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The Effects of Wooden Furniture Color, Floor Material, and Age on Design Evaluation, Visual Attention, and Emotions in Office Environments

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Abstract: The selection of floors and furniture in offices can impact the interior environment and potentially influence employees' emotions and health. This study aims to investigate the effects of floor material, furniture color, and age on design evaluation, fixation duration, and time to first fixation. Twenty-four younger adults (M = 21.9, SD = 1.75) and twenty-four older adults (M = 48.1, SD = 6.85) participated in the experiment, where they viewed four different designs: wood floor—brown furniture (WF-BF), wood floor—dark furniture (WF-DF), tile floor—brown furniture (TF-BF), and tile floor—dark furniture (TF-DF). Participants also evaluated the designs and their emotions. Results showed the main effects and interactions of floor material, furniture color, and age. WF-BF performed the best in design evaluation, fixation duration, and time to first fixation, and also scored highest in joy, admiration, fascination, and desire. Older adults favored the texture of wood, while younger adults showed better acceptance of TF-DF. This study provides insights for interior design in office environments.

Keywords: wooden furniture; interior design; design evaluation; eye-tracking; PrEmo; office

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1. Introduction

For many professionals, the office is a crucial workspace, occupying a significant portion of their working hours within an enclosed indoor environment. Due to its excellent natural and aesthetic properties, wooden furniture is widely used in offices. These wooden furnishings not only support employees' work but also influence their emotions. In this chapter, we first introduce the application of wood in indoor environments and related research findings. We then discuss the basic principles of eye-tracking, an important research tool in this study, and its application in wood furniture research. Following this, we present tools for assessing emotions. Finally, we outline the three specific objectives of this study.

1.1. Wood in Interior Environment

Wood is a natural material that has a positive impact on humans and is widely used in construction and interior environments. Using wooden furniture or other decorations in indoor spaces can bring nature into the interior [1]. A review indicated that the presence of solid wood in indoor environments reduces stress levels and improves indoor air quality, perceptions derived from the visual and tactile senses of wood [2]. Personalization studies in interior design mainly focus on furniture selection and floor plans [3]. In offices, desks and chairs are essential pieces of furniture, making the choice of office furniture crucial in interior design.

In addition to maintaining the natural wood color, there are other ways to treat the surfaces of wooden furniture. Painting not only brings new color effects to wood but also

enhances its usability [4]. Therefore, painted wooden desks and chairs are also common in offices, in addition to natural wood-colored ones. Regarding color, when asked about the most important aspects of a room, people first think of the color of the walls, followed by the color of the furniture [5]. Studies have shown that the color and texture of office furniture influence the evaluation of the office environment [6,7]. In one study, 80% of participants paid attention to the color of wooden furniture, with matte brown being the most preferred [8]. A similar conclusion was drawn in another study: the most popular furniture color is natural wood, followed by achromatic colors [5].

Consumer evaluations of wooden products in interior environments are influenced by various factors. A study indicates that the environmental friendliness of the product, its compatibility with lifestyle and home design, visual and tactile appeal, and technological robustness can all affect evaluations of wooden products in interior environments [9]. The floor is the lowest part of an office, providing support for activities in the room and shaping the character of the space. The floor occupies a large area in the interior environment and is a crucial aspect of interior design, as it is an area that users observe for extended periods [10]. Solid wood floors and ceramic tile floors are two common types of flooring in interior design. They differ not only in thermal parameters [11] but also in aesthetic characteristics [12]. The visual harmony between the floor and furniture affects users' evaluations of interior design [13]. Age also influences furniture preferences [14]. In furniture selection, older adults prefer materials with strong natural attributes and have higher emotional needs [15]. Younger people prioritize functionality and have a higher preference for modern-style furniture [16]. In terms of design style, older adults are more accepting of traditional-style furniture.

The design of office spaces with positive aesthetic evaluations can increase employees' acceptance of the work environment, improve mental health, and enhance productivity [17]. Office employees inevitably spend long hours looking at desks, chairs, and floors in the office, and different furniture colors and floor textures may lead to different visual perceptions and emotions. In addition, the role of age cannot be ignored. Study in this field can help us better understand the aesthetics and emotions of employees in office environments, which is beneficial for optimizing the interior design of offices and improving their working environment. To better study visual cognition and emotions, appropriate research instruments are essential.

1.2. Eye-Tracking

Eye-tracking technology refers to the use of optical devices to record participants' eye behavior, thereby collecting eye movement data. Eye-tracking technology provides objective data for the study of visual attention, complementing the subjective data. Many scholars combine eye movement data with subjective data to explain visual-related issues [18,19]. Eye-tracking technology is widely used in psychology [20], education [20], human–computer interaction [21], art [21], design [22], and other fields. Eye movement data can reflect participants' visual attention preferences and the allocation of visual attention, making it widely used in studies related to design evaluation and aesthetic preferences [22,23].

Fixation refers to the process in which the fovea remains fixed on a specific area to collect visual information. Information about fixation includes the position (coordinates), time (start and end), and sequence. Fixation duration and the number of fixations is generally considered to represent the degree of attention participants pay to specific areas [24–26]. Time to first fixation refers to the time taken by participants to fixate on a specific area from a certain time point. Time to first fixation can reflect the intensity of an object attracting participants' attention [21,27].

In studies related to visual and aesthetic aspects of wooden furniture and interior design, eye-tracking technology is also used by researchers to explain participants' psychological characteristics. A study collected participants' evaluations of Chinese-style wooden furniture and their eye movements, showing that fixation duration and pupil diameter are

related to subjective evaluations and can serve as effective indicators for evaluating new Chinese-style wooden furniture [28]. In another study, researchers used images of 40 chairs as stimuli and demonstrated that eye-tracking metrics can reflect participants' appreciation of product details [29]. Eye movement data have shown that the color of furniture has a significant impact on people's visual perception [30]. Eye-tracking technology is also used to measure the psychological responses of wood in interior spaces, revealing that the extent of wood use, wood coverage, and surface changes of wood significantly affect visual attention and psychological impressions [31]. Fixation duration and the number of fixations are used as measures of visual attention in these studies.

1.3. Emotions

Emotions encompass various feelings involving senses, mentality, and spirit [32]. The emotional experience or process of using products or systems plays a crucial role in its competitiveness, especially when functional, economic, and durability differences between products are not significant [33]. Researchers are increasingly recognizing the role of emotions in design and human–computer interaction [34,35]. Most of the time, people's emotions are not singular but a mixture of different types of emotions. Emotions can be categorized as positive and negative, with opposite effects on happiness and mental health [36]. Studies indicate that the emotional experience of innovative products may be a blend of emotions, and the roles of functionality and innovativeness in arousing emotions differ [37]. The significance of emotions in design and consumption has led many scholars to engage in emotion measurement research. The most direct method of measuring emotions is through verbal instruments, usually achieved through verbal reporting. While this allows participants to express themselves directly, it may be challenging to ensure the communicative effectiveness of speech and the understanding of words. Experts from various fields have also attempted to use non-verbal instruments to measure emotions, including facial expression analysis, vocal analysis, and EEG analysis. This type of measurement generally does not interrupt user behavior and is more objective, but may struggle with identifying complex emotions. The Product Emotion Measurement Instrument (PrEmo) is an effective measurement method that uses cartoon animations (expressions) instead of words for assessment. The original tool included 14 cartoon characters corresponding to seven pleasant emotions and seven unpleasant emotions [33]. This tool has been updated with new cartoon characters and word expressions [38,39]. PrEmo has been used in the emotional assessment of various designs [40,41].

1.4. The Present Study

In general, the office environment is crucial for employees, affecting their physical and mental health as well as work efficiency, with office furniture and indoor flooring playing important roles. In an office environment, furniture and flooring are viewed by employees for extended periods, making the cognitive responses to this prolonged visual stimulation significant factors in evaluating office design and influencing emotions. Therefore, when discussing design evaluation and emotions in office environments, focusing on visual cognition is of great importance. Eye-tracking is an effective instrument for studying visual cognition, validated in furniture and design-related research, and performing well when combined with subjective data for analysis. Some scholars have already studied and discussed the health and aesthetic factors of office environments, contributing significantly to the field. However, publications that simultaneously consider the colors of furniture, flooring, and the age of employees are scarce, leaving a gap in this research area. Furthermore, the relationship between visual cognition and subjective factors in office environments has not been adequately emphasized, despite its significance. We aim to reveal the interactions between furniture, flooring, and age in office environments through this study and discuss how these factors influence design evaluation, visual attention, and emotions. Such research can attract more scholars and institutions to focus on this field, thereby advancing the study of office environments.

Specifically, it had three research questions:

RQ 1: Do the color of wooden furniture, the material of the floor, and age have independent or interactive effects on design evaluation?

RQ 2: Do the color of wooden furniture, the material of the floor, and age have independent or interactive effects on visual attention?

RQ 3: Do the color of wooden furniture, the material of the floor, and age have independent or interactive effects on emotions?

2. Materials and Methods

This study employed a 2 (age: older/younger) × 2 (floor: wood/tile) × 2 (color: brown/dark) design. The dependent variables included design evaluation, fixation duration, time to first fixation, and 14 emotions.

2.1. Participants

A total of 48 participants were recruited for this study, comprising 24 younger adults and 24 older adults. The younger adults were aged between 18 and 25 years (M = 21.9, SD = 1.75), while the older adults were aged between 40 and 60 years (M = 48.1, SD = 6.85). There were 12 males and 12 females in the group of young adults, and the same proportion was in the group of older adults. All participants were office workers who needed to work in an office setting. All participants had normal or corrected-to-normal vision. All participants signed informed consent forms before the experiment.

2.2. Stimuli

The stimuli used in the experiment were designed and drawn by the researchers. Three-dimensional models were created using Rhino 7 and imported into KeyShot 7 for rendering, resulting in four renderings. The stimulus pages consisted of 4 renderings of indoor furniture (Figure 1). Each rendering included a chair, a table, and a floor, all of which were the same size, orientation, and style. The differences lay in the floor material and furniture color. The four types were: WF-BF (wood floor—brown furniture), WF-DF (wood floor—dark furniture), TF-BF (tile floor—brown furniture), and TF-DF (tile floor—dark furniture). The brown furniture utilized the "Oak Wood Rough" material with a refractive index of 1.5. The corresponding RGB values for the texture were (119, 90, 67), (105, 74, 53), (115, 86, 62), and (106, 79, 58). The diffuse scale was set to 4 mm, with an angle of 0° and an environment width of 3.5. The bump scale was also 4 mm, with an angle of 0°, a bump height of −0.4, a bump environment height of 0.4, and an environment width of 3.5. The dark furniture used the "Paint Matte Black #2" material with an RGB color of (13, 13, 13), a roughness of 0.1, a refractive index of 1.3, and no texture. The tile floor was made using the "White Ceramic" material with a roughness of 0, and a refractive index of 1.5. The color used the texture "tile floor" (Appendix A) without bump or opacity maps. The texture type was texture map, the mapping type was box, and it was aligned with the model. The wood floor used the "Fine Grain Wood" material with a roughness of 0.2, a refractive index of 1.5, and the color used the texture "wood floor" (Appendix B) without bump or opacity maps. The texture type was texture map, the mapping type was box, and it was aligned with the model. The startup.hdr environment was used, with a brightness of 1, a contrast of 1, a size of 1770 mm, a height of 0, and an angle of 110°. The lighting environment color was (255, 255, 255), ground shadows were enabled, with a ground size of 885 mm. The lighting preset was indoor, shadow quality was set to 2, and refined shadows were enabled. The ray bounce value was 16, global illumination was enabled, and the rendering technique was indoor mode. To eliminate the effect of image location, the four different types of stimuli were arranged in a Latin square manner. As a result of this arrangement, there were a total of 24 types of stimuli.

Figure 1. The stimuli examples used in the experiment (the first row from left to right: TF-BF and WF-BF, the second row from left to right: TF-DF and WF-DF).

2.3. Instrument

The experiment was conducted in a closed and soundproof laboratory. A 24-inch monitor with a resolution of 1920 × 1080 pixels was used to present the stimuli. Eye-tracking data, including fixation duration and time to first fixation, were collected using Tobii Glasses Pro 2.

Design evaluation was assessed using a 7-point Likert scale, with one item: "Please rate the design of the office environment you see", where 1 represents extremely dislike, 4 represents neutral, and 7 represents extremely like.

The evaluation of emotions was conducted using the PrEmo [42]. This tool uses cartoon characters to help participants assess their feelings towards products or experiences. The revised scale contains 14 words and their corresponding 14 new animated characters, including versions for both male and female [38,39]. There are a total of 7 positive words (joy, admiration, pride, hope, satisfaction, fascination, desire) and 7 negative words (sadness, fear, shame, contempt, anger, boredom, disgust). The correspondence between words and characters is shown in Figure 2 [33]. Participants were asked to score each emotion using a 5-point scale: I do not feel this (1), I feel this a little (2), I feel this somewhat (3), I do feel this (4), I do feel this strongly (5).

2.4. Procedure

Participants were briefed on the research procedures and instructions before participating in the experiment. After wearing the eye tracker, participants underwent calibration to ensure the accuracy of eye movement data collection. The experimental procedure is shown in Figure 3. Participants sat facing the screen, read the instructions, and pressed the space bar to confirm understanding. A black dot appeared in the center of the screen, and after 1000 ms, the experimental stimulus was automatically presented. Participants

were instructed to score two scales while observing the stimulus images. After scoring, participants pressed the space bar to end the experiment.

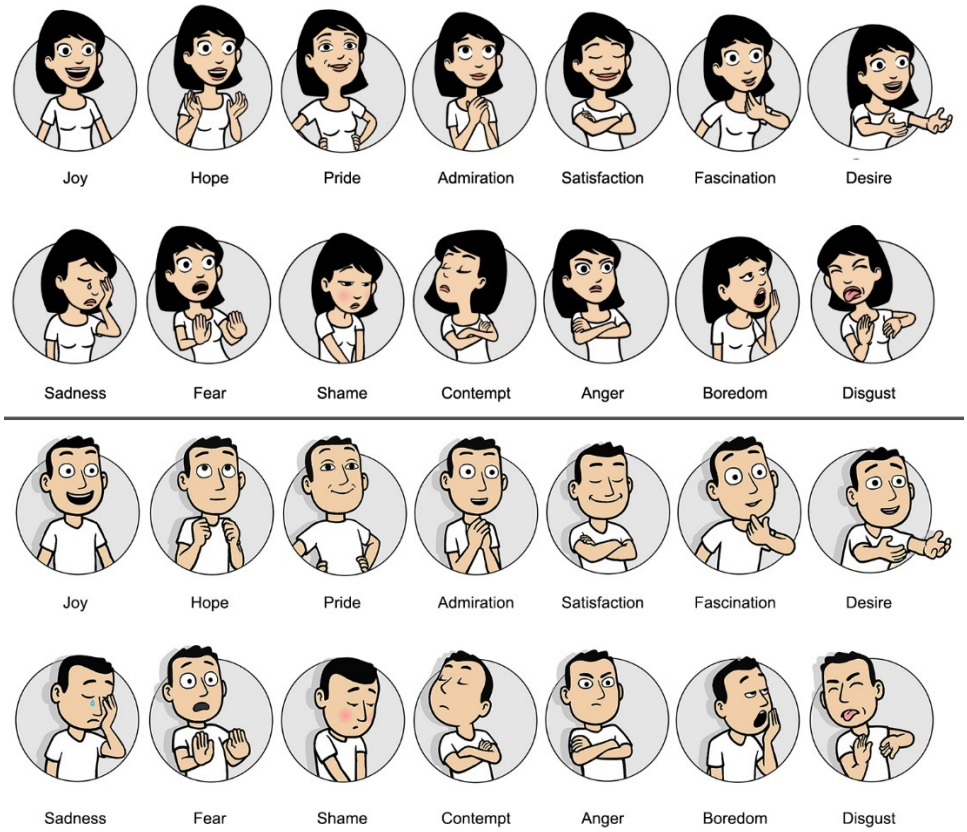

Figure 2. Fourteen emotions in PrEmo (including female version and male version).

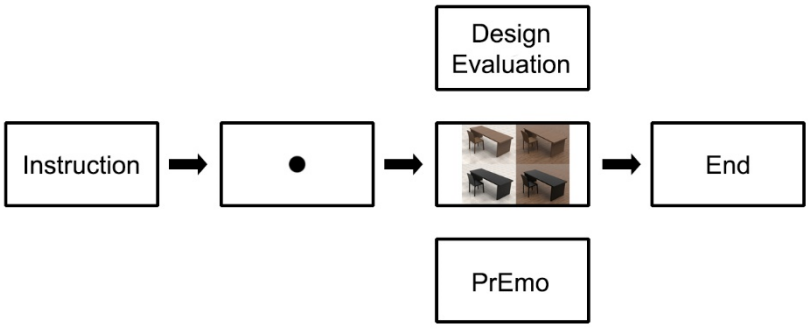

Figure 3. Experimental procedure.

2.5. Data Analysis

The fixation duration and time to first fixation were exported directly from Tobii Pro Lab (Tobii Pro, Stockholm, Sweden). The scores for design evaluation and PrEmo were manually entered by the researchers into Excel. All statistical analyses were conducted using SPSS for Windows v. 26.0 (IBM, Armonk, NY, USA).

Descriptive statistics were used to summarize the results of design evaluation, fixation duration, time to first fixation, and the 14 dimensions of PrEmo for the four different types of stimulus images. Age, floor type, and furniture color were used as independent variables. Main effects analysis and interaction effects analysis were conducted for design evaluation, fixation duration, time to first fixation, and PrEmo. Simple effects analysis was conducted for significant interaction terms. A significance level of $p < 0.05$ was used for all analyses.

3. Results

Table 1 displays the descriptive statistics for design evaluation, fixation duration, time to first fixation, and the 14 emotions.

Table 1. Descriptive statistics for design evaluation, fixation duration, time to first fixation, and the 14 emotions.

Variable	Older				Younger			
	WF-BF	WF-DF	TF-BF	TF-DF	WF-BF	WF-DF	TF-BF	TF-DF
Design evaluation	5.17 ± 1.308	3.04 ± 1.546	2.92 ± 1.381	2.58 ± 1.472	4.33 ± 1.579	3.13 ± 1.541	2.88 ± 1.393	4.17 ± 1.55
Fixation duration (s)	1.65 ± 0.547	1.22 ± 0.474	1.24 ± 0.259	1.26 ± 0.500	1.09 ± 0.354	1.06 ± 0.445	0.98 ± 1.075	1.08 ± 0.449
Time to first fixation (s)	2.01 ± 0.446	2.66 ± 0.818	2.21 ± 0.514	2.38 ± 0.689	1.95 ± 0.656	2.59 ± 0.576	2.22 ± 0.655	2.35 ± 0.570
Joy	2.92 ± 0.929	1.63 ± 0.875	2.00 ± 0.885	1.54 ± 0.779	2.38 ± 0.924	2.00 ± 0.659	2.08 ± 0.717	2.17 ± 0.761
Admiration	3.21 ± 1.021	1.71 ± 0.908	2.63 ± 1.056	1.58 ± 0.776	2.79 ± 0.833	2.21 ± 0.779	2.83 ± 1.204	2.42 ± 0.881
Pride	1.21 ± 0.509	1.00 ± 0	1.00 ± 0	1.00 ± 0	1.00 ± 0	1.00 ± 0	1.00 ± 0	1.00 ± 0
Hope	2.58 ± 0.974	1.29 ± 0.550	2.33 ± 0.817	1.38 ± 0.647	1.29 ± 0.464	1.13 ± 0.338	1.13 ± 0.338	1.42 ± 0.584
Satisfaction	3.21 ± 1.141	1.29 ± 0.464	3.04 ± 1.122	1.42 ± 0.584	2.92 ± 1.018	2.42 ± 0.881	2.38 ± 0.970	2.63 ± 1.014
Fascination	3.21 ± 1.062	2.29 ± 0.690	2.75 ± 0.737	1.79 ± 0.658	3.08 ± 1.100	2.29 ± 0.908	2.21 ± 0.779	2.71 ± 0.908
Desire	3.58 ± 1.060	1.63 ± 0.711	3.29 ± 0.806	1.58 ± 0.654	3.00 ± 0.978	2.50 ± 0.978	2.50 ± 0.780	2.79 ± 0.833
Sadness	1.00 ± 0	1.00 ± 0	1.00 ± 0	1.00 ± 0	1.13 ± 0.338	1.00 ± 0	1.00 ± 0	1.00 ± 0
Fear	1.00 ± 0	1.00 ± 0	1.50 ± 0.834	2.13 ± 0.992	1.00 ± 0	1.00 ± 0	1.00 ± 0	1.00 ± 0
Shame	1.00 ± 0	1.00 ± 0	1.00 ± 0	1.00 ± 0	1.00 ± 0	1.00 ± 0	1.00 ± 0	1.00 ± 0
Contempt	1.00 ± 0	1.00 ± 0	1.00 ± 0	1.00 ± 0	1.00 ± 0	1.00 ± 0	1.00 ± 0	1.00 ± 0
Anger	1.00 ± 0	1.00 ± 0	1.33 ± 0.637	1.00 ± 0	1.00 ± 0	1.00 ± 0	1.00 ± 0	1.00 ± 0
Boredom	1.00 ± 0	1.50 ± 0.834	2.04 ± 0.751	2.50 ± 1.180	1.00 ± 0	1.63 ± 0.770	1.00 ± 0	2.08 ± 0.974
Disgust	1.00 ± 0	1.00 ± 0	1.00 ± 0	1.00 ± 0	1.00 ± 0	1.00 ± 0	1.00 ± 0	1.00 ± 0

3.1. Design Evaluation

The repeated-measures ANOVAs were conducted for design evaluation. The results indicated that the main effect of age was not significant, $p > 0.05$. However, the main effect of floor was significant, with the wood floor (M = 3.92, SD = 1.729) scoring significantly higher than the tile floor (M = 3.14, SD = 1.553), F(1, 184) = 13.481, $p < 0.001$, $\eta^2 = 0.068$. Similarly, the main effect of color was significant, with the brown furniture (M = 3.82, SD = 1.704) scoring significantly higher than the dark furniture (M = 3.23, SD = 1.612), F(1, 184) = 7.786, $p = 0.006$, $\eta^2 = 0.041$.

There was a significant interaction between age and floor (Figure 4a), F(1, 184) = 7.250, $p = 0.008$, $\eta^2 = 0.038$. A significant interaction was also found between age and color (Figure 4b), F(1, 184) = 8.918, $p = 0.003$, $\eta^2 = 0.046$. Additionally, a significant interaction was observed between color and floor (Figure 4c), F(1, 184) = 25.425, $p < 0.001$, $\eta^2 = 0.121$. However, there was no significant three-way interaction among age, floor, and color, $p > 0.05$.

Table 2 shows the results of simple effects. Younger adults rated the tile floor higher than older adults. Older adults rated the wood floor higher than the tile floor. Younger adults rated the dark furniture higher than old adults. Older adults rated the brown furniture higher than the dark furniture. The brown furniture on the wood floor was rated higher than the brown furniture on the tile floor. The brown furniture on the wood floor was rated higher than the dark furniture.

Table 2. Results of simple effects in design evaluation.

Interaction	Variables	I	J	Mean Difference (I-J)	F	*p*	η^2
Floor × Age	Wood floor	Older	Younger	0.375	1.5553	0.214	0.008
	Tile floor	Older	Younger	**−0.771** *	6.562	0.011	0.034
	Old	Wood floor	Tile floor	**1.354** **	20.251	<0.001	0.099
	Young	Wood floor	Tile floor	0.208	0.479	0.490	0.003
Color × Age	Brown furniture	Older	Younger	0.438	2.144	0.148	0.011
	Dark furniture	Older	Younger	**−0.833** *	7.669	0.006	0.040
	Old	Brown furniture	Dark furniture	**1.229** **	16.685	<0.001	0.083
	Young	Brown furniture	Dark furniture	−0.042	0.029	0.890	<0.001
Floor × Color	Brown furniture	Wood floor	Tile floor	**1.854** **	37.967	<0.001	0.171
	Dark furniture	Wood floor	Tile floor	−0.292	0.939	0.334	0.005
	Wood floor	Brown furniture	Dark furniture	**1.667** **	30.676	<0.001	0.143
	Tile floor	Brown furniture	Dark furniture	−0.479	2.536	0.113	0.014

Note: * represents $p < 0.05$, ** represents $p < 0.01$.

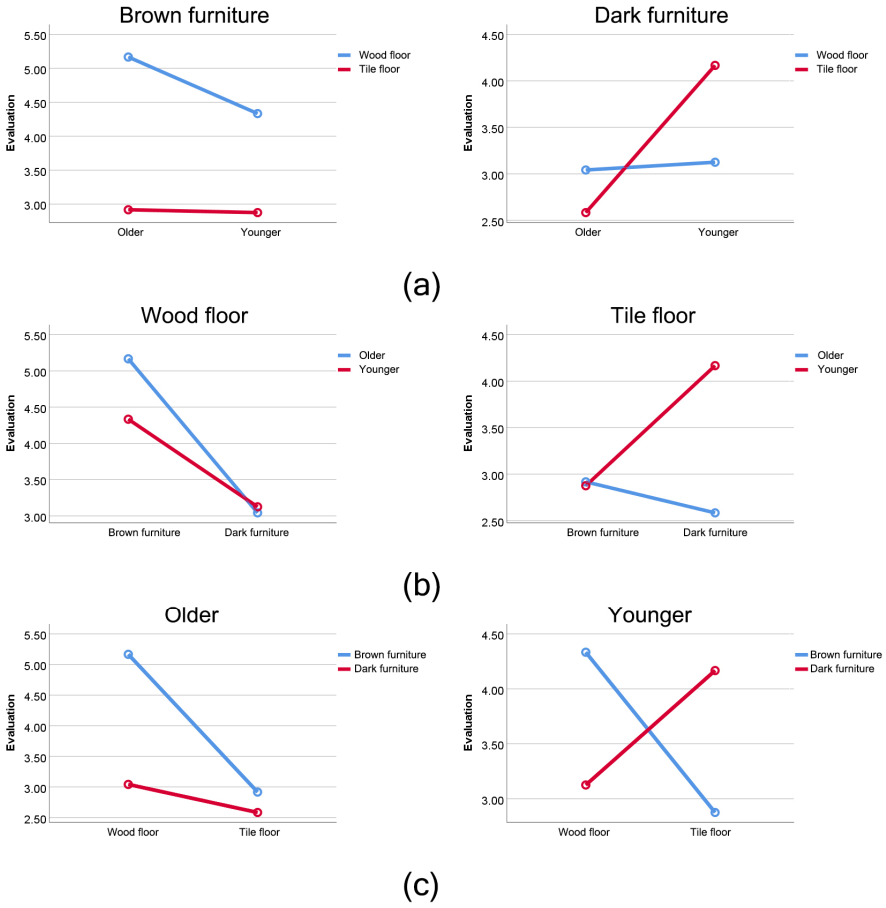

Figure 4. Interaction in design evaluation: (**a**) interaction between age and floor, (**b**) interaction between age and color and (**c**) interaction between color and floor.

3.2. Eye-Tracking

3.2.1. Fixation Duration

The repeated-measures ANOVAs were conducted for fixation duration. The results showed a significant main effect of age, with older adults having a significantly longer fixation duration (M = 1.34, SD = 0.500) than younger adults (M = 1.05, SD = 0.423), $F(1, 184) = 19.864$, $p < 0.001$, $\eta^2 = 0.097$. There was no significant main effect of floor or interaction effect between floor and age, $p > 0.05$. However, there was a significant interaction effect between floor and color (Figure 5), $F(1, 184) = 4.689$, $p = 0.032$, $\eta^2 = 0.025$. There were no significant interaction effects between age and color, age and floor, or among age, color, and floor.

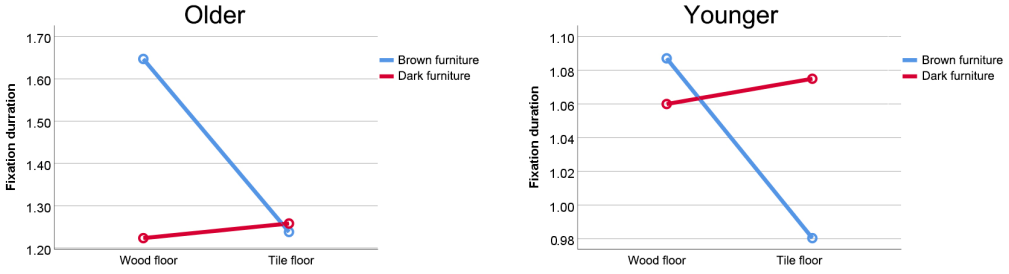

Figure 5. Interaction in fixation duration.

Table 3 shows the results of the simple effects. The fixation duration for brown furniture on wood floor was longer than that on tile floor, and the fixation duration for brown furniture on wood floor was longer than that for dark furniture.

Table 3. Results of simple effect in fixation duration.

Interaction	Variables	I	J	Mean Difference (I-J)	F	*p*	η^2
Floor × Color	Brown furniture	Wood floor	Tile floor	**0.258** **	7.805	0.006	0.041
	Dark furniture	Wood floor	Tile floor	−0.025	0.072	0.789	<0.001
	Wood floor	Brown furniture	Dark furniture	**0.225** *	5.962	0.016	0.031
	Tile floor	Brown furniture	Dark furniture	−0.057	0.385	0.536	0.002

Note: * represents $p < 0.05$, ** represents $p < 0.001$.

3.2.2. Time to First Fixation

The repeated-measures ANOVAs were conducted for time to first fixation. The results showed that the main effects of age and floor were not significant ($p > 0.05$). However, the main effect of color was significant, with the time to first fixation for brown furniture (M = 2.10, SD = 0.579) being significantly lower than that for dark furniture (M = 2.50, SD = 0.673), F(1, 184) = 19.856, $p < 0.001$, $\eta^2 = 0.097$. There was a significant interaction effect between floor and color (Figure 6), F(1, 184) = 7.643, $p = 0.006$, $\eta^2 = 0.040$. There were no significant interaction effects between age and floor, age and color, or age, color, and floor.

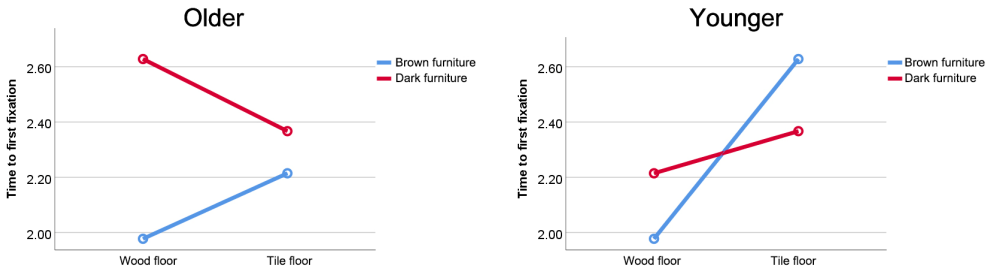

Figure 6. Interaction in time to first fixation.

Table 4 shows the results of the simple effects in time to first fixation. The time to first fixation for brown furniture on wood floor was significantly shorter than that on tile floor; the time to first fixation for brown furniture on tile floor was significantly shorter than that for dark furniture on tile floor.

Table 4. Results of simple effect in time to first fixation.

Interaction	Variables	I	J	Mean Difference (I-J)	F	*p*	η^2
Floor × Color	Brown furniture	Wood floor	Tile floor	**−0.651** **	26.069	<0.001	0.124
	Dark furniture	Wood floor	Tile floor	−0.152	1.430	0.233	0.008
	Wood floor	Brown furniture	Dark furniture	−0.237	3.463	0.064	0.018
	Tile floor	Brown furniture	Dark furniture	**−0.261** *	4.198	0.042	0.022

Note: * represents $p < 0.05$, ** represents $p < 0.01$.

3.3. Emotion

The results of PrEmo are shown in Figure 7. The analysis of repeated-measures ANOVAs indicated significant differences in joy, admiration, fascination, and desire (Table 5).

For positive emotions, except for pride, all other six positive emotions were present. Overall, the positive emotions elicited by WF-BF were the strongest, which was consistent for both older and younger adults. For older adults, TF-BF was second only to WF-BF, while for younger adults, TF-DF was second. Regarding dark furniture, younger adults experienced higher positive emotions than older adults, reflected in joy, admiration, satisfaction, and desire. It was challenging to evoke hope in young adults across all designs, but brown furniture could evoke hope in older adults.

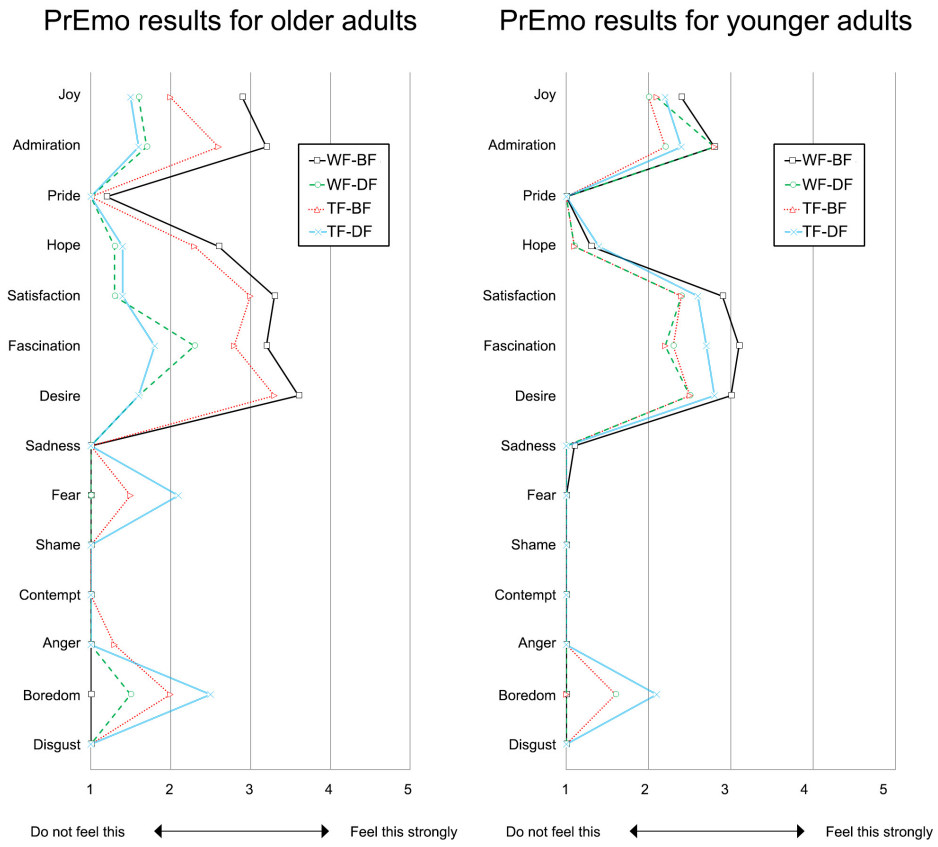

Figure 7. PrEmo results for older and younger adults.

Table 5. Results of repeated-measures ANOVA for PrEmo (only significant items are listed).

Emotion	Variables	F	*p*	η^2
Joy	Floor	5.635	0.019	0.030
	Color	18.525	<0.001	0.091
	Age × Color	9.452	0.002	0.049
	Floor × Color	7.415	0.007	0.039
Admiration	Age	4.274	0.040	0.023
	Color	42.359	<0.001	0.187
	Age × Color	8.026	0.005	0.042
Fascination	Floor	7.965	0.005	0.041
	Color	18.632	<0.001	0.092
	Age × Color	9.950	0.002	0.051
	Floor × Color	5.201	0.014	0.033
	Age × Floor × Color	7.056	0.009	0.037
Desire	Color	60.853	<0.001	0.249
	Age × Color	48.470	<0.001	0.208
	Floor × Color	4.397	0.037	0.023

For negative emotions, neither older nor younger adults experienced sadness, shame, contempt, or disgust. Older adults felt fear towards tile floor, while younger adults did not. Both older and younger adults felt boredom towards TF-BF and TF-DF, while only older adults felt boredom towards WF-DF, and WF-BF did not evoke boredom in either group.

4. Discussion

In this study, floor material, wood furniture color, and age were considered as independent variables, while design evaluation, fixation duration, time to first fixation, and

emotions were treated as dependent variables. The study aimed to explore the potential effects among them. The results indicate that floor material, wood furniture color, and age can independently or interactively influence these four dependent variables. The specific discussions are as follows:

For design evaluation, age did not have a standalone effect, but floor material and furniture color did. Both wood floor and brown furniture received higher scores. Wood flooring shapes and creates a warm ambiance and wood floors are more comfortable and softer than tile floors and marble or granite floors [12]. Additionally, a qualitative study found that wood flooring is used for aesthetic reasons or for the beauty of the room, and workspaces with natural wood grain look more natural [12]. Wood floor finishes create a sense of spaciousness and add aesthetic value to the interior space of buildings [43]. In a survey, 88% of respondents answered that the color of furniture has a significant impact on our lives [5]. For furniture, most users prefer the natural color of wood [5,8]. The combination of wood floor and brown furniture received the highest rating, both in the older and younger age groups. In addition to the preference for wood flooring or brown furniture, the harmony between the two is also essential. The natural texture and color of wood can bring a strong sense of comfort, which is very suitable for interior decoration [44]. Moreover, using wood in offices can effectively reduce employee fatigue [7]. The coverage of wood is also an important factor affecting indoor environment assessment. A study experimented with three wood coverage rates (0%, 45%, 90%) in rooms and found that a 45% coverage rate was the most popular [45]. Both the floor and furniture reflect the texture and color of wood, helping to achieve a moderate level of wood coverage in offices, which also makes it easier to obtain higher design evaluations.

When considering age as a factor, the results indicate that older adults preferred wood floors and brown furniture more than younger adults, who did not show a significant preference. Compared to older adults, younger adults have a higher acceptance of aesthetic styles in furniture [46]. They can accept traditional interior design styles as well as modern craftsmanship in office environments. Their furniture preferences are mainly influenced by the internet and social networks [16]. Younger adults also pay more attention to factors beyond visual appearance, such as price and productivity [47]. On the other hand, older adults prefer traditional-classic styles [48] and are less resonant with currently popular designs. This aesthetic preference difference is also reflected in the fact that younger adults were more accepting of tile floors and dark furniture compared to older people. In terms of emotions, older adults showed fear towards tile floors, which may also be one of the reasons why they rated tile floors lower.

For fixation duration, only age had an independent effect, with older adults having longer durations. This may be related to age-related visual acuity and information processing speed. Older adults perform worse than younger adults in saccade frequency, amplitude, peak velocity, and mean velocity [49]. When performing visual tasks, older adults need longer fixation durations, experience more fatigue, and have lower task performance [50]. Therefore, the longer fixation duration in older adults cannot be inferred to be related to design preferences. Floor and color can interact to affect fixation duration, and the combination of wood floor and brown furniture had the longest fixation duration. This result is consistent with design evaluation, indicating that WF-BF not only received better ratings but also attracted more visual attention from participants.

For time to first fixation, only color had an independent effect. The time for participants to fixate on brown furniture was shorter than for dark furniture. This metric can be interpreted as the time needed to capture participants' interest [21,27]. Therefore, we can infer that, compared to floor material, changes in furniture color have a greater impact on participants' interest. The combination of wood floor and brown furniture remained the most distinctive, with the shortest time. Thus, we can say that WF-BF can attract users' attention more quickly, attract more observation time, and are more likely to receive higher design evaluations. Therefore, this combination should be considered in office interior design.

For emotions, overall, negative emotions were not strong, but positive emotions showed different patterns. The scores for positive emotions in WF-WF were significantly higher in joy, admiration, fascination, and desire than in other combinations, for both older and younger participants. This result corresponds with design evaluation, fixation duration, and time to first fixation. It validates that wood can evoke positive emotions in observers [51]. An office environment with a natural wooden color can reduce stress responses and improve stress recovery [52]. In a study where participants randomly viewed images of wood textures and grayscale images, the concentration of oxygenated hemoglobin in the left and right frontal lobes was significantly reduced when viewing wooden images compared to grayscale images. Participants also subjectively assessed the images. The results showed that viewing wooden images provided a significantly more "comfortable", "relaxed", and "natural" impression, reducing negative emotional states [1]. This study builds on previous research by specifying differences in joy, admiration, fascination, and desire.

Among the four positive emotions with significant differences, TF-BF ranked second in older adults. Therefore, we can infer that, compared to the floor, the color of wooden furniture is more likely to bring pleasant feelings to older adults. In younger adults, TF-DF's positive emotions ranked second, indicating that the overall performance of the combination of the floor and wooden furniture is more important to young adults. Young adults are more accepting of modern design styles than old adults [46]. Although TF-DF may not match WF-BF in terms of natural attributes, this combination is more in line with the harmony of modern design, hence its better performance in emotions.

Among the negative emotions, only fear, anger, and boredom were observed. These results did not show statistically significant differences, likely due to many results being 0. Therefore, we believe that these non-zero results are worthy of discussion. Older adults expressed fear of tile floors, as mentioned earlier, mainly due to the fear of falling associated with tile floors. Wooden floors are considered safe and healthy, with the lowest incidence of household accidents [43]. Healthy older adults take twice as long as young people to get up, while older people in congregate housing take two to three times as long [53]. Therefore, older adults are more concerned about the safety of the floor and fear floors that are easy to slip on. Few older adults expressed anger towards TF-BF, while no anger was observed in any other combination among older or younger participants. In addition, WF-DF, TF-BF, and TF-DF were associated with boredom. We speculate that this may be due to a design style that does not resonate with some participants, but it is difficult to draw strong conclusions from the data.

This study has limitations. The stimuli used in the study simulated an office environment using design software, rather than having participants conduct experiments in a real office. The study selected two common types of office furniture: natural brown wood and dark painted furniture, along with commonly used white ceramic tile and brown natural textured wood flooring, creating four design schemes. The stimuli in the experiment could not fully replicate the office environment, so further validation is needed when applying the study's conclusions to office design. We attempted to minimize the influence of irrelevant demographic factors, such as gender and cultural background, in the selection of samples. However, the number and composition of the samples cannot fully represent all office staff, a limitation inherent in user research. In future studies, we will further reduce errors caused by sample bias. Different types of designs were evaluated for their visual attention and emotional expressions, each showing their unique characteristics. These significant results provide some guidance for office design. However, the reasons behind these results require further exploration. Therefore, in addition to quantitative research, further qualitative research is necessary to delve into users' deeper psychology. Overall, the current study revealed some patterns in the design evaluation, visual cognition, and emotions related to furniture and flooring design in office environments, considering age factors, filling current research gaps. However, for a deeper understanding of this field and the application of its findings in design, continuous research in this field is necessary.

5. The Future Study

There are still many unresolved questions and unverified aspects in the current research, necessitating further in-depth studies in the field of office environments. Future research should begin with validation in real-world settings, where participants will be situated in an actual office, directly observing interior designs and physically interacting with furniture materials. Our research will place a stronger emphasis on users, acknowledging that design evaluation, emotions, and visual cognition are significantly influenced by human factors. Therefore, additional demographic variables (such as gender, occupation, and working hours) will be analyzed as independent variables. This will be the key focus of the second phase of future research. In the third phase, we will adopt a more comprehensive approach to discussing psychological and physiological responses, introducing new indicators (such as pressure distribution when using chairs and EEG assessments during design evaluations). Additionally, in-depth interviews with participants will be included to help explain quantitative data results and uncover new issues. Building on the above research, the final phase will focus on the practical application of these findings to office environment design. The goal will be to enhance office employees' satisfaction and experience by improving office design based on their subjective perceptions and physical responses.

6. Conclusions

Overall, the material of the floor, the color of wooden furniture, and age all play a role in design evaluation, visual attention, and emotions. The combination of wood floor and brown furniture performs best in office interior design, which is most suitable for both younger and older individuals. This combination not only quickly attracts attention but also engages people for longer periods. It also performs best in the emotions of joy, admiration, fascination, and desire. When considering combinations other than WF-BF, preferences differ between young and older individuals. Young people have a better acceptance of tile floor and dark furniture, especially when these two are combined, whereas older individuals do not prefer them. Older people have feeling of fear of tile floor, which is likely related to a fear of falling. Therefore, wood floor and natural wooden color furniture are a relatively safe choice in office interior design. If there are more young staff in the office, it may be considered to abandon the element of wood and adopt a more modern design scheme. However, this approach may not be satisfactory for older employees.

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Appendix A

Figure A1. Texture 1: tile floor.

Appendix B

Figure A2. Texture 2: wood floor.

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