Article

Co-Creating New Directions for Service Robots in Hospitality and Tourism

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Abstract: Research on the relationship between automation services and tourism has been rapidly growing in recent years and has led to a new service landscape where the role of robots is gaining both practical and research attention. This paper builds on previous reviews and undertakes a comprehensive analysis of the research literature to discuss opportunities and challenges presented by the use of service robots in hospitality and tourism. Management and ethical issues are identified and it is noted that practical and ethical issues (roboethics) continue to lack attention. Going forward, new directions are urgently needed to inform future research and practice. Legal and ethical issues must be proactively addressed, and new research paradigms developed to explore the posthumanist and transhumanist transitions that await. In addition, closer attention to the potential of "co-creation" for addressing innovations in enhanced service experiences in hospitality and tourism is merited. Among others, responsibility, inclusiveness and collaborative human-robot design and implementation emerge as important principles to guide future research and practice in this area.

Keywords: automation; co-creation; enhanced service experience; hospitality; posthumanism; roboethics; service robots; smart tourism

1. Introduction

Travel and tourism revolve around hospitality—in the encounter with the "other"—in the welcome of the B&B host, the friendly taxi driver, the tour operator, and the greeting of the flight attendant. However, the service delivery sector is no longer the same since the World Health Organization declared a global pandemic on 11 March 2020. Adjusting to COVID-19 is accelerating transitions to new technological platforms and processes, and significant structural changes. Struggling to survive and recover, the hospitality industry is racing to instill contactless technologies, employ robots to deliver food, and innovate "safe" distanced spaces to carefully resume leisure and recreational offerings. Technological innovations are perceived as key to successful transition to a post-covid world, but even before the pandemic, significant structural shifts were already occurring towards Tourism 4.0. Buhalis and Sinarta [1] emphasized that hospitality and tourism businesses must implement technological innovations that foster real-time services and optimize the host-guest interaction in order to be competitive. This has become even more challenging in rapidly changing smart environments where robots, artificial intelligence and service automation (RAISA) are anticipated to become increasingly influential on service quality and service experience [2].

The race is on toward Tourism 5.0. "Robots are coming" said Bowen and Morosan [3] and it is anticipated to bring significant change to an industry whose core is "hospitality". By 2030, robots are predicted to constitute about twenty-five percent of the hospitality industry's workforce [3]. The adoption of automation services in tourism has led to a new service landscape where the role of robots is gaining both practical and research attention. As Pransky [4] explained, "unlike industrial robots, which are typically found in

manufacturing environments, service robots (or "serve us" robots as I like to refer to them) will cater to the masses, millions of end-users in a variety of settings from the hospital to the home, from restaurants to offices" (p.4). In this sense, a service robot is a type of autonomous robot that executes functions without human intervention [5]. In the service context, service robots are also seen as social agents that can substitute for human providers. Their use as social robots opens possibilities for human-robot interactions that require new ways to understand and study experience and meaning-making, transforming "existential authenticity" and ways of being and becoming [6].

So, surely, for an industry based on hospitality, innovations in the development and use of service robots deserve careful forethought and proactive planning in the diffusion of innovation from human-centered to human-machine environments and interactions. What might such a posthumanist world of leisure and travel look like? What changes are being implemented towards this and why? Who stands to win and lose from the rapidly shifting technoscapes within social-ecological systems? Additionally, what does hospitality mean in the brave new world that is rapidly emerging as surveillance becomes commonplace, and "privacy" less than assured as Alexa and Siri, Google, Facebook and Twitter, along with multiple travel booking platforms and apps, gather data on you (add to this now the rise of service robots!). While we are unable to explore these questions in depth, these are the ones that concern us, and as we begin to explore them, an additional research question arises: What shifts in thinking and approach are needed for us as researchers to be able to understand the new techno-social landscapes that are continually transforming travel, tourism, and hospitality?

Whether the issue is pandemics or technological innovations and digital transitions, it is clear that ethical guidelines are needed to ensure "corporate digital responsibility" [7] along with new management strategies and principles to successfully navigate through the technological and structural changes occurring globally throughout the tourism and hospitality system. Drawing on an extensive literature review, we examine the role of service robots in hospitality and tourism, critically discuss some of the challenges arising as identified in the research literature, and offer some directions to guide future research and practice.

The paper is structured as follows. A preliminary review of the literature presented in the next section introduces some general concepts, an overview of the rise of service robots in hospitality and tourism, and discusses some resulting transformations. A detailed review of the literature is then undertaken in the subsequent section, examining the growing use of robots as a business strategy, their central role in service experiences, and some important ethical and management issues arising from robotization, specifically, the use of service robots in hospitality and tourism. Following this is a discussion section that forwards considerations for addressing some of the management and ethical issues, and offers some directions for future research in service robots for hospitality and tourism. The paper closes with a brief summary and look forward to the interesting and challenging post- and trans-humanist world that awaits.

2. Overview of Service Robots

2.1. The Rise of Service Robots in Hospitality and Tourism

Bowen and Morosan [3] describe robots as autonomous machines in forms such as human-like, animal-like, object, or functional. According to Murphy, Hofacker, and Gretzel [8], industrial robots appeared more than fifty years ago as semi-autonomous robot types assisting with uncomplicated tasks requiring repetitive activities, for example, fast food preparation. They heralded a new landscape of automation in the hospitality and tourism industry. A few decades later, by the mid-nineties, service robots had joined the field, emerging in two forms: professional and personal service robots. Professional service robots are used for tasks such as cleaning or delivery, while personal service robots are commonly seen to undertake activities with social interaction.

Numerous definitions of service robots exist. The International Federation of Robotics [5] describes a service robot as a typology of autonomous robot that performs tasks without human intervention. Bowen and Morosan [3] state that service robots are "physically embodied artificially intelligent agents that can take actions that have effects on the physical world" (p.727). Ivanov, Webster, and Berezina [9] add that service robots are "programmable, intelligent devices, with a certain degree of autonomy, mobility, and sensory capabilities, designed to perform a certain task" (p.2) which is useful for humans. In addition, the term social robot is used to denote a type of service robot that is programmed with ability to interact and communicate with humans, and follow behavioral norms [10]. As such, they are anticipated to become increasingly relevant in hospitality and tourism environments to enhance service experience and service quality [11].

Not surprisingly, some of the earliest adopters of service robots are geographically situated in technologically leading countries like Japan. In 2015, Japan was the first country to inaugurate a robotic hotel, Henn-na [12,13]. The Japanese are perceived to be more comfortable with service robots in their technologically advanced society, with innovations in many areas ahead of other countries [14,15]. Other Asian countries such as Taiwan have also been increasingly adopting service robots in hospitality settings, based on positive perceptions of service robotization [16].

Evolving Service Robot Roles in Tourism and Hospitality

In the context of tourism and hospitality, service robots, say Wirtz et al. [17], are "adaptable interfaces that interact, communicate and deliver service to an organization's customers" (p.909), while Van Doorn et al. [6] (p.909) describe them as "social agents" that provide service experiences. Early adoption in tourism and hospitality has occurred with service robots taking on increasing visible roles such as becoming delivery robots (e.g., delivering room services), hotel concierges, or housekeepers in the accommodation sectors, waiters and bartenders, guides or destination greeters [18]. Neuhofer, Magnus, and Celuch [19] explore the impact of service robots on events and describe the pivotal role of RAISA as experience facilitators. Such intelligent automation has been growing for a wide range of reasons, for example, labor shortage in some industry sectors, increased cost-effectiveness, and of course capacity to provide 24/7 availability of services [20,21].

Tuomi, Tussyadiah, and Stienmetz [22] observe two principal roles for robot automation: supportive automation, such as in dealing with customers' payments, and substitutive automation, where robots perform the entire experience, for example, robot bartenders. Roles in service robotics range from automation for novelty, for example, a restaurant that places a personal robot assistant on every table as a way to create a unique experience, to automation for improving service quality, such as in delivering orders efficiently and punctually. Increasing sophistication is also being observed, such as in the rise of robot chefs [23]. Ivanov et al. [24] believe the increasing adoption of RAISA technologies will lead to attrition of human workers, but the loss of certain repetitive jobs will also result in a creation of new and more interesting jobs. "We will not feel sorry for dish washers and cleaners if robots do their work, or if we use chatbots and kiosks that provide a quicker, cheaper, and more efficient service than human employees" [25] (p.53). As they point out, technology is a tool, not a goal. The economic assessment of the costs and benefits of RAISA adoption also needs to consider the improvement of businesses' processes that are also influenced by the implementation of RAISA [20]. By this, they mean that businesses need to analyze not just profit (bottom line), but also real practical implications of RAISA adoption due to changes in employees' roles and customers' perceptions. Zhang and Qi [26] similarly note that while RAISA enables high efficiency, low labor costs, and offers novelty experiences, the practical operation of robotic hotels face numerous challenges (for instance, managing user expectations of the use of service robots).

2.2. Enhanced Service Experiences

New robot technologies are also transforming consumer experiences with increasing human-robot interactions. Lu, Cai, and Gursoy [27] argue that implementation of RAISA in service interactions needs to focus not only on performance efficacy, but also on aspects such as emotions expressed by guests and the social influence of service robots. Robots are being increasingly used as front-line service providers to greet and provide information to visitors, for example, when they act as concierges. Robot concierges used in hotels include Connie, the Hilton robot concierge [12], and Mario, a Marriott robot concierge [28]. They are also being used to entertain customers, for example, when they are able to address travelers' multi-information demands [24,29]. Additionally, starting with early roles in fast-food preparation, they are now being increasingly used to prepare food at higher levels of culinary skills and expertise. Robot chefs are perceived to create unique eatertainment experiences [23]. For example, they are being used as front-line service providers in complex restaurant settings, such as Spyce, a robotic restaurant in Boston led by MIT students and celebrity chef Daniel Boulud [30].

The adoption of service robots can also be used to improve perceived service quality in such settings [29]. Service robots can be structured to provide unique and novel experiences that enable competitive advantage and brand positioning [15,18,28]. Belanche, Casaló, and Flavián [31] state that the incorporation of service robots results in service enhancement and can also reduce transaction times, provide faster assistance, and increase customers' intentions to use and recommend service robot usage. A range of such studies highlights that smart environments enhance customer experiences and quality of service delivery [32,33]. However, social interactivity, social presence, and rapport skills need to be developed to match consumer expectations [34]. Technical failures and customers' complaints in the Japanese hotel, Henn-na, led to significant elimination of their robotic workforce [35].

Types of Service Robots that Enhance Experience

Tung and Law [15] wrote one of the early review papers on robotics research and offer useful directions for future hospitality and tourism research. They note that early engineering research used hospitality and tourism as its context, but typically focused on the technical aspects of robotic design, architecture, and performance rather than consumer/tourist experiences arising from human-robot interactions (see also [36]). Their paper is particularly valuable in addressing embodiment and morphology, and how these affect tourist perceptions of service robotization. Embodiment is affected by morphology, "which represents a robot's form and structure, such as the shape of its body and limbs" [15] (p.2502).

Four types of embodied morphologies have been distinguished in the literature: anthropomorphic, zoomorphic, caricatured, and functional. Anthropomorphic robots are humanoid robots that mimic human-like forms [37], zoomorphic robots imitate non-human forms such as animals [38], caricatured robots adopt machine-like forms that do not resemble living creatures [39], and functional robots are created according to the task they perform, for example, "a service robot at a fitness center of a hotel may be in a form of a basket to collect used towels from guests" [15] (p.2502). The growing social skills of robots and especially anthropomorphic designs contribute toward enhancing services experiences and the co-creation of value in the social interactions between customers and robots [6,40,41]. Social robots such as those used for service encounters will help to facilitate the integration of robotics into everyday life, as Tung and Law [15] indicate.

2.3. Transformative Changes in the Hospitality and Tourism Domain

Robotics has been transforming the hospitality and tourism sector for the past couple of decades, but COVID-19 is accelerating innovation and change through a range of disruptive technologies. As Sigala [42] states, "developmental trends and adoption of smart destinations and tourism services, AI, robotics and other digital advances are now

accelerated to combat the COVID-19 tourism implications" (p.314). Authors like Kwok and Koh [43] note that the pandemic will drive forward technological innovations such as extended reality, for example, implementation of immersive technologies such as virtual reality, where 3D virtual worlds or 360-degree videos can replace direct human presence in assisting visitors to get oriented to hotels or destination attractions. New technology adoption also reinforces the shift towards e-tourism and collaborative consumer engagement with smart peer-to-peer (P2P) platforms [44,45]. Various technologies integrating large data sets offer smooth, smart tourism experiences: "the Internet of Things, the Internet of Everything, fifth generation mobile network (5G); Radio Frequency Identification (RFID); mobile devices, wearable smartphones and devices; 3D printing, apps along with APIs, Cryptocurrency and Blockchain, sensor and beacon networks, pervasive computing, gamification as well as enhanced analytical capabilities supported by Artificial Intelligence (AI) and machine learning (ML)" [40] (p.269).

The expanding range of disruptive technologies informs what Buhalis [40] calls ambient intelligence (AmI) tourism. Here, technology-empowered tourism allows travelers to co-create enhanced experiences and value during different travel stages in real time. Buhalis and Sinarta [1] identify "nowness" as immediate and relevant engagement with customers, and nowness service as based on five interconnected characteristics: real-time, co-creation, data-driven, consumer centric, and experience enhancement. Among the disruptions contributing to nowness, of course, is the increasing adoption of service robots in the workplace, and a growing number of hospitality and tourism companies, "both large (Disney, Carnival Cruises, Mandarin Oriental, etc.) and small (Henn-na Hotel, Café X, Zaxby's, etc.) have begun to embrace and use AI and robotics" [46] (p.625).

The rising importance of human-robot interactions and activities, however, requires careful attention to collaborative interactions between service actors in the co-creation of services and service encounters, and provision of excellence in service delivery. Robotic environments can disrupt the industry and lead to both positive and adverse behavioral and organizational changes as the traditional framework of a service-provider relationship is being re-constituted. A primary challenge for hospitality and tourism players is to decide which technologies to adopt or ignore, note Tuomi, Tussyadiah and Stienmetz [47], and how robotics and AI can effectively and synergistically complement rather than replace human labor. See Table 1 in Cain, Thomas, and Alonso Jr. [46] for an excellent review of research which identifies trends, themes, and factors for management consideration and service provision related to AI and robotics. RAISA technologies will significantly affect decision-making processes in the service industry and lead to change in employment structures and employees' tasks, for example, where robotics service can help hotels handle seasonal employment and labor utilization [16]. The needs and interests of visitors also need to be considered in decision making. For instance, service robots are useful to deploy to customers who like to see consistent service quality and efficient service provision (e.g., speedy delivery of food to hotel rooms and tables) [31]. These types of human-robot interactions (HRIs) can help to enhance positive perceptions of robotization of tourism experiences.

Considering Employee Roles in Relation to Service Robots

The use and implementation of service robots by policy makers and businesses certainly need to consider desires, benefits and safety with respect to visitors engaged in the highly co-creative process of HRI and service delivery. However, it is important to also analyze and understand service robot acceptance and experiences in relation to employees in order to improve human-robot interactions that will increasingly dominate the new tourism scenario [37]. Hospitality and tourism businesses must include employees in determining how best to use service robots because of the valuable contribution of RAISA to "behind the scenes" performance. For example, robots provide employees with efficient data analysis and processing abilities [48] which in turn reduces employee workloads [22] and improves both employee and customer satisfaction [49]. In order to make such RAISA

adoption effective, organizational support must be provided, for example, in terms of training programs for employees [50].

The impact of service robots on service employees includes advantages like reduced routine work and enhanced productivity, or disadvantages such as loss of autonomy and job insecurity [51]. Both ease of use and usefulness of service robots influence employees' attitudes towards RAISA. Hospitality and tourism businesses must accurately design how robots can support or substitute human tasks, and determine "joint complementary functions" [52] as the introduction of service robots can adversely affect employees' sense of workplace belonging and dedication [53]. The implementation of RAISA in hospitality and tourism could, for instance, enable employees to focus on providing a more personal guest experience [28].

The assessment of human-robot services must therefore take into account indicators such as usability and user experience, as well as social acceptance and societal impact of RAISA [54]. Understanding more carefully robot interactions with employees, visitors and tourists will also help to identify and consider some of the ethical implications of the robotization of hospitality services. We explore below further implications of the effect of robotic use and encounters in the hospitality and tourism context, including the business value of robotic hospitality and tourism offerings, and ethical considerations related to robotic encounters in an increasingly interrelated social-technological world.

3. Management and Ethical Issues in Service Robot Implementation

Following a general review of the literature to provide some background above, a more specific review of recent research on service robots in hospitality and tourism was undertaken to explore enhanced service experiences. Both scientific databases and search engines are used as sources of information [55–60]. Web of Science, EBSCO Hospitality and Tourism, as well as Google Scholar were searched using the following terms: service robot AND hospitality and service robot AND tourism. Further searches followed using additional terms that were identified as the articles were examined, for example, automation, ethics, covid, co-creation, and service experience. A total of 80 publications were identified. These were examined guided by the main themes identified through the general literature review above on robots, hospitality, and tourism, and then iteratively incorporating new themes that arose. The search revealed issues and insights on the relationships between service robots, hospitality, and tourism that reinforce previous reviews and point to the need for new discourses and directions to guide a future that will be increasingly informed by digital transitions and robotic-enhanced service experiences.

Results are structured as follows. First, the robotization of businesses is discussed, followed by factors influencing the provision of robotic experiences. Ethical issues related to service robots that need to be proactively examined are then summarized and lead to a section discussing directions forward.

3.1. A Business Strategy to Increase Efficiency and Competitive Advantage

A recent report by the International Federation of Robotics (IFR) showed a 12% increase in the total number of robots at work globally as manufacturers turn to automation to remain competitive amidst systemic shocks (like COVID-19), geopolitical trade tensions, and other operational challenges [61]. As the report indicates, at the end of 2019, 2.7 million robots were at work around the globe, over three-quarters of them in manufacturing, but rapid advances in AI, automation, and digital technologies have expanded the tasks they can perform and eased installation, programming, and digitization (digitization in the context of service robots here "means robots can transfer data to enable continuous performance optimization") [62]. Service robots are now exerting a growing influence on the service industries to provide a wide range of value-added services.

From being used more in back-room contexts like food preparation in the kitchen in the early stages, service organizations are now implementing robots in frontline service provision. McLeay et al. [63] discuss humanoid frontline service robots, for instance, in

check-in and check-out procedures in hospitality and tourism. Service robots are increasingly regarded as an effective strategy to increase productivity, efficiency, and reduce costs (especially labor costs). This points to an urgent need for managers to better understand the costs, risks and benefits of service provision delivered by service robots [64–66]. Webster and Ivanov's [18] study indicates that the adoption of service robots can reduce costs to businesses and consumers (over the long term, they may pay less for services delivered by robots than by human staff).

From an industry perspective, the implementation of robotic technology can influence brand perceptions and service ratings in hospitality and tourism. Chan and Tung [38] investigated the effects of robotic services on guest evaluations and found that while human-robot interactions did not result in a higher rating for luxury accommodations, they did for mid-scale and budget hotels. Their findings are supported by other research such as Fuentes-Moraleda et al.'s [52] analysis of TripAdvisor reviews.

Early research indicates businesses may also gain competitive advantage by developing robots with social skills to facilitate service interactions and constructive experiences. However, careful market research is needed to ensure positive interactions, and especially understanding how this might change the overall culture of "hospitality" in service sectors like hotels and restaurants, as well as customer perceptions of the kinds of tasks and interactions they feel are permissible and feel comfortable with undertaking. Study of Bulgarian hotel managers' perceptions of service robots indicates comfort with "repetitive, dirty, dull, and dangerous tasks" as more appropriate for robots, and that the hotel managers "would rather use employees for tasks that require social skills and emotional intelligence" [67] (p.505). Research on human resource managers' perceptions of service robots show that they feel that while service robots may increase efficiency and productivity of hotel activities, they may also end up resulting in high costs, skill deficits and significant changes to the organizational structure and hotel culture [68]. Their concerns are worth heeding here, and disruptive technologies are creating rapid structural changes through automation, big data mining, smart digital grids that facilitate interoperability, smart tourism, and increasing human-machine interactions. Service robots with continually improving social skills and anthropomorphic characteristics are being implemented, such as the service robot Pepper [12] and the service robot Sacarino [29] that are being used in hotels.

Aside from raising questions about the meaning of "hospitality" and "service quality", well-established management practices need to be revisited and revised to accommodate new landscapes of human-machine interactions and existence. In this context, "the anticipated applications and integration of robotic technology will require also carefully consideration of the roles of service robots and human employees in the guest experience and to nurture a work environment that embraces open-mindedness and change", say Xu, Stienmetz and Ashton [68] (p.2217). They discuss how hotel managers can establish an organizational culture that empowers employees to work well alongside service robots and emphasize "the value of human employees and the importance of human interactions with guests" (p.2232). Study by Choi et al. [65] corroborates this and shows that hotel guests value human staff services higher in terms of interaction quality than the services of service robots or the physical environment. However, as noted in Lu et al. [51], review of the impacts of service robots on customers and employees, service workers will require significant re- and up-skilling to be able to re-position their roles and take advantage of advances in robotic technologies.

Based on a survey of travelers residing in the United States, Park [29] developed a trust model of service robots where what the robots do (performance), how the service robots operate (process), and why the service robot is developed (purpose) are critical factors for visitors to build trust in robot enhanced service experiences. The performance of the robots arose as the most influential factor in this study, but the context in which the service robot is deployed is vital to building trust as discussed below. Cultural factors, age, and technological comfort level of the target market, are additional variables to consider as described below.

3.2. Structuring (Responsible) Service Experiences

The adoption of robotics in hospitality and tourism portends a disruptive paradigm shift where companies will need to increasingly grapple with the design of automated service delivery systems and human-machine relationships. Belanche, Casaló, and Flavián [31] state that "customers' affinity with the robot is a greater predictor of robot introduction success in hospitality services" (p.10) and this is based on anthropomorphic designs which "should be considered an instrumental variable to increase customers' perceptions of affinity (as a kind of familiarity and closer connection) with the service robot". Tussyadiah, Zach, and Wang [69] note that robotic automations will transform the tourist experience, and understanding the roles of service robots and how to best situate the interactive human-machine domain is crucially important, even more so as the COVID-19 pandemic progresses and service providers are racing to automate, designing and implementing contactless technologies to help reduce the risk of virus transmission. A few issues and insights identified from the literature review are addressed below to help inform this dynamically evolving terrain in the context of service robots in hospitality and tourism.

3.2.1. Developing Diverse and Responsible Modes of Robotic Deliveries

Kabadayi et al. [32] (p.326) argue that "the characteristics of smart services (the intelligent, anticipatory, and adaptable use of data and technology) permit customers to experience services that previous conceptualizations of the service experience could not capture". Indeed, bots and AI are being increasingly used to help visitors understand their environments and facilitate communication. Different forms of robotic deliveries have arisen to enable this, including replacement of some face-to-face experiences, such as substituting a receptionist in a hotel with digital check-in services delivered online by a computer generated anthropomorphic human face. Among other things, the smart service experience can be positive and enabling, facilitating empowerment (e.g., through social media and wider access worldwide to mobile communication devices), seamless experiences as digital interoperability increases, as well as enjoyment, privacy and security, and accurate, reliable service delivery through human-machine encounters in real-time. As Buhalis and Sinarta [1] (p.563) explain, "the integration of real-time consumer intelligence, dynamic big data mining, artificial intelligence, and contextualization can transform service co-creation" by "dynamically engaging consumers in experience co-creation in real time".

Rapid diffusion of service robots into various travel and tourism spaces and places of hospitality is anticipated to grow into greater real-time engagement and interaction with visitors and community residents in front-line service provision, for example, providing information and guiding visitors at events, performing indoor and outdoor tours at various touristic sites, events, and attractions. Giuliano et al. [70] provide an interesting example of responsible use of a service robot to assist tour guiding in a way that supports and supplements the tour guide, and where the design of the service robot, Virgil, is specifically oriented to supporting human employees rather than replacing them. Virgil brings visitors to an exploration of inaccessible museum areas through multimedia content, enhancing the cultural storytelling technologically and with excellent information content. Virgil offers a good example of responsible design and delivery of enhanced service experience, where the design-based process of creating Virgil was specifically guided by ethical principles of fairness and equity.

3.2.2. Technological and Cultural Drivers

The influence of social and cultural backgrounds on visitor perceptions of service interactions between themselves and robots is a significant factor in the design and delivery process. Tung and Law [15] note that morphology and embodiment are critical factors influencing customers' perceptions and intention to use robotic services, and these need to be examined alongside cultural considerations. Study of the perceptions of humanoid robots at Henn-na hotels found that Japanese tourists indicate greater tendency to demonstrate

more emotional responses to human-robot interaction. By contrast, non-Japanese tourists were seen to value the functional and technical aspects of robot-provided services [14].

Ease of technology acceptance by the visitor may also lead to easier acceptance of robots [33], and willingness to use a robot in a hospitality setting may be directly related to a person's general attitude towards robots [71]. McCartney and McCartney [37] studied the adoption of service robots by the hospitality industry from the perspectives of customers, employees, and policymakers. Their study identified a range of technological, legislative, and risk factors that inform corporate decision making for effectively integrating service robots in businesses. Study by Webster and Ivanov [18] explored motivations to use robots in hospitality and tourism and reported that people are comfortable to use robots that perform repetitive tasks such as store luggage, housekeeping, supply information, and processing transactions. However, consumers are less inclined to support robots being used for hairdressing, dancing, or looking after their children [18]. Survey by Ivanov and Webster [71] indicated that occupation did not seem to play a significant role in educators, industry professionals, and tourists' perceptions of which tasks are most appropriate for robots in tourism related settings.

Disruptive technologies are driving robotics and robotization of tourism into a more complex dimension where dynamic big data mining and artificial intelligence (AI) as well as emotional intelligence (EI) will need to be carefully engaged to identify visitor needs and their comfort levels with different types of service and social robots, and a range of delivery modes, ensuring safe and enriching experiences, and responsibly attending to issues of privacy and surveillance in the gathering and use of vast amounts of information. Hospitality and tourism businesses, marketing organizations, and destination managers will also need to assess the implementation of robotics from the understanding of diverse customers' needs and perceptions. What are the needs of people with disabilities in this rapidly changing environment of automation and rapid diffusion of disruptive technologies, big data mining enabling smooth interoperable smart digital platforms and tools, et cetera? How can fairness and equity be assured in providing innovative, helpful digital tools accessible to diverse ethnic, income, and age groups, avoiding anthropomorphic challenges like ethnic and gender stereotyping of service robots?

3.2.3. Anthropomorphism, Zoomorphism, and Robotic Embodiment

The adoption of humanoid robots by hospitality and tourism businesses is a critical evolution in service landscapes and "interactions between consumers and humanoid service robots will soon be part of routine marketplace experiences" [11] (p.535). Increasingly sophisticated robotic embodiment and anthropomorphic designs play a critical role in influencing customer acceptance and comfort with the presence and use of humanoid robots. Kim and McGill [72] state that anthropomorphism enhances willingness to interact since it "can enable a sense of efficacy with nonhuman entities, or it can increase emotional bonding with them, which can positively affect judgments of nonhuman entities" (p.2). Anthropomorphism is described here as "how robots look, move and communicate similar to humans" (p.4). Murphy, Gretzel, and Pesonen [73] add that humanoid robots, because of their complex interaction potential, will also play an increasing role in the processes of marketing robotic services.

Embodiment relates to the appearance and morphology of robots [74]. As noted earlier, service robots can be classified as anthropomorphic (or humanoid), zoomorphic, and caricatured robots [15]. While caricatured robots do not resemble living creatures, zoomorphic robots are inspired by living creatures and anthropomorphic robots imitate human characteristics and behaviors to facilitate their performance. A robot's morphology influences users' perceptions [29], and "robots' being perceived as humanlike or intelligent can positively affects customer robot rapport building and the hospitality experience" [75] (p.247).

Both trust and rapport are key factors of robot acceptance, as Park [29] and Nomura and Kanda [76] observe. Designing specific anthropomorphic traits, emotions, and affects can positively influence consumers' perceptions of service robots, and plays an important

role as antecedents of trust in human-robot service encounters. Tussyadiah, Zach, and Wang [69] offer the example of robot bartenders—the closer a robot bartender appears to resemble a human being, the more likely it would be trusted. In other words, a humanoid robot will more likely be trusted to act as a bartender that a patron could interact comfortably with than a more visibly mechanical robot behind the bar counter, because humanoid robots are expected to be helpful which therefore generates a higher degree of trust.

The design of anthropomorphic characteristics of the service robot (emotion and affect included) appears to be a significant variable in customer-robot trust and rapport building, but a number of intervening factors may be at play as various studies reveal. In some instances, guests found it disconcerting to deal with robots that appeared to be "too human" [41]; in other instances, visitors seemed comfortable with service robots they could identify with as humanoid in morphology [31]. Shin and Jeong's [12] study of guests' attitudes towards robot concierges revealed that guests "had relatively unfavorable attitudes toward anthropomorphic robot concierges than caricatured ones, suggesting the human-likeness of a non-human feature might provoke discomfort" in that particular setting (p.2626). In other words, a very humanoid bartender may be acceptable in the bar context while it may not be in other settings. It should be noted that some researchers like Fernandes and Oliveira [77] argue that reaction to anthropomorphism is also dependent on technological literacy. Their study is focused on young consumers and indicates that frequent users of robotic experiences do not pay much attention to robotic embodiment: the more knowledge consumers have about how automation and nonhuman agents work, the less important robot morphology is. Pillai and Sivathanu's [78] study of customers' behavioral intentions towards robotization noted this technological aspect among several aspects that require careful attention in designing successful HRIs: the perceived intelligence of the service robot, trust relations, technology anxiety, and the need to reduce customer uncertainties (see also [79,80]).

3.3. Ethical Considerations

While tasks high in cognitive and emotional complexity may be best delivered by humans supported by robots in the near future, rapid technological innovations will soon make robots increasingly sophisticated in appearance and behaviors, and able to take on more complex roles in social interactions. This raises significant practical, legal, and ethical issues, as well as related regulatory issues with respect to developers, designers, and managers who are involved in structuring automation, smart products, and human-machine interactions. For example, who monitors or regulates "social engineering" of visitor behavior [81], learning, and experiences towards corporate interests and short-term profit advantage (but not necessarily overall individual or societal well-being, nor long-term planetary sustainability)?

Ethics is a young area in tourism studies, though it is being argued that a new platform of studies in justice and ethics in tourism is emerging [82], and progress on roboethics in the context of service robots and enhanced service experiences is worryingly slow. Giuliano et al. [70] (p.93) say that "in a vision of future implications of human–robot interactions, it is vital to investigate how computer ethics and specifically roboethics could help to enhance human's life". Roboethics here refers to the human ethics of the designers, manufacturers, and users of robots, as Kopacek and Hersh [83] mention (see also [84]). Commonly cited ethical concerns for both service providers and the consuming public include: are sex robots acceptable to offer among various room services to customers [81]? Where is the cut-off on morphology, design, and deployment—say "yes" to adult-looking sex robots, but "no" to child sex robots as that crosses the boundary towards encouraging pedophile behavior? What constitutes an ethical robotic experience? What does an *ethic of care* look like, for example, how is it represented in designing and deploying service robots in medical tourism, for example, and to what end (whose interests are at heart here?)?

Rising adoption of anthropomorphic robots are raising a wide range of other ethical concerns as well, such as related to stereotyping and other representation issues pertaining

to gender, race, and ethnicity [85]. RAISA technologies are based on programmed datasets that may result in inadvertent effects, for instance, "the service quality of the hotel may have unintentional ethnic biases, resulting in critical ethics and fairness issues", observe Chi, Denton, and Gursoy [10] (p.22). Surveillance, security, and loss of privacy are growing consumer concerns as automation, big data mining, and diverse digital interconnections enable swift and extensive collection and storage of personal information. What role will service robots play in extensive surveillance of travelers and visitors? [86].

Other related concerns arise here too. Will the continued instrumentalizing of nature and culture through transformational and disruptive technologies contribute to the continued distantiation of human beings from the physical world and from "nature", as Heidegger raised in *The Question Concerning Technology* in 1953? Or is Heidegger's approach here instrumental too, and it may be possible for humans to dwell "poetically" [87] with service robots, cyborgs and other transhumans [88] in a happy technological determinism where such transformational and disruptive technologies enable flourishing, provide useful services, reducing unfulfilling repetitive tasks or heavily burdensome roles, stimulate learning and interest in diverse cultures and languages (recall Virgil the "ethical" robot that Giuliano et al. [70] describe; see also [69])? Additionally, will large transnational corporations and online booking platforms that transcend old national boundaries into a neoliberal global playfield exercise corporate digital responsibilities (CDR; see [7]) and restrain power and influence over surveillance and social engineering?

Lu et al.'s [51] review notes that Wirtz et al. [17] was the only study they found that raised significant ethical concerns with respect to organizations, employees, and customers. For customers, these range from "privacy and security risks, algorithm-based decision making to customers feeling dehumanized and socially deprived and the immense amounts of data generated by AI-governed service delivery platforms" (p.384). While much awaits resolution in these complex social-technological systems, it is clear that rapid advances in the use of service robots requires proactive ethical and legal attention by the hospitality and tourism industry to ensure not just establishing legal guidelines but also transparency and regulation (see, for example, the Ethics Guidelines for Trustworthy Artificial Intelligence of the European Union: https://ec.europa.eu/digital-single-market/en/news/ethics-guidelines-trustworthy-ai). However, should policy action and laws establishing and regulating ethical norms applicable to the design, manufacturing, programming, and implementation of service robots be left to institutions like the European Union or are more democratic processed needed to guide the development of ethical guidelines and monitor institutional actions locally, regionally and globally? What roles do (or should) diverse "stakeholders" (residents and the traveling public, businesses and service providers including employees, NGOs, and the public sector) undertake to ensure "just" transitions towards greater automation and RAISA, "just" and "good" enhanced service experiences, fair and equitable distribution of the costs and benefits of RAISA, monitoring and fair regulation of RAISA (watchdog role?)? We take up this and other concerns and opportunities identified above in the next section.

4. Discussion and Directions Forward

Innovative transitions and the development of post-pandemic tourism as a technologically driven, safe, and healthy tourism is in the process of creating systemic structural changes in hospitality and tourism related sectors. The race towards Tourism 4.0 has accelerated towards Web 3.0 and Tourism 5.0 with increased focus on digital transitions, interconnectivity and interoperability of integrated technologies [40], drawing on big data, smart tourism for value co-creation [44] and enhances service delivery, including the use of service robots to enable contactless delivery to covid sensitive travelers. Significant disruptions are anticipated as innovation towards ambient intelligence (AmI) tourism occur:

> *Increasingly smartness and AmI support real-time service, empowering the co-creation of value for all stakeholders across multiple platforms. Interactions take place in real-time, at the exact moment when consumers are willing to engage with brands.* [...]

> *Inevitably, smart environments transform industry structures, processes and practices, having disruptive impacts for service innovation, strategy, management, marketing and competitiveness* [40] (pp.269-270).

4.1. Structural Transformations and "Just" Transitions

COVID-19 has also significantly disrupted the travel and tourism sector, and the service sectors have been hard hit, with deep cuts and layoffs of frontline workers expected to contribute to the structural shifts in long-term unemployment that are being set in place. Businesses are under immense pressure to survive economically, and the hospitality, entertainment, and leisure industries are racing to deliver contactless technologies, safety, and assurance to pandemic sensitive travelers. The pandemic is a catalyst spurring rising adoption of service robots in hospitality and tourism [37,89]. Jiang and Wen [90] identify three areas—artificial intelligence and robotics, hygiene and cleanliness, and health and health care—as actionable avenues to promote the development and sustainability of the hotel sector.

Service robots are certainly versatile and can undertake increasingly challenging roles in the front line of hospitality and tourism encounters, ranging from the delivery of food and other materials, check-in and check-out, providing security and information, to acting as tour guides in indoor and outdoor settings. The risk of service failure, however, should be heeded. As novelty and speed to regain profitability and competitive advantage need to be carefully considered with respect to market readiness and customer needs (recall the failure of the hotel Henn-na that was fully equipped with service robots in Japan [13]).

As noted earlier, one key issue that will require much greater attention is growing consumer concerns related to surveillance, privacy, and security as digital transformations, interoperable smart technologies, and the growing use of bots and service robots interpellate user information into big data banks for data mining. Attention to social justice, equity, and just transitions is also needed as economies shift towards greater mechanization and automation. At a keynote speech in Frankfurt am Main on November 20, 2020, Christine Lagarde, President of the European Central Bank, at the European Banking Congress said that 20% of spending by the Next Generation EU fund will be spent on digital projects and at least 30% on green projects, with entities like the European Investment Bank focused on accelerating clean energy innovation and adoption of renewables. She offers some comforting perspectives as the transitions anticipated:

> *Digitalisation will not necessarily reduce, but rather transform jobs. Research finds that unemployment rates are generally lower in more digitalised economies, but it does typically lead to jobs being reallocated across industries. By one estimate, faster automation as a result of the pandemic will destroy 85 million jobs across 26 countries by 2025, but will also create 97 million new jobs—a net gain of 12 million* [91].

In addition to socioeconomic transitions, there are numerous social and cultural considerations going forward. Ethical and legal issues, and responsible use of service robots, are key issues (consider the frequently raised concerns of use of robots for sex tourism, exploitation, and trust issues with anthropomorphism of robots for the care industry, as Belk [81] and others point out). Robot ethics (also referred to as roboethics) is an under-investigated area in the context of service robots in tourism and hospitality, Ivanov et al. [24] note (see also [17,51]). Tendencies to anthropomorphize robots move sensemaking beyond the realm of technology-related ideologies, as Gretzel and Murphy [92] discuss, and "not recognizing the importance of robot ethics might lead to conflict and ineffective regulation of service robots in the future" (p.101). The design of humanoid robots—including embodiment, morphology, and anthropomorphism—clearly requires careful attention, but who is responsible for ensuring that their deployment in local-global spaces of hospitality and tourism are oriented towards responsible use and societal and public good, i.e., the "good" of those who interact with them?

4.2. Co-Creating Democracy and Regulatory Action through Collaborative Human-Robot Endeavors?

The anticipated growth of service robots in hospitality and tourism as a global phenomenon raises issues across the spectrum from the socio-economic to the eco-cultural and political. There are clear ethical and legal issues to be tackled as soon as possible, but without global regulatory systems, how will the kinds of issues raised above be responsibly and successfully managed? Given the close human–machine interrelationships involved in enhanced service encounters such as described above, collaborative design approaches to co-create value in digital and robotic environments could be an interesting and valuable avenue for greater customer involvement in designing and deploying service robots towards well-being and societal good. Direct participation and involvement can help visitors and residents to be informed and aware of the enhanced service experiences being co-created, opening avenues for civic action to call for policy and regulation, and monitoring and holding institutional stakeholders and policymakers accountable. Phi and Dredge [93] note the emancipatory potential of co-creative endeavors, but also warn of possible exclusion from the innovation domain:

> Co-creation is closely associated with contemporary ideas about innovation. Innovation in systems of production and consumption, in business ecosystems and supply chains, in processes and practices, have emerged as a result of collaborative ways of working together. Co-creation (sharing, collaboration, gifting, etc.) has redefined how we access resources such as knowledge expertise, capital, labour, and so on. [. . .] We need to understand more about how co-creation may enhance innovation through inclusive thinking, or impeded it through exclusive (invitation only) cocreation practices [93] (p.295).

Hybrid products are arising through human–robot encounters in the hospitality and tourism industry, and new issues and opportunities emerge through collaborative, inclusive engagement by consumers in co-creating enhanced service experiences. Understanding and facilitating human–machine interactions and experiences to collaboratively co-create "hospitality" and enhanced service experiences involves responsibility and inclusivity—involving hotel managers and staff, as well as visitors and other key stakeholders (e.g., relevant community members, residents, businesses, and tourism actors) in collaboratively co-creating service experiences and products that work towards the "good" of tourism, including individual and communal well-being (of human and non-human others), resilient communities, and ecological sustainability [94]. As such, it can be argued that among the various benefits of human–robot collaborations (HRCs, as Sigala [95] refers to them) is that co-creative endeavors can facilitate a democratic ethos and technological awareness that can drive policy and calls for regulatory actions through a more empowered, informed and involved citizenry and traveling public. In the context of service robots in hospitality and tourism, it opens opportunities for *smart democracy* with greater visitor and resident involvement in service co-creation in real-time, facilitated by "nowness" technologies as per [1]).

4.3. Blurring Human-Technological Dualisms towards Posthumanist Perspectives

Machine learning, artificial intelligence, automation and digital interoperability, big data, and robotics are creating disruptive digital transformations with many useful outcomes for consumers, such as democratized access to information through social media, new ways to co-create and deliver smart leisure experiences, and explosive growth in platform businesses and the peer to peer economy [96]. They also "blur the boundaries between the familiar binaries of human and nonhuman, culture and nature, and human and animal that have dominated Western thinking since at least the Enlightenment" and "underscore the ways in which nonhumans—whether environmental or technological—have new kinds of agency in the world", and introduce hybrid, non-dualist, relational modes of action and interaction [97] (p.18). New research approaches and new posthumanist research paradigms are therefore needed, drawing on a rich interdisciplinary literature to inform service robot ethics (roboethics) in tourism and hospitality. New theoretical

perspectives and new methodologies are especially needed, for example, situated and standpoint epistemologies, critical theories (including feminist and critical race theory), to address social justice, recognition, fairness and equity for people with disabilities, issues of ethnicity and gender representation, etc., and the rise of new entities in an increasingly transhuman and posthuman world (e.g., [84,88,94,98]).

In this sense, "as a person becomes more attached to IT emotionally and psychologically, technology gains more influence and control, eventually becoming part of the person's identity, and a new form of techno-human identity" [95] (p.154). However, research has not yet commenced to examine the emergence of this new type of "techno-human tourists", says Sigala [95] (p.154). Stankov and Gretzel [99] point out that the technological innovations of Tourism 4.0 ease, enhance, and improve such interactions, however, the "marvels of tourism information technology often come with a serious lack of human-centered design" (p.477), since they are more focused on efficiency rather than people. For design thinking projects and innovations transforming human–machine interactions, Forlano [97] offers some "critical" questions to explore power relations and guide future research and practice, such as:

> *How, and in what ways—competitively/collaboratively, hierarchically/horizontally—are capabilities, agency, and power distributed across human, machines, and natural systems?*
>
> *What new knowledge(s), questions, stakeholders, and partnerships are needed in order to adequately design for this problem?*
>
> *How are ethics, values, and responsibilities reflected and embedded throughout the design process?* [97] (p.19).

What "hospitality" means needs to be revisited in the new posthumanistic paradigm shift toward what some fear will result in increasing dehumanization and distancing from the physical and natural world. As the role of robotization increases in daily life practices, how will this influence travel patterns? We are willing to experience service robots as part of tourism experiences because they are "new", say Zhang and Qi [26], but how will this change when robots get used more at home? Will tourists seek more human–human encounters as integral to traveling elsewhere? Other questions raised by this paper include:

- What constitutes a safe and "good" (ethical) robot-visitor encounter?
- How does increased automation and robotics, for example, service robots greeting you as you enter the hotel lobby or delivering food to your hotel room, affect the hospitality experience?
- Robots are increasingly being used to support and act as tour guides in museums and other destination settings. How can they facilitate cultural exchange by which visitors gain a rich experience of the local, facilitate learning about the destination, and challenges such as climate change and environmental literacy? What is gained and lost in the process? Will they significantly substitute meeting local residents?
- What additional questions and ethical issues arise as social-ecological systems turn increasing posthuman and transhuman?

5. Conclusions

This paper identifies a number of management issues related to automation and the deployment of service robots in increasingly front-line roles and situations in hospitality and tourism service experiences. Significant regulatory, legal, and ethical issues are arising as the race to transition to a rapidly digital world progresses, and hospitality and tourism stakeholders must be proactive in addressing the kinds of issues raised in the service literature and as discussed earlier.

Greater and proactive consideration of roboethics and what "hospitality" means in an increasingly digitalized and roboticized world is needed, but research progress on roboethics in travel and tourism is slow, despite the fact that adoption of RAISA is accelerating. Legal and ethical issues must be proactively addressed, as prior reviews have also identified. In addition, closer attention to the potential of co-creation in addressing

innovations in enhanced service experiences in hospitality and tourism is also merited. Responsibility, inclusiveness, and co-creation emerge as important principles to guide future research and practices in this area. Co-creation in the context of service robots in hospitality and tourism relates to collaborative human-robot design and implementation, involving residents and visitors along with other key stakeholders (e.g., [70]) Empowering consumers to co-create desired services and service experiences through human–robot collaborations has important implications for democratizing the use and power of disruptive technologies, enabling greater public participation in monitoring, policy making and other actions needed to ensure corporate digital responsibility and social well-being. Digital literacy aided by equitable access to information and communication technologies and various digital tools are, of course, crucial to facilitate co-creating *smart democracy* to complement digital democracy [100].

As human–machine interactions and co-creative collaborations increase, design thinking projects and business hospitality education courses will need to engage responsibly and thoughtfully with disruptive technologies in social-technological systems where human beings are being decentered by posthumanist and transhumanist "others". Embodiment and creative transformations in anthropomorphism and zoomorphism are de-centering privileged humanist values and blurring the boundaries of what constitutes "personhood". Future research will require new strategies and methodologies to understand posthuman encounters as well as critical perspectives, situated knowledges and standpoint epistemologies [88], posthumanist approaches such as Actor Network Theory and poststructural Deleuzian ethics [101]. Relational, non-dualist epistemologies, and posthumanist ontologies offer avenues to explore and develop new research paradigms and new approaches to design thinking that are needed to engage responsibly and effectively with service robot innovations in hospitality and tourism (see, for example, [97]).

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