance (χ^2 = 47.39, df = 15, $p < 0.01$, $[ICC]_{[1]} = 0.09$), thereby justifying the use of HLM. All study variables were group-mean centered as our model implied individual-level predictors and interactions between individual-level variables [91]. As recommended by Preacher and Selig [92], we used the Monte Carlo method to calculate confidence intervals for the hypothesized indirect and conditional indirect effects.

Table 3 presents the results of HLM analyses predicting LMX, TMX, and proactive performance, and provides the basic information for testing Hypotheses 1–6. Hypotheses 1 and 2 predicted that psychological wellbeing would be indirectly and positively related to proactive performance via LMX and TMX, respectively. Table 3 shows that wellbeing was positively associated with LMX ($\gamma = 0.59$, $p < 0.01$; Model 2) and TMX ($\gamma = 0.49$, $p < 0.01$; Model 5); in turn, LMX ($\gamma = 0.19$, $p < 0.01$), but not TMX ($\gamma = -0.04$, ns), was positively related to proactive performance (Model 8). Based on 20,000 Monte Carlo replications, the results revealed that the indirect effect of wellbeing on proactive performance via LMX

was significant (0.11, 95% CI = 0.02, 0.21). Therefore, Hypothesis 1 is supported while Hypothesis 2 is not.

Hypotheses 3 and 4 stated that TMX and LMX would be more strongly related to proactive performance at high levels of job complexity and task interdependence, respectively. As shown in Table 3 (Model 9), the LMX x job complexity interaction ($\gamma = 0.09$, $p < 0.05$) and the TMX x task interdependence interaction ($\gamma = 0.11$, $p < 0.05$) were significant. A likelihood ratio test [93] indicated that the model including these interaction terms (Model 9) yielded a better fit ($\Delta\chi 2 = 12.61$, df = 4, $p < 0.01$) than the model with no interaction terms (Model 8). Simple slopes analyses [94] revealed that the LMX–proactive performance relationship was significantly positive ($\gamma = 0.30$, $p < 0.01$) at high levels (i.e., 1 SD above the mean) of job complexity but non-significant ($\gamma = 0.03$, ns) at low levels (i.e., 1 SD above the mean) of it (Figure 2), thus supporting Hypothesis 3. Further, the TMX–proactive performance relationship was significantly negative when task interdependence was low ($\gamma = -0.20$, $p < 0.05$) but non-significant when it was high ($\gamma = 0.06$, ns) (Figure 3). This pattern is not entirely consistent with Hypothesis 4 as the latter predicted the relationship between TMX and proactive performance to be stronger and positive when task interdependence was high.

Finally, to test whether job complexity (Hypothesis 5) and task interdependence (Hypothesis 6) moderated the indirect relationship between psychological wellbeing and proactive performance via LMX and TMX, respectively, we used 20,000 Monte Carlo replications of the data to generate 95% bias-corrected CIs for the indirect effects of wellbeing at different values of these moderators. As predicted, the indirect effect of psychological wellbeing on proactive performance via LMX was significantly positive when job complexity was high (0.18, CI = 0.08, 0.29) but non-significant when it was low (0.02, CI = −0.07, 0.11). Hypothesis 5 is thus supported. The indirect effect of psychological wellbeing via TMX was significantly negative when task interdependence was low (–0.10, CI = −0.19, −0.01) but non-significant when it was high (0.03, CI = −0.06, 0.13). As for Hypothesis 4, this result is not entirely supportive of Hypothesis 6.

3.3. Supplemental Analyses

We performed a series of supplemental analyses to examine several alternative effects, namely whether (a) LMX and TMX interacted to predict proactive performance, (b) job autonomy or (c) task interdependence moderated the relationship between LMX and proactive performance, (d) job complexity moderated the relationship between TMX and proactive performance, and (e) job complexity and task interdependence moderated the relationship between wellbeing and LMX and TMX (i.e., the first stage of the mediation).

First, as TMX has been reported in previous research to moderate the relationship between LMX and work performance [41], we examined the interaction between LMX and TMX predicting proactive performance. Model 10 (Table 3) indicates that the LMX × TMX interaction was unrelated to proactive performance ($\gamma = -0.10$, ns), while the LMX × job complexity ($\gamma = 0.09$, $p < 0.01$) and the TMX × task interdependence ($\gamma = 0.12$, $p < 0.05$) interactions remained significant. Second, as prior research found job autonomy to moderate the relation between LMX and change-related behaviors [65], we tested whether it would moderate the LMX–proactive performance relation. Model 11 (Table 3) showed that the LMX × job autonomy interaction was unrelated to proactive performance ($\gamma = -0.03$, ns), while the LMX × job complexity remained significant ($\gamma = 0.09$, $p < 0.01$). Third, we tested whether task interdependence moderated the relationship between LMX and proactive performance and whether job complexity moderated the relationship between TMX and proactive performance. Model 12 (Table 3) indicates that task interdependence did not moderate the LMX–proactive performance relation ($\gamma = 0.03$, ns) and that job complexity did not moderate the TMX–proactive performance relation ($\gamma = -0.05$, ns), while the LMX × job complexity ($\gamma = 0.09$, $p < 0.01$) and TMX × task interdependence ($\gamma = 0.11$, $p < 0.05$) interactions remained significantly related to proactive performance. Fourth, we examined whether job complexity and task interdependence moderated the first stage of

the mediation sequence. The results showed that job complexity did not moderate the wellbeing–LMX (γ = 0.04, ns; Table 3, Model 3) and wellbeing–TMX (γ = 0.02, ns; Table 3, Model 6) relations. Likewise, task interdependence did not moderate the relation between wellbeing and LMX (γ = −0.02, ns; Table 3, Model 3) and TMX (γ = 0.04, ns; Table 3, Model 6).

Table 3. Hierarchical Linear Modelling Results for LMX, TMX and Proactive Performance.

Variables	LMX			TMX			Proactive Performance					
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12
Gender	−0.01	−0.01	−0.00	0.05	0.05	0.06	0.13	0.13	0.14	0.14	0.13	0.14
Age	0.03	0.01	0.00	−0.03	−0.05	−0.05	−0.09 *	−0.11*	−0.10 *	−0.10 *	−0.10 *	−0.10
Educational level	−0.06	−0.03	–0.07	0.06	0.08	0.04	−0.05	−0.03	−0.07	−0.07	−0.08	−0.07
Organizational tenure	0.00	0.01	0.00	0.06 **	0.07 **	0.07 **	−0.02	−0.02	−0.02	−0.03	−0.03	−0.02
SRPP	0.17 **	−0.00	−0.01	0.27 **	0.12 *	0.12 *	0.05	−0.02	−0.05	−0.04	−0.05	−0.05
PWB		0.59 **	0.56 **		0.49 **	0.44 **		0.21 *	0.20 *	0.18 *	0.18	0.21 *
LMX								0.19 **	−0.23 **	−0.22	−0.38 *	−0.26
TMX								−0.04	−0.66 *	−0.74 *	−0.67 *	−0.64 *
Job complexity			0.02			–0.03			−0.31 **	−0.30 **	−0.34 *	−0.33 **
Task interdependence			0.09 *			0.13 **			−0.30	−0.33	−0.32	−0.29
Job autonomy											0.03	
LMX × Job complexity									0.09 *	0.09 *	0.09 *	0.09 **
TMX × Task Interdependence									0.11 *	0.12 *	0.11 *	0.11 *
LMX × TMX										−0.10		
LMX × Job autonomy											−0.03	
PWB × Job complexity			0.04			0.02						
PWB × Task interdependence			−0.02			0.04						
LMX × Task interdependence												0.03
TMX × Job complexity												−0.05
R^2	0.03	0.12	0.13	0.09	0.11	0.16	0.04	0.08	0.12	0.12	0.12	0.12
$\Delta\chi^2(df)$		35.10(1) **	7.76(4)		36.13(1) **	20.86(4) **		17.16(3) **	12.61(4) **	1.45(1)	1.25(2)	1.95(2)
Deviance	688.51	653.41	645.65	561.56	525.43	504.57	710.62	693.46	680.85	679.40	679.59	678.89

Note. N = 318. Models 3, 6, and 10–12 refer to supplemental analyses. R^2 values are calculated based on proportional reduction in error variance resulting from predictors in the models of Table 3 [95]. The fit of Models 10–12 is compared to the fit of Model 9. PWB = Psychological wellbeing; SRPP = Self-reported proactive performance; LMX = leader-member exchange; TMX = team-member exchange. For Gender: 1 = female, 2 = male. For Age: 1 = ≤ 25 years, 2 = 26–35 years, 3 = 36–45 years, 4 = 46–55 years, 5 = 56–65 years, 6 = ≥ 66 years. For Educational level: 1 = primary school, 2 = secondary school, 3 = college, 4 = undergraduate, 5 = graduate. For Organizational tenure: 1 = < 6 months, 2 = 6 months-1 year, 3 = 1–2 years, 4 = 2–5 years, 5 = 5–10 years, 6 = 10–15 years, 7 = >15 years. * $p < 0.05$; ** $p < 0.01$.

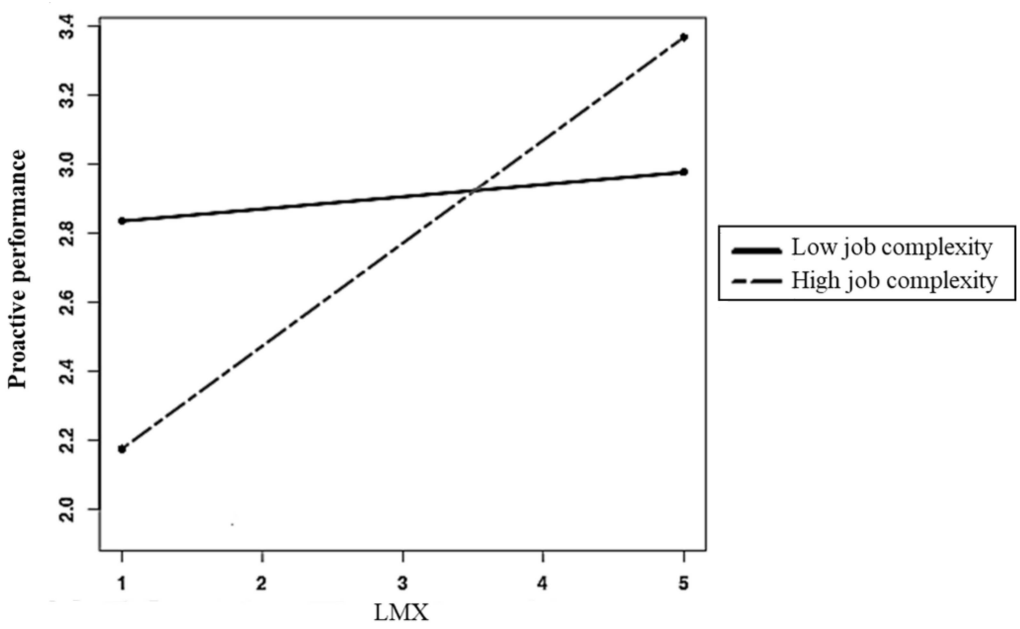

Figure 2. Proactive performance as a function of LMX at ±1 standard deviation of job complexity.

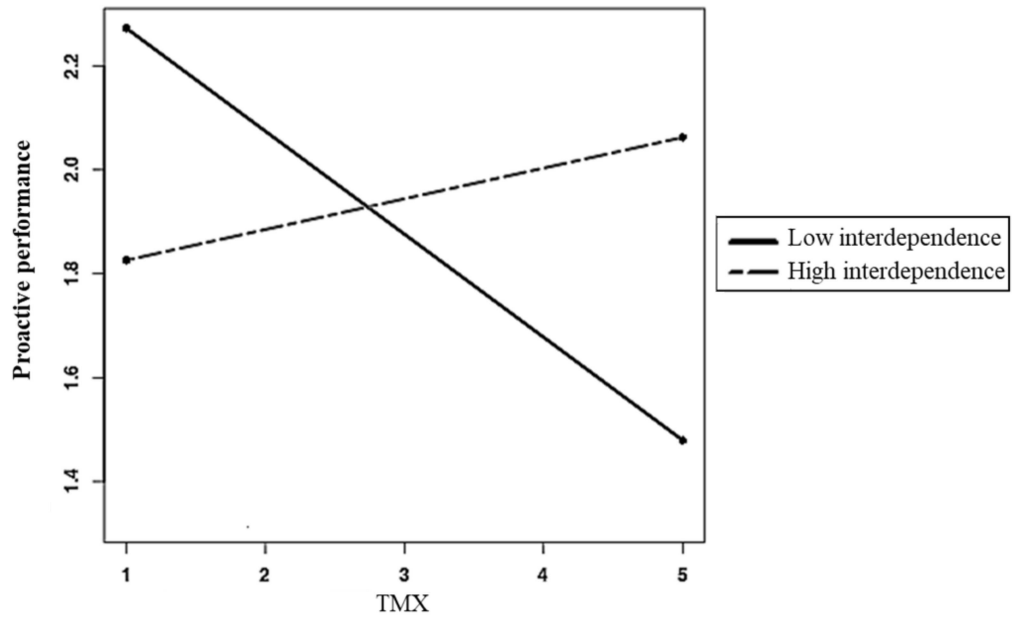

Figure 3. Proactive performance as a function of TMX at ±1 standard deviation of task interdependence.

4. Discussion

The goal of this study was to investigate how and under what conditions psychological wellbeing can contribute to proactive performance. Based on the COR theory [25], we posited that employees with higher levels of wellbeing may develop more positive exchange relationships with their supervisor (LMX) and coworkers (TMX), two social resources that can be instrumental to proactive performance. Analyses revealed that LMX, but not TMX, mediated the wellbeing–proactive performance relation. While the idea that wellbeing fuels TMX was supported, TMX was unrelated to proactive performance. Further, we explored whether the motivational potential of LMX and TMX was moderated by specific job characteristics [62]. As expected, LMX was more strongly related to proactive performance when job complexity was higher. While we expected that the contribution of TMX to proactive performance would be stronger when task interdependence is high, the

results indicated that TMX negatively contributed to proactive performance when task interdependence was low. Taken together, our study indicates that psychological wellbeing is indirectly related to proactive performance through two social exchange mechanisms, both of which were subject to boundary conditions. The theoretical and practical implications of these findings are discussed in the next sections.

4.1. Theoretical Implications

This research has implications for how we theorize psychological wellbeing's role in the workplace as well as for the understanding of the social mechanisms through which it leads to proactive performance. Based on our results, future theorizing of these relationships ought to go beyond the simplistic paradigm of the happy-productive worker [96,97]. Based on the COR theory, we proposed that psychological wellbeing would facilitate the development of general social resources relevant for work adjustment. Consistent with the motivational fit theory [24], we also contended that these resources could become more (vs. less) relevant to the enactment of proactive behaviors depending on job requirements [20]. Our study has the potential to resolve the inconsistent findings concerning the relation between employee wellbeing and performance [9] as well as those regarding the association between social resources and proactive performance [20].

Our findings supported our assumption that psychological wellbeing eases the access to social resources at work. However, the development of the two general resources examined (i.e., LMX and TMX) does not provide an equally relevant set of resources for employees to engage in proactive behaviors in their jobs. The results indicate that LMX is conducive to proactive behaviors while exchange relationships with coworkers are not. This suggests that supervisors can provide more instrumental resources for job improvement (e.g., organizational resources, coaching, and feedback) and more socio-political support than coworkers, who are recognized as major information and emotional support providers [48]. This result is compatible with the finding that instrumental support from a supervisor is more important than parallel support from coworkers for job performance [98]. This also fits the proactivity literature where LMX was found to be more strongly related to proactive performance than TMX across various job conditions [20]. Our study adds to this stream of research by revealing that LMX is a more instrumental resource in the context of complex tasks, which are typically completed by knowledge workers. Presumably, knowledge workers benefit more from LMX because it allows the relationship with the supervisor to be customized to their needs [51,52].

One reason why TMX was unrelated to proactive performance might be that proactivity was targeted at employees' core tasks. Maybe a different pattern of results would emerge if proactive behaviors were targeting the team [11,99]. We found that TMX was detrimental to proactivity when task interdependence was low. In line with the motivational fit perspective [24], one may speculate that TMX would be beneficial for proactivity directed at the team level in the context of high task interdependence. Presumably, the "collective" motivational potential of TMX would be facilitated as a driver of team-directed proactivity when employees must coordinate work efforts with coworkers. Another possibility is that proactive attempts to challenge the status quo could threaten the high-quality relationships with coworkers in task-interdependent situations [23]. For example, De Dreu and West [100] found that task interdependence was negatively related to minority dissent, a type of proactive behavior that implies voicing personal views against the majority [101]. However, conflicts about tasks resulting from working interdependently with others can also stimulate change-oriented behaviors when they coexist with a positive mood or with an innovative group climate [10]. In such conditions, group cohesiveness might enhance, rather than attenuate, the effects of psychological wellbeing on proactive performance [102]. These contrasting perspectives suggest that the ability of task interdependence to indirectly enhance the relationship between employee wellbeing and proactive performance through TMX may be dependent on additional boundary conditions (e.g., the ability to deal with conflicts that can arise in a work group).

The current study also has theoretical implications for research on the "energy-to" factors related to proactivity [12]. Prior research has suggested that activated positive emotions directly foster proactive behaviors at work [50,103]. However, employee well-being at work does not boil down to highly activated positive emotions. In this study, we used a measure of psychological wellbeing which is aligned with the employees' phenomenological experience of being psychologically fulfilled at their job. Such experience implies having a positive view of oneself, the social context, and job activities [1,2]. As such, feeling well at work may not only have a direct effect on proactive behaviors but can exert an indirect effect by facilitating the development of other general resources that can be beneficial for responding to unpredictable opportunities for improvements in one's job. Rather than being contradictory, these two approaches are complementary. In line with the COR theory, the indirect perspective, by emphasizing the role of general resources for work adjustment, can be complemented by the direct perspective, which is theoretically anchored in the principle of energy activation [104]. Interestingly, our moderated mediation findings concur with this integrative possibility: job complexity played an activation role by providing a proximal "reason-to" display proactive behaviors to employees in high-quality LMX relationships. Further theoretical integrations related to the "energy-to" reasons for proactivity could help clarify how the distal, proximal and boundary factors jointly explain the emergence of proactive performance.

4.2. Managerial Implications

This study has practical implications for the promotion of proactive work performance. Our results indicated that the positive relationship between psychological wellbeing and proactive performance occurs because wellbeing relates to quality exchange relationships with supervisors. Therefore, human resource management interventions aimed at nurturing employees' wellbeing may boost the availability of social resources (i.e., LMX), which is conducive to proactive performance. Psychological wellbeing and LMX will contribute the most to employee proactivity when the task is complex. Therefore, human resource managers should see the promotion of wellbeing and LMX relationships as a ground out of which proactive behaviors can flourish. As such, promoting psychological wellbeing and LMX should be diligently encouraged and be viewed as complimentary means that can enhance performance. As a boundary condition, we nevertheless must caution that the promotion of psychological wellbeing does not appear a relevant strategy to improve employees' proactivity when their tasks are simple.

Further, this study discloses a possible adverse effect of psychological wellbeing in relation to proactive performance, namely when this effect occurs through social exchange relationships with coworkers in the context of low-interdependent tasks. When task interdependence is low, intense social exchanges with coworkers should be avoided to prevent drops in proactive performance. In sum, our results suggest that TMX does not add value over LMX in stimulating proactive performance. Therefore, augmenting the quality of relationships with supervisors remains the best means to improve proactive performance. Interestingly, recent research on followership indicates that employees can play an active role in crafting relationships with their leaders [105].

Moreover, by providing evidence for the positive effect of job complexity on the indirect relationship between wellbeing and proactive performance via LMX, our study emphasizes the importance of increasing job complexity among psychologically healthy employees who have high-quality relationships with their supervisors in order to bring out their proactive potential. To this end, organizations could broaden the tasks assigned to such employees and increase their decision-making authority. Likewise, it is advisable to make jobs mentally stimulating and challenging, and to allow employees to use cognitive skills as well as to exploit opportunities for learning, exploring, and experimenting. However, it is worth noting that, in the case of jobs that are already inherently complex, such as knowledge-based jobs, further increasing the levels of their complexity (e.g., by augmenting information processing or task variety) might result in increased job over-

load, which may reduce the resources needed to exert proactive efforts. Accordingly, the management of job complexity should be based on a preliminary diagnosis of current job characteristics to optimize the effectiveness of the aforementioned job design practices in spurring proactive performance among psychologically healthy employees who benefit from satisfactory LMX. Supporting these recommendations, and consistent with our study findings, Volmer and colleagues [65] showed that LMX was most beneficial to employee innovative performance (i.e., a form of proactive behavior) when employees experienced high levels of job autonomy (i.e., a core characteristic of knowledge jobs).

Overall, our results suggest that improving psychological health is a good starting point for developing constructive social exchange relationships and fostering proactive performance in jobs characterized by high-complexity and low interdependence. However, the knowledge-based characteristics of our study sample set key boundaries to the application of this general practical recommendation, suggesting that the well-being-oriented route to effective social exchanges and proactive performance might be more fruitful when applied to knowledge workers, namely to those high-skilled employees who use theoretical and analytical knowledge acquired through formal education in creating new and useful business solutions.

4.3. Strengths, Limitations, and Directions for Future Research

This research has strengths and limitations that need to be discussed. The first strength was that a three-wave design was used to examine our moderated mediation model. Such design allowed us to accurately assess the processes as they unfold in our theorized model [106]. As such, the measurement of wellbeing at Time 1, social resources at Time 2, and proactive performance at Time 3 followed recommended practices [106,107]. The three-month interval between measurement times was selected based on prior research suggesting that attitudes-to-behavior relationships tend to diminish after six months [75,76,108]. However, our design does not allow us to draw conclusions in terms of causality. For example, a time-lagged design is less powerful than a cross-lagged panel design where directional relationships between variables can be examined and reverse effects can be tested. However, we controlled for self-reported proactive performance at Time 1, which helped alleviate concerns regarding potential effects of proactive performance on LMX and TMX.

For establishing appropriate time lags between measurements, while short time lags (i.e., weeks or a few months) appear advisable [109], the relative stability of phenomena under study should be considered for defining optimal time intervals. For example, previous research has suggested that the link between employee wellbeing and positive social exchange behaviors can develop quickly (daily to three months) [54,110–112]. However, social resources such as LMX and TMX may require longer periods to develop and stabilize before they can influence proactive behaviors. As such, the three-month lag between psychological wellbeing and social resources was appropriate. In contrast, the relationship between social resources and proactive performance may become stronger over periods of time longer than three months [113]. Future research could explore this issue by measuring proactivity multiple times (e.g., over six months or one year). Proactive behaviors in core tasks [77] and performance ratings in general [114] are often more stable than is generally thought. Thus, allowing for more time between measurement occasions for these outcomes would be well-advised.

The second strength of this study was the use of supervisor ratings to assess proactive performance. As a formal agent of the organization, the supervisor is the legitimate individual who can provide this assessment [115]. Further, other-ratings reduce the social desirability of performance assessments and common method variance bias in the attitude-performance relationship [108]. However, there are also some limitations to this approach. Liking effects may bias the supervisor's judgment of subordinate performance. Following Dulebohn et al. [116], there is a strong relationship between supervisor liking and the assessment of employee extra-role behaviors. Therefore, one may wonder if the LMX-

proactive performance relation is partly affected by a liking bias. Still, Dulebohn et al. [116] found that LMX accounted for a larger proportion of variance in extra-role performance than liking.

Future studies aiming at examining the role of psychological wellbeing in proactive performance may explore some worthwhile avenues. First, future research may want to investigate this relationship by focusing on a collective target of proactive performance (i.e., team-directed proactive performance) or adopting a group-level perspective [10]. This may extend what we currently know of the relationship between wellbeing and proactive performance and would have benefits for team-based organizations. Second, it would be interesting to examine whether cultural dimensions (e.g., collectivism vs. individualism) moderate the relationship between LMX and proactive performance, as observed in previous research [41]. In relation to this point, it should be noted that our study was conducted in Canada, a country characterized by a horizontal-individualism configuration [117]. In this type of society, people focus on their individuality to define themselves and tend to value equal relationships with figures of authority. This cultural feature could have influenced how the individuals surveyed in this study construed their representation of being interdependent to others or how they weighted their individual (vs. collective) interests in the enactment of proactive performance. Therefore, the generalization of our results to collective-vertical societies, such as those located in Asia, as well as in highly multicultural contexts, is uncertain. Accordingly, future research is warranted to investigate whether collectivist values may act as another boundary condition in the relationship between TMX and proactive performance. Third, this study focused on social exchange relationships as intervening factors between psychological wellbeing and proactive performance relationships. Other relevant mechanisms may be motivation [118] and cognitive flexibility [119], which may have their own boundary conditions [120].

5. Conclusions

The present study explored two pathways through which psychological wellbeing may affect proactive performance, namely social exchange relationships with supervisors (LMX) and coworkers (TMX). While findings indicated that LMX was the unique mediator, the relationship between both LMX and TMX and proactive performance was moderated by job characteristics, namely job complexity and task interdependence. We hope future research will further explore how and when psychological wellbeing contributes to work performance.

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Appendix A

Following review studies on LMX [38,39] and TMX [43], as well as a range of studies targeting both constructs [121–125], these variables are defined and measured in this study at an individual level, with follower rather than leader perceptions.

Appendix B

Based on theory [126] and research [127] on proactivity, self-reported proactive performance can be considered the behavioral manifestation of proactive personality, since this latter represents "a stable disposition to take personal initiative in a broad range of activities and situations" (p. 847) [128], which is the core characteristic of proactive behaviors.

Appendix C

Because one of the dimensions of well-being, namely social harmony, has an interpersonal focus, it could present conceptual redundancies with the interpersonal variables of LMX and TMX. We therefore explored the bivariate correlations and compared different CFA models to determine the distinctiveness between social harmony, and LMX and TMX. The bivariate correlations of social harmony with LMX (r = 0.36, $p < 0.01$) and TMX (r = 0.37, $p < 0.01$) were below 0.50, thus representing medium-strength correlations [129]. The CFA results revealed that a three-factor model encompassing social harmony, TMX and LMX was a significantly better fit to the data than either a two-factor model merging social harmony and LMX ($\Delta\chi^2$ [2] = 351.18, $p < 0.01$) or a two-factor model merging social harmony and TMX ($\Delta\chi^2$ [2] = 342.66, $p < 0.01$). Taken together, the results from the correlation and CFA analyses indicate that the construct of social harmony is distinct from and not overlapping with the constructs of LMX and TMX.

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Mindfulness and Psychological Distress in Kindergarten Teachers: The Mediating Role of Emotional Intelligence

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Abstract: Kindergarten teachers are often exposed to great stress. Considering that, mindfulness has been demonstrated to act as a critical role in the psychological well-being of kindergarten teachers. The present study assessed mindfulness in teaching (MT), psychological distress and emotional intelligence (EI) among 511 kindergarten teachers in mainland China and investigated the mediating role of EI to explore the association mechanism between kindergarten teachers' MT and psychological distress. The major results suggested that kindergarten teachers' MT was negatively related to their psychological distress (depression, anxiety, and stress). Results of path analyses indicated that the total score of EI and dimension of regulation of emotion (ROE) could serve as significant mediators. The findings suggest that mindfulness might be beneficial to relieve kindergarten teachers' psychological distress through the mediating role of EI.

Keywords: kindergarten teacher; mindfulness; emotional intelligence (EI); psychological distress

1. Introduction

Teaching has always been considered as a demanding, challenging and stressful profession [1]. Prior research has supported that teachers' psychological symptoms, including job-related stress, anxiety, depression and emotional exhaustion were significantly associated with job satisfaction [2], teacher-child relationship [3], child-care quality [4], children's behavioral problems and higher turnover [5]. The educational objects faced by kindergarten teachers are usually immature and uncontrollable groups, which invisibly increases the difficulty of teachers' work [6]. Moreover, with the development of the economy, more attention is paid to the quality of individual early education. Thus, kindergarten teachers are now required to complete high-intensity tasks in their daily lives and endure high pressure from society. That includes projecting a myriad of new forms of teaching, participating in practical research, managing disruptive classroom behaviors and promoting children's social and emotional development [1]. In short, compared with other groups of educators, kindergarten teachers are more vulnerable to psychological distress [1]. It is worth noting that psychological distress is often caused by emotional, work, family and general problems, which leads to weak to severe psychological problems. Considering this scenario, Lovibond and Lovibond proposed the concept of psychological distress, including three dimensions of depression, anxiety and stress [7]. In the present study, we mainly used the concept and measure of psychological distress developed by Lovibond and Lovibond to present the general state of kindergarten teachers' mental health [7].

Mindfulness, which is significantly associated with a series of mental health outcomes, may be a protective factor of kindergarten teachers' psychological distress [8]. The concept of mindfulness, rooted in Buddhism, directly refers to an awareness of internal, receptive attention and external experiences

at the time of the occurrence [8,9]. Individuals with a high level of mindfulness tend to observe and accept their thoughts and emotions rather than avoiding, suppressing or over-engaging with them [10]. In previous studies, the terms of mindfulness have been described at both trait and state levels. It is categorized as a trait or a disposition with individuals, which tends to be relatively stable between people in the inherent capacity for engagement of mindfulness processes [8,11]. State mindfulness is more focused on the within personal fluctuations in the engagement with the process that rely on the present moment. In this case, it usually occurs naturally in daily life or during mindfulness practice [11]. Many previous studies also demonstrated that mindfulness-based programs could effectively improve individuals' state mindfulness [12]. Moreover, there is growing empirical evidence supporting the inverse relationship between mindfulness and mental health problems, involving depression, anxiety, stress and emotional symptoms [13], whereas people with higher dispositional mindfulness are hardly affected by habitual patterns [9] and they are more prone to taking opportunities to become aware of, understand and accept negative emotions in current experiences [14].

In recent years, some researchers have begun to pay attention to the association between mindfulness in teaching (MT) and teachers' mental health [15]. Existing studies suggested that MT is positively related to mental health. Elreda et al. [16] suggested that MT usually promotes teachers' job satisfaction, ambition and relieves teachers' perceived stress and improves their ability to be emotionally supportive. Mindful educators tend to have better sleep quality and experience less stress [17]. Researchers also found that teachers having a higher level of dispositional mindfulness was related to better quality teacher-student relationships and lower depressive symptoms, which acted as a partial mediator between greater mindfulness and lower conflict among teachers [18]. Going further, mindfulness could have impacts on teachers' emotional support in class and relationships with children and play, which have a big impact on student outcomes [19,20]. In addition, some previous related research suggested that mindfulness-based interventions (MBIs) could help reduce stress through recognizing and regulating emotions [21]. The effective outcomes of MBIs on teachers' mental health include the improvement of well-being, self-compassion, emotional awareness in the classroom and reduction of stress, burnout and depression [22]. Based on prior research, it can be concluded that mindfulness is significantly related to teachers' psychological symptoms and that a mindful teacher may perform and feel better at work. Nevertheless, the existing limited studies have focused on the samples of primary and secondary school teachers, and there is a dearth of research on this aspect when it comes to kindergarten teachers.

Considering the mechanism underlying mindfulness and psychological symptoms, some researchers have already put forward certain mediating variables, such as emotional regulation [23], self-esteem [24], rumination [25] and autonomy [26]. Emotional Intelligence (EI) as a potential psychological factor might also help to explain the potential mechanism underlying the association between kindergarten teachers' mindfulness and psychological distress. Salovery [27] hold that EI should be defined as an ability that includes reflectively regulating, understanding, absorbing, perceiving and expressing emotions. Wong and Law [28] proposed four dimensions of EI: (i) self-emotional appraisal (SEA), which means the capability to observe, realize and state an individual's profound emotions appropriately and naturally; (ii) others' emotional appraisal (OEA), which is related to the individual's capability to be aware of and understand the emotion of other people accurately in the surrounding settings; (iii) use of emotion (UOE), which is the capability to use emotions for facilitating one's constructive behaviours and personal performance; (iv) regulation of emotion (ROE), which means the capability to control and regulate emotions and may be the determinant to mitigating one's psychological distress.

Generally speaking, there is a positive association between mindfulness and EI [8]. To some extent, both have similar concerns and highly emphasize individual ability to observe, comprehend and regulate their emotions [29]. Characteristics of mindfulness contain clarity of awareness, non-judgment, orientation to the present, openness and acceptance to positive and negative emotions [9]. Mindful individuals tend to have much better cognitive flexibility and could be more sensitive to the emotions of other people around them, an aspect that might be beneficial to the clarity of emotional state [30].

In addition, individuals with greater mindfulness may accept any thoughts and emotions with self-compassion rather than engaging in ruminative thinking of negative emotions excessively [25]. In this sense, mindfulness is regarded as an association with SEA and OEA. Furthermore, mindfulness emphasizes attention to a present experience and facilitates the choice of behaviors, including one's needs, interests and values [8]. In addition, mindfulness could help to generate more lucidity and vividness of a current experience and stimulate internal sensation to be intimately in contact with the present life. This would strengthen the ability of self-regulation as a consequence and be accompanied by sustained attention sensitivity to psychological, physical and environmental cues [31]. Studies have demonstrated that mindfulness training is closely connected with the amelioration of attention functions, cognitive flexibility and problem-solving features [32]. That said, individuals would perform well on their current tasks in positive emotions, and the ability of UOE and ROE could even be enhanced [33,34].

EI has also been demonstrated to be related to psychological health across different samples. Individuals with higher EI show more positive mood [35], greater satisfaction with life [36], higher levels of well-being [37] and lower levels of psychological stress [23]. Additionally, Schutte and Malouff [38] found that EI proved to be a partial mediator among subjective well-being with mindfulness in university students and perceived stress in Chinese adults [31]. In the study of Wang and Kong [39], EI also significantly mediated the relationship between mindfulness and perceived distress in a sample of adolescents. However, even with a few studies regarding this aspect, EI is considered as multi-dimensional construct [27], which aspects of EI play a more important role in the relationship between mindfulness and psychological distress is unclear. Therefore, it is necessary to explore the mediating role of EI and its dimensions between mindfulness and psychological distress.

To sum up, this study might help clarify the relationships of MT, EI and psychological distress among kindergarten teachers and investigates the specific mechanism of EI and its dimensions as mediating variables. The following hypotheses are tested: (i) MT is positively associated with EI (including the EI total score and subscale scores), (ii) MT is negatively associated with psychological distress, and (iii) EI (including the EI total score and subscale scores) mediates the effect of MT on psychological distress.

2. Materials and Methods

2.1. Participants and Procedure

Participants in this study were 511 kindergarten teachers from Shaanxi Province, China, aged from 18 to 57 years old (M = 30.39, SD = 7.46). The average work experience was 9 years (M = 8.83, SD = 7.63), and 490 were females (95.9%). Participants' education levels were distributed as high school and below (n = 131, 25.6%), bachelor's degree (n = 352, 68.9%) and master's degree and above (n = 28, 5.48%). This was similar to the gender ratio, age distribution and educational background compared with kindergarten teachers in other studies [6,40]. This research followed the principles of the Declaration of Helsinki. Before the survey, teachers receivedinformed consent, and the ethics committee approved all the process of the present study.

2.2. Measures

2.2.1. Mindfulness

The Mindfulness in Teaching Scale (MTS) [41] is a 14-item scale consisting of two dimensions measuring teacher intrapersonal mindfulness (e.g., When I am teaching, I find myself doing things without paying attention) and teacher interpersonal mindfulness (e.g., I am aware of how my moods affect the way I treat my students). Participants were asked to rate on a 5-point Likert-type scale (1 = almost never to 5 = almost always). The higher total score indicated higher levels of mindfulness in

teaching. The Chinese version of the MTS was verified with good validity and reliability [42]. The scale had a Cronbach alpha coefficient of 0.82 in this study, which showed good internal consistency.

2.2.2. Emotional Intelligence

The 16-item Wong Law Emotional Intelligence Scale (WLEIS) was used to measure emotional intelligence in the study [28], which included four dimensions: self emotion appraisals (SEA: "I have a good understanding of my own emotions"); others' emotion appraisals (OEA: "I have a good understanding of the emotions of people around me"); regulation of emotion (ROE: "I am quite capable of controlling my own emotions"); and use of emotion (UOE: "I would always encourage myself to try my best"). Items were rated on a 5-point Likert-type from 1 (strongly disagree) to 5 (strongly agree). A higher score reflected a higher level of emotional intelligence. The Chinese version of the WLEIS has been validated with good psychometric properties [43]. In this study, the Cronbach alpha coefficients of the four subscales were SEA = 0.84, OEA = 0.80, ROE = 0.84 and UOE = 0.77, and the total scale was 0.92, which indicated good internal consistency.

2.2.3. Depression Anxiety Stress Scale

The Depression Anxiety Stress Scales-21 (DASS-21) is a 21-item measure, including three subscales (depression, anxiety, and stress) [7], and each subscale includes 7 items. Participants rated the frequency they experience symptoms related to depression (DASS-D; e.g. "I couldn't seem to experience any positive emotion at all"), anxiety (DASS-A; e.g. "I experienced trembling [e.g. in the hands]") and stress (DASS-S; e.g. "I found it hard to wind down") on a 4-point scale, from 0 ('not for me at all') to 3 ('very or most of the time'). The higher the total score, the higher the level of psychological distress. The factor structure of the Chinese version of DASS-21 was supported by previous studies, and the internal consistency of each subscale was above 0.75 [44]. In this study, Cronbach's alphas of the DASS-21 subscale were 0.86 (depression), 0.77 (anxiety) and 0.80 (stress). The Cronbach alpha coefficient of the total scale was 0.92. Therefore, the scale showed good internal consistency.

2.3. Data Analyses

Descriptive data of the main variables were reported (means and standard deviations), and then Pearson's correlations were performed to test the relationship among variables. The bootstrap method was used in a procedure of 5000 samples to analyze the mediating effects via the SPSS macro 'process' [45]. In this process, a 95% confidence interval would be generated to test the significance of the indirect effect between MT and psychological distress through mediating roles of EI (including the EI total score and subscale scores). The indirect effects were identified as significant if zero does not exist between the lower and upper confidence intervals (CIs).

3. Results

Descriptive statistics and Pearson's correlations among variables were presented in Table 1, including mean values, standard deviations and correlations. MT was positively related to the total score of EI and the scores of subscales including SEA, OEA, UOE and ROE. Conversely, MT was negatively related to the psychological distress total score and subscales of depression, anxiety and stress. In addition, the total score of EI and its subscales were negatively correlated with psychological distress and its dimensions.

Table 1. The means, standard deviations and inter-correlations of all the studied variables.

Variables	Means (SD)	1	2	3	4	5	6	7	8	9	10
1.MT	3.86 (0.59)	1									
2.EI	4.08 (0.55)	0.43 **	1								
3.SEA	4.31 (0.62)	0.43 **	0.84 **	1							
4.OEA	3.97 (0.68)	0.28 **	0.80 **	0.57 **	1						
5.UOE	4.08 (0.64)	0.34 **	0.85 **	0.62 **	0.53 **	1					
6.ROE	3.98 (0.68)	0.39 **	0.87 **	0.65 **	0.55 **	0.70 **	1				
7.Psychological Distress	0.65 (0.46)	−0.26 **	−0.31 **	−0.29 **	−0.16 **	−0.28 **	−0.33 **	1			
8. Depression	0.51 (0.48)	−0.31 **	−0.34 **	−0.31 **	−0.21 **	−0.30 **	−0.33 **	0.92 **	1		
9. Anxiety	0.63 (0.48)	−0.21 **	−0.24 **	−0.23 **	−0.12 **	−0.21 **	−0.25 **	0.92 **	0.78 **	1	
10.Stress	0.80 (0.52)	−0.21 **	−0.28 **	−0.24 **	−0.13 **	−0.25 **	−0.32 **	0.93 **	0.77 **	0.78 **	1

Note: N = 511. ** $p < 0.01$. MTS = Mindfulness in Teaching Scale; EI = emotional intelligence, SEA = self emotion appraisals; OEA = others' emotion appraisals; UOE = use of emotion; ROE = regulation of emotion.

We first explored the mediating role of EI total score in the relationship between MT and psychological distress. As shown in Figure 1, the results of regression showed that MT had a significant positive effect on EI, and EI had a significant negative effect on psychological distress. The indirect effect of MT on psychological distress was significant when EI total score was the mediating variable (Figure 1 and Table 2). In addition, the direct effect of MT on psychological distress was still significant after accounting for the mediator variable of EI total score (Figure 1). The results indicated that EI total score could serve as a partial mediating variable between MT and psychological distress.

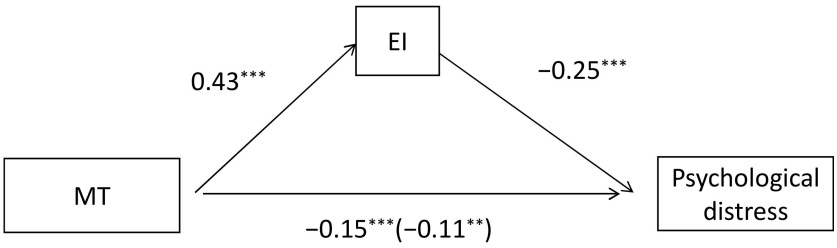

Figure 1. Mediator model examining the indirect relationship between MT and psychological distress through EI total score. Numbers in parentheses represent indirect effects for mediator variable. ** $p < 0.01$.

Table 2. Indirect effects of MT on psychological distress through mediating variables.

Variables	b	DASS 95% CI	*p*
EI	−0.11	−0.15, −0.06	<0.01
SEA	−0.04	−0.1, 0.01	0.11
OEA	0.02	−0.01, 0.06	0.13
UOE	−0.02	−0.07, 0.02	0.31
ROE	−0.08	−0.14, −0.02	<0.01

Note: N = 511. EI = emotional iIntelligence, SEA = self emotion appraisals; OEA = others' emotion appraisals; UOE = use of emotion; ROE = regulation of emotion.

We further tested the mediating effects through the four dimensions of EI in a multiple mediation model. As seen in Figure 2, the results of regression showed that MT had significant effects on

each mediator variable: SEA, OEA, UOE and ROE. Three of the mediators, SEA, OEA and UOE, had non-significant effects on psychological distress. The other, ROE, had a significant effect on psychological distress. After including the four subscales as mediators in the model, the total indirect effect was still significant, but only the dimension of ROE served as a significant mediating variable compared with other dimensions of EI. What is more, the direct effect of MT on psychological distress was still significant after accounting for mediating variables (Figure 2). These results indicated that EI dimensions, especially ROE could partially mediate the relationship between MT and psychological distress.

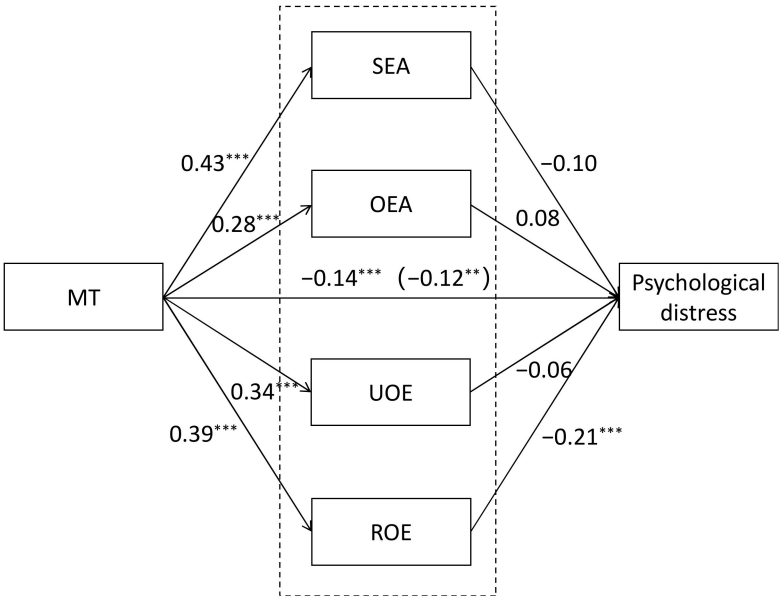

Figure 2. Multiple mediator model examining the direct and indirect relation of MT and psychological distress. Numbers in parentheses represent indirect effects. Note: all regression coefficients are standardized. SEA, ROE, UOE and OEA are the subscales of the Wong Law Emotional Intelligence Scale. ** $p < 0.01$.

4. Discussion

This study mainly examined whether MT would be negatively associated with psychological distress and positively associated with emotional intelligence in a sample of kindergarten teachers. In addition, we also investigated the mediating role of emotional intelligence between kindergarten teachers' MT and psychological distress. The present study might helpe to closely investigate the mediating role of different dimensions of EI between kindergarten teachers' MT and psychological distress. The results partially supported the hypotheses. The link between MT and psychological distress was mediated by the total score of EI and its subscales of ROE.

The outcomes of this research supported that MT was inversely related to teachers' psychological distress, which was consistent with previous research that proved a negative association between kindergarten teachers' mindfulness and negative emotions (e.g., emotional exhaustion and depression) [46]. A previous study suggested that teachers' mindfulness might help teachers build positive relationships and promote an emotionally supportive classroom climate in the face of stressors, and deal with complicated situations more proactively or more adaptively. Mindful teachers also responded to classroom circumstances and students' needs with openness, acceptance and compassion [19,41,47]. Therefore, teachers who have higher dispositional mindfulness would be likely to experience low levels of psychological distress.

As expected, the results support that MT was positively related to EI and its subscales, which was consistent with previous studies which reported that mindful attention awareness was positively

related to EI [31,39]. Wang and Kong [39] also suggested a significant positive association between mindful attention awareness and the total score of EI. The capability to recognize individual own emotions is a central aspect of EI, also named SEA, which is in line with a person's mindfulness and especially related to the self-acceptance of mental state [8]. Therefore, compared with other dimensions, the positive correlation between mindfulness and SEA seemed the most significant, which was consistent with previous studies [31]. People with a higher degree of dispositional mindfulness are inclined to pay attention to their internal experience, external judgments and keep awareness of every moment [8,48]. Our results also showed that MT was also positively related to OEA. An existing study regarding this indicated that mindfulness helped individuals to perceive their own emotions as well as others' emotions more accurately and effectively [31,38]. In addition, the present findings suggested that MT could positively predict UOE and ROE. Recent studies have demonstrated that mindfulness training was closely connected with the amelioration of attention functions, cognitive flexibility and problem-solving features [49]. In this case, mindful individuals are more likely to motivate themselves to regulate their emotions with the aim to achieve better performance. Some other researchers also found that mindfulness skills were associated with perceived self-control of negative emotions, which promoted a sense of control, and greater perceived control was associated with greater self-efficacy and work performance [32]. Furthermore, mindfulness focuses on consciousness and open awareness to the current experience, nurturing a stronger sense of self-control and behavioural regulation [29]. Kindergarten teachers usually need a high degree of emotional control and use due to the particularities involved in their profession [1]. Wang and Kong [39] also found that mindfulness was positively related to UOE and ROE. Thus, MT might positively assist teachers in promoting a higher level of UOE and ROE, which is consistent with previous studies [31].

The present results also showed that the EI total score played a mediating role between MT and psychological distress. This finding was consistent with those of Wang and Kong [39], who found that the total score of EI could mediate the relationship between mindfulness and psychological distress. We further extended the mediation model to the MT and psychological distress relationship in kindergaten teachers. The results of multiple mediation analyses suggested that only the dimension of ROE could play a significant mediating role between MT and psychological distress compared with other dimensions, which was not in line with our hypothesis. That is to say, the self-regulated functioning inherent in mindfulness relates to the ROE component of EI. This was consistent with previous studies about behavioural and neuroimaging evidence whereby emotion regulation has been linked with mindfulness [50]. In the study of Bao and Kong [31], dimensions of UOE and ROE could also mediate the relationship between mindfulness and perceived stress. Our result suggested that especially ROE might be an essential mechanism by which MT might help reduce psychological distress. Judging from the essential characteristics of ROE, it emphasizes the capability to control and regulate emotions, and it is the determinant to mitigating one's psychological distress [28], which is crucial for one's emotional experiences and adaptation to socioemotional challenges [51,52]. What is more, ROE was related to awareness, adapt, clarity and acceptance of emotions, as well as the ability to control emotional impulse and act in desired ways [53]. In other words, people with a higher degree of emotional regulation have a clearer cognition of their own emotions, find it easier to recover from negative situations and adjust their emotions flexibly, thereby avoiding emotional dysregulation to the greatest extent. As a result, ROE could effectively help kindergarten teachers cope with occupational stress with positive emotions, which proved the significant mediating role of ROE between EI and psychological distress.

We proposed the possible reasons for these results here. Judging from the essential characteristics of OEA, the ability of OEA emphasizes individuals' ability to perceive and comprehend emotions of other people and thereby to predict the possible emotional expression and emotional response of others around them [54], paying more attention to external people or situations, and so contributes relatively little in the process of mindfulness alleviating one's own psychological distress. As for SEA, which means the capability to recognize personal and individual emotions, it is in line with

a person's mindfulness and especially related to the self-awareness of mental state. Both SEA and OEA emphasize the appraisal of psychological quality. However, relieving psychological distress is often achieved through the direct regulation of psychological mechanisms. Compared with ROE, SEA [31] and OEA had a smaller association with psychological distress. UOEwas closely connected with the amelioration of attention functions, cognitive flexibility, self-efficacy and problem-solving features [32,49], which helped to enhance their performance and then indirectly relieved ones' psychological distress. Thus, ROA had a smaller association with psychological distress. Moreover, considering that OEA, SEA and UOE refer to the appraisal and use of emotions, and given that such dimensions are negatively correlated with psychological distress, it is possible that such dimensions can have a direct effect on reducing psychological distress by allowing people to have better social interactions and increase their performance, but not through more self-awareness and a regulatory process as mindfulness implies. Further studies should shed some light on this interesting research avenue and explore the effect of EI dimensions on different outcomes or dependent variables.

This study still has some limitations worth noting. First, the methods of this study were correlational and cross-sectional. Although previous studies have verified the impact of mindfulness on psychological distress, future studies could use longitudinal data to conduct cross-lag analysis to eliminate reverse causality to enhance the reliability of the results. Thus, longitudinal design or interventions are suggested in the future to provide more precise information about the direction of the causal relationship between kindergarten teachers' MT and emotional intelligence and psychological distress. Second, the data were dependent on self-report measures. Despite the excellent reliability and effectiveness of the tools used here, self-reported measures are inherently subjective and may cause bias (e.g., social expectations). A variety of assessment methods could be used to reduce the influence of subjectivity, such as behavioural measurements and so on. Third, the mediation effect of the study was relatively small. This may be due to the existence of various mediating mechanisms between MT and psychological distress. Some other mediating variables may help explain this relationship, such as attachment style [33], rumination [55] and psychological capital [56]. We mainly explored the potential relationship between MT and psychological distress of kindergarten teachers from the perspective of EI. Therefore, it is important to conduct more research to deepen our understanding of the connection between MT and psychological distress from different theories.

Despite these limitations, the present research provided insight into the internal paths between mindfulness and psychological symptoms in a sample of kindergarten teachers. The present study proposed that kindergarten teachers' mindfulness exerted effects on psychological distress through emotional intelligence, especially via dimensions of emotional regulation. This result may provided some valuable guidance for kindergarten teachers to implement mindfulness practice. What is more, COVID-19 poses a huge challenge to the work and life of an individual [57,58]. A recent study suggested that mindfulness-based training can effectively mitigate the negative psychological consequences of the COVID-19 outbreak, helping to restore well-being in the most vulnerable individuals [59]. Like other professions [58], kindergarten teachers have also experienced tremendous occupational pressure following the COVID-19 outbreak. Mindfulness skills may enable kindergarten teachers to regulate, control and use their own emotions better and better perceive the emotions of others, thereby enhancing their emotional adaptability and regulating ability [57,58]. Thus, it is necessary for kindergartens to pay attention to the mental state of kindergarten teachers and incorporate mindfulness into the teacher training system, which could help teachers realize the remission of psychological distress and better focus on their work. All in all, the findings are of great significance to the psychological rehabilitation and guidance of kindergarten teachers in the post-COVID era.

5. Conclusions

This research investigated the mediating path between kindergarten teachers' mindfulness, emotional intelligence and psychological distress and found that: (i) MT was positively associated with EI (including the EI total score and subscale scores), (ii) MT was negatively associated with

psychological distress, and (iii) EI and its dimension, especially ROE, mediated the effect of MT on psychological distress. These results provide some valuable guidance for kindergarten teachers to implement mindfulness, which helps achieve psychological health. In the field of early childhood education, mindfulness intervention as a preventive therapy may help kindergarten teachers effectively recognize and regulate emotions, thereby reducing their psychological distress. All in all, this is of great significance for promoting the professional mental health of kindergarten teachers. Additionally, the present findings may provide a better understanding of new issues and challenges for occupational health psychology in the post-COVID era.

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Effect of Employees' Perceived Green HRM on Their Workplace Green Behaviors in Oil and Mining Industries: Based on Cognitive-Affective System Theory

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Abstract: Drawing on cognitive-affective system theory, this study proposes that employees' perceived green human resource management (HRM) influences their workplace green behaviors through two psychological processes: the cognitive and the affective route. By analysing 358 questionnaires collected from Chinese firms in the oil and mining industry, we obtain evidence in support of our predictions, finding that employees' perceived green HRM positively impacts their voluntary workplace green behaviors and green creativity. Additionally, green psychological climate and harmonious environmental passion are found to partially mediate the relationship between employees' perceived green HRM and voluntary workplace green behavior while harmonious environmental passion is found to fully mediate the relationship between employees' perceived green HRM and green creativity. These findings shed light on the importance of green HRM in shaping employees' proactive workplace green behaviors and uncover how green HRM transforms employees' cognitive, affective, and motivational (CAM) factors into green actions.

Keywords: perceived green HRM; green psychological climate; harmonious environmental passion; voluntary workplace green behavior; green creativity

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1. Introduction

At present, economic development has inevitably brought about issues related to environmental pollution in China, including climate change, sewage discharge, and biodiversity loss. Such environmental issues are directly or indirectly caused by people's daily behaviors [1]. As organizations draw essential inputs from the natural environment, the sustainability of business depends greatly on their treatment of the natural environment [2]. Research [3,4] has found that organizations can generally increase their levels of branding recognition and sales by having a set of green policies in place. Employees, as the agents who actually implement such green practices, play an important role in helping an organization achieve its corporate green goals [5]. Given that human resource management (HRM) is mainly presented in relation to the environmental bottom line [6] and HRM practices play a critical role in dictating whether employees feel comfortable exhibiting their proactive tendencies [7], organizations have increasingly adopted green HRM practices to promote employees' green behaviors, such as organizational citizenship behaviors (OCB) towards the environment [8], task-related and voluntary employee green behaviors [9], eco-friendly behavior [10], and proenvironmental behavior [11]. Green HRM can be defined as "HRM aspects of green management", to promote employee green behavior in the workplace [12] (p. 1). Despite a recent surge in green HRM research, an understanding of how HRM is

perceived by employees and affects their attitudes and behaviors remains limited. For example, little is known about whether and how green HRM shapes prospective employee outcomes from both cognitive-affective frameworks. Even though the current literature has documented the antecedents of employees' workplace green behaviors, including individuals' values and behavioral intentions [13], corporate environmental responsibility [14], corporate social responsibility [15], daily affect [16], and transformational leadership [17], little work has focused on the effect of formal organizational context (i.e., HRM). In fact, compared to individuals' characteristics or leadership styles, which are usually stable and hardly change over a short period of time, green HRM as an instrumental strategy helps organizations to achieve their sustainability-oriented goals through creating a green environmental culture and green employees who are concerned about environmental issues [6,11,18]. Moreover, some HR literature [19] suggests that different HRM practices may influence employees' behavior through different psychological processes, however, it still remains unclear how green HRM influences employees' green behavior in the workplace. Therefore, it would be of great significance to focus more on the effect of the organizational situation factor, i.e., the green HRM on employees' proactive green behaviors as well as on the mediating process about how such HRM practices exert important influence on employees' workplace green behaviors.

This paper focuses on employees' proactive workplace green behaviors (i.e., voluntary workplace green behavior and green creativity). Voluntary workplace green behavior refers to "discretionary employee actions that contribute to the environmental sustainability of the employer organization but are not under the control of any formal environmental management policies or system" [20] (p. 3). It can also be seen as an extra-role behavior in which employees use their initiative to engage in behavior that encourages sustainability in the work context going beyond their formal job-tasks [21]. According to Kim et al. [20], this behavior benefits organizations directly by conserving resources and energy for cost reduction and indirectly by preserving the natural environment for organizational sustainability. Besides, green creativity refers to "the development of new ideas about green products, green services, green processes, or green practices that are judged to be original, novel, and useful" [22] (p. 109). Nurturing green creativity among employees to produce innovative end results is the primary concern of managers [22,23]. To achieve sustainable development of environment, organizations heavily depend on the behaviors of their employees [24]. Thus, we purpose that voluntary workplace green behavior and green creativity are two importance outcomes of green HRM, which is beneficial to an organization's operations.

This study intends to make three main theoretical contributions. First, it adds to the literature of green HRM by exploring the employee outcomes of green HRM in the workplace, thus help better understand the concept of green HRM as well as its consequences. As an emerging research topic of HRM, green HRM has not been sufficiently explored in terms of its effect on employees' workplace outcomes. Even though past research mostly reached the conceptualization stage [12,25], empirical testing and theorizing of the effect of green HRM on employees' workplace green behaviors is still in its infancy. Our study thus contributes this stream of research by empirically testing the effect of employees' perceived green HRM on their green behaviors, especially such effect in the context of the oil and mining industry in which the companies are very environmentally sensitive in nature and employees' proactive green behaviors are encouraged and valued.

Second, past research suggests that HRM practices might not directly exert influence on employee outcomes in the workplace, but indirectly does so through certain path or some psychological processes [19]. However, such a mediation path has been merely studied. Our research therefore contributes to these streams of research and enriches the literature on the psychological processes of individuals' green behaviors such as employees' green psychological climate and harmonious green passion. Responding to the call of Renwick et al. [12] for better understanding of the underlying mechanisms between organizations' practices and employees' green behavior, our research fills such major gap in the existing literature, thus making an indispensable contribution theoretically.

Last but not least, existing research explained the influence mechanism of green HRM on employees from various theoretical perspectives, such as the theory of planned behavior (TPB) [24], supplies-values fit theory [26,27], social identity and stakeholder theory [11,28], social exchange theory [29], Ability-Motivation-Opportunity (AMO) and contingency theory [30,31], but few studies have examined the mechanism from the cognitive-affective system theory. In fact, cognitive-affective system theory encompasses important psychological determinants of behavior within one dynamic system and provides a more detailed conceptual model for people's attitude and behaviors, thus can be a very helpful theoretical perspective in explaining how green HRM transforms employees' cognitive, affective, and motivational (CAM) factors into green actions. However, this perspective has been absent from the current literature in the field of green HRM and environmental protection. Our current study, therefore, fills such a research gap and makes an important contribution theoretically.

The remainder of this paper is organized as follows. First, we develop our hypothesis based on cognitive-affective system theory. We then conduct an empirical study from the oil and mining industry and discuss the results, while detailing the associated methods. From there, we present the theoretical contributions and practical implications of this research. Finally, we summarize the current study by outlining its limitations and potential future research directions.

2. Theory and Hypotheses

2.1. Cognitive-Affective System Theory

Cognitive-affective system theory was first used to describe the dynamics between individuals' personalities and related behaviors [32]. It states that individuals' behaviors are influenced by their own characteristics. Cognitive-affective units are not isolated, but rather are interconnected and organized, guided by a stable network of cognitions and affects the characteristic for that individual [32]. An organization can be regarded as a unit, and individuals' personalities and behaviors can be activated and processed dynamically through the cognitive, affective and motivational mediating processes that occur within such a unit [33]. Besides, cognitive-affective system theory assumes that individual differences in social behaviors tend to show some variability across different situations. In other words, the extent to which individuals exhibit different personalities and behaviors depends on the different units or organizations they are in, i.e., there exists a dynamic interactive effect between the environment and the individuals' behaviors [34].

According to this theory, the personality system contains mental representations whose activation leads to the behavioral consistencies that characterize the person. These representations consist of diverse cognitive-affective units, which include the person's construal and representations of the self, people, and situations, enduring goals, expectations, beliefs, and feeling states, as well as memories of people and past events [35]. Drawing on cognitive-affective system theory, in this study, we argue that it is possible that employees may exhibit different levels of green behaviors in the workplace based on the organizational situation factors as well as their different cognitive-affective psychological processes or psychological features they experience. In other words, the current study assumes that individuals' levels of green behaviors can be influenced by the interactive effect among the cognitive, affective and motivational factors.

2.2. Green HRM and Employee Workplace Green Behavior

This paper measures green HRM from employees' perceptions because differences in personal experiences and idiosyncratic preferences may lead employees to react differently to practices [36,37]. Existing studies have identified that green HRM can encourage employees to participate in practices beneficial to an enterprise's sustainable development (e.g., electronic filing, virtual conferencing, online training or energy-saving office management) [38,39], as well as improve employees' cognition and levels of commitment towards their organizations' environmental agendas and then better address their orga-

nizations' green goals and objectives [10]. Specifically, in the recruitment and selection process, green HRM focuses more on employees' green values and tends to attract those who value sustainable development [40]. For instance, green and sustainable development agendas can be incorporated into job descriptions and organization descriptions. Interview questions related to green issues and an organization's sustainable development can also be used to help select employees who exhibit potential and knowledge in terms of green issues [39]. With green HRM training, it helps increase employees' environmental protection awareness [41], improve their skills and abilities in terms of environmental protection [42], enhance their sense of responsibility and motivation in regard to environment management and encourage their engagement and participation in green behaviors. As for performance appraisal, green HRM considers employees' green performance in the appraisal, promotion and rewards process. For instance, bonuses, promotions and extra gifts can be given to employees who engage in green behaviors so that employees are more likely to be motivated to contribute to and engage in green activities [12,43]. For the employee involvement, green HRM focuses more on empowering employees in terms of green issues and should encourage and value employees' suggestions regarding pro-environmental initiatives [44]. To sum up, green HRM incorporates "green" elements into these sets of practices in terms of recruitment, training, performance appraisals, and rewards, which can influence employees' attitudes to elicit green behavior in the workplace. When employees perceive that their organization is adopting an openly communicated and formalized series of policies and practices that can overtly demonstrate their organization's green commitment and goals [10], they are more likely to not only act in accordance with their organization's green policies but to also engage in more voluntary workplace green behaviors and even green creativity. Hence, we hypothesize the following:

Hypothesis 1a. *Employees' perceived green HRM is positively related to employees' voluntary workplace green behavior.*

Hypothesis 1b. *Employees' perceived green HRM is positively related to employees' green creativity.*

2.3. The Mediating Role of Green Psychological Climate

In this study, we draw from cognitive-affective system theory and propose that employees' perceptions of green HRM may transmit its influence on employees' proactive green behaviors through two different paths (i.e., cognitive and affective routes). Cognitive attributes such as expectancies influence how individuals perceive cues and construct meaning of green HRM [45]. In particular, we argue that green psychological climates can serve as key psychological and social factors through which employees' perceived green HRM influences their green behaviors in the workplace. Green psychological climate is developed from psychological climate and green climate. Psychological climate refers to how organizational environments are perceived and interpreted by their employees [46,47]. Green climate has been described in the literature as the climate that applies to corporations that achieve sustainable objectives by implementing a range of pro-environmental policies [18,48,49]. Green psychological climate, therefore, is the perception an individual has of the organization's pro-environmental policies, processes, and practices that reflect the organization's green values [26]. Research has shown that green psychological climate is positively related to employees' green behavior [13,26,49].

Employees' social interaction with their organizations will contribute to the psychological climate, and they can determine the value of organizational practices, procedures and policies that they observe or encounter [50], including green HRM. When an organization has a strong HRM system in place, employees may interpret and digest such a management style and in turn determine how they perceive such green values and their organization [36,51]. It is through such a cognitive process that employees gradually develop views regarding organizations' green psychological climates. When an organization adopts a series of HRM practices, employees view the organization as concerned not only

with economic gains but also with employees' green-related activities and decisions [12]. In other words, organizations adopted green HRM and will incorporate these "green" elements into management areas by clarifying green responsibilities through job design and appraisals, rewarding green behaviors or promoting employee involvement in green behaviors. All of these strategies can help employees bring "green" to their attention and perceive a strong green psychological climate.

We argue that the green psychological climate perceived by employees could increase their willingness to make extra efforts beyond their duties. Prior research [52] suggests that an organization's climate can predict its employees' behavior and performance to some extent. For instance, employees may increase their overall effort in response to perceived concern for their climate safety [53]. Parker et al.'s [54] literature review also demonstrates that psychological climates are related to employees' outcomes, including job burnout, job satisfaction and job performance. Specifically, Rupp et al. [55] found that employees' perceptions of activities involving corporate social responsibility can trigger their attitudinal, emotional and behavioral responses. Similarly, Norton et al. [49] found that the association between employees' perceptions of the presence of environmental policies and green behaviors, including proactive and task-related green behaviors, and green work climate perceptions constitute psychological mechanisms that link such policies with behaviors. Based on the above arguments, we hypothesize the following:

Hypothesis 2a. *Green psychological climate mediates the relationship between employees' perceived green HRM and employees' voluntary workplace green behavior.*

Hypothesis 2b. *Green psychological climate mediates the relationship between employees' perceived green HRM and employees' green creativity.*

2.4. The Mediating Role of Harmonious Environmental Passion

In addition to the cognitive mediating process of green psychological climates, employees' perceived green HRM may influence employees' green behaviors via an affective route. Affect refers to a broad range of feelings that individuals experience including emotions (intense feelings that are directed at green HRM), moods (feelings that tend to be less intense, longer-lived, and more diffuse feelings), and attitudes (positive or negative orientations toward green HRM) [45,56]. Based on the affective concepts related to this theory, the current study investigates the other path, i.e., harmonious environmental passion, through which green HRM influences employees' proactive green behaviors. According to Robertson and Barling [57], harmonious environmental passion refers to a positive emotion that results in an individual wanting to engage in pro-environmental behaviors. Gilal et al. [27] found that green HRM enhances environmental performance via employees' environmental passion. When employees view the organization that they work for adopting a set of green HRM practices that penetrate various human resource attributions (e.g., rewards for environmentally friendly behaviors, high levels of empowerment given to employees to engage in pro-environmental initiatives and strong employee involvement in green decision-making, take initiative on environmental issues) [58], they are more likely to exhibit a high degree of passion towards these environmentally friendly activities. In this case, green HRM perceived by employees will evoke their harmonious passion for environmental sustainability.

Harmonious passion consists of two key characteristics: the activity that one feels harmoniously passionate about is autonomously integrated into one's identity and is enjoyable to oneself [59]. Employees who experience a high level of harmonious passion will feel energized and such passion will inspire them to make a difference [60,61] and further motivate employees to engage in activities that are the object of their passion. Research has identified positive effects of harmonious environmental passion on individuals' attitudes and behaviors. Specifically, Robertson and Barling [57] reveal that employees' environmental passion is a driver of employees' environmental behaviors. Afsar et al. [62] reported that employees' levels of environmental passion serve as a predictor of pro-environmental

behavior. Moreover, prior studies [63] suggest that positive emotions such as job satisfaction and happiness can encourage employees to exhibit pro-environmental behaviors in the workplace. In this vein, harmonious environmental passion can also be regarded as a positive emotion that is more likely to encourage employees' green behaviors. Additionally, research conducted by Dong et al. [64] identifies the mediating role of harmonious passion that connects contextual autonomy support and individual autonomy orientation with employee creativity. In summary, we predict that when employees develop higher levels of harmonious passion for the environment, they feel sense of responsibility and are more likely to be motivated to engage in green behaviors such as voluntary workplace green behavior and green creativity to benefit the organization's environmental development. Thus, we hypothesize the following:

Hypothesis 3a. *Harmonious environmental passion mediates the relationship between employees' perceived green HRM and employees' voluntary workplace green behavior.*

Hypothesis 3b. *Harmonious environmental passion mediates the relationship between employees' perceived green HRM and employees' green creativity.*

In sum, the hypothesis model is shown in Figure 1.

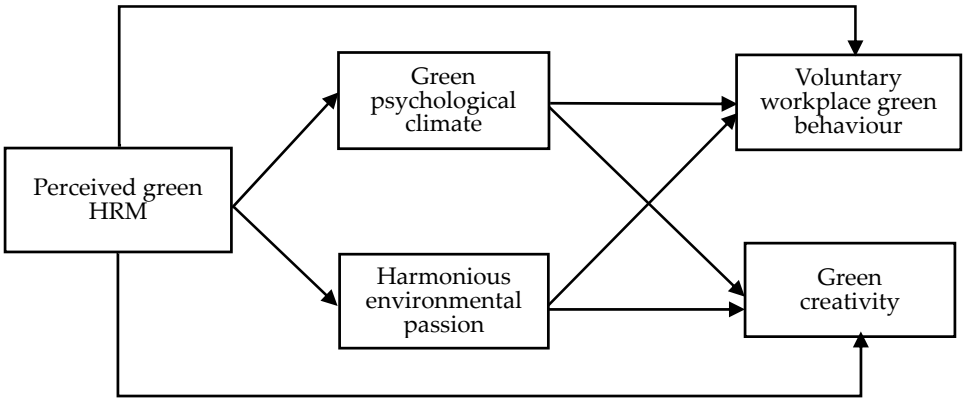

Figure 1. The concept model.

3. Materials and Methods

3.1. Participants and Procedure

The sample of firms examined in this study was drawn from the oil and mining industries in China. Compared to other industries, companies of the oil and mining industries generally pose a greater threat to the environment [65]. The oil and mining industry mainly includes oil field and mining services, as well as petroleum and mining equipment manufacturing. It uses oil field and mining as the main business, also providing engineering technical support and solutions for oil and mining exploration and production. Employees in this industry usually work in remote areas next to the oil fields and mines, and they are increasingly adopting highly efficient, energy-saving modern technology. In China, comprehensively improving the level of green and low-carbon recycling, mining technology innovation, and process equipment upgrade has become an urgent task for the high-quality development of the oil and mining industry. Thus, these companies do not simply meet their economic and legal obligations, but consider their green responsibilities to their employees and wider stakeholder groups in society. Before the mass distribution of questionnaires, we contacted four firms located in Hubei province and found that they have implemented green HRM practices to varying degrees. For instance, they have established an energy-saving, emission-reduction and low-carbon office as a daily management organization for energy conservation. Besides, they have established a green training program to ensure that employees fully understand the green standards. Employees are also

encouraged to participate in green activities such as process innovation projects, recycling programs, and clean production. Thus, we conducted an onsite investigation and invited frontline employees and their supervisors to participate in our survey. We offered 5 RMB incentive for participation.

A cover letter attached with the questionnaire assured the participants that their participation was voluntary and their responses would be used only for research purposes [66]. To reduce common method variance, data were collected from two sources: employees and their supervisors [67]. We used a code to match employees' ratings to their supervisors' responses. Employees completed questionniare included items on their demographic information and perceived levels of green HRM, on their surrounding green psychological climate and on their levels of harmonious environmental passion. A separate questionnaire for supervisors evaluated their subordinates' behaviors, including their voluntary workplace green behavior and green creativity. The questionnaire was sent onsite three times with a two-week time lag in data collection applied between the measurement of the predictor (perceived green HRM), mediator (green psychological climate and harmonious environmental passion), and outcomes (voluntary workplace green behavior and green creativity).

For the initial survey, we distributed 500 questionnaires, and 100 individuals failed to respond to our survey invitations. After removing incomplete questionnaires, we obtained 358 valid questionnaires yielding a response rate of 71.60%. The majority (57.82%) of the respondents were males. Of the respondents, 19.83% were under 25 years old, 22.90% were 26–35 years old, 22.35% were 36–45 years old, and 34.92% were more than 46 years old. Regarding their work experience, 10.90% had less than 5 years, 21.23% had 5–10 years, 32.12% had 11–15 years, and 35.75% had more than 16 years. Regarding their education level, 16.20% had a secondary technical school degree, 26.26% had a junior college degree, 31.56% had a Bachelor's degree, and 25.98% had a Master's degree. As to their occupations, 33.16% engaged in mining work, 21.08% engaged in geological prospecting work, 27.91% engaged in oil and gas field development, and 17.85% engaged in petroleum refining work.

3.2. Measures

We followed the standard translation and back-translation procedures [68] to ensure that the survey materials were accurately translated from English into Chinese. We used a 7-point Likert-type scale (from 1 = strongly disagree to 7 = strongly agree) for the participants' ratings of our survey measures.

3.2.1. Perceived Green HRM

Perceived green HRM was assessed with items taken from Tang et al. [40] (see Appendix A). The 18-item scale represents green HRM in terms of green recruitment and selection, green training, green performance management, green pay and reward, and green involvement. Participants rated their perceptions of their companies' HRM practices. Items measured included the following: "we attract green job candidates who use green criteria to select organizations", "we have integrated training to create the emotional involvement of employees in environment management", "our firm sets green targets, goals and responsibilities for managers and employees", "in our firm, there are financial or tax incentives (bicycle loams, use of less polluting cars)", and "in our firm, there is a mutual learning climate among employees for green behavior and awareness in my company". The coefficient alpha for this scale was measured as 0.83.

3.2.2. Green Psychological Climates

Green psychological climates were assessed with five items taken from Norton et al. [13] (see Appendix B). Each participant rated the extent to which his or her company "is worried about its environmental impact" and "is concerned with becoming more environmentally friendly". The coefficient alpha for this scale was recorded as 0.83.

3.2.3. Harmonious Environmental Passion

Harmonious environmental passion was assessed with the 10-item scale developed by Robertson and Barling [57] (see Appendix C). Sample items included "I am passionate about the environment" and "I enjoy practicing environmentally friendly behaviors". The coefficient alpha for this scale was recorded as 0.73.

3.2.4. Voluntary Workplace Green Behavior

Voluntary workplace green behavior was assessed with a measurement developed by Kim et al. [20] (see Appendix D). Supervisors rated the voluntary green workplace behaviors of each member of their work group with 6 items. Behaviors measured included the following: "using stairs instead of elevators when going from floor to floor in the building," and "recycling reusable things in the workplace". The coefficient alpha for this scale was recorded as 0.72.

3.2.5. Green Creativity

Green creativity was measured with the 6-item scale developed by Chen and Chang [22] (see Appendix E). Supervisors rated the following behaviors of their employees such as "the members of the green product development project suggest new ways to achieve environmental goals" and "the members of the green product development project promote and champion new green ideas to others". The coefficient alpha for this scale was recorded as 0.74.

3.2.6. Control Variables

Control variables included each employee's gender, age, years of work experience and education level because this demographic information may influence individual's attitude and behavior towards environmental issues based on previous research [11,29].

4. Analysis and Results

Table 1 reports the confirmatory factor analysis (CFA), which shows that the proposed five-factor model provides a good fit (χ^2/df = 1.93, RMSEA (Root Mean Square Error of Approximation) = 0.05, CFI (Comparative Fit Index) = 0.90, IFI (Incremental Fit Index) = 0.90). Table 2 shows the means, standard deviations and correlations among the focal variables. Perceived green HRM is positively related to green psychological climates, harmonious environmental passion, voluntary workplace green behavior and green creativity (r = 0.14, $p < 0.01$; r = 48, $p < 0.01$; r = 33, $p < 0.01$; r = 24, $p < 0.01$, respectively).

Table 1. Confirmatory factor analysis results for model comparisons.

Model Types	χ^2/df	Change χ^2	RMSEA	CFI	IFI
Five-factor model (expected model)	1.93	-	0.05	0.90	0.90
The best four-factor model (1: Perceived green HRM; 2: GPC; 3: HEP; 4: VGB + GC)	2.16	198.05 ***	0.06	0.87	0.88
The best three-factor model (1: Perceived green HRM; 2: GPC + HEP; 3: VGB + GC)	2.49	479.90 ***	0.07	0.84	0.84
The best two-factor model (1: Perceived green HRM + VGB + GC; 2: GPC + HEP)	2.82	758.59 ***	0.07	0.80	0.81
One-factor model (1: Perceived green HRM + VGB + GC+ GPC + HEP)	3.22	1101.91 ***	0.08	0.76	0.76

Notes: *** $p < 0.01$; GPC = Green psychological climate; HEP = Harmonious environmental passion; VGB = Voluntary workplace green behavior; GC = Green creativity.

Table 2. Descriptive statistics and correlations of variables.

Variables	1	2	3	4	5
1. Perceived green HRM	1				
2. Green psychological climate	0.14 **	1			
3. Harmonious environmental passion	0.48 **	0.38 **	1		
4. Voluntary workplace green behavior	0.33 **	0.20 **	0.29 **	1	
5. Green creativity	0.24 **	0.19 **	0.37 **	0.30 **	1
Mean	4.88	4.04	4.68	4.60	4.49
S.D.	0.61	1.07	0.63	0.75	0.77

Notes: ** $p < 0.01$ (Two tailed).

We applied the PROCESS method [69] to test the main effect of perceived green HRM on voluntary workplace green behavior and green creativity. The results of a Bootstrap 5000 test are shown in Table 3. The overall effect of perceived green HRM on voluntary workplace green behavior is valued at 0.40 (95% CI: 0.28, 0.52), supporting Hypothesis 1a. Similarly, the overall effect of perceived green HRM on green creativity is valued at 0.30 (95% CI: 0.17, 0.44), supporting Hypothesis 1b. After controlling for the mediating effect of green psychological climates and harmonious environmental passion, the direct effect of perceived green HRM on voluntary workplace green behavior is valued at 0.30 (95% CI: 0.17, 0.44), showing that the direct effect of perceived green HRM on voluntary workplace green behavior is significant. The direct effect of perceived green HRM on green creativity is valued at 0.10 (95% CI: −0.04, 0.24), showing that the direct effect of perceived green HRM on green creativity is non-significant.

Table 3. Total and direct effects.

Model Pathways	Effect	SE	BC95% CI Lower Upper
Total effects			
Perceived green HRM→VGB	0.40	0.06	(0.28, 0.52)
Perceived green HRM→GC	0.30	0.07	(0.17, 0.44)
Direct effects			
Perceived green HRM→VGB	0.30	0.07	(0.17, 0.44)
Perceived green HRM→GC	0.10	0.07	(−0.04, 0.24)

Notes: GPC = Green psychological climate; HEP = Harmonious environmental passion; VGB = Voluntary workplace green behavior; GC = Green creativity; SE = standard errors; CI = confidence intervals.

We also applied the PROCESS method [69] to test the indirect effect of perceived green HRM on voluntary workplace green behavior and green creativity. The results of a Bootstrap 5000 test are shown in Tables 4 and 5. As Table 4 shows, the mediating effect of green psychological climate between perceived green HRM and voluntary workplace green behavior is 0.02 (95% CI: 0.001, 0.06), supporting Hypothesis 2a. The mediating effect of harmonious environmental passion between perceived green HRM and voluntary workplace green behavior is 0.08 (95% CI: 0.01, 0.15), supporting Hypothesis 3a. When comparing the two mediating effects, the confidence interval of difference is −0.06 (95% CI: −0.14, 0.03), showing that the difference is non-significant. Similarly, as Table 5 shows, the mediating effect of green psychological climate between perceived green HRM and green creativity is 0.01 (95% CI: −0.004, 0.04), which does not support Hypothesis 2b. The mediating effect of harmonious environmental passion between perceived green HRM and green creativity is 0.19 (95% CI: 0.11, 0.28), supporting Hypothesis 3b. When comparing these two mediating effects, the confidence interval of difference is −0.18 (95% CI: −0.28, −0.10), showing that the difference is significant.

Table 4. Indirect effects of perceived green HRM and voluntary workplace green behavior.

Model Pathways	Effect	SE	BC95% CI Lower Upper
Total indirect effects	0.10	0.04	(0.03, 0.17)
Mediating effect of GPC	0.02	0.02	(0.001, 0.06)
Mediating effect of HEP	0.08	0.04	(0.01, 0.15)
GPC vs. HEP	−0.06	0.05	(−0.14, 0.03)

Notes: GPC = Green psychological climate; HEP = Harmonious environmental passion; GPC vs. HEP = GPC − HEP, SE = Standard errors; CI = Confidence intervals.

Table 5. Indirect effects of perceived green HRM and green creativity.

Model Pathways	Effect	SE	BC95% CI Lower Upper
Total indirect effects	0.20	0.04	(0.12, 0.29)
Mediating effect of GPC	0.01	0.01	(−0.004, 0.04)
Mediating effect of HEP	0.19	0.04	(0.11, 0.28)
GPC vs. HEP	−0.18	0.05	(−0.28, −0.10)

Notes: GPC = Green psychological climate; HEP = Harmonious environmental passion; GPC vs. HEP = GPC − HEP, SE = Standard errors; CI = Confidence intervals.

Besides, combining Table 3 with Tables 4 and 5, we can conclude that green psychological climates and harmonious environmental passion partially mediate the relationship between perceived green HRM and voluntary workplace green behavior while harmonious environmental passion fully mediates the relationship between perceived green HRM and green creativity.

5. Conclusions and Implication

The main purpose of this study was to examine the relationship between employees' perceived green HRM and their proactive outcomes (including voluntary workplace green behavior and green creativity) and to explore underlying mechanisms. In line with our expectations, employees' perceived green HRM positively impacts their voluntary workplace green behavior and green creativity. This finding is in line with past research showing that green HRM has a direct impact on employee outcomes [11,24,26]. Moreover, green psychological climates and harmonious environmental passion were found to partially mediate the relationship between employees' perceived green HRM and voluntary workplace green behavior while harmonious environmental passion was found to fully mediate the relationship between perceived green HRM and green creativity. These finding are consistent with previous research showing that it is useful to cultivate employees' green psychological climates and harmonious environmental passion to improve their outcomes [13,57]. Employees' green psychological climates only partially mediate the relationship between perceived green HRM and voluntary workplace green behavior, which may be because employees are generally motivated to exhibit behaviors that are consistent with their perceptions (cognition) of organizational practices [13] when their emotions (affection) regarding creativity have not been evoked. When employees experience positive emotions (i.e., harmonious environmental passion), they are more likely to become passionate about something of organizational and social importance (e.g., green creativity) to achieve environmental sustainability [57].

5.1. Theoretical and Practical Implications

The findings of this study make important contributions to the literature in three respects. First, past research suggests that HRM practices might not directly influence employee outcomes in the workplace but may indirectly do so through certain paths or psychological processes [19]. Despite the considerable volume of literature centered on the effect of green HRM, there is still much to be learned. Specifically, existing research investigated the influence mechanism of green HRM from the theory of planned behavior (TPB) [24], supplies-values fit theory [26,27], social identity and stakeholder theory [11,28],

social exchange theory [29], Ability-Motivation-Opportunity (AMO) and contingency theory [30,31], and most of them focused on cognitive perspective of psychological process. Our research therefore contributes to these streams of research and enriches the literature on the psychological processes (i.e., both cognitive and affective paths) that shape individuals' green behaviors, including employees' green psychological climates and harmonious green passion. In responding to Renwick et al.'s [12] call for a better understanding of the underlying mechanisms that operate between organizations' practices and employees' green behaviors, our research fills a gap in the existing literature and thus makes an indispensable contribution theoretically. Secondly, our study contributes to the literature on environmental management by investigating how individual green behaviors could be promoted in the workplace. While the current literature has documented the antecedents of employees' green behaviors, including individuals' values and behavioral intentions [13], corporate environmental responsibility [14], corporate social responsibility [15], daily affect [16], and transformational leadership [17], few works have focused on the role of formal organizational context such as employees' perceived green HRM. As HRM practices take care of systems and processes to influence employees in an orderly manner on a bigger scale [70], by identifying green HRM as an important management style that contributes to employees' green behaviors, this study enhances our understanding of human and organizational elements of environmental management and especially of the antecedents of individuals' proactive green behaviors in the workplace.

As a key practical implication of this study, we find that employees' perceived green HRM may help organizations stimulate their proactive environmentally oriented behavior. To achieve an organization's green goals and elicit broader positive employees' attitudes and behaviors, organizations should hire employees with strong environmental sensibilities and develop training programs to enhance employee skills for effectively undertaking green activities and enhancing green cognition. Organizations should also provide green performance indicators to performance management systems and appraisals. Further, organizations should offer green rewards to employees and involve employees in problem-solving and decision-making regarding green issues. In addition, our findings show that employees' perceived green HRM influences their outcomes through difference paths. Voluntary workplace green behavior is stimulated by both green psychological climates and harmonious environmental passion. Green creativity is only stimulated by harmonious environmental passion. As green creativity is connected to the maintenance of core competencies of an organization and is very important for firm growth, managerial attention should focus on ways to foster and develop employees' positive emotions, including their levels of harmonious environmental passion. For example, organizations may cultivate employees' harmonious environmental passion by strengthening their sense of psychological ownership (e.g., green empowerment and autonomy) and may provide guidance on issues concerning creativity to enhance their employees' positive views of their organizations.

5.2. Limitations and Directions for Future Research

Several limitations of our study can guide future research. Firstly, the data collection process was all carried out in a single location and the data from the oil and mining industry has limited representativeness. As such, it may be necessary to explore how green HRM is implemented in different parts and different industries in China. The present work might be extended to other geographic and industrial settings, both in China and cross-culturally. Secondly, we only tested two mediating effects of cognitive- and affective-based variables on relations between employees' perceived green HRM and their proactive green behaviors. In order to respond to the call for the development of the psychology of human behaviors and cognitive processes in complex environments [71], future works should explore other potentially mediating processes and the boundary conditions (i.e., task complexity) through which relationships between employees' perceived green HRM and their proactive green behaviors can be strengthened or weakened. Thirdly, consider the literature on general HRM which strongly emphasizes that culture affects people's aspirations, attitudes, and

behavior. Environmental (or green) organizational culture, which reflects how important environmental problems are to the organization, serve as invisible guiding principles of an employee in the workplace [72]. Future research is recommended to consider the role of green culture when examine the visible green practices. In addition, this study only focused on greenery and green model. Future research is thus suggested to explore more the biological aspects of greenery to see if there are other methods, such as brief relaxation practice, that are more effective to improve cognitive performance of employees [73]. Lastly, the current study mainly talked about psychological theories and did not study the biological aspects of greenery. However, there is also research evidence examining the greenery issue from the biological perspective, proving that certain horticultural therapy and greenery can be helpful in improving employees' physical health and mental health, thus activating more proactive green behaviors [74]. Future research is suggested to study more about the biological mechanism through which proactive green behaviors are more likely to be aroused.

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Institutional Review Board Statement: The studies involving human participants were reviewed and approved by Central China Normal University's ethics committee.

Informed Consent Statement: Not applicable.

Data Availability Statement: The data presented in this study are available on request from the corresponding author.

Conflicts of Interest: The authors declare no conflict of interest.

Appendix A. Items Used to Measure Perceived Green HRM

Appendix A.1. Green Recruitment and Selection

1. We attract green job candidates who use green criteria to select organizations;
2. We use green employer branding to attract green employees;
3. Our firm recruits employees who have green awareness;

Appendix A.2. Green Training

1. We develop training programs in environment management to increase environmental awareness, skills and expertise of employees;
2. We have integrated training to create the emotional involvement of employees in environment management;
3. We have green knowledge management (link environmental education and knowledge to behaviors to develop preventative solutions);

Appendix A.3. Green Performance Management

1. We use green performance indicators in our performance management system and appraisals;
2. Our firm sets green targets, goals and responsibilities for managers and employees;
3. In our firm, managers are set objectives on achieving green outcomes included in appraisals;
4. In our firm, there are dis-benefits in the performance management system for non-compliance or not meeting environment management goals;

Appendix A.4. Green Pay and Reward

1. We make green benefits (transport/travel) available rather than giving out pre-paid cards to purchase green products;
2. In our firms, there are financial or tax incentives (bicycle loans, use of less polluting cars);
3. Our firm has recognition-based rewards in environment management for staff (public recognition, awards, paid vacations, time off, gift certificates);

Appendix A.5. Green Involvement

1. Our company has a clear developmental vision to guide the employees' actions in environment management;
2. In our firm, there is a mutual learning climate among employees for green behavior and awareness in my company;
3. In our firm, there are a number of formal or informal communication channels to spread green culture in our company;
4. In our firm, employees are involved in quality improvement and problem-solving on green issues;
5. We offer practices for employees to participate in environment management, such as newsletters, suggestion schemes, problem-solving groups, low-carbon champions and green action teams [40].

Appendix B. Items Used to Measure Green Psychological Climates

1. (Our company) is worried about its environmental impact;
2. (Our company) is interested in supporting environmental causes;
3. (Our company) believes it is important to protect the environment;
4. (Our company) is concerned with becoming more environmentally friendly;
5. (Our company) would like to be seen as environmentally friendly [13].

Appendix C. Items Used to Measure Harmonious Environmental Passion

1. I am passionate about the environment;
2. I enjoy practicing environmentally friendly behaviors;
3. I enjoy engaging in environmentally friendly behaviors;
4. I take pride in helping the environment;
5. I enthusiastically discuss environmental issues with others;
6. I get pleasure from taking care of the environment;
7. I passionately encourage others to be more environmentally responsible;
8. I am a volunteered member of an environmental group;
9. I have voluntarily donated time or money to help the environment in some way;
10. I feel strongly about my environmental values [57].

Appendix D. Items Used to Measure Voluntary Workplace Green Behavior

1. (This member) avoiding unnecessary printing to save papers;
2. (This member) using personal cups instead of disposable cups;
3. (This member) using stairs instead of elevators when going from floor to floor in the building;
4. (This member) reusing papers to take notes in the office;
5. (This member) recycling reusable things in the workplace;
6. (This member) sorting recyclable materials into their appropriate bins when other group members do not recycle them [20].

Appendix E. Items Used to Measure Green Creativity

1. The members of the green product development project suggest new ways to achieve environmental goals;

2. The members of the green product development project propose new green ideas to improve environmental performance;
3. The members of the green product development project promote and champion new green ideas to others;
4. The members of the green product development project develop adequate plans for the implementation of new green ideas;
5. The members of the green product development project would rethink new green ideas;
6. The members of the green product development project would find creative solutions to environmental problems [22].

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Perceived Environmental Dynamism Promotes Entrepreneurial Team Member's Innovation: Explanations Based on the Uncertainty Reduction Theory

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Abstract: This study aims to examine the effect of perceived environmental dynamism on entrepreneurial team member's innovation. Based on the uncertainty reduction theory, this study constructs a multilevel moderated mediation model of the relationship between perceived environmental dynamism and entrepreneurial team member's innovation. By collecting questionnaires from 117 entrepreneurial team leaders and 479 team members in China, this research found that perceived environmental dynamism could stimulate entrepreneurial team members' innovation via triggering their information exchange behavior. In addition, entrepreneurial team members' intolerance for uncertainty and team cooperative climate can moderate the indirect positive relationship between perceived environmental dynamism and individual innovation. Our findings contribute to a better understanding of entrepreneurial team members' responses to dynamic environment and their innovation behavior.

Keywords: entrepreneurial team; environmental dynamism; individual innovation; uncertainty reduction theory; information exchange behavior

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1. Introduction

Compared to teams in mature organizations, high external environmental dynamism is one of the most prominent traits of entrepreneurial teams [1–3]. Since entrepreneurial teams have an exceptionally flat organizational structure [4], members usually assume multiple roles and have more opportunities to be in direct contact with customers and markets on the frontline [5]; thus, they have a clearer perception of environmental dynamism. However, the effect of highly perceived environmental dynamism on their behavior remains unknown. Since individual innovative behavior among members is critical to the survival and development of entrepreneurial teams [6–8], this study attempts to investigate the relationship between external environmental dynamism, as perceived by entrepreneurial team members, and their innovative behavior. The aim is to better understand environmental dynamism's effect on entrepreneurial team members, and to help them cope with external dynamic environments and improve individual innovation.

To investigate these effects, this study introduces the uncertainty reduction theory, which holds that since uncertainty evokes discomfort and anxiety, individuals are strongly motivated to engage in specific behaviors to reduce it [9,10]. Dynamism is a key characteristic of an environment that indicates a degree of rapid, unpredictable, and turbulent change [11]. In highly dynamic work situations, "there is rapid and discontinuous change in demand, competitors, technology and/or regulation, such that information is often inaccurate, unavailable, or obsolete" [12]. When members in an entrepreneurial team perceive that they are in a fully dynamic external environment, they may feel that they lack

the accurate information to make correct decisions, which leads to a decline in the team's predictive power, increasing feelings of uncertainty [13]. According to the uncertainty reduction theory [14], entrepreneurial team members that perceive high environmental dynamism have a stronger motivation to reduce uncertainty via action.

During field interviews with entrepreneurial team members, information exchange behaviors—the act of exchanging work-related information, knowledge, and ideas, such as "exchanging ideas with colleagues" and "exchanging ideas with team leaders"—was repeatedly mentioned as the preferred strategy for reducing uncertainty [15,16]. Since some studies propose that information exchange effectively reduces individual uncertainty [17], this study suggests entrepreneurial team members, who perceive high environmental dynamism, should frequently engage in this behavior. In doing so, individuals can obtain more information [18,19] and expand their ideas to develop [20], improve, and implement ideas. Thus, individual innovation can be improved [21].

The uncertainty reduction theory also suggests that individuals have varying perceptions of uncertainty and their choices regarding uncertainty-reducing behavior in different situations [9]. Intolerance for uncertainty is an important individual variable that influences individuals' processing of and responses to information about highly uncertain environments [22]. In a dynamic working environment, individuals with a high intolerance for uncertainty are often prone to negative emotions, like anxiety, and are unable to engage in appropriate behaviors that allow them to cope with the environment. Therefore, this study opines that intolerance for uncertainty among entrepreneurial team members affects their coping behaviors and subsequent behavioral outcomes.

Team cooperative climate emphasizes that a mutual sense of help and cooperation is incredibly important for a team's success [23]. In a team with a high cooperative climate, individuals that engage in information exchange behavior will receive better feedback, more recognition, and bear lower social costs. In an entrepreneurial team with a high cooperative climate, this study poses that members who perceive a high environmental dynamism will adopt information exchange behavior more frequently to reduce uncertainty, improving subsequent individual innovation. Contrariwise, in a team with a low cooperative climate, information exchange behavior is often discouraged, causing members that perceive a high environmental dynamism to adopt information exchange behaviors less frequently to reduce uncertainty, which also affects subsequent innovative behavior.

Figure 1 illustrates the theoretical framework of this study. In the following, we will first develop the hypothesis in the next section. Additionally, we will introduce our research design and the results of our data. Then we will discuss the contributions and future directions of this study.

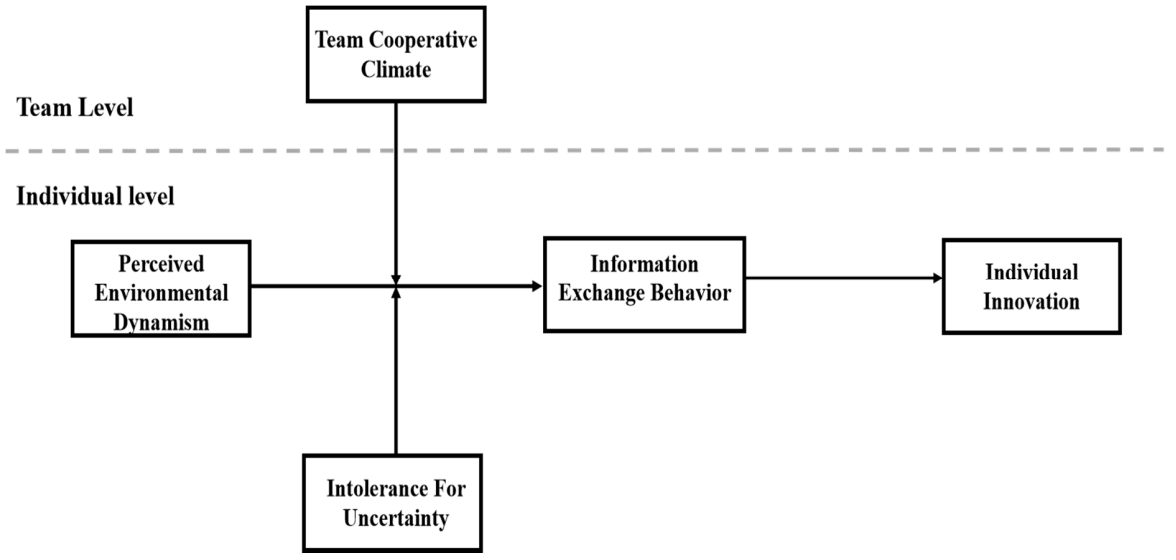

Figure 1. This study's theoretical framework.

2. Theories and Hypotheses

2.1. Information Exchange Behavior: A Mediating Effect

Based on the uncertainty reduction perspective, this study opines that individual's information exchange behavior increases with environmental dynamism. First, entrepreneurial team members that have a high perception of environmental dynamism believe that as the market information changes rapidly, they lack the required information for decision-making and accurate behavior [24], increasing their feeling of uncertainty. By taking information exchange behavior, team members can acquire more work-related knowledge and others' suggestions [20,25], which can provide more information for individuals to reduce uncertainty. Second, due to the increasing difficulty of decision-making under dynamic environment, entrepreneurial team members usually lack self-confidence in their behavior and decision-making skills [26], which further increases their feeling of uncertainty. Exchanging information in teams can promote interpersonal cooperation and support [27], improving individuals' confidence and an affirmation of their judgment and ideas [27]. Thus, entrepreneurial team members tend to exchange more information with other team members when they perceive high environmental dynamism. This study proposes the following:

Hypothesis 1. *Entrepreneurial team members' perceived environmental dynamism is positively related to their information exchange behavior.*

The individual innovation process among team members is comprised of three stages: Idea generation, screening, and modification [28]. This study opines that individual's information exchange behavior plays a role in promoting the three stages of individual innovation. First, entrepreneurial team members can obtain more varied information and ideas through information exchange, which provides them with additional raw materials for generating new and innovative ideas [20,29,30]. Second, sharing personal ideas also helps them improve understanding about others' comments and suggestions regarding their ideas [20], enabling them to better screen and improve their innovative ideas. Lastly, information exchange behavior can promote trust and cooperation among team members [20,31], which may allow for the realization of innovative ideas [32]. Thus, this study proposes the following:

Hypothesis 2. *Entrepreneurial team members' information exchange behavior is positively related to their innovation.*

When entrepreneurial team members perceive that the work environment is dynamic, they will feel higher uncertainty about their decisions and performance. According to the uncertainty reduction theory, they tend to ask others to collect and confirm their information before making decision to reduce the uncertainty. With more exchanged information, they can produce innovative outcomes. Thus, this study proposes that member's information exchange behavior can mediate the influence of environmental dynamism on member's innovation.

Hypothesis 3. *Entrepreneurial team members' information exchange behavior can mediate the positive relationship between perceived environmental dynamism and their innovation.*

2.2. Intolerance for Uncertainty: A Moderating Effect

An individual's trait of intolerance for uncertainty refers to the degree that an individual responds to negative emotions, perceptions, and behaviors when encountering uncertain situations [22]. Studies find that people with a high intolerance for uncertainty are not only more likely to notice uncertain factors in a particular situation and even amplify their effects, but also demonstrate more negative reactions, such as "I cannot sleep soundly when I feel uncertain" and "I cannot do other things when I feel uncertain" [33].

Berenbaum et al. [34] find that people with a high intolerance for uncertainty are easily overwhelmed by negative feelings in a highly uncertain environment; thus, they can only experience negative emotions—like feeling miserable and anxious—but are unable to respond to other clues in the environment and engage in uncertainty-reducing behavior. As a result, entrepreneurial team members with a high intolerance for uncertainty often pay too much attention to an environment's uncertainty, overestimating its negative aspects and experiencing negative emotions, like anxiety. They may fail to cope with the environment when they perceive that it is highly dynamic. In contrast, entrepreneurial team members with a low intolerance for uncertainty will not exaggerate the uncertainty that emerges from dynamic environments and be affected by negative emotions. They can positively cope with dynamic environments, engage in information exchange behavior to reduce feelings of uncertainty, and improve individual innovation. Hence, this study proposes the following:

Hypothesis 4. *Among entrepreneurial team members, their intolerance for uncertainty can negatively moderate the indirect positive relationship between perceived environmental dynamism and individual innovation through information exchange behavior. This indirect positive relationship will weaken when entrepreneurial team members demonstrate a high intolerance for uncertainty.*

2.3. Team Cooperative Climate: A Moderating Effect

In addition to individual differences, organizational factors can also affect uncertainty-reducing behavior among individuals [9]. Team cooperative climate is a unique organizational factor that stresses interdependence and cooperation [23]. In teams with a high cooperative climate, members will be more willing to provide others with sincere and useful information. Therefore, individual's information exchange behavior will have a better uncertainty reduction effect. Second, Previous studies posit that information sharing may reduce individuals' relative resources, negatively affecting information exchange behavior [35,36]. In teams with high cooperative climate, members focus more on encouraging cooperation and mutual help [37], and do not overly stress about competitiveness. This reduces potential costs for team members to engage in information exchange behavior, and enables engagement when members perceive high environmental dynamism. Therefore, this study proposes the following:

Hypothesis 5. *Entrepreneurial team cooperative climate can moderate the indirect positive relationship between members' perceived environmental dynamism and individual innovation through information exchange behavior. This indirect positive relationship weakens when entrepreneurial teams demonstrate a low cooperative climate.*

3. Research Design

3.1. Sample Selection and Data Collection

We used questionnaire survey to test our hypothesis. Considering the particularity of our research goal, we applied purposive sampling. The questionnaire survey was conducted among entrepreneurial teams from three incubators in Beijing. All entrepreneurial teams are from the Internet industry. Thus, these teams can involve in dynamic environment and innovation. We used online questionnaire to collect data. The administrators of these incubators helped us to collected data. To prevent common method bias, data were collected across two periods with an interval of two weeks. In the first period, this study collected data on three variables, including perceived environmental dynamism, team cooperative climate, and individuals' intolerance for uncertainty, as described by team members. Two weeks later, this study collected data on team members' innovative behavior, as described by team leaders, and data regarding information exchange behavior, as depicted by team members.

One hundred and twenty team leader questionnaires and 484 team member questionnaires were collected. Three team leader questionnaires and five team member question-

naires were invalid (with incomplete data) and were excluded. Finally, 117 team leader questionnaires and 479 of their team members questionnaires were effective. Three to eight questionnaires were collected from team members in each entrepreneurial team. The average team size of these teams are 12.04 team members. Additionally, the average formation time of these teams are 11.24 months. The average age of team members is 28.62 and 47% are male.

3.2. Variable Measurement

This study used scales that has been widely adopted by overseas scholars and translates the original English scale into Chinese by strictly adhering to the translation method proposed by Brislin [38]. All variables are measured using the seven-point Likert scale, where one represents "Strongly Disagree" and seven represents "Strongly Agree."

- Perceived external environmental dynamism: Drawing upon the scale proposed by Miller and Droge [39], this scale consists of five items, including "I think that our team has to constantly change marketing strategies to cope with market changes and external competition." The Cronbach's alpha is 0.91.
- Information exchange behavior: This variable is measured using the scale employed by Gong et al. [20], which consists of four items, including "I often exchange information with my team members and learn from them." The Cronbach's alpha is 0.93.
- Individual innovation: This study adopts the scale developed by Liu and Shi [40], which consists of six items, including "He/she often proposes innovative ideas at work." The Cronbach's alpha is 0.92.
- Intolerance for uncertainty: This variable is measured by using a simplified scale proposed by Carleton, Norton, and Asmundson [41]. It consists of 12 items, including "Unforeseen events make me feel very anxious." The Cronbach's alpha is 0.90.
- Team cooperative climate: This variable is measured using the scale proposed by Bogaert et al. [42], which consists of three items, including "In this team, cooperation is considered very important." The Cronbach's alpha is 0.93. This variable is a team-level variable that is aggregated from the scores of each entrepreneurial team member. Upon testing, the average Rwg of this variable is 0.85, while the median Rwg of this variable is 0.92. Since both are higher than the standard value of 0.7 that is adopted in general studies, this variable has a sufficient within-group consistency. The value of ICC (1) for this variable is 0.41. Based on Bliese's [43] (recommendation, this variable meets the criteria of being greater than 0.05 and less than 0.5, indicating that it has large between-group differences. The value of ICC (2) for this variable is 0.73, which is greater than the standard value of 0.7, which further indicates that it has large between-group differences. ln summary, all three indicators above meet the requirements, indicating that team cooperative climate demonstrates a sufficient level of aggregation and agreement, where this variable can be aggregated.
- Control variables: At the level of individual variables, this study controls for entrepreneurial team members' age, gender, and education levels. Regarding team variables, this study controls for entrepreneurial teams' size and time of their formation, where the size of a team is measured by its number of stable employees.

4. Results

This study conducted the following steps to do the statistical analysis. First, we tested the reliability of variables (Cronbach's alpha) and discriminant validity between variables (CFA). Second, we did descriptive statistical analysis of our sample including mean, standard deviation, and correlation. Third, because our data are nested with team and individual level variables, we used the cross-level path analysis to test hypotheses.

4.1. Confirmatory Factor Analysis

This study conducts a confirmatory factor analysis using Mplus 7.4, and the results of this analysis are shown in Table 1. This study fits a five-factor model (χ^2 = 2106.27,

df = 395, RMSEA = 0.03, TLI = 0.98, CFI = 0.98, SRMR = 0.02). According to the parameter criteria, this model fits the data well. As observed in Table 1, the chi-square value of the five-factor model is significant, and its parameter indicators perform better compared to the four-factor model and other models. This indicates that the fitting effect of other models is significantly worse than that of the five-factor model, while the five variables involved in this study have adequate discriminant validity.

Table 1. Results of the confirmatory factor analysis.

Description	χ^2	df	RMSEA (90% CI)	TLI	CFI	SRMR
Five-factor model (hypothetical model)	582.27 ***	395	0.03 (0.026, 0.037)	0.98	0.98	0.02
Four-factor model (perceived environmental dynamism and intolerance for uncertainty combined)	2126.35 ***	399	0.10 (0.091, 0.099)	0.86	0.87	0.12
Three-factor model (perceived environmental dynamism, intolerance for uncertainty, and team cooperative climate combined)	3272.74 ***	402	0.12 (0.118, 0.126)	0.77	0.80	0.13
Two-factor model (perceived environmental dynamism, intolerance for uncertainty, team cooperative climate, and information exchange behavior combined)	4728.04 ***	404	0.15 (0.146, 0.153)	0.66	0.68	0.17
One-factor model (all combined)	8120.14 ***	405	0.20 (0.196, 0.203)	0.40	0.44	0.22

*** $p < 0.001$.

4.2. Descriptive Statistical Analysis

Table 2 summarizes the mean, standard deviation, and correlation coefficient for each variable in this study. Perceived environmental dynamism among entrepreneurial team members has a positive correlation with their information exchange behavior ($\beta = 0.57$, $p < 0.01$), while the latter is positively correlated with individual innovation ($\beta = 0.55$, $p < 0.01$). Meanwhile, a positive correlation exists between the perceived environmental dynamism among entrepreneurial team members and their individual innovation ($\beta = 0.30$, $p < 0.01$). These findings preliminarily support some of the hypotheses posed in the above theoretical model.

Table 2. Variables and coefficients: Descriptive statistics of a correlation between variables.

Variable	Mean	Standard Deviation	1	2	3	4	5	6	8	9
Individual level										
1. Gender	0.67	0.47								
2. Age	28.62	5.89	−0.09							
3. Education	2.24	0.72	0.04	0.32 **						
4. Perceived environmental dynamism	4.96	0.95	0.05	−0.07	0.02					
5. Information exchange behavior	5.47	1.21	0.03	−0.04	0.01	0.57 **				
6. Individual innovation	5.12	1.40	0.00	−0.04	−0.04	0.30 **	0.55 **			
7. Intolerance for uncertainty	4.71	1.49	−0.03	−0.05	−0.02	−0.03	−0.22 **	−0.22 **		
Team level										
8. Team size	12.04	5.21								
9. Team formation time	11.24	3.18							0.14 **	
10. Team cooperative climate	4.11	1.17							0.21 **	0.21 **

Note: The number of individual-level samples = 479; the number of team-level samples = 117, ** $p < 0.01$.

4.3. Hypothesis Testing and Analysis

This study distinguishes the effects of different levels by using a cross-level path analysis method and performing hypothesis testing using the statistical software, Mplus. A model was constructed based on the above research hypotheses, and the parameters of model fitting were as follows: $\chi^2 = 3.24$ *** and df = 5; RMSEA = 0.01, which is lower than 0.05; CFI = 0.98 and TLI = 0.98, demonstrating a relatively adequate fit for the model. Based on the relatively satisfactory fit for the overall model, this study obtains the path coefficients for its direct and indirect effects, while also conducting path testing on moderating effects. These coefficients are shown in Table 3.

Table 3. The results of unstandardized path coefficients.

Structural Path	Unstandardized Path Coefficient
H1: Perceived environmental dynamism →information exchange behavior	a: 0.74 (95% CI: 0.349, 1.121)
H2: Information exchange behavior → individual innovation	b: 0.53 (95% CI: 0.308, 0.742)
H3: Perceived environmental dynamism →information exchange behavior → individual innovation	A × b: 0.39 (95% CI: 0.103, 0.669)
Moderating effect of intolerance for uncertainty on H1	c: −0.08 (95% CI: −0.133, −0.019)
Individual level: Information exchange behavior →individual innovation	b: 0.53 (95% CI: 0.308, 0.742)
H4: Moderating effect of intolerance for uncertainty on (perceived environmental dynamism →information exchange behavior → individual innovation) with a mediator	c × b: −0.04 (95% CI: −0.076, −0.004)
Moderating effect of team cooperative climate on perceived environmental dynamism at team level →information exchange behavior	d: 0.19 (95% CI: 0.103, 0.279)
Individual level: Information exchange behavior →Individual innovation	b: 0.53 (95% CI: 0.308, 0.742)
H5: Moderating effect of team cooperative climate on (perceived environmental dynamism → information exchange behavior → individual innovation) with a mediator	d × b: 0.10 (95% CI: 0.028, 0.185)

Figure 2 illustrates this study's path testing results. Hypothesis 1 suggests that perceived external environmental dynamism among entrepreneurial team members will positively affect information exchange behavior. According to Figure 2, the path coefficient for this effect is 0.74 ($p < 0.005$, 95% CI [0.349, 1.121]), which is significant. Therefore, Hypothesis 1 is supported.

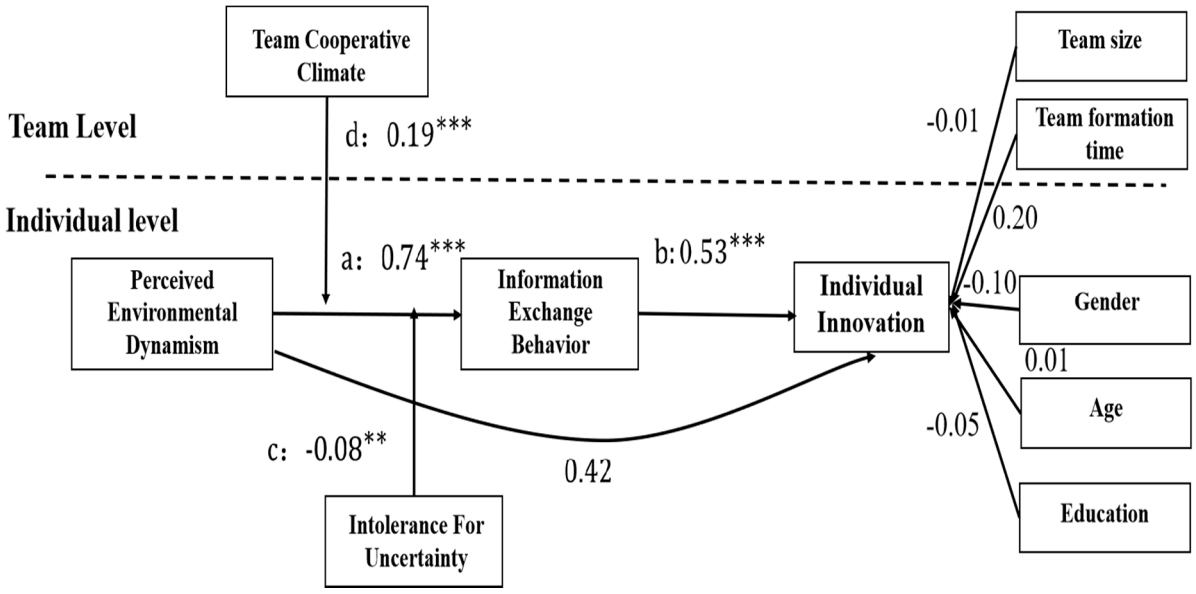

Figure 2. The model's path diagram. Note: ** $p < 0.01$, *** $p < 0.001$.

Hypothesis 2 suggests that information exchange behavior will positively affect individual innovation. According to Table 3, the path coefficient for this effect is 0.53 ($p < 0.005$, 95% CI [0.308, 0.742]), which is significant. Therefore, Hypothesis 2 is supported.

Hypothesis 3 suggests that information exchange behavior can mediate the positive effect of perceived environmental dynamism on individual innovation. According to Table 3, the path coefficient for this indirect effect is 0.39 ($p < 0.01$, 95% CI [0.103, 0.669]), which is significant. Hypothesis 3 is supported.

Hypothesis 4 suggests that entrepreneurial team members' intolerance for uncertainty will moderate the indirect positive relationship between their perceived environmental dynamism and individual innovation, which is mediated by information exchange behavior. Table 3 shows that the unstandardized path coefficient of the moderating effect with a mediator is −0.04 ($p < 0.05$, 95% CI [−0.076, −0.004]), which is significant. Therefore, Hypothesis 4 is supported. To better demonstrate the moderating effect of intolerance for uncertainty, this study illustrates the interaction—as shown in Figure 3—according to the recommendation of Cohen et al. [44]. Although the correlation coefficient's change between the groups with a high and low intolerance for uncertainty among entrepreneurial team members is small (only −0.187), the correlation coefficients change significantly ($p < 0.05$). When entrepreneurial team members have a low intolerance for uncertainty, a stronger correlation exists between perceived environmental dynamism and individual innovation; when they have a high intolerance for uncertainty, perceived environmental dynamism has a lower positive effect on individual innovation.

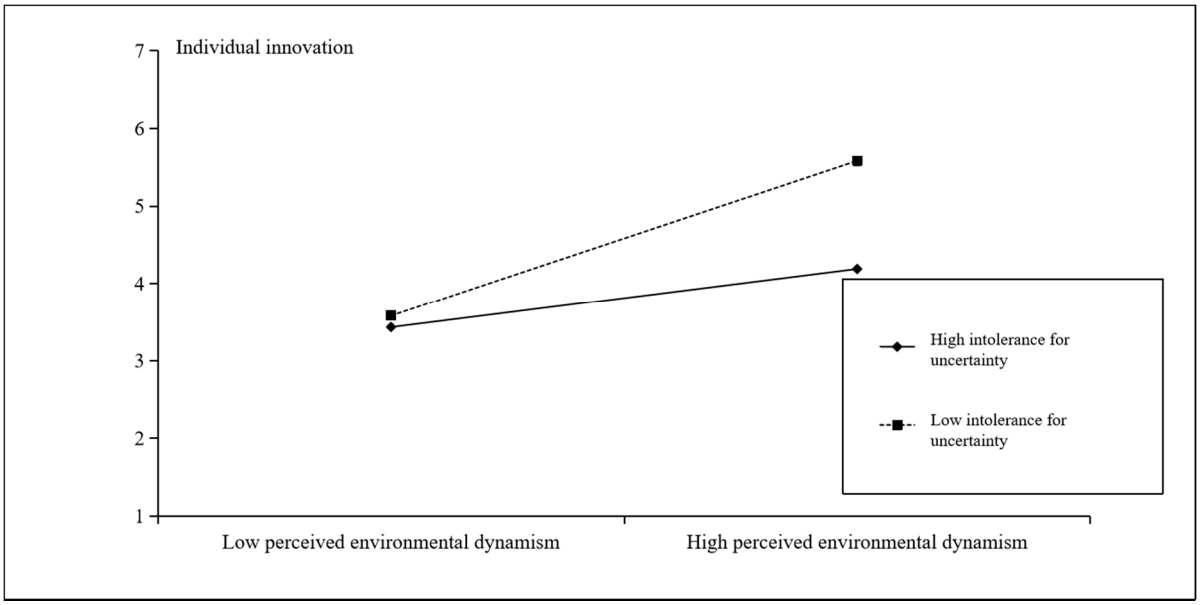

Figure 3. The moderating effect of intolerance for uncertainty.

Hypothesis 5 suggests that team cooperative climate will moderate the indirect positive relationship between perceived environmental dynamism and individual innovation across levels, which is mediated by information exchange behavior. According to Table 3, the unstandardized path coefficient of the cross-level moderating effect with a mediator is 0.10 ($p < 0.01$, 95% CI [0.028, 0.185]). Therefore, Hypothesis 5 is supported. As shown in Figure 4, the correlation coefficients of perceived environmental dynamism and individual innovation between groups with varying levels of cooperative climate differ significantly, which is 2.86 ($p < 0.005$). When entrepreneurial teams have a strong cooperative climate, a stronger correlation exists between perceived environmental dynamism and individual innovation; when entrepreneurial teams have a weak team cooperative climate, perceived environmental dynamism has a lower positive effect on individual innovation.

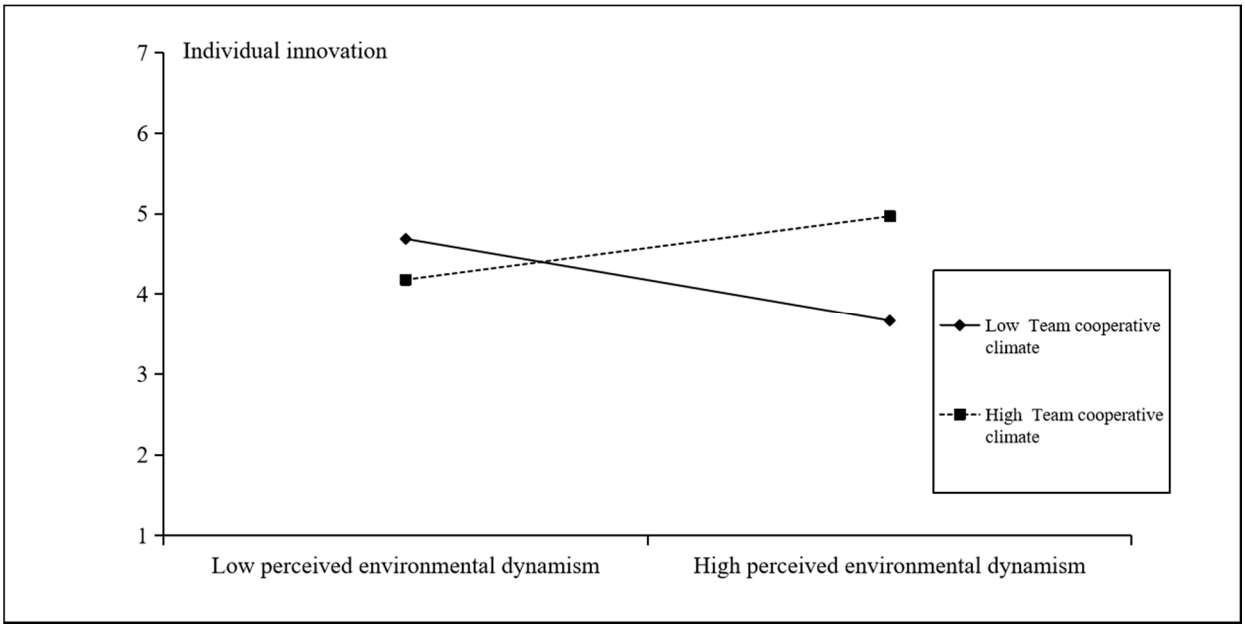

Figure 4. The moderating effect of team cooperative climate.

5. Discussion

5.1. Theoretical Contributions

This study has made some theoretical contributions. First, although prior entrepreneurship studies have realized the influence of the uncertain environment on venture teams [45], few of them focuses on the effect of uncertain environment on individual level factors. This study has taken the lead in investigating the effect of perceived environmental dynamism on entrepreneurial team members' innovation. It fills in the research gap of finding the influence of environmental dynamism on individual, broadening the existing entrepreneurship research.

Second, to explore how dynamic environment can influence organizational behaviors, the existing environment research usually starts with a strategic perspective [46,47]. However, the strategic perspective cannot be applied to the individual level. This study uses the uncertainty reduction theory, which introduces a new perspective. It not only explains the relationship, but also broaden the scope of application of the uncertainty reduction theory.

Lastly, this study reveals the whole mechanism that impose the effect of uncertain environment on member's innovation, where information exchange behavior is the mediator and the intolerance for uncertainty and team cooperative climate are the moderators. It further enriches research on the general effects of environmental dynamism in entrepreneurial teams on individual innovation.

5.2. Practical Implications

This study's results have practical implications for entrepreneurial team to improve innovation under dynamic environment. First, the results suggest team member's information exchange behavior is the antecedents of member's innovation, which indicates that boosting this behavior of members is more likely to improve innovation. Practically, organizations in dynamic environment can encourage and give support to team member's information exchange behavior [48,49]. Second, our results support the hypothesis that high team cooperative climate and high individual intolerance for uncertainty can strengthen the positive relationship between perceived environmental dynamism and individual innovation. Thus, we suggest that team leaders can build up cooperative climate in the team and select team members with the personality of the intolerance of uncertainty, when the external environment is dynamic.

5.3. Limitations

This study has some limitations. First, although the questionnaires were collected at different times, they were completed by entrepreneurial team members, so the common method bias is unavoidable. Future research may collect data from multiple sources or employ other research methods to reduce the common method bias. Second, all of the samples come from Beijing and Internet-related industries. Although the possible effects of regional and industry factors have been reduced, this sample selection may influence the representativeness of the conclusions. In the future, the scope of research can be further expanded to reduce bias. Third, this study only focuses on the positive effects of environmental dynamism on individual innovation. In fact, a dynamic environment also entails a higher risk [21], so it is worthwhile to investigate the potential negative effects on individual innovation and other team behaviors. Lastly, according to feedback from previous field interviews, this study uses the information exchange behavior as the primary means for reducing uncertainty among entrepreneurial team members. Since individuals also adopt other uncertainty-reducing methods, however, future research can enrich and expand the topic from this perspective [50].

6. Conclusions

Based on the uncertainty reduction theory, this study utilizes empirical research to investigate the effect and boundary conditions of perceived environmental dynamism among entrepreneurial team members on their individual innovation behavior [51]. The results showed that perceived environmental dynamism positively affected their individual innovation through their information exchange behavior. When entrepreneurial team members have a high intolerance for uncertainty, the indirect positive relationship between perceived environmental dynamism and individual innovation (via information exchange) is weakened [52]. When their team have a high cooperative climate, the indirect positive relationship between perceived environmental dynamism and individual innovation (via information exchange) among entrepreneurial team members is strengthened.

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Does Paradoxical Leadership Facilitate Leaders' Task Performance? A Perspective of Self-Regulation Theory

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Abstract: As an emerging Chinese indigenous leadership style, paradoxical leadership has received considerable attention from researchers. Many studies have demonstrated the positive impact of paradoxical leadership on employees, teams, and organizations; however, there is less information on how paradoxical leaders influence their own work outcomes. On the basis of self-regulation theory, in this study, we examined the impact of paradoxical leadership on leaders' task performance. In addition, we investigated the mediating effects of job crafting and career resilience on this relationship. Through a survey of 120 leaders and 271 of their immediate followers, our empirical analysis found the following: (1) paradoxical leadership was positively related to leaders' task performance, (2) job crafting mediated the relationship between paradoxical leadership and leaders' task performance, and (3) career resilience positively moderated the relationship between paradoxical leadership and job crafting, and had an indirect effect on task performance through job crafting. Our model offers novel insights into the paradoxical leadership literature and implications for improving leaders' job crafting and task performance.

Keywords: paradoxical leadership; job crafting; career resilience; task performance; self-regulation theory

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1. Introduction

Paradoxical leadership refers to leaders who simultaneously use two mutually opposing, interdependent, and complementary behaviors to satisfy both structural and individual needs [1]. This type of leadership is the most effective when leaders deal with organizational paradoxes related to balancing short- and long-term goals [2]. Emphasizing the coexistence of mutually independent elements, paradoxical leadership is a process that is based on personal characteristics and cognition, using a "both-and" strategy instead of an "either-or" strategy to resolve organizational paradoxes [1]. Research has documented the benefits of paradoxical leadership for employees, teams, and organizations; for example, positive impacts include the following: employees' proficiency, adaptability, proactivity [1], voice [2], creativity [3,4], ambidexterity [5], resilience [6], in-role and innovative performance behavior [7], team perspective-taking, and innovative performance [8], as well as organizational creativity [9], ambidextrous innovation [10], and strategic agility [11].

Nevertheless, little is known about how leaders are affected by engaging in such behavior. Specifically, the literature on paradoxical leadership has mainly focused on recipients of such leadership practices; however, more recent studies have shown that there are also benefits for the leaders themselves [12,13]. Since paradoxical leadership is more abstract and less predictable than other leadership styles, to what extent this type of leader manages the contextual paradox that influences the critical success factors, so far, it has been ignored [1,14]. Meanwhile, the focus of previous studies on task performance has been on the followers rather than leaders [15,16]. In this study, we focused on leaders' task performance, which has been considered by Organ and Paine [17] (p. 375) to be "part and

parcel of the workflow that transforms inputs of energy, information, and materials into outputs in the form of goods and services to the external constituency." Task performance is the most direct type of performance for evaluating job performance, representing an individual's behaviors for completing the tasks specified by job responsibilities, including the quantity and quality of work expected by an organization [18]. It is usually considered to be a particular aspect of an individual's in-role performance within an organization [19]. Specifically, previous studies have proposed that when people want to achieve good job performances, they must develop a precise understanding of their role and task requirements [20,21]. Accordingly, in contrast to previous studies that have focused on the impact of paradoxical leadership on followers' consequences, in this study, we explore the effects of paradoxical leadership on leaders' task performance from an actor-centric perspective.

Previous studies on the effects of leadership behaviors on leaders themselves have mostly been based on resource conservation theory [13,22] or affective event theory and self-determination theory [12]; however, these studies have lacked discussions from the perspective of self-control. In order to better understand the relationship between paradoxical leadership and leaders' task performance, we drew from self-regulation theory. Self-regulation theory is a self-control process by which people notice or anticipate differences or contradictions between themselves and their work and take the initiative to make changes [23,24]. Paradoxical leaders continuously face higher expectations that require them to use their psychological, cognitive, and emotional resources, which inevitably increases their stress [1,14]. A discrepancy between the goals and current state occurs, and negative (or positive) feedback loops develop, leading to changes in behaviors to realign goal attainment, therefore, awakening the self-regulation mechanism [25]. We thus argued that job crafting is a self-control process that is responsible for goal setting, self-improvement, and self-management behaviors, while self-regulation ensures the completion of plans, focusing on goals, inhibition of impulses, and regulation of behaviors [26,27]. Job crafting has been defined as an individual initiative that helps to improve the conflict between people and work, to enhance work adaptability, and to maintain the continuous challenge, motivation, and sense of meaningfulness in work [28]; it includes increasing work resources, increasing challenging work demands, and reducing impeding work demands [29]. Scholars have emphasized the necessity and importance of job crafting from an actor-centric perspective [30,31], whereas how leaders' job crafting influences their own task performance is unclear. In addition, studies in developmental psychology have emphasized that resilience contains self-regulatory functions that serve to buffer the negative effects of an undesirable environment [32]. Self-regulation is an internal or transactional process that enables individuals to guide their goal-directed activities over time and across changing circumstances [33]. For example, Gardner et al. [34] regarded resilience as a relatively positive adaptation in the face of heightened risk for maladaptation and argued that such adaptation required an actor's self-regulation. Resilience can be defined as an effective response and adaptation in the face of loss, difficulty, or adversity [35]. Career resilience extends resilience research to the career field, which is defined as an individual's resilience to professional setbacks in a poor work environment [36,37]. Therefore, this study inferred that job crafting can transform the stress of paradoxical leadership into motivation and plays an intermediary role in the relationship between paradoxical leadership and leaders' own task performance. Career resilience is used as a boundary condition for paradoxical leadership to influence leaders' job crafting and task performance, thereby constructing an integrated theoretical model (Figure 1).

The key contributions of this research are as follows: First, scholars have pointed out that behaving paradoxically may tax leaders' cognitive resources, which can cause leaders to experience psychological stress [1,14]; as such, we shifted our research focus from the influence of recipients to the sender and we explored the impact of paradoxical leadership on their job-crafting and task performance. Second, previous studies on the role of leadership practices on leaders themselves have mostly been done by considering resource conservation theory [13,22] or affective events theory and self-determination theory [12].

In this study, we investigated the impact of paradoxical leadership on leaders' task performance based on self-regulation theory to open the above "black box," highlighting the necessity and importance of job crafting on leaders. Finally, we took an initial step toward examining an important boundary condition, i.e., career resilience, which is considered to be the key to overcoming career stress [38]. We aimed at enriching the understanding of how career resilience explains the relationship between paradoxical leadership and leaders' task performance.

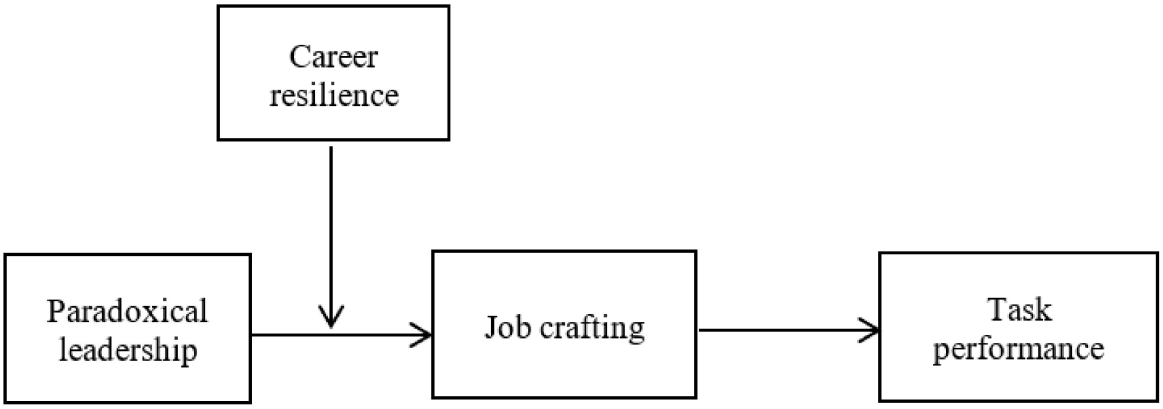

Figure 1. The conceptual model.

2. Research Framework

2.1. Paradoxical Leadership and Task Performance

Paradoxical leadership is defined as the use of seemingly competing, yet inter-related, behaviors to simultaneously respond to structural and follower demands over time [1], that is, a leader adopts "both-and" behaviors that integrate and accept opposite demands simultaneously in order to gain from the intent behind the paradox [39]. Scholars insist that behaving paradoxically taxes leaders' cognitive resources, which may cause them psychological stress and then influence their attitudes and behaviors [1,14]. In this paper, we propose a positive relationship between paradoxical leadership and leaders' task performance from two aspects.

First, it has been shown that the nature of work stressors (i.e., challenge and hindrance) can affect individuals' intrinsic motivation and way of thinking, and therefore, affect their work attitudes and behaviors [40]. Challenge stressors include workload, time pressure, and job complexity, which can be overcome and can have a positive impact on individual growth and development; hindrance stressors include organizational politics, role conflict, role ambiguity, and work insecurity, which are difficult to overcome and can hinder individual development and the achievement of goals [41]. In this study, we considered the pressure that paradoxical leadership brings to leaders in the form of a challenge stressor that promotes leadership progress. As a benign stressor, relevant studies have shown that challenge stressors correlate positively with task performance [40]. Therefore, we believe that paradoxical leadership requires cognitive resources and can cause pressure on leaders [1,14], and this kind of challenge stressor encourages them to achieve better task performance.

Second, according to previous studies, paradoxical leadership has four skills, i.e., cognitive complexity, confidence, conflict management, and communication [42]. In a similar vein, we explain the influence of paradoxical leadership on leaders' task performance based on these four skills. First, cognitive complexity enables paradoxical leaders to explore contradictions to find new possibilities and reframing the existing mind-set [42]. Leaders who explore the dynamics of a contradictory tension are able to cautiously recognize new relationships and connections [43], which guide them to achieve improved task performance. Second, confident paradoxical leaders view setbacks as learning opportuni-

ties, seek to stand out from seemingly conflicting goals, and have the courage to accept challenges at every turning point [42], increasing the probability of better task performance. Furthermore, paradoxical leaders understand how to deal with difficult conflicts and how to make the best decisions [44]. They usually use creativity instead of passively responding to paradoxes and purposefully deal with competing demands to prompt themselves and their followers to question existing assumptions and seek new breakthroughs [45]. Finally, leaders need to inspire followers to accept the paradox by effectively articulating the overall vision of conflicting needs [46]. In this case, paradoxical leaders can clarify their own logic and justify their own decisions for more effective paradoxical management [42]; thus, effective communication can promote leaders' task performance. On the basis of the above analysis, we proposed the following hypothesis:

Hypothesis 1 (H1). *Paradoxical leadership is positively associated with leaders' task performance.*

2.2. Mediating Role of Job Crafting

According to the theory of self-regulation, individuals use self-regulation resources to narrow the difference between a current state and a target in order to achieve a desired state [47]. Consistent with the view of Searle and Lee [48], people usually display active behaviors to achieve a better match between work requirements and resources. This means that achieving a person-work fit is one of the purposes of people engaging in active behaviors.

Job crafting indicates the extent to which individuals change their behavior according to their abilities and needs to balance work requirements and resources [49,50], which is called spontaneous behavior change [51]. Berg et al. [52] found that the complexity and challenge of a task can stimulate an individual's job-crafting behavior. The following self-regulating behaviors are involved in job crafting: (1) self-observation, when relevant factors motivate job crafting; (2) self-judgment, when suitable job crafting opportunities are identified; (3) self-reaction, the action of job crafting [53]. Therefore, according to this theory, paradoxical leadership, as a more complex and challenging way of leadership [1,14], encourages leaders to reshape their work, increase work resources, and realize the matching of people and work, that is, engage in job crafting. In addition, paradoxical leadership is characterized by self-confidence, which is a manifestation of self-efficacy. People become more confident when they can overcome difficulties, and they are therefore more willing to try a variety of opportunities to prove their ability [31]. In this regard, leaders with self-confidence are more willing to redesign their work and accomplish more tasks, that is to say, they are more willing to craft their jobs.

Additionally, both qualitative [52,54] and quantitative studies [29,55] have confirmed that job crafting is positively related to performance. These studies assume that job crafting can improve a leader's task performance based on the following three reasons: first, job crafting requires modifying the number and types of tasks, the number and intensity of interactions with others, and adjusting the meaning of work according to one's own needs to increase individual work resources [51]; second, because individuals can adjust their workload and participate in new projects, job crafting increases the demand for challenging work, which promotes personal growth and development [56]; finally, because job crafting allows individuals to change the content and scope of their work according to their own needs, it reduces obstructive work demands, as well as the pressure and burnout caused by work demands [29]. Accordingly, we suggest that paradoxical leadership activates a self-regulation mechanism and helps leaders to increase their own task performance by adjusting their work (i.e., job crafting). On the basis of the above analysis, we propose the following hypothesis:

Hypothesis 2 (H2). *Job crafting mediates the relationship between paradoxical leadership and their task performance.*

2.3. Moderating Role of Career Resilience

Career resilience originated from the career motivation theory put forward by London in 1983, which divides career motivation into three dimensions, i.e., career identity, career planning, and career resilience [37]. This study only used the dimension of career resilience based on Noe's suggestion because they found that among the three components, career resilience had a more prominent predictive effect on various aspects of career behavior [57].

According to the theory of self-regulation, people's self-regulation systems are also affected by personal factors, such as self-efficacy, personal development orientation, and self-response [58]. In this study, we suggested that career resilience has an impact on leaders' self-regulation systems. When leaders face the pressure of contextual paradox, which continuously consumes more resources, higher career resilience gives paradoxical leaders higher self-efficacy and independence [37]. Studies have shown that when people perform well or are considered to be competent and credible, they are more likely to engage in job crafting [59,60]. In addition, independent leaders can adopt changes at work without undue restrictions [49,61] and improve job crafting. In the case that leaders' career resilience is low, they have a lower sense of self-efficacy and higher dependence, and therefore, reduced willingness for job crafting. Furthermore, lower career resilience motivates paradoxical leaders to avoid risk [37] and choose not to change their work so that they can retain security, safety, and responsibility, resulting in a low level of job crafting [49]. On the basis of the above analysis, we proposed the following hypothesis:

Hypothesis 3 (H3). *Career resilience moderates the relationship between paradoxical leadership and job crafting. Specifically, for leaders with high career resilience, paradoxical leadership has a stronger positive impact on their job crafting, and conversely, the relationship is weaker.*

Combined with hypotheses 2 and 3, we further anticipated that the regulatory role of career resilience in the relationship between paradoxical leadership and job crafting may change the indirect effect of paradoxical leadership on leaders' task performance through job crafting. In the case of high career resilience, the relationship between paradoxical leadership and job crafting is stronger; this means a higher sense of self-efficacy, risk-taking, and independence will regulate and strengthen the leaders' current state of resource depletion, such as through job crafting, which improves their task performance. When career resilience is low, which means leaders have low self-efficacy and independence, and choose to avoid risks, they will engage in less job crafting, resulting in low improvement in task performance. Therefore, this research proposes the following hypothesis:

Hypothesis 4 (H4). *Career resilience moderates the indirect effect of paradoxical leadership on their own task performance through job crafting. Specifically, for leaders with high career resilience, paradoxical leadership has a stronger positive impact on their task performance through job crafting, and conversely, the relationship is weaker.*

3. Materials and Methods

3.1. Samples and Procedures

Data were collected from full-time employees and their immediate supervisors in some small and medium enterprises in Anhui, Hubei, Jiangsu, and Shanghai, in China. Details of the purpose of the study and survey instructions were clearly explained to the participants. All participants were reassured that the data were used solely for the purpose of this study and confidential. Each leader (supervisor) was responsible for evaluating the feedback from one to three followers (employees). The data were collected at two different time points, i.e., time 1 and time 2, with 1 month between the first and second time points. This time frame was similar to that used in a previous study for data processing [62] and was also selected because the temporal separation of 1 month was intended to reduce the common method variance [63] by reducing biases in participants' retrieval and reporting of responses [64]. At the first time point, we assigned an identification (ID) to each questionnaire and matched

the leaders' (supervisors) and followers' (employees) responses. The basic information on leaders and job crafting was evaluated by leaders (supervisors); paradoxical leadership and leader's task performance were evaluated by followers (employees). At the second time point, we assigned the previous IDs on the questionnaires for the leaders (supervisors) to fill in to facilitate the final pairing. Career resilience was evaluated by the leaders (supervisors).

At time 1, the surveys were distributed to 181 leaders (supervisors) and 392 followers (employees). The time 1 survey was completed by 147 leaders (81.22% response rate) and 323 followers (82.40% response rate); the time 2 survey was completed by 125 leaders. After deleting blank and unmatched questionnaires, our final sample (time 2 surveys) was comprised of matched responses from 120 leaders (66.30% response) and 271 followers (69.13% response rate, using time 1 as the baseline).

In the final sample of 120 leaders, 45.83% of the participants were men. The average age was 30.58 years (SD = 7.31). A total of 12.50% of participants were under 25 years of age, 29.17% were between 25 and 35 years, 34.16% of participants were between 36 and 45 years, and 24.17% were over the age of 45. Regarding education level, the majority of participants held a bachelor's degree or above (85.00%). With respect to job positions, both junior and middle managers accounted for 38.33%, while senior managers accounted for 23.34%. Regarding tenure, approximately 25.83% of participants had tenure of fewer than 3 years, 32.50% had between 3 and 6 years, 23.34% had between 7 and 12 years, and 18.33% had more than 12 years. About 20.00% of participants worked in educational institutions, 14.17% worked in the manufacturing industry, 16.67% worked in the financial industry, 20.83% worked in the service industry, and 28.33% worked in other types of industries.

3.2. Measurement Items

We followed an established back-translation procedure for translating the English scale items into Chinese [65]. First, two language specialists, fluent in both English and Chinese, independently translated the original English scale items into Chinese. Then, two other experts (not the authors) independently back-translated the Chinese scale items into English. Finally, we had a discussion with four experts to review the survey items and ensure the accuracy and validity of the translated version of the measurement items.

3.2.1. Paradoxical Leadership

To measure paradoxical leadership, 22 items were developed and validated by Zhang et al. [1] (see Appendix A), which can be divided into the following five dimensions: (1) treating subordinates uniformly while allowing individualization, (2) combining self-centeredness with other-centeredness, (3) maintaining decision control while allowing autonomy, (4) enforcing work requirements while allowing flexibility, and (5) maintaining both distance and closeness. The first two dimensions were measured using five items each, and the last three dimensions were measured using four items each. Sample items are "[your leader] uses a fair approach to treat all subordinates uniformly but also treats them as individuals, shows a desire to lead but allows others to share the leadership role, controls important work issues but allows subordinates to handle details, stresses conformity in task performance but allows for exceptions, and recognizes the distinction between supervisors and subordinates but does not act superior in the leadership role." All the items were evaluated using a five-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree). The scales were considered to be equivalent in Chinese culture, because Yang et al. [3] cited the scale and confirmed its reliability and validity with Chinese samples ($\alpha = 0.95$). In our study, the Cronbach's α of this scale was 0.92 (for the five dimensions it was 0.86, 0.87, 0.81, 0.78, and 0.83, respectively). The ICCs (intra class correlation) were (ICC(1) = 0.66 and ICC(2) = 0.81) and the r_{wg} (within-group interrater reliability) was 0.98, which indicated that data aggregation was appropriate.

3.2.2. Task Performance

Following Methot et al. [66] (see Appendix B), task performance was measured using five items with a five-point Likert scale from 1 (strongly disagree) to 5 (strongly agree). Sample items were "[your leader] adequately completes assigned duties." The Cronbach's alpha value of this scale was 0.81. The ICCs were (ICC(1) = 0.52 and ICC(2) = 0.71) and the r_{wg} was 0.98, which indicated that data aggregation was appropriate.

3.2.3. Job Crafting

Job crafting was measured using 15 items ($\alpha = 0.89$) that were developed by Slemp and Vella-Brodrick [67] (see Appendix C). The scale measured the following three dimensions: task crafting (e.g., "introduce new approaches to improve your work"), cognitive crafting (e.g., "think about how your job gives your life purpose"), and relational crafting (e.g., "make an effort to get to know people well at work"). Respondents indicated the frequency of each crafting behavior on a five-point Likert-type scale from 1 (hardly ever) to 5 (very often).

3.2.4. Career Resilience

We measured career resilience by adapting a four-item scale developed by Carson and Bedeian [68] (see Appendix D). A sample item was "the costs associated with my line of work/career field sometimes seem too great." Respondents indicated agreement with each description on a five-point Likert-type scale from 1 (hardly ever) to 5 (very often). The Cronbach's alpha value of this scale was 0.84.

3.2.5. Control Variables

Following the recommendations for the use of theoretically potent control variables [69,70], we considered several relevant control variables, including leaders' gender, age, education, job position, job tenure, and industries, because those factors may exert an influence on their task performance.

4. Results

Table 1 lists the means, standard deviations, and correlations of our variables. Paradoxical leadership was positively correlated with job crafting ($r = 0.22$, $p < 0.05$) and task performance ($r = 0.27$, $p < 0.01$), job crafting was positively correlated with task performance ($r = 0.52$, $p < 0.\ 01$), and career resilience was positively correlated with job crafting ($r = 0.32$, $p < 0.01$) and task performance ($r = 0.19$, $p < 0.05$).

Prior to testing our hypotheses, first, we conducted confirmatory factor analyses (CFA) using Mplus 7.0 (Muthen & Muthen, Los Angeles, CA, USA) to evaluate the distinctiveness of paradoxical leadership, job crafting, task performance, and career resilience. The results revealed that the four-factor measurement model had a good fit (Table 2), i.e., $\chi^2 = 196.05$, $\chi^2/df = 1.74$, CFI (Comparative Fit Index) = 0.90, TLI (Tucker-Lewis Index) = 0.87, RMSEA (Root Mean Square Error of Approximation) = 0.07, and SRMR (Standardized Root Mean Square Residual) = 0.07, as compared with other alternative models. Although the hypothesis model had a relatively low TLI value, as suggested by Zheng et al. [71], the observed items had significant loadings on their respective latent factors, supporting the measurements used in this study. Second, we utilized SPSS software v19.0 (IBM, Almaden, CA, USA) to conduct Herman's single factor test on the survey data. The total variance explained by a single factor was 22.54%, indicating that the given dataset did not suffer from common method bias [64].

We used the method of hierarchical regression to test the hypotheses, which puts the control variables first. The results in Table 3 show that paradoxical leadership was positively related to task performance (model 6, $b = 0.25$, $p < 0.01$), thus supporting hypothesis 1. In addition, paradoxical leadership was positively related to job crafting (model 2, $b = 0.23$, $p < 0.05$) and job crafting was also positively related to task performance (model 7, $b = 0.39$, $p < 0.001$). When paradoxical leadership and job crafting were combined for predicting task

performance, the coefficient of job crafting was still significant (model 8, $b = 0.35$, $p < 0.001$) and the coefficient of paradoxical leadership decreased (model 8, $b = 0.17$, $p < 0.05$), thus supporting hypothesis 2.

Table 1. Descriptive statistics and correlations.

Variable	1	2	3	4	5	6	7	8	9	10
1. Gender	-									
2. Age	−0.17	-								
3. Education	−0.08	0.01	-							
4. Job rank	−0.24 **	0.66 **	0.15	-						
5. Job tenure	−0.17	0.79 **	−0.08	0.67 **	-					
6. Nature of job	−0.01	−0.11	−0.18	−0.05	0.04	-				
7. Paradoxical leadership	−0.22 *	0.28 **	−0.17	0.22 *	0.18 *	−0.04	-			
8. Job crafting	−0.12	0.16	0.10	0.11	0.17	−0.26 **	0.22 *	-		
9. Career resilience	0.10	0.06	−0.10	−0.01	0.12	−0.03	0.14	0.32 **	-	
10. Task performance	0.10	0.17	0.13	0.18 *	0.13	−0.21 *	0.27 **	0.52 **	0.19 *	-
Mean	1.54	2.78	4.21	1.85	2.73	3.50	3.96	3.94	3.21	4.40
SD	0.50	1.10	0.97	0.77	1.63	1.91	0.47	0.51	0.67	0.39

Notes: N = 120, * $p < 0.05$ and ** $p < 0.01$.

Table 2. Confirmatory factor analysis results.

Model	χ^2	χ^2/df	CFI	TLI	RMSEA	SRMR
Four-factor model	196.05	1.74	0.90	0.87	0.07	0.07
Three-factor model 1	261.18	2.25	0.82	0.79	0.10	0.08
Three-factor model 2	290.84	2.51	0.78	0.74	0.11	0.12
Three-factor model 3	311.76	2.69	0.75	0.71	0.12	0.13

Notes: Three-factor model 1—paradoxical leadership, job crafting + task performance, and career resilience; three-factor model 2—paradoxical leadership, career resilience + job crafting, and task performance; three-factor model 3—paradoxical leadership + job crafting, task performance, and career resilience; four-factor model—paradoxical leadership, job crafting, career resilience, and task performance. CFI: Comparative Fit Index, TLI: Tucker-Lewis Index, RMSEA: Root Mean Square Error of Approximation, SRMR: Standardized Root Mean Square Residual.

Table 3. Analysis of the mediation and moderating effects.

Variable	Job Crafting				Task Performance			
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Gender	−0.10	−0.06	−0.10	−0.11	0.12	0.16 *	0.16 *	0.18 ***
Age	−0.01	−0.05	−0.03	0.002	0.02	−0.01	0.03	0.003
Education	0.04	0.06	0.06	0.07	0.04	0.07	0.02	0.04
Job rank	−0.06	−0.08	−0.05	−0.04	0.07	0.05	0.09	0.07
Job tenure	0.08	0.09	0.07	0.04	0.01	0.02	−0.02	−0.01
Nature of job	−0.07 **	−0.07 **	−0.07 **	−0.06 *	−0.04 †	−0.04	−0.01	−0.01
Paradoxical leadership		0.23 *	0.17 †	0.19 †		0.25 **		0.17 *
Job crafting							0.39 ***	0.35 ***
Career resilience			0.22 **	0.21 **				
Paradoxical leadership × career resilience				0.36 *				
ΔR^2	0.12	0.04	0.08	0.04	0.11	0.08	0.23	0.19
F	2.48 *	2.92 *	4.13 ***	4.39 ***	2.20 *	3.56 **	8.06 ***	8.09 ***

Notes: N = 120; † $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, and *** $p < 0.001$ (the result is an unstandardized regression coefficient).

To further verify hypothesis 2, we used the bootstrap method with 5000 samples with a 95% confidence interval, as proposed by Preacher and Hayes [72]. The results are shown in Table 4. The confidence interval of the indirect effect of paradoxical leadership on task performance through job crafting was 0.08 (95% CI: 0.01, 0.21), indicating the mediating

role of job crafting; the confidence interval of the direct effect of paradoxical leadership on task performance was 0.17 (95% CI: 0.02, 0.32), indicating that job crafting played a partial role of a mediator, thus further verifying hypothesis 2.

Table 4. Test of the mediating effect of job crafting.

Effects	Estimate	95% Confidence Interval
Total effect	0.25	(0.11, 0.39)
Direct effect (paradoxical leadership→task performance)	0.17	(0.02, 0.32)
Indirect effect (paradoxical leadership→job crafting→task performance)	0.08	(0.01, 0.21)

Hypothesis 3 proposed that the career resilience of leaders moderates the positive relationship between paradoxical leadership and job crafting. To test hypothesis 3, first, we put the control variables in the regression equation; second, the paradoxical leader and career resilience were put into the equation; thirdly, the interaction term of the paradoxical leadership and the career resilience (to prevent multicollinearity, the interaction term of the independent variable and the moderating variable was mean-centered) were put into the equation (as shown in Table 3). The interaction term of paradoxical leadership and career resilience was positively related to job crafting (model 4, $b = 0.36$, $p < 0.05$), supporting hypothesis 3. According to Aiken and West's [73] suggestion, the effect of the interaction was plotted and the high/low level of career resilience was divided based on the mean plus or minus one standard deviation. As shown in Figure 2, the results of the simple slope test showed that for leaders with high career resilience, paradoxical leadership had a relatively stronger positive effect on job crafting; for leaders with low career resilience, the effect of paradoxical leadership on job crafting was not significant (simple slope for high resilience = 0.44, $t = 2.88$, $p < 0.001$; simple slope for low resilience = −0.05, $t = -0.33$, ns), thus further verifying hypothesis 3.

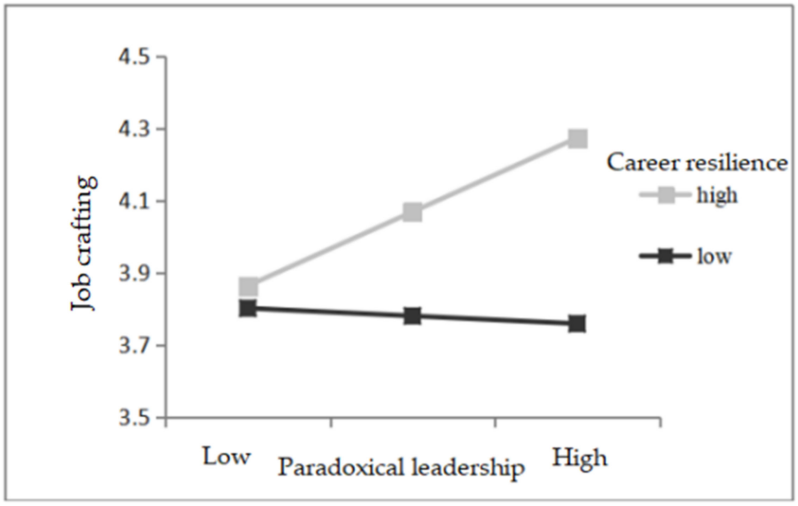

Figure 2. The moderating effect of career resilience between paradoxical leadership and job crafting.

Finally, we used model 7 of the process to generate bootstrap confidence intervals for the conditional indirect effect of paradoxical leadership on their own task performance via job crafting (see Table 5). The result demonstrated that paradoxical leadership with a high level of career resilience had a positive indirect impact on leaders' task performance ($b = 0.16$, bias-corrected (95% CI: 0.03, 0.31)). While paradoxical leadership with a low level of career resilience, the indirect effect was not significant ($b = -0.02$, bias-corrected (95% CI: −0.11, 0.09)). Furthermore, the index of the moderated mediation was 0.13 (95% CI: 0.01,

0.26), indicating that the indirect effect of paradoxical leadership on task performance through job crafting was moderated by career resilience [74], thus supporting hypothesis 4.

Table 5. Conditional indirect effect test.

Mediator	Indirect Effect	95% Confidence Interval
Low career resilience	−0.02	(−0.11, 0.09)
High career resilience	0.16	(0.03, 0.31)
Index of moderated mediation	0.13	(0.01, 0.26)

5. Discussion

On the basis of self-regulation theory, we developed and tested a model to explain how and when engaging in paradoxical leadership affects leaders' job crafting and task performance. The results of a questionnaire survey of 120 leaders and 271 followers from small- and medium-sized Chinese enterprises found that paradoxical leadership promoted leaders' job crafting, thereby improving their own task performance. Moreover, the effect of paradoxical leadership on leaders' job crafting depended on the leader's career resilience. Specifically, the positive effect of paradoxical leadership on leaders' job crafting was stronger among leaders with higher career resilience. In addition, career resilience had a positive moderating effect on paradoxical leadership for improving task performance through job crafting, i.e., as career resilience increased, the indirect effect of paradoxical leadership on task performance through job crafting increased.

5.1. Theoretical Contributions

Our research makes several key theoretical contributions. First, we contribute to the literature on paradoxical leadership by taking an actor-centric perspective and focusing on the intrapersonal consequences of paradoxical leaders and their own task performance. While previous studies have established that paradoxical leadership has an impact on followers [1–7], the impact on leaders who engage in paradoxical leadership behaviors has been largely overlooked since working through paradoxes is an effortful, multi-stepped process [46]. Behaving paradoxically may tax leaders' cognitive resources, which can result in psychological stress for leaders, and therefore, possibly influence their attitudes and behaviors [1,14]. Our study provides additional understanding of the consequences of paradoxical leadership and examines its potential influence on leaders themselves.

Second, from the perspective of self-regulation theory, in this study, we explored the psychological mechanism of paradoxical leadership on leaders' task performance, which we considered to be a self-regulation process. Although some previous studies have explored the effects of certain leadership styles, such as transformational and abusive styles, on leaders themselves, most studies have been based on the theory of resource conservation [13,22] or affective events theory and self-determination theory [12] and ignored the self-regulation mechanism of job crafting between leaders and their performance. In addition, as compared with the vast amount of research on employees' job crafting, there is limited information about how job crafting contributes to leaders' outcomes. In response to the suggestion that managers engage in job crafting because of its positive influence on their performance [30,31], our study introduced job crafting as the path of action, providing a more appropriate perspective for understanding the impact of paradoxical leaders on their own task performance.

Finally, this study has important theoretical constructive significance for a deeper understanding of the relationship between paradoxical leaders and their own task performance. As the internal structure of arousing career decision-making and behavior, career resilience can enable individuals to work hard and have the courage to overcome various career barriers, such as job switching and job stress [75]. However, few studies have used it as boundary conditions for the influence mechanism of leadership behaviors on job crafting. Therefore, this study addressed this shortcoming and found that career resilience is an important contingency factor affecting leaders' behaviors.

5.2. Practical Implications

Our research findings provide several important managerial implications. First, organizations need to acknowledge the limitations of their existing leadership styles in order to confront the contradictory requirements in today's dynamic internal environment. Organizations are also encouraged to popularize and train leaders in paradoxical knowledge to strengthen their ability to effectively solve the problem of paradoxes. Today, leaders should be encouraged to change the previous thinking of "one or the other" and cultivate their own integration and paradoxical thinking to deal with the increasing uncertainties.

Second, our findings suggest that job crafting is a useful tool for enhancing the task performance of leaders. When leaders implement paradoxical leadership practices, they inevitably face a large loss of resources and energy. The organization should give sufficient autonomy and support to enable leaders to satisfy their needs. It enables leaders to adjust their work according to their own needs and interests, and therefore, promotes task performance through job crafting. Our study shows that paradoxical leadership is conducive to leaders' task performance through the intermediary mechanism of job crafting, which provides an effective way for paradoxical leaders to improve their task performance under stress.

Finally, organizations should pay more attention to leaders with low career resilience. Career resilience is a form of adaptability that involves continuous learning and the acceptance of new things. Organizations should provide low-career-resilience leaders with more opportunities to learn and accept new things to cultivate their career resilience such that they can still adopt a positive response when facing the pressure brought about by resource consumption.

5.3. Limitations

This research also has some limitations and needs to be further deepened. First, this is a cross-sectional study, which makes it difficult to draw conclusions about causality. Future research should employ a longitudinal study to show the cause-and-effect relationship between the variables of this study to enhance the strength of the causality argumentation. In addition, future research should be supplemented by more differentiated scenario designs for experimental data measurement to investigate whether the hypothesis in this article is still supported in richer scenarios.

Second, we used a convenient sample, where the participants were approached using the snowball sampling method. Therefore, our sample represented small- and medium-sized enterprises and caution should be taken when generalizing our findings to different enterprise sizes. Therefore, future research should expand the sample to large enterprises. In addition, since we collected data on leaders and followers from Chinese organizations, our results may not hold validity in other cultures. Therefore, we suggest future studies conduct a cross-country examination of paradoxical leadership and leaders' attitudes and behaviors in both Eastern and Western cultures.

Finally, although this study confirmed the role of career resilience in paradoxical leadership and job crafting from the perspective of self-regulation theory, it did not consider other contextual factors (such as the task context). Therefore, future research on the moderating effects of other situational factors that may affect leaders' job crafting and their consequences would enhance the reliability of our conclusions.

6. Conclusions

This study represents an initial attempt to explore the impacts of paradoxical leadership on leaders rather than the recipients of such behaviors. In particular, we highlighted the potential benefits of such behavior for leaders, which included job crafting and task performance. These beneficial effects were further enhanced by career resilience. Awareness of the benefits of paradoxical leadership for leaders could be leveraged to effectively increase their task performance through job crafting. We hope that our study motivates

scholars' interest to further explore leadership practices that trigger leaders' psychological mechanisms and subsequent behaviors.

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Appendix A. Items Used to Measure Paradoxical Leadership

Treating subordinates uniformly while allowing individualization

1. Uses a fair approach to treat all subordinates uniformly but also treats them as individuals.
2. Puts all subordinates on an equal footing but considers their individual traits or personalities.
3. Communicates with subordinates uniformly without discrimination but varies his/her communication style depending on their individual characteristics or needs.
4. Manages subordinates uniformly but considers their individualized needs.
5. Assigns equal workloads but considers individual strengths and capabilities to handle different tasks.

Combining self-centeredness with other-centeredness

6. Shows a desire to lead but allows others to share the leadership role.
7. Likes to be the center of attention but allows others to share the spotlight as well.
8. Insists on getting respect but also shows respect toward others.
9. Has a high self-opinion but shows awareness of personal imperfection and the value of other people.
10. Is confident regarding personal ideas and beliefs, but acknowledges that he or she can learn from others.

Maintaining decision control while allowing for autonomy

11. Controls important work issues but lets subordinates handle details.
12. Makes final decisions for subordinates but lets subordinates control specific work processes.
13. Makes decisions about big issues but delegates lesser issues to subordinates.
14. Maintains overall control but gives subordinates appropriate autonomy.

Enforcing work requirements while allowing flexibility

15. Stresses conformity in task performance but allows for exceptions.
16. Clarifies work requirements but does not micromanage work.
17. Is highly demanding regarding work performance but is not hypercritical.
18. Has high requirements but allows subordinates to make mistakes.

Maintaining both distance and closeness

19. Recognizes the distinction between supervisors and subordinates but does not act superior in the leadership role.
20. Keeps distance from subordinates but does not aloof.
21. Maintains position differences but upholds subordinates'dignity.

22. Maintains distance from subordinates at work but is also amiable toward them.

Notes: The above 22 items were from Zhang et al. [1].

Appendix B. Items Used to Measure Task Performance

1. Adequately completes assigned duties.
2. Fulfills responsibilities specified in his/her job description.
3. Performs tasks that are expected of him/her.
4. Meets formal performance requirements of the job.
5. Engages in activities that will directly affect his/her performance evaluations.

Notes: The above five items were from Methot et al. [66].

Appendix C. Items Used to Measure Job Crafting

Task crafting

1. Introduce new approaches to improve your work.
2. Change the scope or types of tasks that you complete at work.
3. Introduce new work tasks that you think better suit your skills or interests.
4. Choose to take on additional tasks at work.
5. Give preference to work tasks that suit your skills or interests.

Cognitive crafting

6. Think about how your job gives your life purpose.
7. Remind yourself about the significance your work has for the success of the organization.
8. Remind yourself of the importance of your work for the broader community.
9. Think about the ways in which your work positively impacts your life.
10. Reflect on the role your job has for your overall well-being.

Relational crafting

11. Make an effort to get to know people well at work.
12. Organize or attend work-related social functions.
13. Organize special events in the workplace (e.g., celebrating a co-worker's birthday).
14. Choose to mentor new employees (officially or unofficially).
15. Make friends with people at work who have similar skills or interests.

Notes: The above 15 items were from Slemp and Vella-Brodrick [67].

Appendix D. Items Used to Measure Career Resilience

1. The costs associated with my line of work/career field sometimes seem too great.
2. Given the problems I encounter in this line of work/career field, I sometimes wonder if I get enough out of it.
3. Given the problems in this line of work/career field, I sometimes wonder if the personal burden is worth it.
4. The discomforts associated with my line of work/career field sometimes seem too great.

Notes: The above four items were from Carson and Bedeian [68].

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Mediational Occupational Risk Factors Pertaining to Work Ability According to Age, Gender and Professional Job Type

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Abstract: The predictive value of work ability for several health and occupational outcomes is well known. Maintaining the ability to work of all employees has become an important topic in research although some evidence suggests that some groups of workers need greater attention than others. Healthcare workers ($\bar{x}$ = 54.46 ± 5.64 years) attending routine occupational health checkups completed their work ability, occupational risk and sociodemographic measures. An analysis examined whether work ability differed according to gender, age and professional category. Mediation of these relationships by occupational risk variables, such as work–family conflict, was examined. Females and older adults had worse work ability than their counterparts. Professional group was not independently associated. Gender-related differences were mediated by current and historic ergonomic risk, psychosocial risk and work–family conflict. Age-related differences were mediated by violence/discrimination at work. All job risk variables, apart from current ergonomic risk, mediated associations between professional category and work ability. The present study identified the importance of risk variables for the work ability of health workers according to gender, age and professional job type. Perceptions of work–family conflict and violence–discrimination seem particularly important and should be considered when targeting improvements in work ability.

Keywords: work ability; healthcare workers; gender; age; occupational risk; mediation

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1. Introduction

Work ability is defined as an individual's perception of physical and mental demands encountered at work and his or her individual ability to cope with these work demands [1].

The ability to work should be considered an important characteristic of human health and well-being [2]. A number of studies show that low levels of work ability are among the key determinants of long-term sickness absence [3], intentions to retire early [4] and early exit from work [5], and is associated with health outcomes both during working life and following retirement [6–9].

Work ability has multicausal determinants. The personal characteristics of workers, family and social factors, working conditions and work organization have been identified as associated with work ability [10]. Previous research has shown that work ability is negatively influenced by high physical work demands, high psychosocial work demands (e.g., lack of possibilities to control one's own work) and unhealthy lifestyles (e.g., lack of physical activity) [11–15].

Maintaining the ability to work of all employees by identifying and targeting modifiable factors has become an important topic in research [16,17], although it could be argued that some groups warrant greater attention than others. Specifically, there is evidence to suggest that gender, age and the nature of one's profession may impact upon work ability [18,19].

With regards to gender, the evidence identifies females as an important group of interest. With just some exceptions [20], the majority of studies have shown that women have worse work ability indices [11–15,21] and that factors affecting work ability are different in males and females [22]. Various models have been proposed to explain gender inequalities in numerous indicators of health and quality of life. Such models include the hypothesis of differential vulnerability and exposure [23]. The exposure hypothesis states that because women and men differ with respect to access to material resources and other social conditions of life, they are exposed to different levels of risk, which in turn results in different health outcomes [23,24]. The vulnerability hypothesis asserts that women and men react differently to various conditions of life and thus differ in their vulnerability to risk factors [25].

In relation to age, research across countries and occupations has generally found work ability to be negatively associated with age [26]. This association has mainly been found in occupational sectors with highly physically demanding work [11]. On the other hand, although some psychosocial factors, such as job control, reward and social support, exert a protective effect over work ability [27,28], recent studies have suggested that the effect of these factors on well-being may vary according to workers' ages [29]. Given that we are witnessing a progressive aging of the working population [30], it is important to deepen knowledge of the factors that mediate the relationship between age and work ability.

A final group to be considered concerns those sectors or professional groups that typically present diminished work ability. Health center employees, in both primary and hospital care, but particularly hospital workers, are exposed to particularly demanding situations that could detract from their work ability [31,32]. Given the importance of these employees, particularly in light of the current health crisis due to the COVID-19 pandemic, they represent another sub-group of interest.

Finally, most studies suggest that work ability worsens with increasing age, whilst also being worse in women. However, other investigations [20] disagree in this regard, suggesting that gender and age differences only appear under certain conditions; in other words, they are dependent upon other mediating or moderating factors [11]. The main contribution of the present paper, therefore, is intended to offer a different perspective by exploring which specific "third factors" mediate the associations between gender, age, professional group and work ability.

In consideration of this, the present study has two main objectives. The first is to study the differences in work ability in health center workers in relation to the determinants of age, sex and professional group. A further objective is to examine whether factors related to working conditions mediate these aforementioned associations.

2. Materials and Methods

Workers from six public health centers attending the occupational health department of participating health centers (three hospitals, two primary health care centers and a combined health facility) to complete a routine health check were contacted. A member of the research team working at each center explained the aims, procedures and ethical considerations of the study. Participants were included in the study on a voluntary basis after signing an informed consent form. In total, 1184 workers (70% of workers invited to participate) answered the questionnaire. Data collection was conducted throughout 2019.

Workers were excluded from the study if they had any other reason for attending the center other than a routine health check-up.

All subjects gave their informed consent for inclusion before they participated in the study. The study was conducted in accordance with the Declaration of Helsinki, and the protocol was

approved by the Andalusian research ethics committee (REC of the Virgen Macarena-Virgen del Rocio university hospitals: d9b449426c41062448a2d8be713a0b063741ae96).

The following variables and instruments were used:

Dependent variables: The work ability index (WAI) provided the dependent variable. The term work ability was first introduced in Finland in the 1980s; the Finnish Institute of Occupational Health conceived an instrument to assess and monitor work ability [33] in groups of interest. The Spanish version of the WAI was used following translation of the English version [33]. The WAI is composed of seven indicators. Indicators WAI1, WAI3, WAI4, WAI5 and WAI6 comprise just one item, item WAI2 comprises two items and item WAI7 is described by three items. Different response formats and different scales are used for each indicator. Outcomes for the seven indicators are therefore transformed before being summed to produce an overall score. Final scores range between 7 and 49, with higher values indicating better work ability. Respondents were grouped according to their scores: poor (7–27), moderate (28–36), good (37–43) and excellent work ability (44–49).

Independent variables: Gender, age and the professional category to which participants belonged (dichotomized as "health worker" or "not a health worker"). Health workers pertained to professionals from the following groups of staff: physicians, nursing, nursing assistant and nursing technicians. Non-health staff included administrative, caretaker, maintenance and general services staff (for example those in kitchen or laundry services).

Mediators: Occupational risk variables were considered as potential meditators of the relationships between WAI and the independent variables (age, gender and professional group). The following types of risk were analyzed: (a) environmental risk; (b) ergonomic risk; (c) psychosocial risk; (d) violence and discrimination; and (e) work–family conflict [34].

Environmental and ergonomic risk each consisted of 4 items rated along a 4-point scale from "never" to "always". Ergonomic risk relates to the aspects of a job or task that impose a biomechanical stress on the work. They are likely to cause or contribute to awkward or static postures, cold temperatures, contact stress, force, repetition and vibration, posing injury risks to the musculoskeletal system. Environmental risk relates to challenges posed by one's surroundings at work. The stem "In the tasks that you perform in your work, to what extent are you exposed to ... ?" preceded all items. Respondents were prompted to respond to each item twice, once in relation to their current condition and, next, in relation to the length of their working career. An example of environmental risk included "extreme environmental conditions", whilst an example of ergonomic risk was "I work in static, painful or tiring positions". Items for each were summed to provide possible scores of between 4 and 16. Higher scores indicated greater risk. Psychosocial risk relates to negative psychological responses to work and workplace conditions and incorporates relationships with colleagues and supervisors. Psychosocial risk composed 14 items, of which 11 began with the stem "In your work, how frequently ... ?" followed by examples of risk situations, e.g., "have to work very fast". Responses were given on a 5-point scale ranging from "never" to "always". The final three items targeted aspects related with the way in which they are managed, e.g., "To what extent do you think you are fairly treated at your workplace?". These items are rated on a 5-point scale from "to a large extent" to "to no extent". Framing varied, thus, where required items were transformed so that higher scores indicated greater risk. Score were summed producing final values of between 14 and 35. The discrimination/violence dimension consisted of seven items with two targeting violence (e.g., "To what extent do you think you have suffered situations of psychological violence (threats, insults etc.)?") and five targeting discrimination (e.g., "to what extent have you suffered sexual harassment?"). Items were reported on a 5-point scale ranging from "never" to "regularly". Scores were summed with higher scores indicating greater risk. Scores ranged from 7 to 35. Three items were used to estimate work–life conflict. Items were rated on a 5-point scale from "always" to "never" and were summed, with higher scores showing worse work–family conflict.

For statistical analyses, Pearson point-biserial correlations were performed between overall WAI and the four binary sociodemographic variables (gender, age and professional category) to establish the presence of independent relationships (see Table S1). Following this, a mediation analysis was conducted using the approach described by Sobel (1982) [35], with occupational risk variables and work–family conflict being the potential mediators. This approach follows three stages. Firstly, unstandardized regression coefficients and their associated error were calculated for the relationship between the independent variable (gender, age and professional category) and the mediator. As all mediators were continuous, linear regression was used for this stage. In the second stage, the total effect (and error) of the mediator on the dependent variable was calculated, whilst controlling for the independent variable. Logistic regression was used at this stage as the dependent variable (WAI) was categorical. WAI was dichotomized to ease interpretation, with poor and moderate scores, and good and very good scores being grouped, respectively. Homoscedasticity was not a problem. In mediation, the relationship between the independent variable and the dependent variable is hypothesized to be an indirect effect that exists due to the influence of a third variable (the mediator). Thus, in the final stage, this indirect effect was calculated from the coefficients calculated in Stages 1 and 2 using the Sobel test. The Sobel test reveals the magnitude of mediation due to the mediator. Following Kenny et al. (1998) [36], it is not necessary for the independent variable to independently predict the outcome for mediation to occur. Thus, the Sobel test was conducted between all study variables and not only when independent relationships were established. Crude coefficients were used following the findings reported by [37] in relation to logistic regression-based mediation analysis with dichotomous outcomes and continuous mediators.

The statistical power of each test was calculated using the joint test of significance described by Hayes and Scharkow (2013) [38]. The statistical program SPSS version 26.0 was used to conduct the mediation analyses, whilst MedPower [39] was used to calculate statistical power.

3. Results

The power for each test ranged between 66.5% and 100%, with most tests having more than 80% power, suggesting that the study was sufficiently powered for the analysis. The questionnaire responses according to gender and professional category are presented in Table 1.

Table 1. Study sample characteristics: overall and by gender and professional category.

Variables	Overall	Gender		Professional Category	
		Female	Male	Health Workers	Non-Health Workers
n (%)	1184 (100)	796 (67.2)	324 (27.4)	757 (63.9)	332 (28.0)
mean (*SD*)					
Age	54.46 (5.64)	54.13 (5.52)	55.11 (5.89)	54.44 (5.81)	54.83 (5.23)
WAI score	37.77 (7.20)	37.00 (7.20)	39.30 (6.95)	37.57 (7.14)	38.00 (7.36)
Current environmental risk	5.94 (1.94)	5.98 (1.96)	5.93 (1.93)	6.17 (2.06)	5.58 (1.72)
Historic environmental risk	6.68 (2.17)	6.76 (2.19)	6.58 (2.11)	7.05 (2.25)	5.83 (1.74)
Current ergonomic risk	9.19 (2.79)	9.36 (2.84)	8.76 (2.61)	9.29 (2.81)	8.92 (2.76)
Historic ergonomic risk	9.59 (2.70)	9.87 (2.74)	9.07 (2.54)	9.82 (2.76)	9.08 (2.51)
Psychological risk	42.36 (6.95)	42.96 (6.93)	40.88 (6.93)	42.92 (6.63)	41.47 (7.69)
Violence and discrimination	9.55 (2.71)	9.62 (2.80)	9.53 (2.57)	9.83 (2.89)	9.16 (2.31)
Work–family conflict	7.60 (2.33)	7.92 (2.36)	6.97 (2.23)	7.91 (2.37)	7.11 (2.20)

Both gender and age were significantly correlated with WAI. Lower WAIs were seen in females ($r^{pb} = -0.148$; $p < 0.001$) and with increasing age ($r^{pb} = -0.217$; $p < 0.001$). Professional group ($r^{pb} = -0.027$; $p = 0.459$) was not independently associated with WAI.

Stage one of the mediation analysis revealed that females and health care workers reported higher indices (greater risk) for all included risk variables (mediators), with outcomes being significant in most cases ($p < 0.05$). In the case of age, the risk of suffering violence and discrimination significantly increased with age ($p < 0.05$). Stage two was

proceeded to when stage one outcomes were significant (see Tables 2–4). When adjusting for gender, greater current ergonomic, historic ergonomic, psychosocial and work–family conflict all predicted worse WAI ($p < 0.001$). Females were less likely to be in the better WAI group even when current and historic ergonomic risk, and psychosocial risk were included in the model, but not when work–family conflict was. When adjusting for age, only violence and discrimination predicted WAI ($p < 0.05$). Finally, when adjusting for professional category, all potential mediators apart from current ergonomic risk predicted WAI ($p < 0.01$).

Table 2. Mediation analysis results of the relationship between gender (females relative to males) and the work ability index (WAI).

Mediator	Stage 1				Stage 2				Sobel Test		
	β1	B	SE	*p*	β2	B2	SE	*p*	*t*	SE	*p*
Current environmental risk	0.048	0.011	0.137	0.725							
Historic environmental risk	0.176	0.038	0.177	0.319							
Current ergonomic risk	0.602	0.098	0.193	0.002	−0.211	0.810	0.033	0.000	2.803	0.045	0.005
Historic ergonomic risk	0.806	0.139	0.218	0.000	−0.247	0.781	0.039	0.000	3.193	0.062	0.001
Psychosocial risk	2.078	0.136	0.472	0.000	−0.098	0.907	0.013	0.000	3.802	0.054	0.000
Violence-discrimination	0.091	0.015	0.181	0.615							
Work–family conflict	0.948	0.183	0.154	0.000	−0.391	0.676	0.042	0.000	5.135	0.072	0.000

Table 3. Mediation analysis results of the relationship between age and the WAI.

Mediator	Stage 1				Stage 2				Sobel Test		
	β1	B	SE	*p*	β2	B2	SE	*p*	*t*	SE	*p*
Current environmental risk	−0.014	−0.041	0.011	0.197							
Historic environmental risk	−0.018	−0.045	0.015	0.236							
Current ergonomic risk	0.003	0.007	0.016	0.835							
Historic ergonomic risk	−0.006	−0.012	0.019	0.757							
Psychosocial risk	0.075	0.061	0.039	0.054							
Violence-discrimination	0.036	0.074	0.015	0.015	−0.142	0.868	0.028	0.000	−2.169	0.002	0.030
Work–family conflict	0.008	0.019	0.013	0.530							

Note: Stage 1 = path (a) from the IV to the mediator. Stage 2 = path (ab) from the IV to the DV adjusted for the mediator. β1 and B: Raw (unstandardized) regression coefficients and standardized regression coefficients, respectively, between the independent variable (gender, age, professional group) and the mediator. β2 and B2: Raw (unstandardized) regression coefficients and standardized regression coefficients, respectively, between the mediator and WAI controlling for the independent variable (gender, age, professional group). Note: Stage 1 uses linear regression and so B > 0 is positive and B < 0 is negative. Stage 2 uses logistic regression and so B2 > 1 is positive and B2 < 1 is negative.

Table 4. Mediation analysis results of the relationship between professional group (health care workers relative to non-health workers) and the WAI.

Mediator	Stage 1				Stage 2				Sobel Test		
	β1	B	SE	*p*	β2	B2	SE	*p*	t	SE	*p*
Current environmental risk	0.584	0.136	0.137	0.000	−0.124	0.883	0.040	0.002	−2.507	0.029	0.012
Historic environmental risk	1.214	0.251	0.179	0.000	−0.168	0.846	0.042	0.000	−3.445	0.059	0.001
Current ergonomic risk	0.365	0.060	0.195	0.061							
Historic ergonomic risk	0.747	0.124	0.228	0.001	−0.257	0.773	0.039	0.000	−2.934	0.065	0.003
Psychosocial risk	1.451	0.096	0.479	0.003	−0.098	0.906	0.013	0.000	−2.812	0.051	0.005
Violence-discrimination	0.665	0.112	0.181	0.000	−0.148	0.862	0.029	0.000	−2.982	0.033	0.003
Work–family conflict	0.792	0.156	0.154	0.000	−0.421	0.657	0.043	0.000	−4.553	0.073	0.000

Note: β1 and B: Raw (unstandardized) regression coefficients and standardized regression coefficients, respectively, between the independent variable (gender, age, professional group) and the mediator. β2 and B2: Raw (unstandardized) regression coefficients and standardized regression coefficients, respectively, between the mediator and WAI controlling for the independent variable (gender, age, professional group). Note: Stage 1 uses linear regression and so B > 0 is positive and B < 0 is negative. Stage 2 uses logistic regression and so B2 > 1 is positive and B2 < 1 is negative.

Analysis using the Sobel test produced a number of significant results (all results presented in Tables 2–4). The relationship between gender and WAI was mediated by current ergonomic risk (t = 2.80; SE = 0.01; $p < 0.01$), historic ergonomic risk (t = 3.19; SE = 0.06; $p < 0.01$), psychosocial risk (t = 3.80; SE = 0.05; $p < 0.001$) and work–family conflict (t = 5.14; SE = 0.07; $p < 0.001$).

The relationship between age and WAI was mediated by violence/discrimination (t = −2.17; SE = 0.00; $p < 0.05$) comparisons.

Mediated relationships were seen between professional group and WAI when current environmental risk (t = −2.51; SE = 0.03; $p < 0.05$), historic environmental risk (t = −3.45; SE = 0.06; $p < 0.01$), historic ergonomic risk (t = −2.93; SE = 0.07; $p < 0.01$), psychosocial risk (t = −2.81; SE = 0.05; $p < 0.01$), violence-discrimination (t = −2.98; SE = 0.03; $p < 0.001$) and work–family conflict (t = −4.55; SE = 0.07; $p < 0.001$) were included in the model.

4. Discussion

Firstly, our results corroborate other studies that have shown women and older individuals to have worse work ability [15,21]. These findings are unsurprising given that females have been shown to have a lower WAI than males in other working contexts [40,41]. However, the present study also found variables to exist that mediated this association. Indeed, the worse WAI in females relative to males was mediated by the fact that women were exposed to a greater extent to current and historic ergonomic risk and work–family conflict. Of these variables, the latter emerged as the strongest mediator as gender-based differences in work ability disappeared when work–family conflict was controlled. In this sense, other studies have shown the importance of especially work–family conflict to better understand the impinged work ability amongst women [22,42].

Gragnano et al. (2020) [43] also recently identified that females rate the family aspect of work–family balance higher than other aspects, with work–family balance influencing job satisfaction through the WAI. Gender inequalities in work–family conflict have been conceptualized as a key element for understanding potential gender inequalities in relation to different health outcomes [44]. In this respect, two alternative hypotheses have been proposed. The first is based on gender differences in vulnerability to family and work stressors (including work–family conflict) [45] and the second concerns differential gender exposure to situations of imbalance between life spheres [46,47].

Whilst evidence of gender differentiated vulnerability is difficult to gather, there is some evidence to support the hypothesis of differential exposure. The role of women in contemporary society is diverse. In Spain, whilst men engage 5 h more a week in paid work than females, women spend on average 13 h more a week than men engaged in all paid and unpaid work [48]. In addition to these concerning national statistics, there is broader evidence that work integration policies are not working for women. Commitment of the European community [49] to equality of opportunities in various societal spheres has seen an increase in the introduction of work–life and family-friendly work policies. With females traditionally being the primary caregiver within families, such policies are designed to ease their path into work. However, there is some evidence that these approaches, including flexible/alternative working arrangements, paid and unpaid leave arrangements, dependent care services and access to information, resources or services, are falling short. For instance, Warren (2004) [50] suggested that, despite efforts, female part-time employees are more likely to be financially insecure, less satisfied with their work–family balance and more likely to intend to quit their job than full-time colleagues. Brough et al. (2008) [51] suggests that workplaces are reluctant to reorganize and enable such policies to be implemented. Thus, work–family balance policies seem better equipped at promoting the "life" side (typically interpreted as "family life" with males being mainly targeted due to their lesser engagement in child rearing, etc.) than the "work" side. As a result, the door to the workplace may remain firmly shut for some women, whilst those females who are gainfully employed may still be at greater risk of suffering from adverse psychological outcomes.

With regards to the associations between work ability and age, older individuals in the present study had a lower WAI than younger colleagues. This relationship remained significant even when violence or discrimination was considered, though violence–discrimination emerged has strengthening this relationship. Other studies have found similar associations regarding work ability, for instance between ageism and older workers' retirement plans [52].

Despite the emergence of laws to prevent age discrimination in the workplace, such discrimination is still frequent [30,53]. Our findings indicate that this dynamic has had a particularly negative impact on the work ability of the older adults working in health centers in the present study.

When we consider professional category (health workers vs. non-health workers), no significant difference in work ability was found. However, when violence/discrimination and work–family conflict are considered as mediators, health workers are more likely to belong to the poorer WAI group. Health care workers are particularly exposed to violence or discrimination [54], with evidence of negative implications of this on psychosocial demand and organizational justice [54]. Violence has also been shown to impair work ability [55,56], with violence not having to be physical to have negative work-related implications [57]. Exposure to violence or discrimination likely impacts upon victims' perceptions of other work-related factors. In the present study, experiences of violence and discrimination meant that health workers had a lower WAI than their counterparts not working in these settings.

Within health workers, work–family conflict was the strongest mediator to emerge of WAI. Previous studies have identified some implications of working in the health setting [58]. These include a lack of flexibility in the working day, managing patient expectations and difficulties in taking time off work, particularly at short notice. Importantly, these aspects of striking a positive balance between the time spent working and engaged in other non-work activities appear to be more deficient in females and health workers, with consequent negative implications for the work ability of these groups.

A number of limitations of the present research should be indicated. The study is cross-sectional in nature and so causal conclusions cannot be made. However, it reports the first-wave cohort data with the second wave of data collection being planned for later in the year. It therefore provides important first insights with the opportunity for later verification. A further limitation is that the statistical procedure applied lacks power relative to other approaches to mediation analysis. For this reason, further outcomes of interest may have been missed; however, the analysis procedure was selected based on its appropriateness to the collected data. Finally, examination of the interceding influence of "third factors" as potential mediators was exploratory in nature. The statistical approach to determine whether a variable is a mediator or moderator is limited and such decisions are better made when framed by prior theoretical or empirical evidence. Despite these limitations, the study benefits from highly novel data collected within a relatively large sample. Whilst the inclusion of only health care workers limits the generalizability of the findings to the wider population, it is important to examine high-risk employees who play a critical role in public health, particularly in the present time with a health pandemic. A future perspective of the present study would be to conduct follow-up analysis within specific groups of health staff (e.g., medical versus nursing staff) in order to identify differences.

5. Conclusions

The present study identified the importance of risk variables for the work ability of health workers according to gender, age and professional group. Females older adults and health workers had a lower work ability after accounting for various aspects of risk. Perception of work–life balance and violence–discrimination may be particularly important and should be considered by interventions targeting improvements in work ability.

Supplementary Materials: The following are available online at https://www.mdpi.com/1660-4601/18/3/877/s1, Table S1: Spearman correlation coefficients between working conditions risk variables and overall WAI scores.

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Informed Consent Statement: All subjects gave their informed consent for inclusion before they participated in the study.

Data Availability Statement: The data presented in this study are available on request from the corresponding author. The data are not publicly available due to privacy reasons specified in the informed consent signed by the participants and participating institutions.

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Article

Interpersonal Conflicts in the Unit Impact the Service Quality Rated by Customers: The Mediating Role of Work-Unit Well-Being

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Abstract: Social dynamics at work are crucial for understanding how internal processes in an organization are related to their performance and productivity. Following the Service-Profit Chain (SPC) theory, this study analyses, at the work-unit level, how interpersonal conflicts are related to service quality in the hospitality and tourism industry through the shared experience of well-being in the work unit. In other words, we examine the mediating role of two main aspects of work-related well-being in the unit (job satisfaction and burnout) on the relationship between interpersonal conflicts in the unit and customers' perceptions of service quality. To do so, we conducted a cross-sectional survey study that collected data from 398 service employees (91 work units) and 1233 customers from three and four-star hotels with restaurant in Spain. Using path analysis in Structural Equation Models, our results supported a full mediation model at the work-unit level: interpersonal conflicts in the work unit are related to customers' service quality perceptions through the work-unit's well-being (job satisfaction and burnout). Therefore, our findings extend the SPC theory by integrating group dynamics and employees' experiences, which should be enhanced through occupational health-oriented policies and practices to increase service quality. In this sense, this study has implications for the development of intervention programs aiming at improving the occupational well-being and quality of service in hospitality and tourism settings.

Keywords: interpersonal conflict; burnout; job satisfaction; service quality; work-unit performance; tourism and hospitality; occupational health and well-being

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1. Introduction

The hospitality industry is a determinant of economic growth, particularly in countries where tourism contributes to an important percentage of the gross domestic product (GDP) [1]. The quality of the service provided by organizations depends to a large extent on the frontline employees of the tourism organization. Providing a high-quality service requires not only having certain skills and competencies, but also experiencing and transmitting positive attitudes and emotions. Indeed, several meta-analyses have shown that employees' job satisfaction is positively related to customers' perceived service quality, which is crucial for building long-term relationships with customers and, therefore, for a firm financial performance [2–8]. Similarly, another meta-analysis comprising 31 studies and more than 10,000 workers concluded that there is a positive relationship between psychological well-being (which incorporates job satisfaction and mental health) and performance, measured in several ways, from leaders' and peers' ratings to organizational records [9].

Therefore, it seems that stimulating human resources practices that improve employees' well-being may repay the investment in these factors through their impact on service

quality and job performance. In that sense, recent research in the hospitality and tourism industry (hotels and restaurants) has explored the link between employees' work-related well-being and service quality [10]. Most of these studies discuss their findings under the lens of the Service-Profit Chain theory (SPC theory: [11,12]), which emphasizes the importance of internal processes ('support services and policies that enable employees to deliver results to customers': [11], p. 165) and external service quality (i.e., customer satisfaction and loyalty) for a firm's financial performance (for a meta-analysis, see [13]).

However, the SPC theory has mainly been applied at the individual level, neglecting the key role of social dynamics at the group or at the organizational level. These internal processes in a company could have an important influence on employees' well-being and on the quality of the service provided by the organization. In response to this gap, this study links an internal processes in the work unit (interpersonal conflict) to two main aspects of well-being at work (job satisfaction and burnout) analyzing their shared impact on the service quality perceived by customers. Our results may help to move the field forward by incorporating group dynamics as a key elements to improve service quality levels.

We have focused on interpersonal conflicts in the hospitality industry (hotels and restaurants) because they have been considered a work-related stressor with detrimental consequences for employees' well-being at work. The main reason is that the hospitality profession is a highly competitive sector where service employees have to work in a turbulent business environment of scarce resources, intense pressure, and rapid rates of technological change [14]. Moreover, frontline employees are usually forced to display positive emotional labor characterized by special attention to the customer to offer high-quality service [15]. This stressful context favors the appearance of conflicts among work-unit members that, if they are not managed correctly, could have consequences, both in the well-being of the employee and the service quality provided [16].

The Service-Profit Chain: Linking Units' Social Dynamics with Customers' Appraisals

According to the SPC theory, when employees are satisfied, service quality improves (e.g., [17,18]). In that sense, frontline employees or customer-contact units are the cornerstones of service quality and customer satisfaction and, therefore, they are ultimately responsible for the overall performance of the service organization [19–21]. Frontline employees (i.e., employees who deliver the service establishing direct contact with customers) represent the face and the voice of their organizations to customers, and their acts and dynamics determine customers' experiences [22–24]. This is particularly evident in services that require customer presence or participation to provide service such as in hotels and restaurants, making the issue of service delivery more dependent on interpersonal interactions than in other organizations [25].

Moreover, service is often provided by employees working in work units and, therefore, when customers evaluate service quality, it is often assesses the quality of service delivered by the work unit as a whole, rather than service offered by individual work-unit members [20]. Hence, in these work units, members spend a long time working together and interacting with customers as a collective entity, which, in turn, leads to customers to experience similar stimuli and share perceptions of service quality.

In addition, internal social processes in the work unit may determine the interaction between employees and customers, which, in turn, may affect how customers evaluate such encounters. Following this rationale, some authors have suggested that interpersonal conflicts in the unit are negatively linked to service quality [26]. For example, Leon-Perez et al. [27], found a negative relationship between interpersonal conflicts within the work unit and self-reported measures of service quality in a sample of 55 units of a vehicle safety and emissions inspection company. Although the effects of interpersonal conflicts on group effectiveness have been studied extensively, these complex relationships have not been fully established and many inconsistencies persevere [28,29]. One of the reasons could be that previous studies used only employees' self-reported data; thus, failing to provide insights into the service encounter, which ideally requires data from both employees and

their customers. For that reason, we hypothesize that interpersonal conflicts within the unit will be reflected negatively in their service quality as a consensus measure reported by their customers (for a review about consensus composition models, see Klein, Conn, Smith, and Sorra [30].

Hypothesis 1. *At the work-unit level, interpersonal conflicts within the work unit will be negatively related to customers' shared perceptions of service quality.*

Although interpersonal conflicts in the work unit may directly impact customers' perceptions of service quality, the SPC theory allows us to suggest a path in which interpersonal conflicts within the unit negatively impact customers' shared perceptions of service quality by decreasing the employee satisfaction and well-being in the unit (see also Whitman, Van Rooy, and Viswesvaran, [31]). In this regard, interpersonal conflicts at the work-unit level bring about strong unpleasant feelings and strained responses [14,32–34]. For example, results from both a cross-sectional and a diary study over a period of two weeks revealed that "conflict may lead to depressive symptoms, which make people even more vulnerable to conflicts, indicating a vicious circle with high psychological and economic costs" ([35] p. 31).

Additionally, there is evidence suggesting that well-being can also be socially induced and passed on (social contagion: [36,37]). Therefore, considering that shared perceptions of the social processes within a work unit can influence work-related well-being at an aggregated level of analysis, experiencing interpersonal conflicts within the work unit may both decrease job satisfaction and increase burnout of the work unit.

Hypothesis 2a. *At the work-unit level, interpersonal conflicts within the work unit will be negatively related to job satisfaction.*

Hypothesis 2b. *At the work-unit level, interpersonal conflicts within the work unit will be positively related to burnout.*

In addition, well-being at work is considered a key factor for developing a satisfactory relationship between the provider and the customer, particularly in the tourism and hospitality sector [38]. Moreover, this association between work-related well-being and service quality has been tested at the unit level of analysis. As Harter et al. [6] concluded after conducting a meta-analysis that comprised 198,514 employees nested in 7939 work-units from 36 organizations, there is a positive association between job satisfaction and engagement and performance at the work-unit level, which explains both customers' satisfaction and organizations' productivity and profitability (e.g., lower levels of turnover and lesser number of work accidents at the organizational level). Equally, previous studies have followed a similar rationale and have analyzed how employees' well-being at work mediates the relationship between group processes and customer satisfaction [39–41]. In particular, the negative side of work-related well-being (burnout, which comprises two core dimensions: emotional exhaustion and cynicism) has been related to a diminished service quality, both at the individual [39] and the group level [41].

Hypothesis 3a. *At the work-unit level, employee satisfaction will mediate the relationship between interpersonal conflicts and customers' shared perceptions of service quality.*

Hypothesis 3b. *At the work-unit level, employee burnout will mediate the relationship between interpersonal conflicts and customers' shared perceptions of service quality.*

In sum, following the SPC theory, this study analyzes the mediating role of work units' satisfaction and burnout (i.e., well-being) on the relationship between interpersonal conflicts in the unit and customers' perceptions of service quality. To do so, we have incorporated measures from different sources to examine the relationship between internal

processes (interpersonal conflicts and well-being in the work unit) and external results (customers' service quality ratings) [42], and we have considered the work unit or the group of employees with whom a particular set of customers interact as the appropriate unit of analysis in service settings, rather than the individual employee-customer dyad [20,43,44]. To sum up, our findings may have relevant practical implications for organizations, incorporating group dynamics as strategical human resources practices to improve service quality levels.

2. Materials and Methods

2.1. Study Design and Procedure

This study followed a cross-sectional survey design, using questionnaires for data collection. To carry out the study, the researchers contacted managers from three- and four-star hotels, with restaurant service, in Andalusia (Spain). Hotel managers were contacted via telephone. After receiving an explanation regarding the aim of the study, they were invited to participate and their permission was requested to administer a questionnaire to a group of their employees and customers.

Data were collected at the service site (real-time service quality approach). The *real-time service quality approach* is associated with an assessment that occurs during an on-site experience and reflects a direct evaluation of the focal service. In contrast, the post hoc *service quality approach* is associated with an assessment that occurs sometimes after the on-site experience and can also reflect the customer experience with different service providers. As this study focuses on the prediction of customers' perceptions of service quality about the focal service, and because focal service information is useful for efforts related to management, design, or policy [45], we followed a *real-time service quality approach.*

The questionnaire administration processes took around 20 min for employees and 5 min for customers. Data were gathered over two high-season days. The confidentiality and anonymity of the answers were guaranteed for both samples. Participation was voluntary, with informed consent following the European regulations on personal data management and research ethics according to the Spanish Association of Psychology.

2.2. Participants and Inclusion Criteria

Our study included two sources of information: frontline employees and customers. Then, the responses of the employees were aggregated into work units (see data analysis strategy). Although participation was voluntary, we included the following inclusion criteria:

Regarding the inclusion criteria, we focused on frontline employees that had to make contact regularly with customers as part of their daily work. Employees filled in the questionnaire during breaks, at the beginning, or the end of their shifts. In addition, hotel customers filled in the questionnaire when checking out. To be eligible, the customers had to have spent at least one night in the hotel. For restaurants, the researchers requested the cooperation of customers immediately after their consumption experience (lunch or dinner) with the main restaurant. In other words, restaurant customers filled in the questionnaire after the service transaction had been completed (i.e., after paying the check). The researchers were present to help employees and customers in case of difficulties with filling in the questionnaires. Finally, regarding work units, we required a minimum of 3 responses from contact employees per work unit and for which service quality was evaluated by a minimum of 10 customers.

We collected self-report data from 398 service employees (receptionists and waiters) and from 1233 customers from 42 hotels and 42 restaurants. The initial sample consisted of 99 work units; however, after applying our inclusion criteria, usable surveys were obtained from 91 work units (91.1%): 49.7% of the units were receptionists and 50.3% were waiters. Information was gathered from a minimum of 3 and a maximum of 11 members of each work unit, with an average of 4.94 members (SD = 3.1). In 57.6% of the sample of work units, three members were surveyed and in 42.4%, more than four members were surveyed.

Regarding participants in the receptionists' work-units, 44.7% were women and 53.8% men (and 1.5% of respondents whose sex was not specified). Participants had different educational levels: elementary school (9.0%), high school (17.6%), high school graduates (20.6%), university graduates (49.2%), and 2.5% without any level of education. Concerning age, 53.8% was situated in the rank of 18 and 29 years old, 33.2% between 30 and 39 years, 7.5% between 40 and 49 years, leaving 5% over 49 years. Position tenure ranged from a few months to 32.6 years, with a mean age of about 5 years (*SD* = 8.45), and 40.7% of the sample consisted of temporary workers.

Regarding participants in the waiters' work units, about 56.1% were men. Age ranged in 51.0% between 18 and 29 years old, in 29.3% between 30 and 39 years, in 15.7% between 40 and 49 years, and in 3.6% over 49 years. Waiters had different educational levels: elementary school (27.3%), high school (33.8%), high school graduates (27.3%), university graduates (8.6%), and 3.0% without any level of education. Regarding contract type, 47.0% were temporary workers.

Finally, the customer sample consisted of 1233 clients from the 91 work units (54% males and 46% females) and the response rate was 95%. Information was gathered from a minimum of ten customers and a maximum of 20 for each of the 91 work units, with an average of about 13 customers.

2.3. Instruments and Measures

Interpersonal Conflicts. This variable was measured through the interpersonal conflict at work questionnaire (CIT), in its Spanish version [46], that comprised both task-oriented conflicts (e.g., "How often do people in your team disagree about opinions regarding the work being done?") and relationship-oriented conflicts (e.g., "How much plotting takes place behind the scenes?"). Response anchors ranged from 1 (*none*) to 5 (*to a great extent*). Cronbach's alpha coefficient was 0.87. The higher the score, the higher the level of interpersonal conflicts experienced.

Work-unit well-being. We defined work-related well-being at the unit level in line with Rothmann's approach [47], who considered that work-related well-being is a multifactorial construct that includes job satisfaction and burnout, among other factors. Therefore, we measured burnout and job satisfaction as key indicators of work-unit well-being. Regarding *Work-unit Burnout,* this factor was measured using the emotional exhaustion dimension (3 items, e.g., "I feel burnout at my work") and the cynicism dimension (3 items, e.g., "I feel that, in my job, I am too hard on the customers") from the Spanish version of the Maslach Burnout Inventory (MBI-GS; [48]). Traditionally, burnout involves experiences of exhaustion (emotional exhaustion), distant or negative attitudes and feelings towards the people one is working with (cynicism), and the development of negative attitudes and feelings of incompetence regarding one's professional role (lack of efficacy) [49]. However, lack of efficacy has been criticized as reflecting a personality characteristic rather than a genuine burnout component [50]. Thus, some research has supported a two-component model, with the inclusion of emotional exhaustion and cynicism dimensions, called the "core of burnout" (e.g., [50,51]). For this reason, in the present study, we considered cynicism and emotional exhaustion as key symptoms of burnout. All the items of the MBI-GS were scored on a five-point frequency rating scale from 1 (*never*) to 5 (*always)*. The consistency coefficient (Cronbach's alpha) of the scale was 0.80. Higher scores on exhaustion and cynicism were indicative of higher levels of burnout.

In addition, *Work-unit Job satisfaction* was measured with the 5 items from the Spanish version of Hartline and Ferrell's scale [17]. This scale follows the conception of job satisfaction as the well-being feeling derived from specific work-related facets: overall job, supervisor, organization's policy, support provided by the organization, and opportunities for advancement with the organization. Response anchors ranged from 1 (*very dissatisfied*) to 7 (*very satisfied*). Cronbach's alpha coefficient was 0.89. Higher scores indicate higher job satisfaction.

Customers' perceptions of service quality. We used Sánchez-Hernández, Martínez-Tur and Ramos's questionnaire to measure service quality [52] according to two dimensions: functional (8 items, e.g., "The services in this hotel/restaurant are efficiently provided") and relational (6 items, e.g., "The employees show a real interest in creating a good relationship with the clients"). All items are scored on a seven-point rating scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*). The consistency coefficient (Cronbach's alpha) for the scale was 0.95. Higher scores indicate higher service quality.

2.4. Data Analysis

First, we aggregated data to the work-unit level. The conceptual rationale for using an aggregated measure of variables in the study was discussed in the introduction. However, as Klein, Dansereau and Hall [53] showed, aggregation must also be accompanied by statistical justification. We used Intraclass Correlation Coefficient (ICC (1)), and also ADI indexes (AD_M index) [54] in order to justify aggregation to higher levels of analysis [55].

To test within-unit agreement, we computed an Average Deviation index (AD_M index) based on the deviation from the item mean for interpersonal conflicts, burnout, job satisfaction, and service quality [55,56]. According to Burke and Dunlap [55], and taking into account the number of response options and their verbal anchors, for interpreting AD values equaled 1 (c/6 = 1) when the response scale is a Likert-type 5-point scale (interpersonal conflicts and burnout) within-unit agreement is acceptable when the values are equal to or less than 1. When the response scale is a Likert-type 7-point scale (job satisfaction and service quality) within-unit agreement is acceptable when the values are equal to or less than 1.16. To determine between-unit differentiation, we computed the interclass correlation coefficient (ICC(1); see [57]).

The mean AD_M values obtained for the study variables were as follows: interpersonal conflicts = 0.63 (*SD* = 0.22); burnout = 0.67 (*SD* = 0.24); job satisfaction = 0.81 (*SD* = 0.32); service quality = 0.57 (*SD* = 0.25). The ICC(1) obtained for each variable was: interpersonal conflicts = 0.10; burnout = 0.29; job satisfaction = 0.20; service quality = 0.22. As we can observe, ICC(1) values were all above 0.10; thus, supporting the use of a multilevel approach [58]. According to the ICC(1) interpretation, 10% of the interpersonal conflicts variance, 29% of the burnout variance, 20% of the job satisfaction variance, and 22% of the service quality variance may be due to work-unit membership. Based on these results, we concluded that levels of within-unit agreement in the present study were sufficient to aggregate work-unit members' scores on all variables to the work-unit level.

We also carried out a one-way analysis of variance (ANOVA) to ascertain whether there was statistically significant between-unit discrimination in the study variables [57]. The results showed significant differences for interpersonal conflicts, F (90, 295) = 1.5, $p < 0.01$; burnout, F (90, 302) = 1.83, $p < 0.01$; job satisfaction, F (90, 302) = 1.88, $p < 0.01$; service quality F (90, 304) = 1.63, $p < 0.01$. These results suggest an adequate between-unit differentiation in all variables and support the viability of these measures.

The research hypotheses were analyzed using the path analysis method. The analyses were conducted in LISREL 8.54 following the main recommendations proposed in the literature (e.g., [59–61]). Missing data were dealt with using mean substitution. Maximum likelihood estimation methods were used, and the input for the analysis was the covariance matrix. As no statistical test or critical values are available to determine the adequacy of absolute indexes, researchers also recommend the computation of relative goodness-of-fit [62,63]. Thus, the following absolute and relative goodness-of-fit indexes were calculated: the chi-square goodness-of-fit statistic (χ^2), Comparative Fit Index (CFI), Tucker–Lewis Fit Index (TLI), Root Mean Square Error of Approximation (RMSEA), and Standardized Root Mean Square Residual (SRMR).

The mediation analysis was performed using the bootstrapping method. Compared to other methods, bootstrapping is one of the methods with the highest statistical power. This method involves bootstrapping the regression model and calculating the empirical confidence intervals [64]. A total of 10,000 resamples were created for the estimation of the

Percentile (PC 95%) confidence intervals of the mediation effects. The mediation effect is significant ($p < 0.05$) when the confidence interval does not include zero (0).

3. Results

3.1. Descriptive Results

We first provide descriptive results for the work units' main variables of this study such as means, standard deviations, and Pearson correlations. As it can be seen in Table 1, interpersonal conflicts presented a significant negative relationship with job satisfaction ($r = -0.30$, $p < 0.01$), and a positive relationship with burnout ($r = 0.30$, $p < 0.01$). Additionally, job satisfaction was positively related to service quality ($r = 0.24$, $p < 0.01$) and burnout was negatively related to service quality ($r = -0.35$, $p < 0.01$). However, interpersonal conflicts were not related to service quality ($r = -0.04$, *ns*).

Table 1. Work unit means, standard deviations, and bivariate correlations among the main variables of the study ($n = 91$ work units).

Variable	Mean	SD	1	2	3	4
1. Interpersonal conflicts	2.38	0.61	(0.87)			
2. Job satisfaction	4.89	0.96	−0.30 **	(0.89)		
3. Burnout	2.41	0.26	0.30 **	−0.11	(0.80)	
4. Service quality	5.89	0.30	−0.04	0.24 *	−0.35 **	(0.95)

Note: * $p < 0.05$ two-tailed; ** $p < 0.01$ two-tailed. Cronbach's alpha coefficients, representing the reliability of the scales at the individual level, are in the correlation matrix diagonal.

3.2. Mediation Analysis

Our proposed model (full mediation, M1) and the alternative model (partial mediation, M2) were compared computing multiple regressions models. The two models showed a good fit: M1 model $\chi^2(2) = 1.83$, $p = 0.39$, TLI = 1.00, CFI = 1.00, RMSEA = 0.00 (90% CI: 0.00, 0.20), and SRMR = 0.04; M2 model $\chi^2(1) = 0.07$, $p = 0.80$, CFI = 1.00, TLI = 1.00, RMSEA = 0.00 (90% CI: 0.18), and SRMR = 0.01, with CFI and TLI coefficients higher than 0.95 and RMSEA and SRMR coefficients below 0.08. The path from interpersonal conflicts to service quality in the M2 model was not significant (Beta = 0.29, *ns*, see Figure 1). Given that both models obtained identical indexes, we retained the full mediation model because it presented greater parsimony with a lesser number of connections (see Figure 2).

Regarding the mediation effect of burnout and job satisfaction, burnout was a significant mediator ($p < 0.05$) in the relationship between interpersonal conflicts and service quality (PC 95% CI: −0.24, −0.04). Job satisfaction was also shown as a significant mediator ($p < 0.05$) between interpersonal conflicts and service quality (PC 95% CI: −0.17, −0.01). Considering the total indirect effect of interpersonal conflicts on service quality, 75.75% was mediated by burnout and 24.25% was mediated by job satisfaction (see Table 2).

Table 2. Indirect and total effects of burnout and job satisfaction on service quality at the work-unit levels ($n = 91$).

Predictor Variable (X)	Mediator Variable (M)	Result Variable (Y)	X → M	M → Y	Direct	Indirect (PC 95% CI)	Total (PC 95% CI)
Interpersonal conflicts	Burnout	Service quality	0.34	−0.37	—	−0.125 (−0.24, −0.04)	−0.125 (−0.24, −0.04)
	Job satisfaction		−0.58	0.14	—	−0.080 (−0.17, −0.01)	−0.080 (−0.17, −0.01)

Non-standardized coefficients. Percentile Confidence Intervals based on 10,000 resamples (95%).

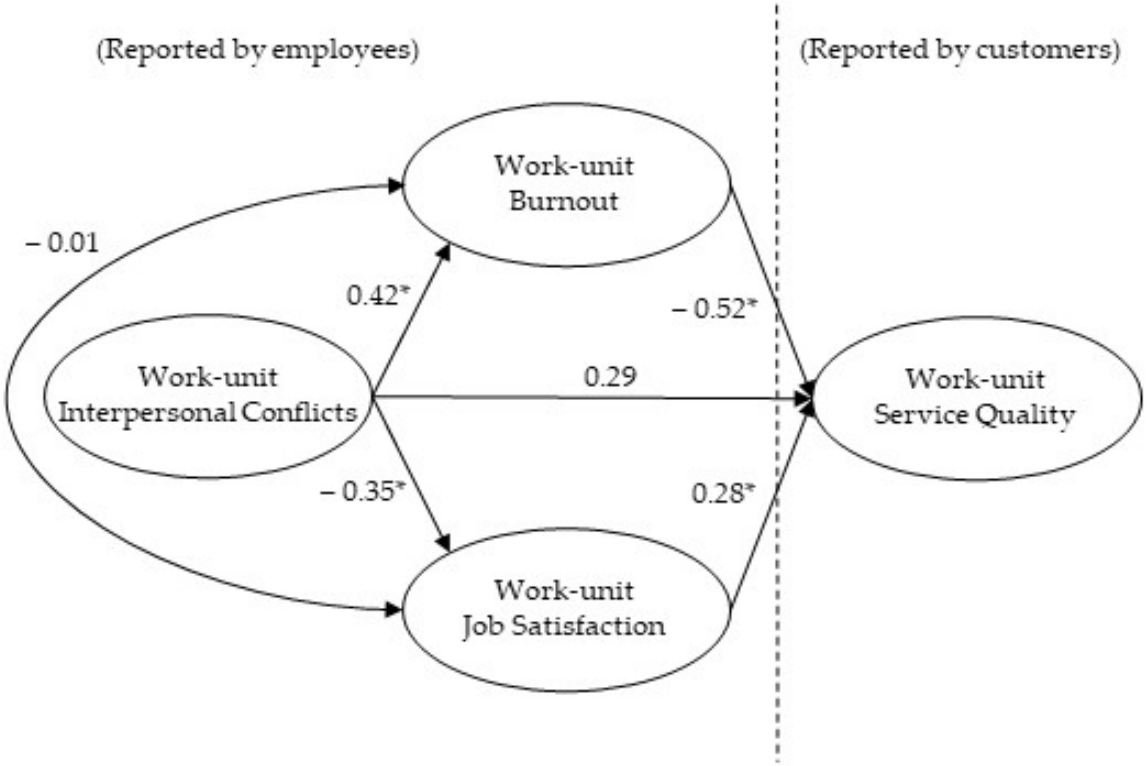

Figure 1. Partial mediation model. * $p < 0.01$. Standardized coefficients.

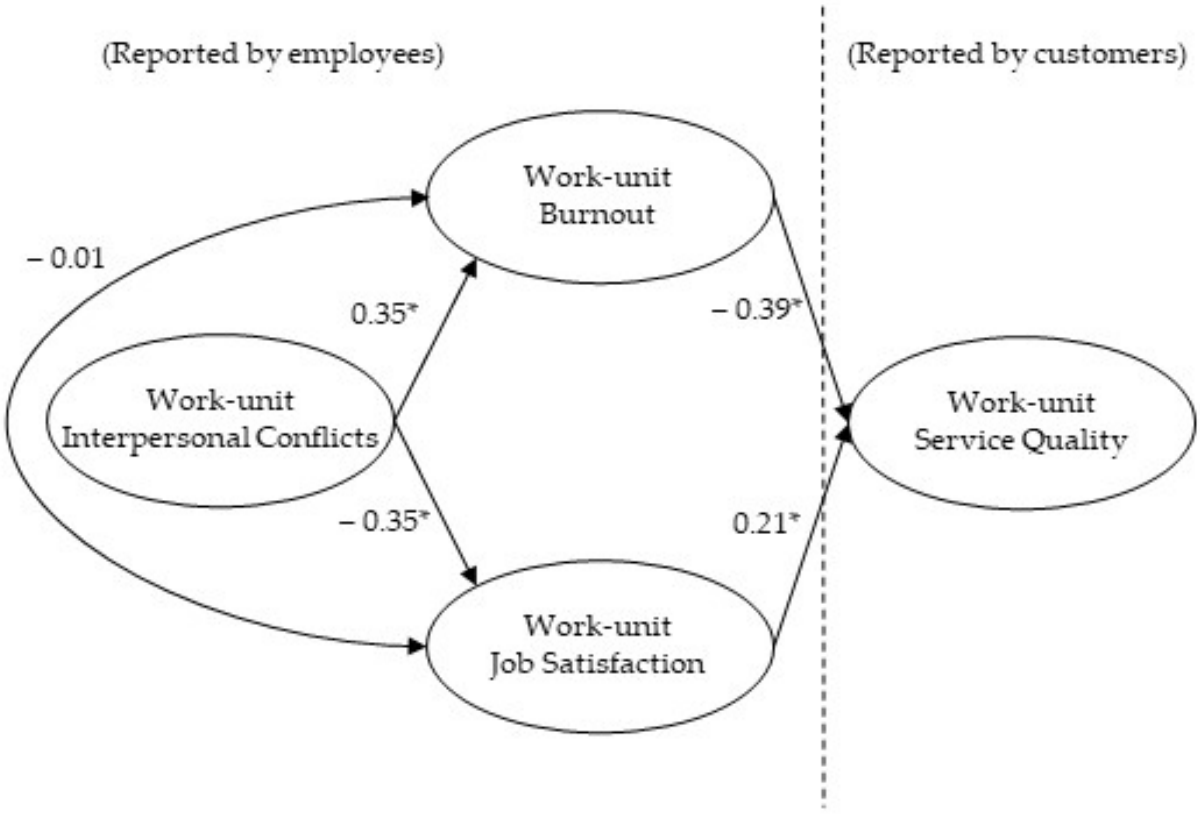

Figure 2. Full mediation model. * $p < 0.01$. Standardized coefficients.

4. Discussion

As the SPC theory proposes, the link between employees' well-being at work (job satisfaction and burnout) and customers' service quality perceptions are crucial for organizational sustainability and productivity. Furthermore, group social dynamics such as interpersonal conflicts may determine employees' satisfaction and burnout, which, in turn, influences customer perceptions of service quality. Our results confirmed this full mediation model at the work-unit level: interpersonal conflicts in the work unit are related to customers' service quality perceptions through employee well-being at the work-unit level in both its positive (job satisfaction) and negative dimensions (burnout).

These findings have relevant implications for theory and practice. From a theoretical point of view, our results confirm the link, in the service-profit chain, between employees' well-being states at work (satisfaction and burnout), and customers' satisfaction (quality of service). Indeed, our results support the idea that employees' well-being at work has an important impact on customers' perceived quality of service, which is crucial for organizational profit and growth [12]. According to the SPC theory, employees' states are primarily derived from organizational policies and practices that support and enable employees to deliver high-quality services to customers. Our results suggest that not only organizational policies and practices are important (e.g., work design, or HR practices) but also social interactions among units' members and group dynamics should be considered when striving for excellence in service organizations.

Moreover, our results extend the SPC theory by incorporating relevant group dynamics (such as interpersonal conflicts) that determine employees' shared perceptions of satisfaction and burnout, which, in turn, is associated with the service quality perceived by customers. In that sense, our findings demonstrate that current service organizations are demanding work environments for employees because workers must follow very high-quality standards with a low tolerance to mistakes [14]. In this context, discrepancies between employees may arise and social relationships can be easily deteriorated, causing interpersonal conflicts among unit members that can be detrimental to service quality [64]. These findings are in line with a previous study conducted in 156 bank branches, revealing that interpersonal conflicts deteriorate the affective climate of the work-unit [65]. The logic behind this idea is that social relationships between employees of an organization transfer to the interaction between employees and customers, which ultimately yields the service quality that customers experience [66].

In a similar vein, our findings are consistent with the thesis of *feeling good leads to doing good* [67] and *the happy-productive worker hypothesis* [68,69]. When work-unit members feel happy (satisfied, engaged), they display helping behaviors and cooperation among workers, and are more inclined to express positive emotions at work directed towards customers [18,70]. On the other hand, work-unit burnout reduces the levels of customer service quality [40,71,72]. In the context of our study, two complementary findings may explain our results: (1) when workers experience negative emotions and strain, it is the captured by customers through emotional contagion processes, affecting the customers' perceived service quality [73]; (2) a study conducted in The Netherlands, that used external observer ratings of service employee–customer interactions, revealed that cynical employees exhibited more negative actions towards their customers; therefore, customers perceived lower service quality [40]. Indeed, the indirect effect of interpersonal conflicts on service quality seems to be higher for burnout than job satisfaction.

In light of these results, from a practical point of view, managers and supervisors should promote a work-unit context with positive experiences, avoiding negative experiences such as tension or anxiety caused by interpersonal conflicts. Indeed, previous studies have highlighted that effectively managing interpersonal conflicts in the wok unit is crucial for performance [29,74]. Findings suggest that customers have a perception of the service quality because of an overall perception of their interactions with employees. For that reason, organizations need to take care of interpersonal conflict and well-being among all the members that interact with customers. Thus, conflict management training may help to

create a good service climate in the work unit that allows employees to establish positive social relationships with both colleagues and customers and deliver a good service (see Leon-Perez et al. [27]). Additionally, team development and positive interventions can complement workplace stress management and health promotion interventions to foster satisfaction and well-being in the work unit (for reviews, see [75,76]).

Limitations and Further Research

This study has also some limitations that should be noted. It is noteworthy the cross-sectional nature of our data which did not permit us to explore these processes over time and to analyze possible reversed causal relation between our main variables. That is, interpersonal conflicts not only trigger poor work-related well-being, but can also be the result of it [77]. Additionally, customer emotions could have a direct impact on employees by reducing job satisfaction and increasing the experience of burnout [68,78,79]. In other words, satisfied employees show better service performance leading to satisfied customers, but also dissatisfied customers exhibit stressful behaviors that cause employee strain and low job satisfaction. In this sense, Ryan, Schmit, and Johnson [80] showed that customer satisfaction is more likely to cause employee job satisfaction than the other way around. These reserved causal relationships clearly need future studies with a longitudinal design.

Finally, the sample of this research only included hotel and restaurant employees' data and, therefore, results generalization is somewhat limited. Testing the present model on other samples, including different types of actors (employees, supervisors), companies, and sectors, will provide good opportunities to explore the generalization of the proposed model. In doing so, future studies may explore the role of different types of conflicts (see [28]).

5. Conclusions

This study emphasizes the role of satisfaction and burnout at the aggregate group or unit level of analysis in the relationship between group dynamics (interpersonal conflicts) and service quality (measured through customers' ratings), which is central to an understanding of organizational performance in service contexts. Our results extend SPC theory by incorporating group dynamics and employees' experiences that can be improved through occupational health-oriented policies and practices.

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Data Availability Statement: The data that support the findings of this study are available on request from the corresponding author, (Benitez, M.). The data are not publicly available due to private agreements with some organizations that participated in the study.

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Occupational Risk for Post-Traumatic Stress Disorder and Trauma-Related Depression: A Systematic Review with Meta-Analysis

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Abstract: There is evidence suggesting that occupational trauma leads to post-traumatic stress disorder (PTSD) and depression. However, there is a lack of high-quality reviews studying this association. We, therefore, conducted a systematic review with a meta-analysis to summarize the evidence of occupational trauma on PTSD and depression. After a database search on studies published between 1994 and 2018, we included 31 studies, of which only four had a low risk of bias. For soldiers exposed to wartime deployment, the pooled relative risk (RR) was 2.18 (95% CI 1.83–2.60) for PTSD and 1.15 (95% CI 1.06–1.25) for depression. For employees exposed to occupational trauma, there also was an increased risk for PTSD (RR = 3.18; 95% CI 1.76–5.76) and for depression (RR = 1.73; 95% CI 1.44–2.08). The overall quality of the evidence according to the Grading of Recommendations Assessment, Development, and Evaluation (GRADE) approach was moderate; the evidence was high only for the association between workers after exposure to trauma and development of PTSD. The study results indicate an increased risk of PTSD and depression in soldiers after participation in war and in employees after occupational trauma.

Keywords: systematic review; occupational trauma; posttraumatic stress disorder; depression; occupational accident; occupational disease

1. Introduction

In many professions, employees might experience traumatic events. For example, it is well known that rescue workers often experience an accident situation that is difficult to cope with when they arrive at accident sites. In a large number of professions (train drivers, soldiers, firefighters, police officers, paramedics, emergency doctors, journalists, photographers in war zones, prison staff, psychiatry staff, and others), there is a debate whether employees in such professions suffer from post-traumatic stress disorder (PTSD) or depression [1–4]. In Germany and several other EU countries, PTSD and depression can be recognized as an occupational accident [5,6]. Up to now, PTSD has only been recognized as an occupational disease in Denmark, while depression has been recognized

as such in at least the Netherlands, Denmark, France, and Sweden [5,7]. In a systematic review, Utzon-Frank et al., 2014 [2] reported a 9.4% PTSD prevalence in firefighters zero to six months after an occupational trauma, and after six months or more, a PTSD prevalence of 12.1%. In their systematic review, Berger et al., 2012 [8] found a PTSD prevalence in firefighters of 7.3%. Sterud et al., 2006 [9], Berger et al., 2012 [8], and Hegg-Deloye et al., 2014 [10] described in their systematic reviews a PTSD prevalence of 4.0–25.5% in paramedics. All authors rated these prevalences to be increased compared to published data in the general population. However, the primary studies included in the mentioned reviews were not included in our systematic review because they were cross-sectional without a reference group.

Furthermore, in a meta-review (Bolm-Audorff et al., 2019 [11]), we found that all reviews [2,8–10] have considerable weaknesses. In this meta-review we assessed systematic reviews studying the relationship between occupational trauma, PTSD, and depression. One result of this metareview was that the quality of most systematic reviews according to AMSTAR ("Assessing the methodological quality of systematic reviews") criteria [12–15] was low. Only about one-sixth of the systematic reviews had carried out their own quality assessment of the original studies included.

Based on our findings indicating a predominantly poor-quality basis in the existing reviews, we conducted our own systematic review with meta-analysis to investigate whether there is an increased occupational risk in particular occupational groups or as a result of specific occupational trauma for PTSD and depression. In particular, we conducted a systematic review and meta-analysis guided by the following research questions:

1. Is there an increased risk of PTSD or depression among workers in specific occupations with frequent exposure to trauma (train drivers, soldiers, firefighters, police officers, paramedics, emergency doctors, war journalists or war photographers, prison staff, or psychiatric staff)? If so, how high is this risk?
2. Is there an increased risk of PTSD or depression among employees who have been exposed to occupational trauma, violence, attacks, sexual harassment, or war? If so, how high is the risk?

2. Methods

A systematic electronic literature search was conducted in the Pubmed and Pilots databases on 20 September 2018 (Supplementary Figure S1). Consideration was given to cohort studies, case-control studies and cross-sectional studies with a control group published between 1 January 1994–31 August 2018. The search started in 1994 due to the publication of the DSM (Diagnostic and Statistical Manual of Mental Disorders) IV criteria [16].

There were no language limitations for inclusion in the study, provided that the studies had an English or German abstract. The inclusion and exclusion criteria can be found in Table S1. The review included all studies with employed persons of both sexes from the general population. We defined two exposure groups to differentiate between a specific occupational risk or a risk due to a specific trauma: exposure group 1 refers to special occupational groups that may have a higher risk of being exposed to occupational trauma (i.e., train drivers, soldiers, firefighters, police officers, paramedics, emergency doctors, journalists/photographers or similar in war zones, prison staff, psychiatric staff), while exposure group 2 refers to employees exposed to occupational trauma (trauma, violence, assault, sexual harassment in the workplace, wartime deployment).

Post-traumatic stress disorder, depressive disorder, and (other) affective disorders were accepted as outcomes. Only cohort studies, case-control studies or cross-sectional studies (all with a response ≥10%) were included in the study. An accepted comparison group for exposure group 1 was the general working population or occupational groups without evidence of increased exposure, and for exposure group 2, a group without exposure to occupational trauma (including groups not exposed to occupational trauma, e.g., soldiers without military service) was considered (for further details see Table S1).

In addition, a hand search was performed by checking the reference lists of the included studies that did not refer to soldier studies. Additionally, a Google Scholar search was performed according to the "citation tracking factor." To address the different occupational groups covered in our meta-review, the following studies were included in the "citation tracking" Google Scholar search: Aoki et al., 2012 [17] (journalists), Utzon-Frank et al., 2014 [2] (different professions), Bills et al., 2008 [18] and Sterud et al., 2006 [9] (disaster relief workers), and Clarner et al., 2015 [19] (train drivers). Qualitative studies, ecological studies, case reports, and experimental studies were excluded.

The titles and abstracts were independently reviewed by two reviewers (U.B.-A. and G.P.-H.) to determine whether the inclusion criteria were met. If no agreement could be reached, a third author (A.S.) was consulted and the study was discussed until a majority consensus was reached. The full texts of the studies included after the review of titles and abstracts were then reviewed by two independent evaluators (U.B.-A. and G.P.-H.). In the absence of agreement, the same procedure was followed as for the review of the titles and abstracts. The reasons for exclusion were recorded for each excluded study.

The data extraction was carried out independently by two reviewers (U.B.-A. and G.P.-H.), who discussed results with each other in case of discrepancies. If no agreement could be reached, the data extraction was discussed together with a third author (A.S.) until a majority was reached. The following information was collected from each included study: first author, year of publication, study region, study design, type of employees investigated, number of exposed and non-exposed persons, response (%), age, time period in which the study was conducted, duration of exposure, job tasks, instrument used for evaluation of PTSD or depression, research institution, funding sources, disease frequency, number of exposed cases and controls, effect estimate, confounders considered, and additional analyses done.

The risk of bias evaluation was carried out according to the study by Ijaz et al., 2013 [20] and was performed by two reviewers (U.B.-A. and G.P.-H.), independently of each other. When there was a disagreement, the study was discussed with a third author (A.S.) until a majority consensus was reached. Six major domains with important sources of bias were evaluated (study recruitment and follow-up, exposure definition and measurement, outcome source and validation, confounding and effect modification, assessment, quality of the statistical analysis, and chronology). Each domain could be judged as having a high risk of bias, a low risk of bias, or an unclear risk of bias. If a study was evaluated with a high or unclear risk of bias in one of the six major domains mentioned above, the study was evaluated as having a high risk of bias. In addition, the following minor domains of bias were recorded: blinding of the evaluators, study funding, and conflict of interest. However, these did not play a role in the overall evaluation of bias for the study.

The study results were summarized descriptively and in meta-analyses (K.R.S). Because odds ratios (ORs) tend to overestimate the relative risk when the prevalence of the outcome of interest is high, we converted the ORs to prevalence ratios (PRs) when the prevalence was higher than 10% using the formula proposed by Zhang and You 1998 [21]. When studies did not directly report PRs, this was manually done if the studies included the necessary information to do so. Meta-analyses were performed to estimate the pooled risk of occupational trauma on depression and PTSD. The meta-analysis was carried out if at least two primary studies which were comparable in terms of exposure and outcome were included. Excluded were studies that had no effect estimator or had no information on trauma. Due to the heterogeneity of the studies, the random effects model was used as the analysis method. The I^2 value in general was given as a measure of heterogeneity, keeping in mind that the I^2 statistic depends on the size of the studies included [20,21]. The occurrence of publication bias was determined using funnel plots and Egger's tests. Stata Version 14.2 (StataCorp, College Station, TX, USA) was used for the meta-analysis.

We used the Grading of Recommendations Assessment, Development, and Evaluation (GRADE) approach for grading the quality of the total body of evidence [22], following the example of Hulshof et al., 2019 [23], with modifications (Romero Starke et al., 2019 [24,25]). We used the following

levels of quality: high, moderate, and low. An initial "high" level would indicate having randomized studies. If only observational studies were included, then the starting level would be set to "moderate." The quality of evidence was downgraded based on five factors: study limitations (high risk of bias), indirectness, inconsistency, imprecision (range of the CI of studies > 2.0), and publication bias (yes or unclear). Study findings with large effect sizes (an effect estimate > 2.0), a dose-response relationship, or the presence of residual confounding (which would increase confidence in the association), resulted in an upgrade of the quality of evidence. If an effect size larger than 5.0 was present, the quality of evidence was upgraded twice.

The study design was published a priori in PROSPERO (Prospero registration number: CRD42019122774, Petereit-Haack et al., 2019 [26]). The review meets all criteria of AMSTAR 2 [15].

3. Results

3.1. Search Results

The Prisma flow chart (Figure 1) shows the results of the literature search. After exclusion of duplicates, we reviewed 12,321 and excluded 12,180 studies based on the title and abstract. After the full-text review, we excluded 110 more studies, yielding 31 included publications [1,27–55]. Table S2 shows the studies excluded based on the full-text review. The reason for exclusion of 25 studies in the full text review was due to the study design. This was mainly due to a lack of response information or due to a response below 10%. Sixty-five studies were excluded either due to the absence of a comparison group or due to the use of an unsuitable comparison which had a similar exposure to that of the study group. In 16 studies, the exposure was not pertinent, and four studies were excluded based on the outcome (Table S2).

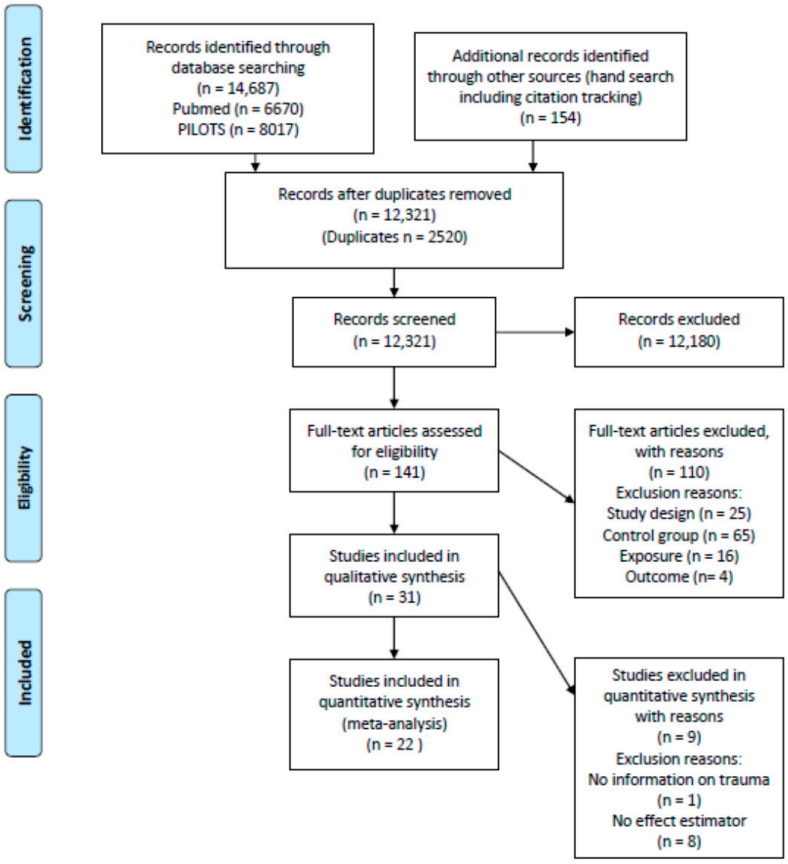

Figure 1. Flow diagram of inclusions and exclusions.

3.2. Study Characteristics

3.2.1. Study Design and Country of Study

The inclusion criteria were met by 31 studies with the following designs: 28 cross-sectional studies, 2 cohort studies [40,47], and 1 matched case-control study [53]. Twelve studies originated in Europe [27,28,31,32,39,40,42,49,52–54,56], nine studies were from North America [35,37,38,41,45–48,50], four studies were from Asia [33,34,51,55], two studies originated from South America [29,43], two studies were from Australia [36,44], one study was from Israel [57], and one study included data from around the world [30]. The studies are listed in Table S3.

3.2.2. Outcomes Studied

Study Population

Ten studies were conducted on soldiers and/or veterans after wartime deployment [28,31,32,35,37,38,41,46,47,50]; seven studies were done on health care workers [36,39,44,45,49,55,57]; three studies included police officers or firefighters [27,32,52]; three studies investigated train drivers or subway train drivers [33,34,56]; and two studies were done on journalists or war journalists [29,30]. Thirteen studies investigated PTSD [28,31,32,37,39,41,44–47,54], 10 studies investigated depression [36,40,42,43,49,51–53], and another 10 investigated both outcomes [29,30,33–35,38,48,50,56,57]. The evaluation of the outcomes varied among the studies. For the outcome PTSD, 16 different instruments were used: IES-R (Impact of Event Scale Revisited) [29,30,45,57], MINI (International Psychiatric Interview) [41,56], PTSD Checklist (PCL-L) [31,35,44,50], Self-rating inventory for post-traumatic stress disorder [32], AUDADIS-5 (Alcohol Use Disorder and Associated Disabilities Interview Schedule DSM-5 Version) [37], CHAMPS (Inpatient or outpatient ICD-9 diagnosis of PTSD according to the archival system for medical personnel) [38], PSS-SR (Self-report Post-traumatic Stress Disorder Symptom Scale, DSM-III) [39], Trauma Assessment for Adults Questionnaire Clinician Administered PTSD Scale [41,45], and the US army data system about treatment for PTSD [47]. For the evaluation of depression, 15 different instruments were used: MINI (International Psychiatric Interview) [50,56,57], HADS (Hospital Anxiety and Depression Scale) [27,42,49], BDI II (Beck depression inventory II) [28–30], GHQ 28 (depression subscale of General Health Questionnaire) [29,30,56], SCID (Clinical interview for axis I DSM IV disorders) [30], CIDI (WHO Composite International Diagnostic Interview) [33,34,48], Depression Scale of the Patient Health Questionnaire, DSM IV [35], CHAMPS (Inpatient or outpatient ICD-9-diagnosis of PTSD according the archival medical personnel system) [38], SF-26 (5-item mental health inventory of the 36-item short-form) [40], register of medicinal product statistics [40], PHQ-9 (major depressive disorder, MDD, Diagnostic and Statistical Manual of Mental Disorders, 4th Edition, DSM-IV) [34], CES-D (Japanese version) [51], SCL-90-R (System Checklist Revised) [52], ICD (Clinical Psychiatric Diagnoses) [53], and the Self-rating depression scale (SDS) [55]. For details, see Table S3.

Exposure

In 17 studies, the exposure was defined as having had a trauma at the workplace [28,29,32–34,36,39,40,42–45,48,51–53,56,57]. Fourteen studies investigated an occupational group [27,30,31,34,35,37,38,41,46,47,49,50,54,55].

Comparison Group

In most studies, unexposed persons of the same occupational group were used as the comparison group, whereas in six studies the control persons came from the general population [27,40,42,43,49,53]. The response was between 11.9% and 100%. Further details on the response, age, and sex distribution can be found in Table S3.

3.3. Risk of Bias Evaluation

In total, four studies showed a low risk of bias [38,40,47,53], and all remaining 27 studies showed a high overall risk of bias. Of the 10 studies which investigated PTSD and depression as outcomes, only one study had a low risk of bias [38]. Two of the 10 studies that evaluated only depression as their outcome were evaluated as having a low risk of bias [40,53]. Similarly, only 1 study [47] of the 13 studies evaluating PTSD as an outcome had a low risk of bias. All 27 cross-sectional studies were classified as having a high risk of bias because of the study design (Table 1).

Five studies had a high risk of bias due to the recruitment procedure [27,39,44,45,49]. Two studies had a high risk of bias due to the exposure [27,28]; 1 study because of the outcome [46]; 11 studies due to confounders [28,29,36,37,39,44–46,51,54,55]; and 12 studies due to the analysis methods [27–30,39,44–46,49,54,56,57]. Results with regard to the minor domains are shown in Table 1. The details of the risk of bias analysis for each of the 31 studies can be provided by the authors on request.

Table 1. Risk of Bias.

			Major Domains					Minor Domains				Overall
No	**Study ID**	**Outcome**	**1. Recruitment Procedure & Follow-up (in Cohort Studies)**	**2. Exposure Definition and Measurement**	**3. Outcome. Source and Validation**	**4. Confounding and Effect Modification**	**5. Analysis Method: Methods to Reduce Research Specific Bias**	**6. Chronology**	**7 Blinding**	**8. Funding**	**9. Conflict of Interest**	
1	Berg et al. 2006 [27]	Depression	0	0	2	2	0	0	1	2	2	0
2	Darves-Bornoz et al. 2008 [28]	PTSD	2	0	2	0	0	0	1	2	1	0
3	Feinstein et al. 2002 [29]	PTSD, Depression	2	2	2	2	0	0	1	2	1	0
4	Feinstein 2012 [30]	PTSD, Depression	2	2	2	0	0	0	1	1	1	0
5	Hotopf et al. 2006 [31]	PTSD	2	2	2	2	2	0	1	2	0	0
6	Huizink et al 2006 [32]	PTSD	2	2	2	2	2	0	1	1	1	0
7	Kim et al. 2013 [33]	PTSD, Depression	2	2	2	2	2	0	1	2	1	0
8	Kim et al. 2014 [34]	PTSD, Depression	2	2	2	2	2	0	1	2	1	0
9	Kline et al. 2010 [35]	PTSD, Depression	2	2	2	2	2	0	1	2	0	0
10	Lam et al. 1999 [36]	Depression	2	2	2	0	2	0	1	1	1	0
11	Lehavot et al. 2018 [37]	PTSD	2	2	2	0	2	0	1	2	2	0
12	Levin-Rector et al. 2018 [38]	PTSD, Depression	2	2	2	2	2	2	2	2	0	2
13	Luce et al. 2002 [39]	PTSD	0	3	3	0	0	0	1	1	1	0
14	Madsen et al. 2010 [40]	Depression	2	2	2	2	2	2	1	3	1	2
15	Magruder et al. 2005 [41]	PTSD	2	2	2	2	2	0	1	2	1	0
16	Niedhammer et al. 2015 [42]	Depression	2	2	2	2	2	0	1	2	2	0
17	Oenning et al. 2018 [43]	Depression	2	2	2	2	2	0	1	2	2	0
18	Opie et al. 2010 [44]	PTSD	0	2	2	0	0	0	1	1	1	0
19	Park et al. 2011 [45]	PTSD	0	2	2	0	0	0	1	1	1	0
20	Proctor et al. 1998 [46]	PTSD	2	2	0	0	0	0	1	2	1	0
21	Rosellini et al. 2017 [47]	PTSD	2	2	2	2	2	2	2	2	1	2
22	Sareen et al. 2007 [48]	PTSD Depression	2	2	2	2	2	0	0	2	2	0
23	Sterud et al. 2008 [49]	Depression	0	2	2	2	0	0	1	2	2	0
24	Thomas et al. 2017 [50]	PTSD Depression	2	2	2	2	2	0	1	2	2	0
25	Tsuno et al. 2016 [51]	Depression	2	2	2	0	2	0	1	2	2	0
26	van der Velden et al. 2013 [52]	Depression	2	2	2	2	2	0	2	1	2	0
27	Wieclaw et al. 2006 [53]	Depression	2	2	2	2	2	2	2	2	2	2
28	Wittchen et al. 2012 [54]	PTSD	2	2	2	0	0	0	1	2	2	0
29	Zhao et al. 2018 [55]	Depres-sion	2	2	2	0	2	0	1	2	2	0
30	Cothereau et al. 2003 [56]	PTSD, Depression	2	2	2	2	0	0	1	1	1	0
31	Ben-Esra et al. 2011 [57]	PTSD, Depression	2	2	2	2	0	0	1	1	1	0

Low risk of bias 2. High risk of bias 0. Unclear risk of bias 1.

3.4. Study Results

The results of the individual studies are shown in Table S4.

A significant association between nurses exposed to violence at the workplace and depression was described by Zhao et al., 2018 [55]. This study could not be included in the meta-analysis because no effect estimator was provided. In the population-based study from France, Niedhammer et al., 2015 [42] described a statistically significant association between physical violence or sexual assault and the risk of depression in men, but not in women. This study could also not be included in the meta-analysis because an effect estimator was not provided.

Luce et al., 2002 [39] described more pronounced levels of PTSD in a survey of health care workers who treated victims of the 1998 Omagh bombing in Northern Ireland compared to health care workers who had no contact with these victims. Opie et al., 2010 [44] described a significant correlation between the extent of sexual harassment experienced by nurses and the severity of PTSD in very lonely areas of Australia. Park, 2011 [45] found an increased prevalence of PTSD in nurses involved in the management of Hurricane Katrina.

We found the following results for occupational groups with a high risk of trauma:

Firefighters: According to the study by Huizink et al., 2006 [32], firefighters who had to extinguish a fire after a plane crash did not have an increased risk of posttraumatic stress disorder compared to firefighters without this exposure (OR = 1.1, 95% CI 0.4–3.7). Van der Velden et al., 2013 [52] described a prevalence of pronounced depressive symptoms in 13.0% of 123 firefighters examined. The prevalence of depression was not significantly increased compared to the comparison group of 144 police officers without specific traumas, of whom 11.8% had such symptoms.

Police officers: In a cross-sectional study of 3272 Norwegian police officers, Berg et al., 2006 [27] reported no difference in the expression of depressive symptoms in this group compared to the control group from the general population after age stratification. Specific traumas in police officers, such as the involvement in a shoot-out or experiences of violence at work, were not described in their study. In their cross-sectional study of 834 police officers, Huizink et al. [32] found that police officers involved in coping with a plane crash had 2.8 times the risk of depression (95% CI 1.5–5.0), compared to police officers who had nothing to do with the crash. Van der Velden et al., 2013 [52] reported in a cross-sectional study that police officers who were professionally involved in the handling of the fire disaster in Enschede in 2000, had a significantly lower risk of developing depression compared to police officers who were not involved in this fire disaster.

Paramedics: In a cross-sectional study of 1180 paramedics in Norway, Sterud et al., 2008 [49], described the prevalence of depression in men as 8.0% compared to that of the general resident population (7.0%). In contrast, the prevalence of depression was lower among female paramedics compared to the unexposed comparison group (4.6 vs. 6.7%). Since no information on trauma was provided in the study, this study was not included in the meta-analysis.

War journalists: In their cross-sectional study of 140 war journalists, Feinstein et al., 2002 [30] described a significantly more pronounced PTSD and depression symptomatology in war journalists compared to journalists without war coverage. Furthermore, in a cross-sectional study of 87 Mexican journalists threatened by drug cartels, Feinstein et al., 2012 [29] did not find a significant increase in PTSD and depression in such journalists, compared to 17 journalists who were not exposed to such threats. A meta-analysis was not possible because neither study provided effect estimates on the risk of disease.

Subway drivers: Two studies considered subway drivers: Kim et al., 2013 [33] and Kim et al., 2014 [34]. The PTSD risk for subway drivers was significantly increased in these studies: 11.70; 95% CI 1.90–225.80 for Kim et al., 2013 [33] and 1.54; 95% CI 0.52–4.55 for Kim et al., 2014 [34]. The risk of depression for subway drivers also showed an increased risk of depression (RR = 2.60; 95% CI 0.70–9.40) for Kim et al., 2013 [33] and (RR = 1.99; 95% CI 0.72–5.53) for Kim et al., 2014 [34]. However, the values were not statistically significant since both studies only had a small number of exposed and unexposed subway drivers with depression.

Soldiers: In a sub-sample of their cohort (n = 326), Hotopf et al., 2006 [31] could not show an association between soldiers after war deployment and PTSD (OR = 0.61; 95% CI 0.39–0.95). In a further study of 296 participants, there was a statistically significant increased risk of PTSD in soldiers after war deployment (Kline et al., 2010 [35]). In another study (Lehavot et al., 2018 [37]) PTSD increased by more than 2.65 times in women (OR = 2.65; 95% CI 0.83–8.41) and by more than five times in men (OR = 5.05; 95% CI 3.60–7.10). A cohort study investigated both PTSD and depression in army soldiers and marines (Levin-Rector et al., 2018 [38]), and also found an increased risk in both outcomes for both soldier groups 11 (PTSD in army soldiers: HR = 1.74; 95% 1.71–1.76, PTSD in marines: HR = 2.04; 95% CI 1.93–2.15, depression in army soldiers: HR = 1.11; 95% CI 1.09–1.12, depression in marines: HR = 1.12; 95% CI 1.07–1.17). In the studies by Wittchen et al., 2012 [54], Thomas et al., 2017 [50], Proctor et al., 1998 [46], and Magruder et al., 2005 [41], the number of cases with PTSD in exposed and non-exposed soldiers was well below 100 persons. The study with the highest number of cases of PTSD (n = 1844) showed a strongly increased PTSD risk for female soldiers exposed to sexual assault (OR = 6.3; 95% CI 5.7–6.9) (Rosellini et al., 2017 [47]).

3.5. Meta-Analysis

A total of 22 studies were included in the various meta-analyses. Excluded were eight studies [27,29,30,39,42,46,55,57] due to the lack of an effect estimator and one study [49] due to lack of information on a specific trauma in police staff. Nine of the included studies were concerned with soldiers after war deployment and PTSD (Figure 2); four studies dealt with depression in soldiers after war deployment (Figure 3); six studies examined PTSD in workers after exposure to occupational trauma (Figure 4); and nine other studies examined depression in relation to occupational trauma (Figure 5). Funnel plots and sensitivity analyses are shown in Figures S2–S9.

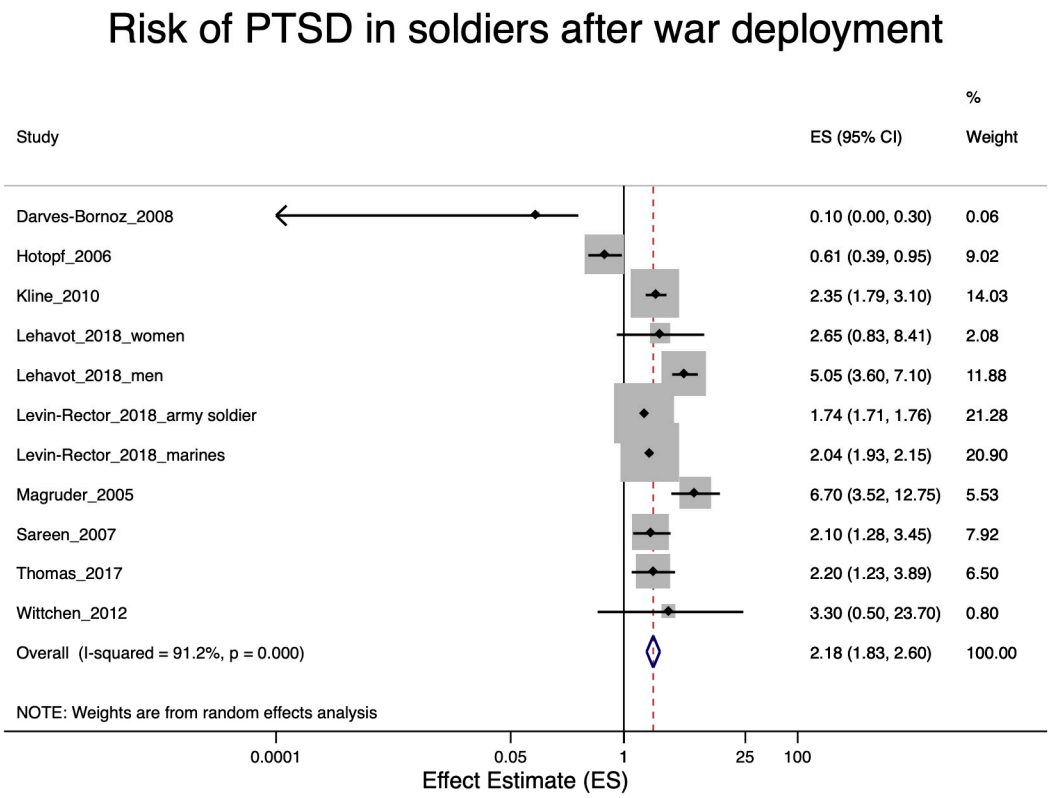

Figure 2. Forest plot of soldiers after war deployment and the estimates of effect size (ES) for post-traumatic stress disorder (PTSD).

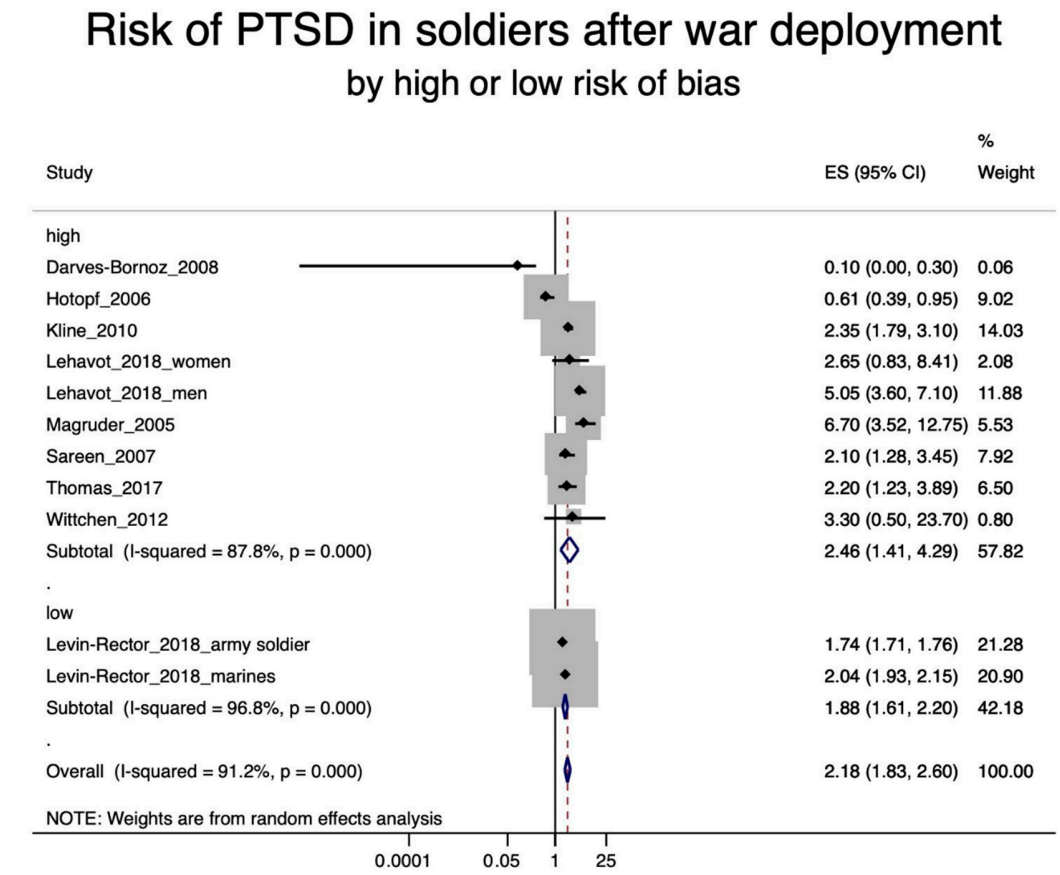

Figure 3. Forest plot of soldiers after war deployment and the estimates of effect size (ES) for post-traumatic stress disorder (PTSD) by high or low risk of bias.

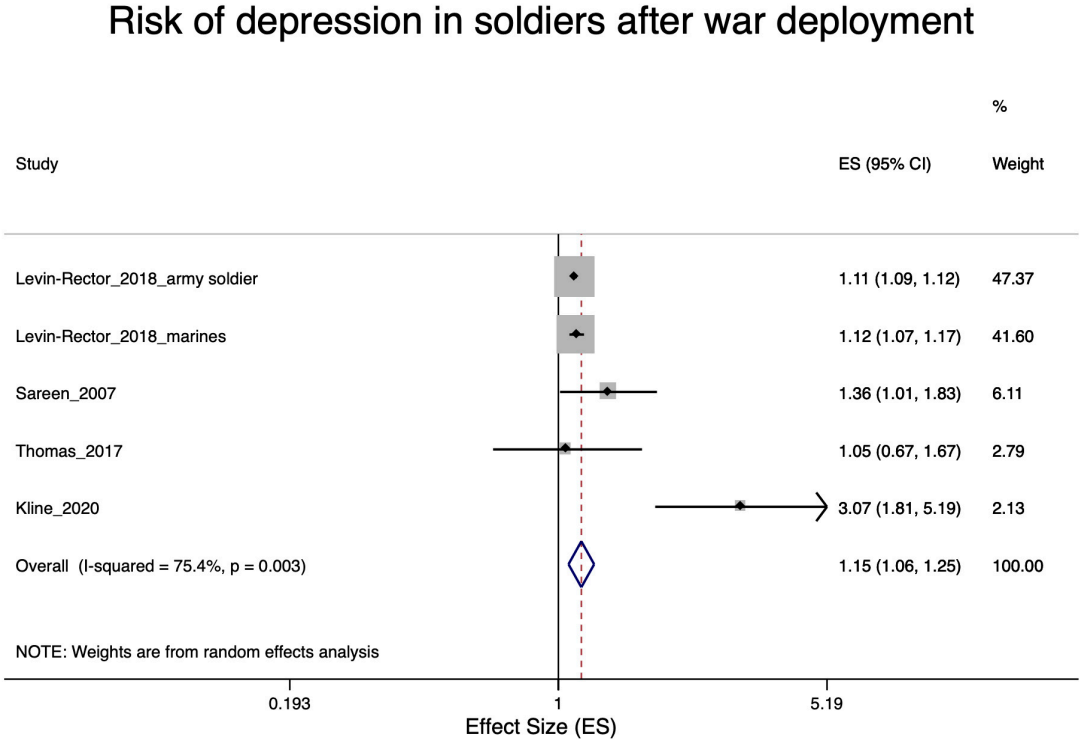

Figure 4. Forest plot of soldiers after war deployment and the estimates of effect size (ES) for depression.

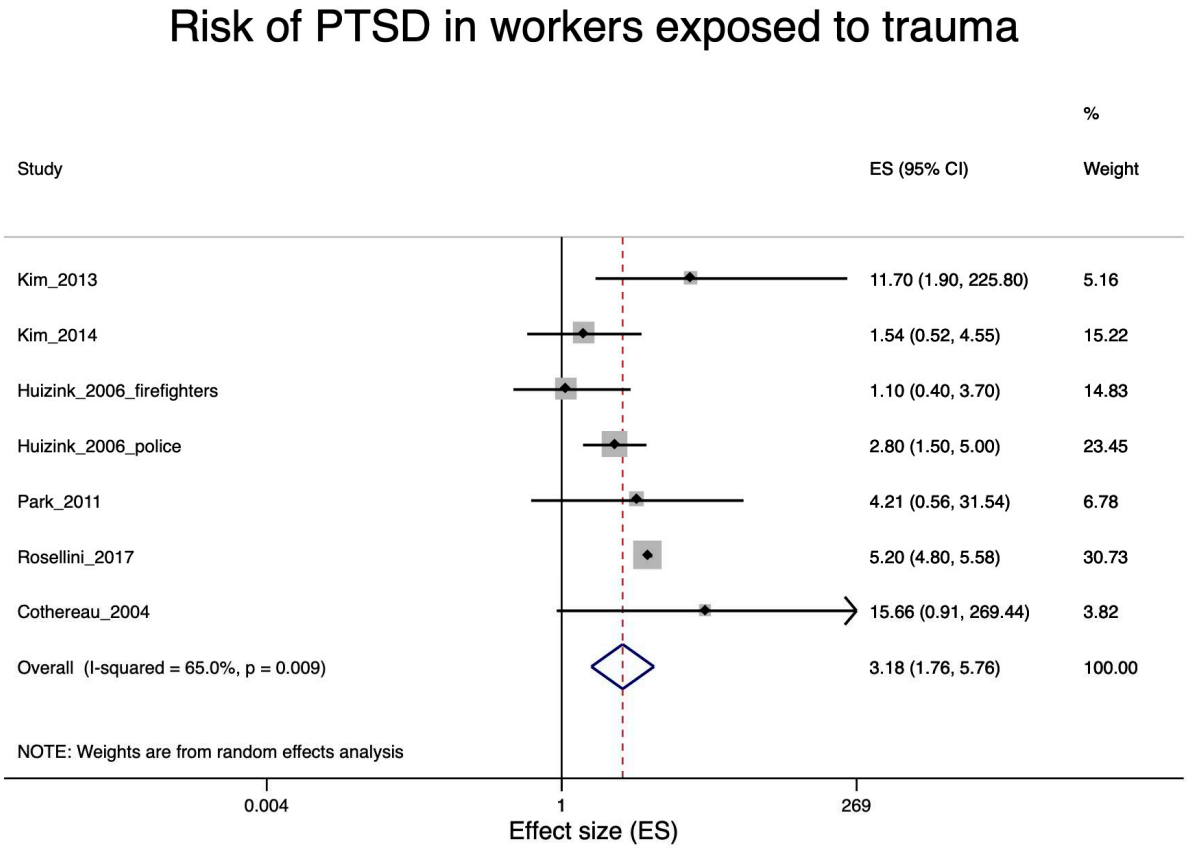

Figure 5. Forest plot of workers exposed to occupational trauma and the estimates of effect size (ES) for post-traumatic stress disorder (PTSD). Note: unadjusted prevalence ratio (PR) for Park et al., 2011 [45] and Cothereau et al., 2004 [56]; Cothereau et al., 2004 [56] was included by adding a 0.5 case to all categories.

3.5.1. PTSD in Soldiers after War Deployment

The meta-analysis included nine soldier studies with PTSD [28,31,35,37,38,41,48,50,54]. The pooled effect resulted in a roughly doubled risk of PTSD in soldiers after war deployment (RR = 2.18; 95% CI 1.83–2.60). The results are shown in Figure 2. When considering the soldiers' studies according their risk of bias, the studies with a higher risk of bias had a higher effect estimate (RR = 2.46; 95% CI 1.41–4.29) than the studies with a low bias risk (RR = 1.88; 95% CI 1.61–2.20) (see Figure 3).

Five different instruments (CIDI, PCL, AUDADIS, register data, and CAPS) were used to measure PTSD in the studies. The pooled relative risk for PTSD in soldiers after war deployment varied with the instrument used: it was 2.13 (95% CI 1.32–3.44) when CIDI was used and 1.47 (95% CI 0.61–3.55) when the outcome was measured with PCL (see Figure S2).

Overall, there was no evidence of publication bias (Figure S3).

3.5.2. Depression in Soldiers after War Deployment

Four studies were included in the meta-analysis for depression in soldiers after war deployment [35,38,48,50]. The pooled risk estimate was statistically significant elevation at 1.15 (95% CI 1.06–1.25, Figure 4.) Studies with a high risk of bias showed a higher pooled relative risk (RR = 1.60; 95% CI 0.93–2.74) than studies with a low risk of bias (1.11; 95% CI 1.10–1.13), see Figure S4. There was no indication of publication bias (Figure S5).

3.5.3. PTSD in Workers Exposed to Occupational Trauma

The PTSD risk for employees exposed to occupational trauma was strongly increased (RR = 3.18; 95% CI 1.76–5.76, Figure 5). Six studies were included in this meta-analysis [32–34,45,47,56]. Studies with a high risk of bias showed a lower pooled relative risk (RR = 2.45; 95% CI 1.36–4.39) than the only study [47] with a low risk of bias (RR = 5.20; 95% CI 4.82–5.61), see Figure S6. Overall, there was no indication of publication bias (Figure S7).

3.5.4. Depression in Workers Exposed to Occupational Trauma

The pooled relative risk estimate of the nine occupational trauma studies included in the meta-analysis [16,33,34,36,40,43,51–53,56] showed a 77% increased risk of depression for employees with work-related trauma (RR = 1.77; 95% CI 1.45–2.15, Figure 6.). Studies with a high risk of bias had a higher effect estimate (RR = 2.10; 95% CI 1.90–2.33) than the two studies with a low risk of bias [40,53], RR= 1.44; 95% CI 1.29–1.61), shown in Figure S8. There was no indication of publication bias according to the funnel plot's and Egger's test (Figure S9).

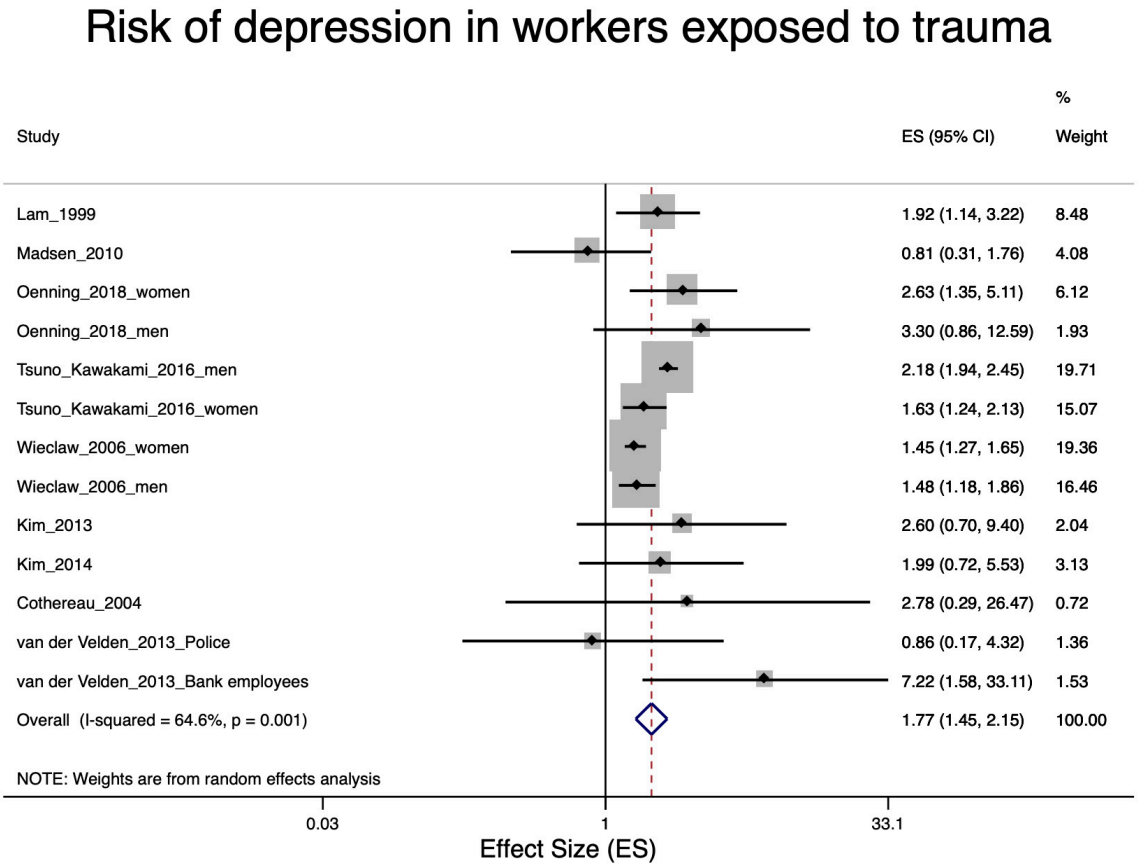

Figure 6. Forest plot of workers exposed to occupational trauma and the estimates of effect size (ES) for depression. Note: unadjusted PR for Cothereau et al., 2004 [56].

3.6. Quality of Evidence Assessment (GRADE)

For the quality of evidence assessment, we started with a "moderate" quality level, because only observational studies were included (Table 2).

Table 2. Assessment of evidence for the risk of studied outcomes based on Grades of Recommendations, Assessment, Development, and Evaluation framework (GRADE).

Risk	Quality of Study Limitations, ↓	Indirect-Ness of Evidence: ↓	Inconsistency: ↓	Imprecision, Range Confidence Interval Effect Size > 2.0: ↓	Publication Bias, Yes: ↓	Effect Estimate >2.0: ↑ >5.0: ↑↑	Dose-Response Effect: ↑	Residual Confounding: ↑	Overall Certainty (High, Moderate, Low)
PTSD in soldiers after war deployment	no (-) [1]	no (-)	no (-) [2]	no (-) 1.83–2.60	no -	no (-) [3] 2.18 (1.83–2.60)	no -	no -	moderate
Depression in soldiers after war deployment	no (-) [4]	no (-)	no (-) [5]	no (-) 1.06–1.25	no -	no (-) 1.15 (1.06–1.25)	no -	no -	moderate
Depression in workers after exposure to trauma	no (-) [6]	no (-)	no (-) [7]	no (-) 1.45–2.15	no -	no (-) 1.77 (1.45–2.15)	no -	no -	moderate
PTSD in workers after exposure to trauma	no (-) [8]	no (-)	no (-) [9]	yes ↓ 1.76–5.76	no -	yes ↑↑ [10] 3.18 (1.76–5.76)	no -	no -	high

[1] 9/11 studies had a high risk of bias, and a high risk of bias increased the RR (RR = 2.46; 95% CI 1.41–4.29). However, in low risk of bias studies, the risk is also significantly increased (1.88; 1.61–2.20), and these studies have an important weight (42.18%). [2] High I^2 observed in the overall analysis and in low risk of bias studies. However, the low risk of bias studies had a high number of participants, which increased the value of I^2. Heterogeneity cannot, therefore, be based solely on values of I^2. Effect estimates between low risk of bias were similarly high (1.74 and 2.04). The weight of the low-risk studies was important at 42.18%. [3] The pooled effect estimate was >2.0, but the high and low risk of bias in studies had pooled effects which differed significantly from each other (high risk RR = 2.46; 95% CI 1.41–4.29; low risk RR = 1.88; 95% CI 1.61–2.20), and the low risk of bias in studies had an effect lower than 2.0. [4] 3/5 studies had a high risk of bias, and in studies with a low risk of bias, the RR was significantly increased (high risk RR = 1.60; 95% CI 0.93–2.74; low risk RR = 1.11; 95% CI 1.10–1.13); however, studies with a low risk of bias were statistically significant. The weight of the studies with a low risk of bias was important at 88.97%. [5] High heterogeneity was observed in the overall analysis (I^2 = 75%), but studies with a low risk of bias were homogeneous. [6] 7/9 studies had a high risk of bias, and a high risk of bias increased the RR (high risk RR = 2.10; 95% CI 1.90–2.33; low risk RR = 1.44; 95% CI 1.29–1.61); however, the RR in studies with a low risk of bias was also significantly increased. The weight of studies with a low risk of bias is important at 39.90%. [7] Moderate heterogeneity was observed in the overall analysis (I^2 = 64.6%), but studies with a low risk of bias were homogeneous. [8] 5/6 studies had a high risk of bias, but in studies with a low risk of bias, the RR was significantly increased (low risk RR = 5.20; 95% CI 4.82–5.61; high risk RR = 2.45; 95% CI 1.36–4.39). The weight of the low-risk studies was important at 30.73%. [9] Moderate heterogeneity was observed overall (I^2 = 65%). [10] The pooled effect estimate was 3.18 (greater than 2.0 but less than 5.0), but the studies with a high and low risk of bias had pooled effects which differed significantly from each other (low risk RR = 5.20; 95% CI 4.82–5.61; high risk RR = 2.45; 95% CI 1.36–4.39). The studies with a low risk of bias had an effect greater than 5.0, so the quality level was upgraded twice. "↓" downgrading, "↑" upgrading, "↑↑" double upgrading.

3.6.1. PTSD in Soldiers after War Deployment

The initial quality level was neither downgraded nor upgraded for any of the categories. The I^2 was high for the overall effect and for the effect of the low risk of bias studies. However, the low risk of bias studies were large studies with high precision and the confidence intervals overlap. It has already been described that I^2 is not a good measure of heterogeneity in large studies [58,59], and therefore, it was decided that there was no indication of inconsistency. Although the pooled effect estimate was greater than 2.0, the high and low risk of bias studies differed significantly from each other (high risk RR = 2.46; 95% CI 1.41–4.29; low risk RR = 1.88; 95% CI 1.61–2.20), and the low risk of bias studies had an effect lower than 2.0. Therefore, we decided not to upgrade due to this category. We finally judged that the quality of evidence for increased risk of PTSD in soldiers after war deployment to be "moderate" (see Table 2).

3.6.2. Depression in Soldiers after War Deployment

All categories remained unchanged after the initial grading, and therefore, the quality of evidence for increased risk of depression in soldiers after war deployment was assessed to be "moderate."

3.6.3. Depression in Workers Exposed to Trauma

The initial quality level was neither downgraded nor upgraded due to any of the categories, and therefore, the quality of evidence for increased risk of depression in workers exposed to trauma was judged to be "moderate."

3.6.4. PTSD in Workers Exposed to Trauma

The quality level was downgraded once because of high imprecision, and it was upgraded twice to reflect the high effect of the pooled estimate (>5.0). Although the pooled effect estimate was 3.18, which would normally cause one upgrade, the high and low risk of bias studies had pooled effects which differed significantly from each other (low risk RR = 5.20; 95% CI 4.82–5.61; high risk RR = 2.45; 95% CI 1.36–4.39). The low risk of bias study had an effect greater than 5.0, and thus, the quality level was upgraded twice. All other categories remained unchanged. The overall quality of evidence for increased risk of depression in workers exposed to trauma was "high."

4. Discussion

This systematic review with meta-analysis finds considerably increased PTSD risks and slightly increased depression risks among soldiers after war deployment. The significantly decreased PTSD risk in the study of Hotopf et al., 2006 [31] is possibly influenced by a "healthy soldier" effect. According to two studies, subway drivers exposed to a person under train (PUT) accident are prone to considerably elevated PTSD risks and potentially elevated depression risks (lacking statistical significance). For the other examined occupational groups with potential traumatic exposure to frequent trauma (firefighters, police officers, paramedics, war journalists), no consistent PTSD or depression risk increases could be observed. We could not identify studies on emergency doctors, prison staff, or psychiatric staff that fulfilled the inclusion criteria.

In workers exposed to trauma, there was a 3-fold increase in PTDS risk, while a 1.7-fold increased risk of depression was observed.

4.1. PTSD Risks due to Occupational Trauma

PTSD risks were found to be considerably increased among soldiers after war deployment. War deployment is characterized by frequent exposure to traumatic situations. However, the respective studies included in our systematic review did not differentiate between subjects with and without exposure to specific traumatic situations, e.g., serious injury of the soldier or confrontation with dead comrades. Therefore, the PTSD risk of soldiers after war deployment might be considerably

underestimated. For other occupations with potential for exposure to traumatic events (firefighters, police officers, paramedics, war journalists)—albeit presumably being more rarely exposed compared to war-deployed soldiers—we did not observe consistently elevated PTSD risks. However, when we looked at persons who were occupationally exposed to traumatic events, PTSD risk was clearly elevated (RR = 3.18; 95% CI 1.76–5.76, Figure 5). We, thus, infer from our results that PTSD risks cannot be adequately reflected by using the occupational group as a proxy variable for occupational traumas.

Most of the included studies did not differentiate between exposures to one or more traumatic events. Kim et al., 2013 [33] reported a prevalence ratio for one-year PTDS after one PUT (person under train) accident of 13.4 (95% CI 1.9–265.3) and of 8.7 (95% CI 0.7–201.7) after ≥2 PUT accidents (Table S4). The risk estimates are wide due to the low number of PTSD cases. Furthermore, there might be a differential selection after the first PUT incident if subway workers leave the profession due to the PUT experience. PTSD might not only develop as a consequence of a single traumatic event, but it might also result after exposure to multiple events over time. As Priebe et al., 2018 [60] suggest, there may be repeated micro-aggressions against police officers or psychiatric staff, and paramedics and emergency doctors might be exposed to multiple experiences of serious accidents, possibly lacking a single worst incident. Accordingly, the DSM-IV (American Psychiatric Association 2000 [61]) Criterion A "has been exposed to a traumatic event" has been modified in the DSM-5 (American Psychiatric Association 2013 [62]) to "traumatic event(s)," therefore comprising multiple events or a recurring exposure. Stein and colleagues (2016) [63] pointed out that subjects exposed to multiple traumas might develop different symptoms by each trauma, which (only) in combination might fulfil the criteria for PTSD; accordingly, the authors speak of cumulative trauma. In a multi-national survey (Karam et al., 2014 [64]), about 20% of the subjects with 12-month PTSD reported symptoms that were associated with more than one traumatic event. While PTSD due to a single occupational trauma would be regarded as an occupational accident in most countries, PTSD due to multiple traumatic events could in principle be regarded as an occupational disease (depending on country-specific legal understandings).

4.2. Depression Risks due to Occupational Trauma

Among soldiers after war deployment, depression risks were slightly elevated, but they were nonetheless statistically significant. The slight risk increase of only 15% might at least partly be explained by a healthy worker effect (healthy hire effect). Moreover, the small magnitude of effect might be due to risk "dilution," as not all deployed soldiers are expected to have been exposed to traumatic events.

According to our meta-analysis, occupational traumatic events were clearly associated with depressive symptoms (pooled relative risk of 1.77; Figure 6). Even though our GRADE assessment resulted in an overall "moderate" certainty level, we must emphasize that the high-quality studies still provided a statistically significant increased effect (44%) of occupational trauma on depression. Most of the applied diagnostic instruments (BDI_R; SF-36; PHQ-9; CES-D; GHQ; SCL-90-R) cannot clearly differentiate trauma-related depressions from adjustment disorders (sometimes also called situational depressions; https://icd.codes/icd10cm/F432), which might also result from traumatic events. This is because symptoms of adjustment disorders are similar to those of affective disorders (e.g., depression; anxiety; conduct or emotional disturbance (Gradus 2017 [65])). Accordingly, three of seven ICD-10 adjustment disorder subtypes include "depressive reaction" in their title (Maercker and Lorenz 2018 [66]). In principle, adjustment disorders resolve in the course of six months [65]. However, in some cases (if the stressor persists for a longer duration or in case of a prolonged depressive reaction; ICD-10 F43.1), adjustment disorders can remain for a longer time, which complicates the differential diagnosis between adjustment disorder and trauma-related depression. Unfortunately, in all studies included in our systematic review information about the time lag between traumatic event and depression diagnosis is lacking. A clear diagnostic assignment of the depressive symptoms is, therefore, not possible.

Several studies reveal high psychiatric comorbidities after trauma exposure (Maercker and Hecker 2016 [67]). Particularly the co-occurrence of PTSD and depression has been consistently demonstrated in the epidemiologic literature [65]. According to a large cohort study among US active duty service members, PTSD occurred most frequently together with depressive disorders (49.0%), adjustment disorders (37.0%), generalized anxiety disorders (36.1%), and alcohol use disorders (26.9%) [68]. In a recently published study among 223 US veterans with combat-related PTSD, Goetter et al. (2020) [69] reported that about 70% of the veterans had comorbid major depressions. Occupational traumas might, therefore, play a role in the development of not only of PTSD, but also depression and other psychiatric diseases, frequently occurring simultaneously in the same employees. However, the temporal relationship and the etiological directionality are not always clear from the currently published studies. Future research on the temporal relationship between occupational traumas and depression as well as PTSD should conduct several follow-ups, taking into account the time course of psychiatric symptoms including PTSD, adjustment disorders, and depression (at best including a clinical diagnosis in addition to psychological assessments).

4.3. Strengths and Limitations

The main strengths of this review were the systematic literature search conducted using a comprehensive search string in two databases (Pubmed and Pilots), the inclusion of studies in all languages, the evaluation of titles, abstracts, and full texts by two independent researchers, and the dual assessment of the study quality, finding a consensus to determine the final quality level of the included studies. The formal risk of bias assessment was integrated into our analysis and conclusions. Studies using a convenience sample or with either no reported response or a very low response were excluded to minimize selection bias.

Unlike previous reviews, this review included only studies with an unexposed comparison group, and therefore, the respective measure of effect due to occupational trauma could be pooled in a meta-analysis. However, most studies compared workers of the same occupation with and without a specific trauma, or with and without war deployment [27–39,41,44–47,49,50,52,54–57]. For instance, Huizink et al., 2006 [32] performed a cross sectional study in firefighters and police officers involved in the handling of an aircraft crash and compared them with firefighters and police officers without involvement in the crash. This comparison might underestimate the true disease risk because firefighters and police officers not involved in the air crash are possibly more exposed to occupational trauma compared to the general working population (i.e., in the rescue of injured or dead victims of normal fires or in the confrontation with aggressive persons during normal police work). One study (van der Velden et al., 2013 [52]) compared bank employees after robbery with police officers without massive trauma. This comparison, again, may possibly underestimate the disease risk because of the exposure of police officers to occupational trauma during their normal work. Only a few studies used the general population as a comparison group [27,40,42,43,49,53].

One of the limitations of the present review is that the types of occupational trauma associated with an increased risk of PTSD and depression were very different (Figures 5 and 6). Our meta-analysis included studies of subway and train drivers after PUT experiences [33,34,56]; firefighters after airplane crashes [32]; nurses who had weathered Hurricane Katrina [45] or who had experienced particularly stressful events in hospital, such as the death or serious injury of a child [36]; female soldiers with a condition following rape or other sexual trauma [47]; police officers after deployment in a plane crash or fire disaster [32,52]; bank employees after a robbery [52]; and workers exposed to violence at work [40,43,51,53]. Only for the trauma of soldiers participating in war were there sufficient studies to conduct a separate meta-analysis.

In the studies, the PTSD and depression outcomes were assessed exclusively by questionnaires. In some singular studies, a specialist diagnosis was also performed. Moreover, the included studies diagnosed PTSD with 10 different instruments, and it is unknown whether the measured effects are comparable between the instruments. As an example, the pooled relative risk for PTSD for soldiers

after war deployment was 2.13 (95% CI 1.32–3.44) when the CIDI instrument used, whereas it was 1.47 (95% CI 0.61–3.55) when the PCL instrument was used (Figure S2). Depression was also measured using various instruments between the studies—15 instruments in total.

5. Conclusions

Our results show a doubling of the risk for PTSD and a significantly increased risk for depression in soldiers exposed to war deployment. Furthermore, there is a tripled risk of PTSD and almost a doubled risk for depression on workers exposed to occupational trauma. These findings have an important impact on public health because of the prevalence of traumatic events in particular occupational groups, along with a considerable frequency of PTSD, depression, and other affective disorders in the general population. Recognizing that members of some specific occupational groups (such as police officers, firefighters, and nurses) might not be exposed to a "single worst incident," but rather might experience multiple distressing events in the workplace, research should focus on quantifying the impact of these repeated workplace experiences on PTSD, depression, and other related disorders, using an appropriate comparison group.

Supplementary Materials: The following are available online at http://www.mdpi.com/1660-4601/17/24/9369/s1, Figure S1: Search string, Table S1: Inclusion and exclusion criteria, Table S2: Reasons for exclusion of studies, Table S3: Characteristics of included studies, Table S4: Effect estimates of studies included, Figure S2: Studies of PTSD in soldiers after war deployment, studies by outcome instrument, Figure S3: Studies of PTSD in soldiers after war deployment: funnel plot with pseudo 95% confidence limits, Figure S4: Risk of depression in soldiers after war deployment by high or low risk of bias, Figure S5. Risk of depression in soldiers after war deployment: funnel plot with pseudo 95% confidence limits, Figure S6: Risk of PTSD in workers exposed to trauma by high or low risk of bias, Figure S7: Risk of PTSD in workers exposed to trauma, funnel plot with pseudo 95% confidence limits, Figure S8: Risk of depression in workers exposed to trauma by high or low risk of bias, Figure S9: Risk of depression in workers exposed to trauma, funnel plot with pseudo 95% confidence limits.

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Article

The Cross-Level Moderation Effect of Resource-Providing Leadership on the Demands—Work Ability Relationship

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Abstract: Employees in female-dominated sectors are exposed to high workloads, emotional job demands, and role ambiguity, and often have insufficient resources to deal with these demands. This imbalance causes strain, threatening employees' work ability. The aim of this study was to examine whether resource-providing leadership at the workplace level buffers against the negative repercussions of these job demands on work ability. Employees (N = 2383) from 290 work groups across three countries (Germany, Finland, and Sweden) in female-dominated sectors were asked to complete questionnaires in this study. Employees rated their immediate supervisor's resource-providing leadership and also self-reported their work ability, role ambiguity, workload, and emotional demands. Multilevel modeling was performed to predict individual work ability with job demands as employee-level predictors, and leadership as a group-level predictor. Work ability was poor when employees reported high workloads, high role ambiguity, and high emotional demands. Resource-providing leadership at the group level had a positive impact on employees' work ability. We observed a cross-level interaction between emotional demands and resource-providing leadership. We conclude that resource-providing leadership buffers against the repercussions of emotional demands for the work ability of employees in female-dominated sectors; however, it is not influential in dealing with workload or role ambiguity.

Keywords: emotional demands; workload; role ambiguity; multilevel modeling; psychosocial workplace factors

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1. Introduction

Work-related stress, sick leave, and work incapacity due to poor mental health have increased [1–4] and become a serious societal problem worldwide [2,5]. Risk groups for poor work-related mental health can be found in certain sectors [6–8], such as the public sector, where human service occupations (e.g., health care, social services, and education) dominate [9–11]. These sectors are often referred to as female-dominated sectors. In these sectors, employees are exposed to increased and more specific job demands [12–14]. For example, work overload, a lack of formal rewards, and work-life imbalance were found to be particularly problematic demands for health care staff, especially nurses [15]. Additionally, emotional demands are high in human service occupations, where the main work task is to respond to people's needs [14]. Moreover, a recent report highlighted that certain work demands involving unclear goals, such as a lack of goal clarity or role

ambiguity, as well as workload are more prevalent for working women than for working men [7]. Employees in female-dominated sectors often report a lack of resources, which makes it difficult to handle work demands [13,16].

According to the job demands-resources (JD-R) model [17,18], employees' well-being is dependent on job resources and job demands in their work environment. Whereas job demands (such as workload or role ambiguity) deplete energy and result in job strain and health complaints, job resources (such as social support or autonomy) play a motivating role by stimulating personal growth and goal achievement. Job demands and resources have independent effects through either the *health impairment process* (demands that deplete resources over time) or the *motivational process* (resources that satisfy needs), and demands and resources also interact. According to the JD-R model [17,18], resources buffer against the negative impact of job demands on well-being. Thus, a properly designed work environment requires a balance between demands and resources for employees to deal with those demands. However, the interactions of demands and resources are nuanced [18]. For example, although the negative effects of workloads may be buffered by high autonomy, learning opportunities seem to be less instrumental [19]. Thus, more research is needed to uncover which resources are functional for specific types of demands, which is also emphasized by the compensation principle of the demand-induced strain compensation model [20].

In the workplace, leaders have the ability to shape employees' work characteristics [21–24]. Adjusting demands and resources has been identified as one pathway to explain the positive effects of leadership, with other pathways including role modeling and leaders' capacities to broaden and build the personal resources of their subordinates [25–27]. For example, employees with transformational leaders were found to experience fewer job demands and more job resources, which resulted in positive outcomes [28]. However, it is not always possible to limit job demands to achieve a balance between demands and resources; thus, it is important to investigate how resources can be provided to help employees deal with such demands. Research suggests that leaders can be a valuable aid in this regard. For example, in one study, social support, autonomy, and opportunities for growth were specific resources that transformational leaders created and employees utilized to deal with job demands [29,30]. When employees are confronted with increased job strain as a result of taxing job demands, they are more likely to use maladaptive strategies of behavior regulation and cannot escape the loss cycle [31,32]. Therefore, when the job becomes more stressful, stable resources become more important, and positive leadership practices may help employees regulate fatigue and avoid burnout or further losses to their work ability [33].

While transformational leadership has proven to be a valuable leadership style for many employee outcomes, transformational leadership does not specifically focus on creating a resource-oriented work environment. Thus, aligned with the JD-R model, we study resource-providing leadership, which captures the modification of demands and resources as a key leadership task [34,35]. In contrast to general leadership behaviors (e.g., transformational or transactional leadership), resource-providing leadership measures leadership behaviors that are directly focused on improving employees' health-related job characteristics, such as employee participation or task control. Hence, resource-providing leadership directly operationalizes the notion that leaders affect employee well-being by modifying work characteristics [18,27].

Work ability can be defined as the ability of workers to perform their job taking into account specific work demands on the one hand and resources on the other [36]. Thus, representing the notion of a proper balance between individuals' perception of their work demands and resources, work ability could be a proximal outcome of leaders' actions related to demands and resources at the workplace. As an employee's greatest asset [37], work ability has frequently been studied, particularly in Nordic countries, as a predictor of long-term sickness absence and as a risk factor for early disability pensions [38]. A time-lagged study among employees of two organizations showed that low work engagement

was related to low work ability beyond known health behaviors and psychosocial work characteristics [39]. This points to the relevance of job resources for preserving work ability by boosting work engagement. Indeed, a recent study by Boelhouwer and colleagues tested four types of job resources and their roles in work engagement and work ability. Autonomy and supportive leadership (but not colleague support) demonstrated both a direct and buffering role in these two outcomes [40].

The overall aim of the present study is to investigate how specific demands that are prevalent in female-dominated sectors relate to work ability and how resource-providing leadership at the group level affects this relationship (see Figure 1 for an overview of the conceptual model). In line with existing research [7,14,15], this study investigates workload, role ambiguity, and emotional demands, presenting demands that might be particularly relevant for employees in female-dominated sectors. More specifically, the following hypotheses are investigated:

Hypothesis 1a–c. *The individual-level job demands of workload (a), role ambiguity (b), and emotional demands (c) are negatively related to work ability.*

Hypothesis 2. *Group-level resource-providing leadership is positively related to work ability.*

Hypothesis 3a–c. *Group-level resource-providing leadership moderates the relationships between individual-level predictors (workload (a), role ambiguity (b) and emotional demands (c)) and work ability such that the individual-level relationships weaken as resource-providing leadership at the group level increases.*

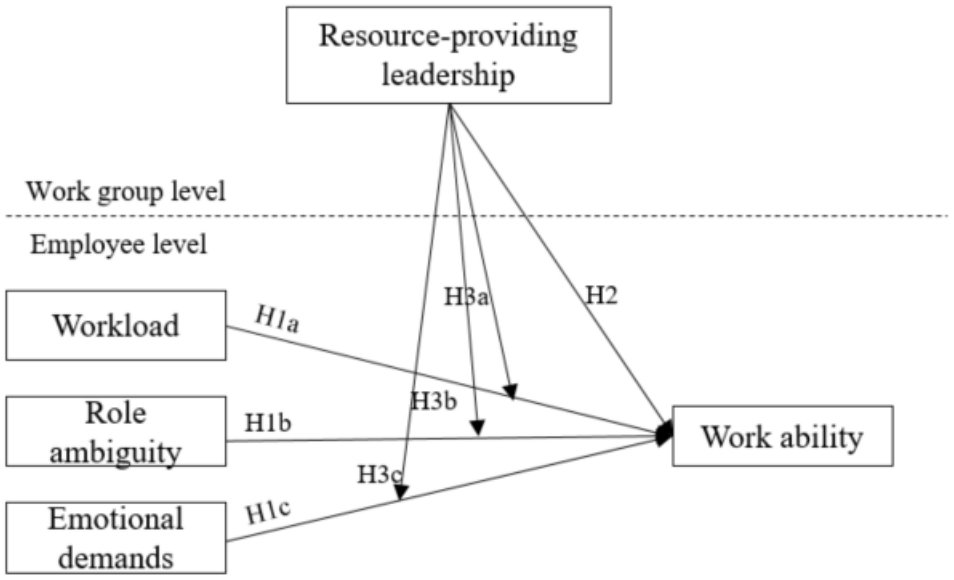

Figure 1. The conceptual model of employee-level job demands and work group-level resource-providing leadership predicting work ability.

2. Materials and Methods

2.1. Participants and Procedure

The current study was part of a larger research project on leadership and health in Finland, Germany, and Sweden [41]. Participants were approached via the human resources department or executive management of their organizations. In all cases, employee representatives were included in the process of obtaining their consent. Data were collected via online and paper-pencil questionnaires, and participants were assured of the confidential and anonymous treatment of their information. The proximity between leaders and employees (in terms of both location and hierarchy) was an important selection criterion in the sampling strategy. In our sample, leaders always directly supervised their

work groups, and work group members reported (directly) only to this manager. In total, 3336 questionnaires were distributed, and usable data (i.e., when employees completed all scales of interest) were obtained from 2383 employees (71% response rate) nested in 290 work groups. Participants were located in three countries: Germany (n = 1363; 57%), Finland (n = 586; 25%), and Sweden (n = 434; 18%). Over half of the study sample was employed in a public sector organization (n = 1352; 57%), and most had a permanent contract (94%). All jobs from the examined sectors—finance (Germany), public administration, healthcare, service, and education (Finland, Germany, and Sweden)—were characterized by high service demands and a customer orientation and required regular interaction and exchange among work group members and their immediate manager. Reflecting the gender structure of the female-dominated sectors that we investigated, the majority of the sample were women (n = 1849; 78%). On average, the study participants were 43.63 years old (SD = 10.64). Their average work tenure at the organization was 14.65 years (SD = 9.90), whereas their average tenure in their work group was 7.31 years (SD = 7.67). Work hours per week ranged from 10 to 65, with an average of 40.

2.2. Measures

For all scales, the distinctiveness of the subscales was previously assessed using confirmatory factor analysis in this sample, and appropriate psychometric properties (including measurement invariance between the three different language versions) were found [41]. In addition to using the scales listed below, we gathered demographic data such as age, gender, and tenure.

Workload. Workload was measured with five items from the Quantitative Workload inventory [42] using a 5-point Likert-type scale ranging from 1 (*very seldom or never*) to 5 (*very often or always*). Two sample items are "How often does your job require you to work very fast?" and "How often does your job require you to work very hard?" Cronbach's alpha for reliability was 0.79.

Role ambiguity. Role ambiguity was measured with three items from the Copenhagen Psychosocial Questionnaire (COPSOQ II) [43] using a 5-point Likert-type scale ranging from 1 (*to a very small extent*) to 5 (*to a very large extent*). A sample question is "Does your work have clear objectives? [reversed]". Cronbach's alpha for reliability was 0.74.

Emotional demands. Emotional demands were measured with four items from the COPSOQ II [43]. Two of the items were measured on a 5-point Likert-type scale ranging from 1 (very seldom or never) to 5 (very often or always). A sample item is "Does your work put you in emotionally disturbing situations?" The two other items were measured on a 5-point Likert-type scale ranging from 1 (*to a very small extent*) to 5 *(to a very large extent*). A sample question is "Is your work emotionally demanding?" Cronbach's alpha for reliability was 0.85.

Resource-providing leadership. Resource-providing leadership was measured with 10 items covering the three areas of task control, participation, and conflict management from the Health- and Development-Promoting Leadership Behavior Questionnaire [34,44]. Subscales from the resource-providing subfactor were chosen, and here, we identified those which fit the demands and context of the female-dominated sector best. Specifically, we aimed at resources that best match the demands we investigated. Providing task control has been shown to mitigate the negative effects of workloads, [45,46], participation seems suitable to negatively affect role ambiguity [47], and conflict management may be especially helpful in dealing with emotional demands [48,49]. Employees rated their immediate manager on a 5-point Likert-type scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). Sample items are "My immediate superior allows me to decide for myself how I organize my tasks" (task control), "My immediate superior includes me in decisions that affect my work or workplace environment" (participation), and "My immediate superior searches for solutions to conflicts with those involved" (conflict management). Cronbach's alpha for reliability was 0.86. This variable was used as a group (i.e., level 2) predictor, and therefore

had to be aggregated. Aggregation was justified based on ICC(1) = 0.24 and ICC (2) = 0.72, as well as a mean r_{wg} of 0.83.

Work ability. Work ability was assessed with one item from the Work Ability Index [36,50] measuring perceived work ability in relation to the demands of the job ("What is your work ability like in relation to the demands of your job?"). The item was rated on a 10-point Likert-type scale ranging from 0 (*bad*) to 10 (*good*).

2.3. Analytical Strategy

We applied hierarchical linear modeling (HLM) analyses to test all hypotheses using HLM 7 [51]. The HLM approach was warranted because the structure of the data was nested (employees nested within work groups, work groups nested within countries), which violated assumptions on the non-interdependence of the data, affecting standard error estimations [52]. We calculated ICC(1) at the work group and country levels using a formula presented in Hox et al. [52]. This formula refers to ICC values as the expected correlation of work ability between the observations of two randomly chosen persons in the same work group (work group-level ICC) or country (country-level ICC). The ICC(1) at the work group level was 0.15, and the ICC(1) at the country level was 0.07. These estimates suggested the need to control for the nesting effect and warranted the use of HLM.

To investigate the direction of the cultural differences, a one-way analysis of variance was conducted at the individual level for all variables. Country was used as a factor with three values. Dunnet C-corrected pairwise comparisons showed significantly lower work ability among German (M = 7.60) than Swedish (M = 8.72) or Finnish (M = 8.54) participants, with no differences between the latter two. Moreover, Germans reported significantly lower emotional demands (M = 3.08) than Finnish participants (M = 3.28), who showed lower demands than Swedish employees (M = 3.52). For resource-providing leadership, Germans (M = 3.55) reported significantly lower levels than Finnish or Swedish employees (M = 3.89 and M = 3.85, respectively). No differences regarding role ambiguity and workload were detected.

Moreover, the model comprised the effect of three job demands at the individual level and the cross-level effect of resource-providing leadership at the work group level (for the conceptual model, see Figure 1) and thus required HLM.

We performed five consecutive models following the procedure delineated in Hox et al. [52]. First, in Model 1, we estimated the null model (with no predictors involved) to decompose the total variance of work ability into three terms (employee, work group and country levels) to benchmark the model fit and explained variance. In Model 2, we added Level 1 predictors (workload, role ambiguity, and emotional demands) to estimate the fixed effects at the individual level. Model 2 tested Hypotheses 1a–c. Because age is likely to affect work ability [53], we added this variable in Model 2 as a control. In the third model (intercept-as-outcome), the intercept estimates derived from the Level 1 analysis were regressed on resource-providing leadership to test whether the latter accounted for the between-group variance in work ability. More specifically, this model tested the cross-level effect of resource-providing leadership at the group level on individual work ability (Hypothesis 2). In Model 4, we estimated whether the relationships between job demands and work ability varied between work groups. The slope of workload, role ambiguity, and emotional demands were tested for randomness in separate models to eliminate the number of random parameters tested at once [52]. We report the model where the variance of the slopes was significant, indicating that the slope differed depending on the work group. Finally, the fifth model tested for cross-level moderating effects that would reveal whether the relationships between any of the job demands and work ability at the individual level varied depending on resource-providing leadership at the work group level (slope-as-outcome). Thus, this final model tested Hypotheses 3a–c. To analyze the effects at various values of the moderator, we used the 16th and 84th percentiles of resource-providing leadership, as Hayes [54] recommends probing at percentiles to guarantee that the probed points are always within the observed range of the data when the distribution

diverts from normal. If the distribution of the data is normal, the 16th and 84th percentiles correspond to ±1 SD from the mean.

Following Enders and Tofighi [55], we group-mean-centered Level 1 predictors and grand-mean centered the Level 2 predictor. Group-mean centering is recommended for Level 1 predictors when investigating cross-level interactions, as it allows distinguishing cross-level interaction from between-group interaction [56]. Simultaneously, grand-mean centering is a better choice for scaling for Level 2 predictors because it helps reduce the covariance between intercepts and slopes, thereby reducing potential problems associated with multicollinearity.

3. Results

Table 1 presents the descriptive statistics of the study variables and simple correlations, whereas Table 2 presents the results of the multilevel analysis.

Table 1. Descriptive statistics of the study variables and sample with 95% CI.

	M (SD)	WA	RA	W	ED	RPL
Work ability (WA)	8.04 (1.80)	—	−0.08 *** [−0.12; −0.04]	−0.22 *** [−0.26; −0.18]	−0.16 *** [−0.20; −0.12]	0.23 *** [0.19; 0.27]
Role ambiguity (RA)	1.92 (0.63)	0.15 * [0.03; 0.26]	—	−0.12 *** [−0.16; −0.08]	−0.15 *** [−0.19; −0.11]	−0.07 *** [−0.11; −0.03]
Workload (W)	3.62 (0.65)	−0.33 *** [−0.43; −0.22]	−0.27 *** [−0.37; −0.15]	—	0.38 *** [0.34; 0.41]	−0.04 * [−0.08; −0.00]
Emotional demands (ED)	3.21 (0.93)	−0.24 *** [−0.25; −0.13]	−0.34 *** [−0.44; −0.24]	0.44 *** [0.34; 0.53]	—	0.12 *** [0.08; 0.16]
Resource-providing leadership (RPL)	3.69 (0.34)	0.44 *** [0.34; 0.53]	−0.12 * [−0.23; −0.00]	−0.04 [−0.15; 0.08]	0.13 * [0.01; 0.24]	—

Notes: Correlations at the employee level (N = 2383) are displayed above the diagonal. Correlations at the work unit level (N = 290) are displayed below the diagonal. The correlational analyses do not account for the nested structure of the data. *** p <.001, * p < 0.05.

Table 2. Multilevel analysis predicting work ability from job demands (Level 1) and resource-providing leadership (Level 2), controlling for country-level variance (Level 3).

	Model 1		Model 2		Model 3		Model 4		Model 5	
Fixed part	Est.	SE	Est.	SE	Est.	SE	Est.	SE	Est.	SE
Intercept	8.30 **	0.29	8.30 **	0.29	8.26	0.23	8.22	0.20	8.22	0.20
Level 1—Employee										
Age			–0.01 **	0.00	–0.01 **	0.00	–0.01 **	0.00	–0.01 **	0.00
Role ambiguity (RA)			–0.52 ***	0.06	–0.52 ***	0.06	–0.52 ***	0.06	–0.51 ***	0.06
Workload (W)			–0.35 ***	0.06	–0.35 ***	0.06	–0.36 ***	0.06	–0.36 ***	0.06
Emotional demands (ED)			–0.35 ***	0.05	–0.35 ***	0.05	–0.36 ***	0.05	–0.34 ***	0.06
Level 2—Work group										
Resource-providing leadership (RPL)					0.68 ***	0.11	0.65 ***	0.11	0.72 ***	0.11
Cross-level interaction ED × RPL									0.39 **	0.13
Random part										

Table 2. *Cont.*

	Model 1	Model 2	Model 3	Model 4	Model 5
Variance decomposition					
Employee	2.77	2.54	2.53	2.44	2.44
Work group	0.23	0.26	0.20	0.22	0.22
Country	0.24	0.24	0.15	0.11	0.12
Random slope of ED				0.16	0.13
Model fit					
Deviance (D)	9345.39	9161.35	9124.73	9103.78	9094.17
Number of estimated parameters	4	8	9	11	12
Δ D (M_{n-1})		184.04 ***	36.62 ***	20.95 ***	9.61 ***
Δ parameters (M_{n-1})		4	1	2	1

Notes: $N_{employees}$ = 2383, $N_{work\ groups}$ = 290. Est. = parameter estimate. M_n = model number. Age, role ambiguity, workload, and emotional demands are group-mean centered. Resource-providing leadership is grand-mean centered. *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

In the intercept-only model (Model 1), the variance components of work ability were significant at both the work group and country levels (ps < 0.001). In Model 2, where we entered group-mean centered Level 1 job demands (role ambiguity, workload, and emotional demands) and controlled for age, the overall model fit improved, that is, deviance decreased: Δ D (4) = 184.04, $p < 0.001$. As expected, when we controlled for age, work ability was negatively predicted by workload ($\gamma = -0.35$, SE = 0.06, $p < 0.001$), role ambiguity ($\gamma = -0.52$, SE = 0.06, $p < 0.001$), and emotional demands ($\gamma = -0.35$, SE = 0.05, $p < 0.001$). Supporting Hypothesis 1a, as workload increased, work ability decreased. In line with Hypothesis 1b, employees who experienced more role ambiguity within their group reported poorer work ability. Finally, as predicted by Hypothesis 1c, employees who expressed having more emotional demands reported poorer work ability.

When we added resource-providing leadership as a Level 2 predictor (Model 3), the model fit significantly improved: Δ D (1) = 36.62, $p < 0.001$. Resource-providing leadership was positively related to work ability ($\gamma = 0.68$, SE = 0.11, $p < 0.001$). In work groups led by leaders rated as more resource-providing, employees reported better work ability. This result supports Hypothesis 2.

We performed three model 4 versions, where we estimated whether the relationships between each of the job demands and work ability varied between work groups. Only the random slope of emotional demands was significant (Hypothesis 3c), and the other models did not converge under the conventional number of 100 iterations for the random slopes of workload (Hypothesis 3a) and role ambiguity (Hypothesis 3b). Model 4, with the random slope of emotional demands and fixed slopes of workload and role ambiguity, had a significantly better fit than Model 3: Δ D (2) = 20.95, $p < 0.001$. The significant variance component of the random slope of emotional demands ($p = 0.010$) indicated that the negative relation between the level of emotional demands and work ability differed depending on the work group.

Thus, in the final model, we tested whether the randomness of the emotional demands–work ability slope could be explained by resource-providing leadership. Adding this cross-level interaction significantly improved the model fit: Δ D (1) = 9.61, $p = 0.002$. Figure 2 demonstrates the buffering role of resource-providing leadership in the link between emotional demands and work ability ($\gamma = 0.39$, SE = 0.13, $p = 0.002$). The lines represent the slopes for low (16th percentile) and high (84th percentile) levels of resource-providing leadership.

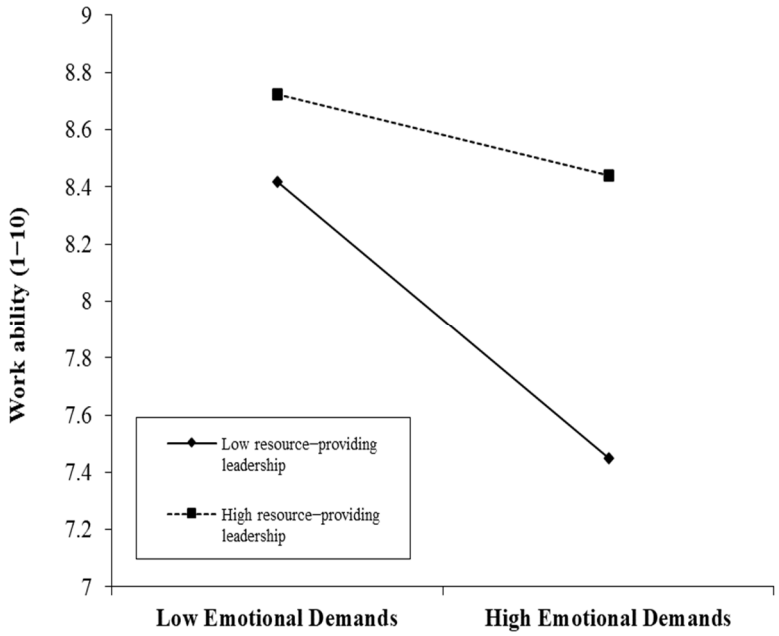

Figure 2. Prediction of work ability by emotional demands (Level 1 and group−mean centered) as a function of resource−providing leadership (Level 2).

Simple slopes analysis revealed that in groups where leaders were low in resource-providing leadership, there was a negative link between emotional demands and work ability (simple slope = −0.48 (0.05), $p < 0.001$). In those work groups, the greater employees' emotional demands, the lower their work ability was. For high values of resource-providing leadership, this relationship was reduced (simple slope = −0.14 (0.07), $p = 0.051$). In work groups led by high resource-providing leaders, emotional demands were not significantly linked with work ability. The difference between high and low resource-providing leadership was most pronounced for high values of emotional demands, where low resource-providing leadership was linked with a substantial reduction in work ability compared to high resource-providing leadership (simple slope = 1.13 (0.18), $p < 0.001$). When emotional demands were low, the difference was smaller, but the work ability of individual employees was still better in work groups led by high resource-providing leaders than in work groups led by low resource-providing leaders (simple slope = 0.35 (0.17), $p = 0.04$).

4. Discussion

This study aimed to investigate how workload, role ambiguity, and emotional demands, which all present specific demands that are prevalent in female-dominated sectors [7], decrease work ability and to examine the extent to which group-level resource-providing leadership buffers against these negative effects. In line with the health impairment process proposed by the JD-R model, the findings show that workload, role ambiguity, and emotional demands were negatively associated with work ability. We propose that these factors should be included in the assessment of risk factors in the psychosocial work environment in female-dominated sectors. Additionally, congruent with the motivational process in the JD-R model, team-shared perceptions of resource-providing leadership were positively related to work ability. This result is congruent with recent findings from the population-based prospective MONICA/KORA study, which demonstrated that people who did not feel supported by their supervisor had a significantly higher risk for suboptimal health ten years later than those who did [57].

In this study, we assumed that leaders who lead in a resource-providing way act as a buffer between work-related demands and employee work ability. The results showed that this buffer effect was visible for one of the three risk factors. Specifically, resource-providing

leadership protected against the negative effects of emotional demands on work ability. However, we did not observe such effects for workload or role ambiguity. There are several possible reasons for these mixed findings. Resource-providing leadership might be better suited to help employees deal with the repercussions of emotional demands on work ability than to help employees deal with other job demands we investigated. For example, servant leadership at cafés and coffee shops buffers the negative impact of customer mistreatment on employee outcomes [58]. When employees have to handle difficult situations with customers or colleagues, they might perceive their manager's efforts to provide them with resources as particularly helpful and supportive. Thus, these resources may help them deal with demands from other people. Workload, on the other hand, might be affected by factors that a line manager does not have the power to address. This demand may depend more on contextual factors, such as the number of patients who seek care at a particular time or the contracts that an organization has signed, which set the target for employees. Additionally, positive leadership may be more relevant for workload when tested on a day-to-day basis: a diary study among teachers demonstrated a buffering role of transformational leadership on the link between workload and work engagement [59]. Alternatively, a different type of leadership behavior was shown to be relevant for increasing demands among police officers, such as health-promoting leadership [60]. When leaders show attention and sensitivity to issues of health or health-impairing work conditions (e.g., noticing when employees need a break), this approach has a buffering effect on employee burnout. Thus, workload may require more immediate or different types of behaviors than what is offered by resource-providing leadership. Even though role ambiguity was associated with work ability, employees indicated a low level of role ambiguity in general. Hence, role ambiguity was not perceived as problematic in this sample, in contrast to other literature on role ambiguity [7]. Under these circumstances, a buffering effect might be neither relevant nor easy to find.

This study makes several important contributions. First, we contribute to theory development by showing that resources and demands need to be matched. In this study, resource-providing leadership was found to be a buffer only for emotional demands and not for the other demands under investigation. The results thus point to the need to find a match between demands and resources that are instrumental in coping with these demands. With these results, we answer the call for a more nuanced analysis of the interactions between job demands and job resources [19]. Second, this study makes an important practical contribution by showing that workplace-level factors such as leadership are important and affect individual-level outcomes such as work ability. These findings are in line with current recommendations that organizational interventions that aim to change how work is designed, organized, and/or managed [61] are more effective than individual interventions that aim to address the primary causes of poor health [62,63]. Providing training to leaders can be an example of an effective organizational intervention [64–66]. Not only do leaders themselves benefit from these trainings, but most importantly, improved leadership skills affect leaders' subordinates [67]. Since training leaders are an organizational intervention that can have widespread positive effects, establishing a training program could be a promising way to help leaders address specific work-related needs. In particular, intervention programs that target factors at the team level and are participatory seem promising [66,68–70]. Leaders who actively involve their employees in shaping the work conditions could facilitate more sustainable results because the focus is beyond individual interactions. Thus, these findings advance the research on female-dominated sectors in highlighting the importance of shared perceptions of workplace-level resources such as resource-providing leadership to promote sustainable employment.

Strengths and Limitations

There are several strengths to this study. First, we addressed the nested data structure of our sample by applying a multilevel approach. This design allows us to investigate the effects that are beyond individual perceptions. Namely, when individual employee

ratings are aggregated to show the group-level perception of leaders' behaviors, it may be considered a more objective assessment of his or her skills. Furthermore, treating leadership as a group-level variable enabled us to compare how these differences in managers' behaviors influence processes observed at the individual level (here, links between individual job demands and work ability). Such analyses are vital to discover how processes may depend on organizational contexts. Second, we drew on a large sample from multiple service-oriented organizations in three countries; hence, we found robust results that can be generalized to this sector.

There are several limitations to this study. First, the cross-sectional nature of our sample does not allow for any inferences about causality. It is possible that low work ability resulting from, for example, functional disabilities or health problems results in employees perceiving their job demands as more intense, which would indicate reversed causality. Therefore, future studies should validate our results using longitudinal data on the time-lagged effects for work ability. Second, we investigated leadership as a possible group-level factor that could buffer job demands that are particularly important for female-dominated sectors. Future studies could investigate other factors relevant to these job demands to build strong empirical evidence that can become the basis for organizational interventions in female-dominated sectors. One such factor could be social job resources, such as teamwork, which seems especially relevant in female-dominated environments [71]. Moreover, investigating other sectors requires a conscious choice of demands that might be particularly important in those sectors. Finally, in this study, we focused on resources at the work unit level; however, other hierarchical levels, such as the team or department levels, might also be interesting to investigate, as the decision latitude for job demands and resources varies across levels [72].

5. Conclusions

In summary, we find that resource-providing leadership is a way to help employees from the female-dominated sector dealing with certain job demands. While we studied three sector-relevant demands (i.e., workload, role ambiguity and emotional demands) and all three as well as resource-providing leadership were relevant for employees' work ability, resource-providing leadership buffered only against the repercussions of emotional demands. Our study makes important contributions to the literature on resources and demands and particularly the matching of these to foster occupational health. Moreover, our results also indicate that leadership development focusing on resource-providing leadership might be a relevant avenue for the future organizational interventions. Furthermore, future research should investigate other demands and resources at different organizational levels to further our understanding of the match between demands and resources and to provide a basis for evidence-based organizational interventions.

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Article

Gender Diversity and Work–Life Conflict in Changing Times

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Abstract: The aim of the study is to contribute to the "well-being, diversity, equity, and inclusion" dialogue of the post-pandemic era. Specifically, we explored the joint effects of biological sex and gender diversity in self-identity on the role demands—work and family conflict relationships. To advance the inclusion of scientific knowledge, the present study was conducted in the cultural context of a Chinese society. We surveyed a sample of 317 Taiwanese employees. We used structured questionnaires to collect data on biological sex, gender identity (self-endorsement on masculinity and femininity traits), work and family demands, work-to-family conflict (WFC), and family-to-work conflict (FWC). We found two sets of significant three-way interactions (sex × femininity × role demands) in predicting work and family conflict. First, for men, identifying with high femininity traits strengthened the positive relationship between work demands and FWC; for women, identifying with low femininity traits strengthened the same relationship. Second, for men, identifying with high femininity traits strengthened the relationship between family demands and WFC; for women, identifying with low femininity traits strengthened the same relationship. Our findings highlight the importance of jointly examining the biological, psychological, and social aspects of gender on the work and family interface. Contextualizing in an Eastern cultural tradition, we put the spotlight on societal pressure on people of nontraditional gender identities.

Keywords: biological sex; gender diversity; masculinity traits; femininity traits; work and family demands; work and family conflict; Chinese culture

1. Gender Diversity and Work-life Conflict in Changing Times

In 2020, the world has been engulfed in a triple pandemic, e.g., COVID-19, the economic recession, and the social revolution. In the post-pandemic era, the creation, communication, and application of scientific knowledge on employee well-being, equity, diversity, and inclusion deserve more concerted efforts from academia of all disciplines. Additionally, in the likely prolonged recession, intensifying work demands will expose employees to greater risk of work and family, which is defined as occurring when participating in one role is made more difficult by virtue of participating in the other role [1]. The work–family conflict is bidirectional, as work may interfere with family (work-to-family conflict, WFC) and family may interfere with work (family-to-work conflict, FWC). Responding to the challenge, the present study aimed to highlight the plethora of gender diversity manifested as self-identified gender traits and its linkage to well-being through work and family

role enacting. Further, contributing to the inclusiveness of scientific content, our study targeted the under-represented Asian populations in the mainstream work and family literature.

The increasing labor participation of women worldwide has been one impetus for the championing of gender diversity at work. The linkage between individuals' sex and the work and family interface is thus a familiar question for work and family scholars. However, systematic reviews revealed that findings of sex differences are very inconsistent. Eby et al. [2] concluded in their meta-analysis that evidence is mixed whether men and women reported different levels of WFC and FWC. For instance, some researchers found *no* sex difference in WFC [3], others found that men reported higher WFC than women [4], or women reported higher WFC than men [5]. A later review found that sex had no direct effect on either WFC or FWC, and rather inconsistent moderating effect on the conflict–satisfaction relationships [6]. To understand the inconsistency of findings, researchers have called for the reconfiguration of "sex" as a multifacet construct encompassing biological, psychological, and sociological aspects of role prescriptions [6,7]. We set out to examine the interactive effects of biological sex, psychological gender (gender traits or gender role orientation), and role demands on WFC/FWC. Our study contributes to the literature by suggesting that it is the intersection of biological sex and psychological gender diversity (masculinity and femininity traits) that makes a difference in the individuals' perceptions of role demands and their experiences of work and family conflict. We thus not only add to the scarce empirical evidence of within-sex differences of men and women in role practicing, our reconfiguration of "sex" also contributes to the post-pandemic gender diversity agenda.

The experience of work and family conflict depends on both the individual's role enacting and the contextual factors. Our second contribution is to extend the generalization of the gender diversity construct to an Eastern society to advance inclusive and equitable contents of scientific knowledge. The cultural context is poignant as "gender" refers to the sociocultural, psychological, and behavioral attributes associated with one's biological sex as decreed normative in a particular society [8]. In Taiwan, where our study was conducted, traditional Chinese values on gender role expectations still prevail, as shown in a nationwide survey that most people (40.7%) endorsed the traditional attitude of "men as breadwinners, women as homemakers" [9]. We thus explored the three-way interaction of biological sex, psychological gender traits, and role demands on WFC/FWC to expand what we already know in the more egalitarian Western societies to the culturally different Eastern societies. We add to the emerging studies in Eastern cultural contexts (e.g., Sri Lanka: [10]; China: [11]) to correct the over-reliance of work and family research on samples from Western cultures (see [12] for a review) and to advance the inclusion of knowledge.

2. Theoretical Framework and Hypotheses Development

2.1. Sex Differences and Gender Diversity in the Work and Family Interface

In line with the theoretical reconfiguration in gender research [13–15], we distinguish the term sex as the binary biological category of male and female, from gender as the psychosocial implications of being male or female. This terminology (sex vis-à-vis gender) is hereafter used in this paper to elucidate how men and women enact the work and family roles.

Our theoretical distinction however, departs from the tradition of work and family literature, where gender has often been operationally equalized to the biological sex, committing the "biopsychological equivalence fallacy" [7]. In other words, work and family researchers often assume that biological men would identify and comply with the socially prescribed male role of "breadwinners," whereas biological women with the female role of "homemakers." The operational equivalence of sex with gender masks the within-sex variations in role-enacting related to gender diversity such as varied gender self-identities. Korabik et al. [7] thus urged researchers to explore the intrapsychic aspects of gender that influence not only individuals' identities but also their behaviors, the roles they choose to enact, and how they choose to enact them. One such psychological gender construct is the gender role orientation theory [16].

Gender role orientation (hereafter GRO) posits that individuals' self-concept inherently contains personal characteristics, which in turn influence the gender-typing of their behavior and cognitions [16]. The two independent dimensions of masculinity and femininity traits capture the cultural descriptions for the identities of men and women. Masculinity describes the beliefs about the degree to which one holds traits that are associated with men (aggressiveness, competitiveness, and dominance), and femininity describes the beliefs about the degree to which one holds traits that are associated with women (sensitiveness, warmth, and compassion) [16,17]. Livingstone and Judge [18] postulate that GRO represents an individual's attitudinal recognition with gender roles, such that men are more likely to exhibit "masculine" traits that are viewed as instrumental in the work domain (e.g., aggressiveness, decisiveness, independence), while women are more likely to exhibit "feminine" traits that are conducive to family life (e.g., compassion, nurturance, sensitivity to the needs of others). Gender diversity as self-identities of psychological traits thus sets expectations for enacting the individual's role [19].

Gender role theory postulates that society sets norms for what role behaviors are appropriate and the roles that men and women should emphasize: women's proper place is in the home and men's in the workplace [20]. Research on the GRO theory has shown that masculinity traits were related to avowed work role importance, whereas femininity traits to avowed family role importance [21]. This is the work and family role enacting for traditional men and women as decreed in a traditional society. Through the process of self-identification, the traditionals (i.e., masculine men, feminine women) will regard their work or family role as more important than the other role. However, Eagly and Diekman [22] pointed out that gender roles are malleable to some extent by men and women, especially during profound social changes in gender attitudes. When societies move towards greater gender equality, there is increasing tolerance for gender diversity such as within-sex variations in the identification of gender traits. Recent evidence showed that cultural change may affect individual personalities as women increased endorsement of masculine traits while men maintained their nonendorsement of feminine traits [23].

Studies have shown that within-sex variation is as critical as those between the sexes to explain differences among individuals' experiences of work and family conflict [24–26]. Thus, we propose that traditional vis-a-vis nontraditional men and women may have different perceptions of work and family roles, and different experiences of work and family conflict. Because the psychological meaning differs immensely for men/women identifying with female/male appropriate traits, we expect there to be a three-way interaction between the focal person's sex, his/her identified gender traits, and work and family demands in predicting WFC/FWC. In a low gender egalitarian context like the Chinese society, traditional men draw their main identity from their bread-earner role, whereby their job-related demands take precedence over family responsibilities, and the family domain is more permeable than vice versa; on the other hand, traditional women draw their main identity from their homemaker role, whereby their family-related responsibilities take precedence over work demands. In the present-day Taiwan, women have been given increasing opportunities for education and career, while men have been increasingly encouraged to participate in family affairs. Nevertheless, research in Taiwan [9,27] shows that for most women it is still "family first," for which they are willing to make compromises/adjustments in their careers, for example, rejecting promotions and/or relocation opportunities with good career prospects, which may take them away from their families. On the other hand, for most men, it is still "career first," for which they are willing to be excessively available for work, for example, working "always on" and seeking expatriation opportunities with advancement prospects. One study in India [28] found that women "traditionals" (nonegalitarians) experienced more FWC than men "traditionals," suggesting across-sex differences among traditionals. However, it is unknown whether within nontraditionals (e.g., feminine men, masculine women) if there are also across-sex differences.

2.2. Gendered Traits and the Prominence of Work and Family Role Demands

Following traditional gender role values, men should emphasize more on the work role, and take on the duty of bread winners; while women should invest more energy on the family role, and act as caregivers [20]. Thus, when competing role demands happen, traditional men and women will respond differently in their resource investment according to their respectively identified gender roles. Specifically, for traditional men (those who identify with masculinity traits), when work demands increase, they will mobilize their resources to fulfill the primary role obligation, and may spend less time and energy in family life with null or low feelings of conflict [11,29]. Similarly, for traditional women (those who identify with femininity traits), when family demands increase, they will mobilize their resources to fulfill the primary role obligation, and may spend less time and energy in work life with null or low feelings of conflict [27,30]. In other words, masculine men and feminine women will prioritize work or family role at the expense of the other role. This is a regulatory resource investment behavior to enact the role identifications.

However, the demarcation between work and family is blurred for nontraditional men and women as they do not identify with traditional gender traits. For men who identify with nontraditional feminine traits, compared to their traditional counterparts who draw self-identity primarily on the work role, femininity traits make them more sensitive to family-related responsibilities [21]. Powell and Greenhaus [31] found a positive association between femininity traits and the importance of family role for both men and women. When work requires more energy exertion, low masculine or high feminine men will be more sensitive to the intrusion of family life detracting from their work performance. As prioritizing the family role is not socially desirable for men, they will experience more intense FWC. For women who identify with high masculine or low feminine traits, compared to their traditional counterparts who draw self-identity primarily on the family role, masculinity traits make them more inclined to pursue career achievements [21]. Research has found that women with the nontraditional gender role identity had higher achievement motivation and pursued career success more rigorously [32,33]. Being more committed to the work role, though not socially desirable for women, high masculine or low feminine women will be more perceptive to the competing expectations in the family realm, especially when they wish to devote themselves to meet work challenges. In sum, when nontraditional men and women face increasing work demands, they may not opt for sacrificing family or work life, as this is inconsistent with their self-identities [34]. While trying harder to protect the roles that are akin to their self-identities, albeit incongruent with society expectations of their sexes, the feelings of distress and conflict will be heightened [35]. Simultaneously examining sex and gender traits, we focused on *within-sex variations* to explain how gender diversity influence the roles men and women choose to enact and how they choose to enact them. We thus hypothesized:

Hypothesis 1 (H1). *There will be a three-way interaction between sex and masculinity in the relationship between work demands and FWC such that masculinity will moderate the relationship between work demands and FWC. Specifically, (a) the positive relationship between work demands and FWC will be weaker for men with higher rather than lower masculinity (for men: traditionals < nontraditionals); (b) the positive relationship between work demands and FWC will be stronger for women with higher rather than lower masculinity (for women: nontraditionals > traditionals).*

Hypothesis 2 (H2). *There will be a three-way interaction between sex and femininity in the relationship between work demands and FWC such that femininity will moderate the relationship between work demands and FWC. Specifically, (a) the positive relationship between work demands and FWC will be stronger for men with higher rather than lower femininity (for men: nontraditionals > traditionals); (b) the positive relationship between work demands and FWC will be weaker for women with higher rather than lower femininity (for women: traditionals < nontraditionals).*

Similarly, when family demands increase, we expect that nontraditional men and women will experience increased WFC. For nontraditional men, compared to their traditional counterparts who draw self-identity primarily on the work role, the femininity traits make them more inclined to pursue family happiness through involvement and participation [21]. When family duty calls, nontraditional men will be more resentful of the competing demands of the work role that depletes their energy and constrains their time. As prioritizing the family role is against the social prescription for men, they will experience more intense work-to-family conflict. For *nontraditional women*, compared to their traditional counterparts who draw self-identity primarily on the family role, and willingly accept devotion to family as the role script, the masculine traits make them more inclined to pursue career achievements and regard family responsibilities as "duties/obligations." As it is against the social prescription for women to prioritize the work role, they will feel "forced" to fulfill the family obligations nonetheless, thus experiencing more intense work-to-family conflict. We thus hypothesized:

Hypothesis 3 (H3). *There will be a three-way interaction between sex and masculinity in the relationship between family demands and WFC such that masculinity will moderate the relationship between family demands and WFC. Specifically, (a) the positive relationship between family demands and WFC will be weaker for men with higher rather than lower masculinity (for men: traditionals < nontraditionals); (b) the positive relationship between family demands and WFC will be stronger for women with higher rather than lower masculinity (for women: nontraditionals > traditionals).*

Hypothesis 4 (H4). *There will be a three-way interaction between sex and femininity in the relationship between family demands and WFC such that femininity will moderate the relationship between family demands and WFC. Specifically, (a) the positive relationship between family demands and WFC will be stronger for men with higher rather than lower femininity (for men: nontraditionals > traditionals); (b) the positive relationship between family demands and WFC will be weaker for women with higher rather than lower femininity (for women: traditionals < nontraditionals).*

3. Method

3.1. Procedure and Participants

The participants in our study were employees working in different organizations of diverse industries across Taiwan. Some of our participants were part-time MBA students and some were recruited through contact managers in organizations. The faculty and managers ascertained the commitment for participation before sending out questionnaires using email or hard copy. A cover letter accompanying the questionnaire informed participants on the purpose of the study and assuring them of anonymity and confidentiality. Upon return of the completed questionnaire, the participant was given a small gift as a token of appreciation. Three hundred seventeen questionnaires were given out and all were returned (response rate: 100%) with usable data. Based on the mean scores of the study variables, we systematically examined differences between participants who filled out the hard-copy questionnaire versus those who completed the e-version through email. Analyses revealed no significant differences overall. We thus pooled the data for further analysis (N = 317).

The sample was 53.3% male and 46.7% female, with a mean age of 35.24 (SD = 11.91), and mean job tenure of 13.62 years (SD = 10.56). Most participants (54.3%) had college-level education and over a quarter of the respondents (27.5%) were managers. Just under half of the sample (45.7%) were married or cohabiting, while the rest were single, widowed, separated, or divorced (54.3%). Regarding family circumstances, 43.8% of our participants had children, and 42.4% were living with parents or in-laws.

3.2. Measures

Gender traits. The Chinese version "Sex Role Inventory" was revised from "Bem's Sex Role Inventory" (BSRI) [16] with Chinese trait descriptors and validated with Chinese subjects [36].

The inventory has a 20-item masculinity (MAS hereafter) scale pertaining to instrumental-agenic traits, and a 20-item femininity (FEM hereafter) scale pertaining to expressive–communal traits. There was evidence supporting construct validity of these two scales [37]. Sample items (adjectives) of the MAS scale are "ambitious" and "independent." Sample items (adjectives) of the FEM scale are "warm" and "empathetic." Five-point rating scales were used (1 = not true for me, 5 = extremely true for me), with higher scores representing higher identification with the MAS and FEM traits. Following Bem's [16] theory, masculinity and femininity traits are two discernible psychological dimensions that coexist within an individual. Thus, they were analyzed as two independent variables in the present study. The internal consistency reliability of the MAS scale was 0.92 and that of the FEM scale was 0.89.

Work demands. Quantitative workload was used to indicate work demands. Five statements from the quantitative workload inventory (QWI) [38] describe quantitative aspects of work demands (e.g., "How often is there a great deal to be done?"). Respondents answered each statement by indicating the frequency of occurrence, from 1 (never happened) to 5 (always happening), with higher scores representing higher work demands. The internal consistency of the QWI was 0.84 in the present study.

Family demands. Family responsibility was used to indicate family demands. Three statements from the family responsibility scale (FRS) [39] describe quantitative aspects of family demands (e.g., "How often do you feel that your family makes too many demands on you?"). Respondents answered each statement by indicating the frequency of occurrence, from 1 (never happened) to 5 (always happening), with higher scores representing higher family demands. The internal consistency of the FRS was 0.87 in the present study.

WFC and FWC. The work–family conflict scale (WFCS) [40] was used to assess WFC and FWC separately. Sample items are: "The amount of time my job takes up makes it difficult to fulfill family responsibilities" (WFC), and "I have to put off doing things at work because of demands on my time at home" (FWC). Respondents rated the items on a five-point Likert scale (1 = absolutely incorrect, 5 = absolutely correct), with higher scores representing higher conflict in both directions. The internal consistency of the WFC scale was 0.92 and that of the FWC scale was 0.85 in the present study.

Demographics. Demographic information on sex (coded as men = 1, women = 0), age, marital status (coded as married = 1, not married = 0), living arrangement (coded as living with parent = 1, not living with parent = 0), tenure on the job (in years), and rank (coded as managers = 1, employees = 0) were recorded. These were used as control variables in all the subsequent analyses.

4. Results

4.1. Descriptive Analysis

Prior to the hypotheses testing, bivariable correlations were computed; the results are shown in Table 1. It is important to note that sex correlated with neither MAS nor FEM, and neither MAS nor FEM correlated with WFC or FWC. However, both work and family demands positively correlated with WFC and FWC. As can be seen in Table 1, sex (biological men) positively correlated with FWC, whereas being married positively correlated with FEM, and holding a managerial position positively correlated with MAS; thus we controlled for all demographic characteristics and job variables in the subsequent analyses.

Table 1. Interrelations among research variables (N = 317).

	Mean	SD	1	2	3	4	5	6	7	8	9	10	11	12
1. Age	35.24	11.91	1.00											
2. Sex	0.47	0.50	−0.01	1.00										
3. Marital status	0.46	0.50	0.74 ***	0.01	1.00									
4. Number of children	0.44	0.50	0.77 ***	0.00	0.85 ***	1.00								
5. Living arrangement	0.58	0.49	−0.45 ***	0.00	−0.33 ***	−0.32 ***	1.00							
6. Rank	0.28	0.45	0.20 ***	0.09	0.17 **	0.14 *	−0.12 *	1.00						
7. WFC	13.04	3.86	0.11	0.05	0.18 **	0.13 *	−0.06	0.10	1.00					
8. FWC	10.91	3.11	0.17 **	0.12 *	0.24 ***	0.22 ***	−0.08	−0.04	0.55 ***	1.00				
9. Workload	17.83	3.51	0.07	−0.10	0.11 *	0.05	−0.12 *	0.20 ***	0.46 ***	0.18 **	1.00			
10. Family responsibility	7.46	2.62	0.30 ***	−0.06	0.30 ***	0.34 ***	−0.15 **	0.05	0.35 ***	0.50 ***	0.32 **	1.00		
11. Masculinity traits	90.83	17.27	0.11 *	0.08	0.08	0.12 *	−0.17 **	0.23 ***	0.06	0.04	0.31 ***	0.24 ***	1.00	
12. Femininity traits	94.38	15.63	0.21 ***	−0.11	0.16 **	0.20 ***	−0.11 *	0.09	0.03	0.00	0.27 ***	0.20 ***	0.58 ***	1.00

Notes: (1) sex: 0 = women, 1 = men; marital status: 0 = not married, 1 = married; living arrangement: 1 = living with parent, 0 = not living with parent; rank: 0 = employees, 1 = managers. (2) * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

4.2. Confirmatory Factor Analyses (CFA) and Testing for Common Method Variance (CMV)

To ensure that the constructs of our research model can be meaningfully distinguished, we conducted CFA to compare a series of measurement models. Specifically, our six-factor research model where items loaded on the theoretically assumed correlated latent factors (i.e., MAS, FEM, work demands, family demands, WFC, FWC) was set against alternative solutions (three-factor model that combined MAS and FEM, work and family demands, WFC and FWC: χ^2/df = 4.16, CFI = 0.54, NFI = 0.47, RMSEA = 0.10, SRMR = 0.13; and one-factor model where all items loaded on one general latent factor: χ^2/df = 5.47, CFI = 0.34, NFI = 0.30, RMSEA = 0.12, SRMR = 0.14. The six-factor solution consistently fitted the data better (χ^2/df = 2.28, CFI = 0.91, NFI = 0.87, RMSEA = 0.04, SRMR = 0.05), thus supporting the structure of our research model. As self-report measures may increase the threat of common method variance (CMV) bias [41], we examined an alternative model that matched our hypothesized research model except for the inclusion of an unmeasured, latent method factor [41]. The model fit was very poor (χ^2/df = 8.69, CFI = 0.56, NFI = 0.48, RMSEA = 0.18, SRMR = 0.18), indicating that it was unlikely that any substantial proportion of variability in responses could be attributable to the method factor.

4.3. Hypotheses Testing

Following Baron and Kenny's [42] suggestion for testing and reporting moderating effects, we conducted a series of hierarchical regression analyses to test our hypotheses. Predictors were standardized and interaction terms were created from these standardized predictors. In keeping with Bem's theoretical proposition and the established gender trait research paradigm, MAS and FEM were tested separately in regression models. When testing H1 and H2, FWC was the dependent variable. We first entered all the control variables in the regression models. At the second step, we entered workload as the independent variable. At the third step, we entered sex and gender traits (MAS or FEM) as moderators. At the fourth step, two-way interaction terms (workload × sex, workload × MAS or FEM, sex × MAS or FEM) were entered. At the final step, the three-way interaction term (workload × sex × MAS or FEM) was entered. The results are reported in Table 2 (for MAS) and Table 3 (for FEM).

Results in Table 2 showed that having controlled for effects of demographics, workload, sex, gender trait of MAS, and two-way interactions, the focal three-way interactive effect pertaining to masculinity was not significant in predicting FWC (Model 5). Thus, Hypothesis 1 was not supported. Results in Table 3 showed that having controlled for effects of demographics, workload, sex, gender trait of FEM, and two-way interactions, the focal three-way interactive effect pertaining to femininity was indeed significant in predicting FWC (Model 5). Thus, Hypothesis 2 was supported.

Table 2. Results of moderated regression on family-to-work conflict (FWC): masculinity traits.

Predictors	FWC				
	Model 1	Model 2	Model 3	Model 4	Model 5
Control variables					
Age	0.01	0.02	0.03	0.01	0.01
Marital Status	0.18	0.15	0.14	0.11	0.11
Living arrangement	0.00	0.02	0.02	0.01	0.01
Having children	0.08	0.11	0.11	0.14	0.13
Rank	−0.07	−0.10	−0.12 *	−0.14 *	−0.13 *
Independent variable					
Workload		0.17 **	0.19 **	0.24 ***	0.23 ***
Moderators					
Masculinity traits			−0.01	−0.03	−0.03
Sex			0.15 **	0.16 **	0.14 *
2-way interactions					
Workload × Masculinity traits				0.07	0.05
Workload × Sex				−0.15 *	−0.14 *
Sex × Masculinity traits				0.14 *	0.14 *
3-way interaction					
Workload × Sex × Masculinity traits					0.06
R^2	0.07	0.09	0.12	0.15	0.15
ΔR^2	0.07 **	0.03 **	0.02 *	0.03 *	0.00
F	4.40 **	5.16 ***	4.87 ***	4.60 ***	4.31 ***
(df)	(5298)	(6297)	(8295)	(11,292)	(12,291)

Notes: (1) All coefficients are standardized beta coefficients. (2) Sex: 0 = women, 1 = men; Marital status: 0 = not married, 1 = married; Living arrangement: 1 = living with parent, 0 = not living with parent; Rank: 0 = employees, 1 = managers. (3) * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table 3. Results of moderated regression on FWC: femininity traits.

Predictors	FWC				
	Model 1	Model 2	Model 3	Model 4	Model 5
Control variables					
Age	0.01	0.02	0.04	0.03	0.03
Marital Status	0.21	0.17	0.15	0.15	0.13
Living arrangement	0.02	0.03	0.04	0.03	0.04
Having children	0.05	0.08	0.10	0.10	0.12
Rank	−0.08	−0.11	−0.13 *	−0.15 *	−0.15 **
Independent variable					
Workload		0.17 **	0.21 ***	0.25 ***	0.26 ***
Moderators					
Femininity traits			−0.06	−0.06	−0.07
Sex			0.16 **	0.17 **	0.14 *
2-way interactions					
Workload × Femininity traits				0.08	0.08
Workload × Sex				−0.12 *	−0.09
Sex × Femininity traits				0.12 *	0.11 *
3-way interaction					
Workload × Sex × Femininity traits					0.14 *
R^2	0.06	0.09	0.12	0.15	0.17
ΔR^2	0.06 **	0.03 **	0.03 **	0.03 *	0.02 *
F	4.12 **	5.03 ***	5.07 ***	4.66 ***	4.81 ***
(df)	(5299)	(6298)	(8296)	(11,293)	(12,292)

Notes: (1) All coefficients are standardized beta coefficients. (2) Sex: 0 = women, 1 = men; Marital status: 0 = not married, 1 = married; Living arrangement: 1 = living with parent, 0 = not living with parent; Rank: 0 = employees, 1 = managers. (3) * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

As we argued earlier, for men and women, identifying with masculinity and femininity, depending on whether such traits are assigned to their sex or those to the opposite sex, has very different meanings and subsequent effects on their behaviors and experiences. Thus, it is meaningful to plot the significant three-way interaction effect at one standard deviation above and below the mean [43] separately for

men (Figure 1) and women (Figure 2). In Figure 1, the simple slope was larger for the high feminine men (0.34, $p < 0.001$) and smaller for the low feminine men (–0.03, n.s.). The result provides support for H2a, namely, nontraditional (feminine) men experienced greater FWC when work demands went higher. In Figure 2, the two slopes for high and low feminine women were 0.13 ($p < 0.05$) and 0.30 ($p < 0.001$). The result lends support for H2b, showing that the relationship between workload and FWC was stronger for nontraditional (low feminine) women when work demands went higher.

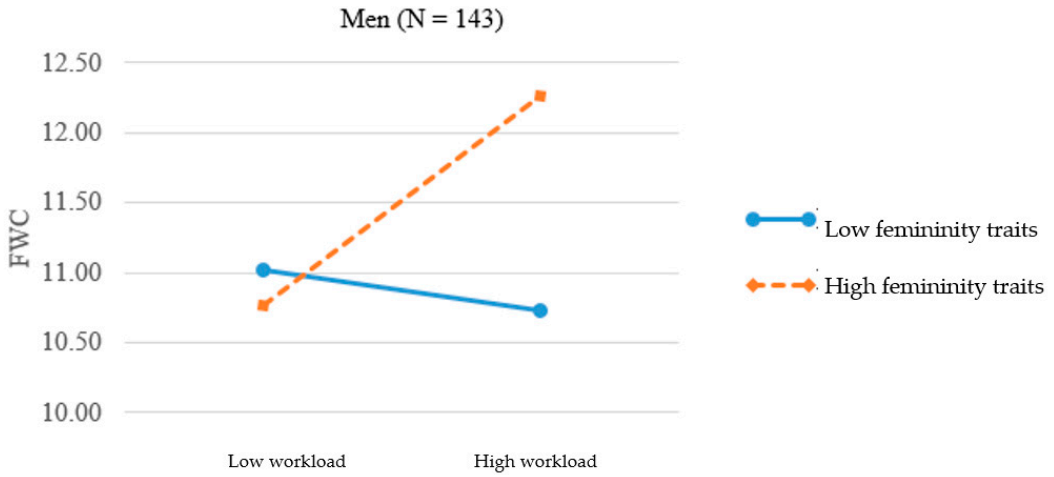

Figure 1. Interaction of femininity traits and workload on FWC for men.

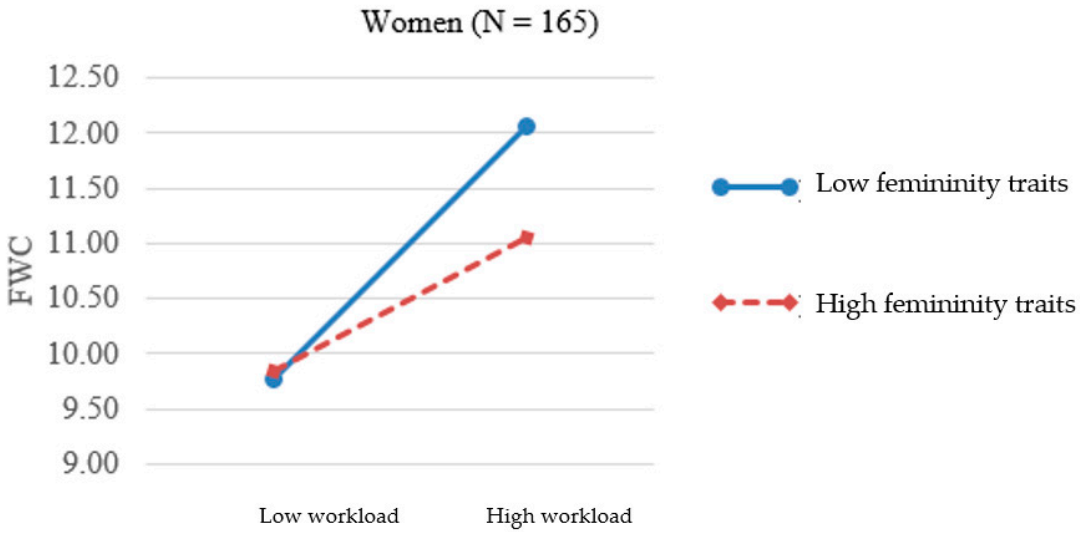

Figure 2. Interaction of femininity traits and workload on FWC for women.

The same logic and procedure described above were followed when testing for H3 and H4. The only differences were this time WFC was the dependent variable and family responsibility was the independent variable. The results of these two sets of regression analysis are reported in Table 4 (for MAS) and Table 5 (for FEM).

Table 4. Results of moderated regression on work-to-family conflict (WFC): masculinity traits.

Predictors	WFC				
	Model 1	Model 2	Model 3	Model 4	Model 5
Control variables					
Age	−0.04	−0.07	−0.07	−0.07	−0.06
Marital Status	0.20	0.20	0.19	0.19	0.20
Living arrangement	−0.03	−0.02	−0.03	−0.03	−0.04
Having children	−0.01	−0.09	−0.09	−0.10	−0.11
Rank	0.08	0.08	0.09	0.09	0.09
Independent variable					
Family responsibility		0.33 ***	0.34 ***	0.35 ***	0.33 ***
Moderators					
Masculinity traits			−0.04	−0.04	−0.03
Sex			0.07	0.07	0.05
2-way interactions					
Family responsibility × Masculinity traits				−0.05	−0.06
Family responsibility × Sex				−0.03	−0.04
Sex × Masculinity traits				−0.04	−0.03
3-way interaction					
Family responsibility × Sex × Masculinity traits					0.09
R^2	0.04	0.14	0.14	0.15	0.15
ΔR^2	0.04 *	0.09 ***	0.01	0.01	0.01
F	2.72 *	7.83 ***	6.12 ***	4.61 ***	4.44 ***
(df)	(5299)	(6298)	(8296)	(11,293)	(12,292)

Notes: (1) All coefficients are standardized beta coefficients. (2) Sex: 0 = women, 1 = men; Marital status: 0 = not married, 1 = married; Living arrangement: 1 = living with parent, 0 = not living with parent; Rank: 0 = employees, 1 = managers. (3) * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table 5. Results of moderated regression on WFC: femininity traits.

Predictors	WFC				
	Model 1	Model 2	Model 3	Model 4	Model 5
Control variables					
Age	−0.09	−0.12	−0.11	−0.11	−0.12
Marital Status	0.25 *	0.25 *	0.25 *	0.25 *	0.28 **
Living arrangement	−0.02	−0.02	−0.02	−0.02	−0.01
Having children	−0.02	−0.12	−0.12	−0.13	−0.13
Rank	0.09	0.09	0.09	0.09	0.09
Independent variable					
Family responsibility		0.34 ***	0.35 ***	0.35 ***	0.33 ***
Moderators					
Femininity traits			−0.03	−0.04	−0.03
Sex			0.06	0.06	0.04
2-way interactions					
Family responsibility × Femininity traits				0.02	0.01
Family responsibility × Sex				−0.05	−0.05
Sex × Femininity traits				−0.06	−0.05
3-way interaction					
Family responsibility × Sex × Femininity					0.14 *
R^2	0.04	0.14	0.15	0.15	0.17
ΔR^2	0.04 **	0.10 **	0.01 **	0.01 *	0.02 *
F	2.67 **	8.29 ***	6.46 ***	4.90 ***	5.11 ***
(df)	(5,300)	(6,299)	(8,297)	(11,294)	(12,293)

Notes: (1) All coefficients are standardized beta coefficients. (2) Sex: 0 = women, 1 = men; Marital status: 0 = not married, 1 = married; Living arrangement: 1 = living with parent, 0 = not living with parent; Rank: 0 = employees, 1 = managers. (3) * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Results in Table 4 show that having controlled for effects of demographics, family responsibility, sex, gender trait of MAS, and two-way interactions, the focal three-way interactive effect pertaining to masculinity was not significant in predicting WFC (Model 5). Thus, Hypothesis 3 was not supported. Results in Table 5 showed that having controlled for effects of demographics, family responsibility, sex, gender trait of FEM, and two-way interactions, the focal three-way interactive effect pertaining to femininity was indeed significant in predicting WFC (Model 5). Thus, Hypothesis 4 was supported.

We again plotted the significant three-way interaction effect separately for men (Figure 3) and women (Figure 4). In Figure 3, the two slopes for high and low feminine men were 0.24 ($p < 0.01$) and 0.20 ($p < 0.05$). The result provides support for H4a, namely, nontraditional (feminine) men experienced *greater* WFC when family demands went higher. In Figure 4, the two slopes for high and low feminine women were 0.21 ($p < 0.05$) and 0.33 ($p < 0.001$). The result lends support for H4b, showing that the relationship between family responsibility and WFC was stronger for nontraditional (low feminine) women when family demands went higher.

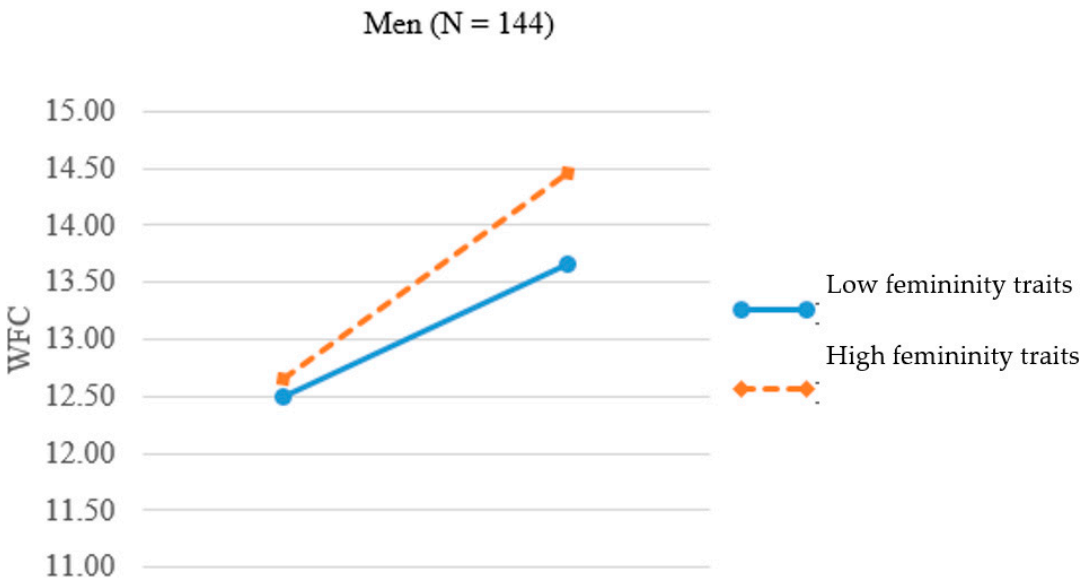

Figure 3. Interaction of femininity traits and family responsibility on WFC for men.

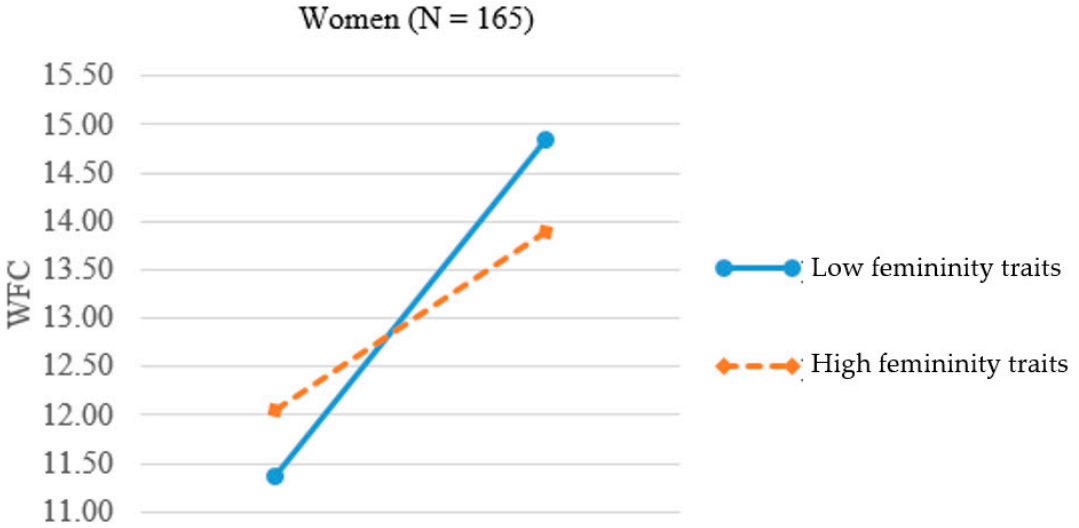

Figure 4. Interaction of femininity traits and family responsibility on WFC for women.

5. Discussion

Previous studies of work and family have found either nonsignificant or inconsistent sex differences on levels of conflict between men and women (see reviews such as [2,6]). We instead viewed "sex" as a multifacet construct with biological, psychological, and social implications for individuals to enact work and family roles. The present study is the first to examine the three-way interaction effects of biological sex, gender diversity, and role demands on the bidirectional work and family conflict

in a Chinese society undergoing rapid social changes. To recap, we found that both nontraditional (high feminine) men and nontraditional (low feminine) women experienced greater FWC when work demands went higher, compared to their traditional same-sex counterparts. Furthermore, the same nontraditional groups of men and women experienced greater WFC when family demands went higher, compared to their traditional same-sex counterparts.

5.1. Theoretical Contribution

Our findings make theoretical contributions to the existing work and family literature on the following fronts. First, through systematic examination of gender diversity in self-identity, our study highlights the folly of "biopsychological equivalence" prevalent in the literature [7]. Our results clearly show that when gender self-identity is measured, biological sex had no relation with an individual's endorsement of gender traits. The gender role orientation theory does not make the assumption of biopsychological equivalence; i.e., both men and women can identify with high or low masculinity and femininity traits [7,16]. To the extent that self-identity directs behavior, individuals will seek and be satisfied with roles that maximize cognitive consistency [44]. For example, to maintain a positive self, individuals would select a coping strategy that is congruent with their gender identity, thereby satisfying the need for self-consistency [45]. Our nuanced approach to include the biological, psychological, and social aspects of "sex" will advance a more equitable understanding of gender diversified men's and women's experiences of work and family in the post-pandemic society.

Second, using biological sex as a proxy for gender has led to overlooking the within-sex variations in work and family roles. Our simultaneous examination of biological sex with psychological gender traits unraveled the protean nature of contemporary gender role identification, such as the "family men" and "career women." Our research demonstrates the utility of gender traits as individual-level psychological constructs and clarifies that it is the intersection of sex and gender role traits that makes a difference in individuals' perceptions of role demands and their experiences of conflict.

Third and most importantly, we consistently found that the identification with nontraditional gender traits (those that differ from the prescribed gender traits for one's biological sex) exposed individuals to a vulnerable position in the work and family interface. Our results highlight the powerful macrocultural contexts that have been largely overlooked in the Western-dominated work and family research. It is important to note that in the East, "family men" and "career women" may suffer from more elevated work and family conflict, compared to their traditional counterparts (e.g., breadwinning men and homemaking women). The systemic examination of gender diversified self-identities (e.g., traditional men with high masculinity, nontraditional men with high femininity, traditional women with high femininity and nontraditional women with high masculinity) lends greater weight to advance gender equitable knowledge. It is thus worth noting that masculinity is not potent in the trilogy of sex, gender, and work and family interface, whereas femininity may hold the key for the adjustment of both men and women. More precisely, it is the feminine men and nonfeminine women who face the precarious circumstances when work and family demands mount. The commonality between the two groups are their nontraditional gender identities: men identifying with female traits and women not identifying with female traits, thus possibly detracting them from the traditional male role of work and female role of family. Although empirical findings are still scarce, the reality for "moving ahead of the tide" may be less than rosy. A recent study in mainland China found that among male managers, those with egalitarian gender attitudes suffered more negative consequences of WFC [11]. Our results complement and extend this preliminary evidence to both men and women, employees, and managers, on both directions of the work and family spillover (WFC and FWC). In a Chinese society that puts great emphasis on conformity and fitting-in, the social pressure on those nonconformists is phenomenal [46]. Such pressure is likely to result in threats to self-worth and conflict over self and others' expectations. All of these render the nonconformists stress-prone in juggling work and family roles. Our findings are in line with the resource view [47]. In a transitional society, while nontraditional men and women desire to immerse in their self-chosen role,

they are still obligated to perform the societal prescribed role, resulting in greater resource competition and depletion, such as extended working hours and reduced leisure time [35,48]. One study in Taiwan found that those who upheld stronger nontraditional values (i.e., prioritizing the individual over the collective) suffered higher WFC/FWC when role demands increased [49]. Along with encouragement of diversity and equity in the post-pandemic era, the challenges for taking the road less trodden still need to be better researched and demythologized.

5.2. Managerial Implications

The stronger associations between role demands and work–family conflict for nontraditional men and women suggest that organizations should invest more efforts to promote equity and inclusion, especially targeting those with nontraditional gender traits with work–life balance resources. Organizational interventions such as flexible work and supervisory support for family values have been shown to decrease work and family conflict [12,50]. Organizations should also establish policies to create a level playing field for all employees to fulfill their aspirations, regardless of sex and gender role orientations.

5.3. Limitations and Future Research Directions

Our study has limitations. First, our data were cross-sectional and self-reported, causal relationships between role demands and work and family conflict cannot be ascertained. Future research should adopt a longitudinal study design to justify causality. As for CMV, our tests confirmed that all research variables were empirically distinguishable and the bias due to common method variance was low. Researchers have argued that interactive effects are less affected by CMV [51]; it is still valuable to obtain other sources of data in future research, such as supervisor or spouse ratings of role demands. Third, due to various restrictions, we could only use a convenient sampling method to obtain data. Comparing to the profile of a published national probability sample of full-time workers in Taiwan [50], our sample was younger (35.24 vs. 40), had more women (46.7% vs. 34%), fewer married (45.7% vs. 70.1%), and about the same proportion of managers (27.5% vs. 29.1%). Thus, we cannot claim the representativeness of Taiwanese working population, and our results have to be interpreted with due caution and reservation. Last but not the least, as our study is contextualized in the Taiwanese conditions, results may not generalize to other cultures. Future research on cross-cultural comparisons is encouraged.

6. Conclusions

Conducted in a transitional Chinese society, the present study simultaneously examined the three-way interaction effects of biological sex, gender diversity in self-identities, and work and family demands on WFC/FWC. We unraveled both the within-sex and across-sex differences on the work and family interface, emanating from individuals' diverse gender identities. Men endorsing high femininity traits and women endorsing low femininity traits are more vulnerable compared to their traditional counterparts. The underlying mechanisms of such vulnerability highlight the pressure of nonconformance to traditional gender role scripts. In the post-pandemic changing times, researchers should thus take into account the full biopsychosocial implications of gender to achieve an equitable and inclusive understanding of men's and women's experiences of work and family roles.

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Conflicts of Interest: The authors declare no conflict of interest.

Data Availability Statement: The data that support the findings of this study are available from the corresponding author, L. Lu, upon reasonable request.

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