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Exploring Landscape Design Intensity Effects on Visual Preferences and Eye Fixations in Urban Forests: Insights from Eye Tracking Technology

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Abstract: Individuals' preferences for urban forest scenes are an essential factor in the design process. This study explores the connection between landscape design intensity, visual preferences, and eye fixations in urban forest scenes. Five pictures representing different urban forest scenes (plaza, lawn, garden path, pond, and rockery) were selected as stimuli, representing the original landscape design intensity. Three additional levels of design intensity (low, moderate, and high) were created by modifying the landscape elements of the original picture. A group of 50 participants was randomly assigned to observe the four levels of design intensity pictures within each type of landscape using eye-tracking technology. They also rated their preferences for each scene. In total, 250 participants took part in the study, with five groups observing five types of urban forest scenes. The results indicate that landscape design intensity has a positive impact on visual preferences, with moderate design intensity showing the strongest effect. However, the influence of design intensity and preferences also depends on the specific landscape scene. The fixation data did not show a significant relationship with design intensity but were associated with the type of landscape scene. In conclusion, this study suggests that moderate design intensity is recommended for urban forest design. However, it also highlights the importance of considering the specific landscape scene type. The research provides valuable insights into urban forest design and contributes to the understanding of eye-tracking technology in landscape perception studies.

Keywords: preference; eye fixation; urban forests; design intensity; scene type

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1. Introduction

Urban forests have increased dramatically recently in China and received a great deal of attention [1–3]. Urban forests offer a wide range of benefits, such as the regulation of air, water, soil, and climate [4], reducing mental stress and depression [5,6], promoting psychological restoration [7,8], enhancing mood and self-esteem [9], and even fostering creativity [10]. Although a growing body of research has highlighted the socio-ecological advantages of urban forests, limited knowledge exists regarding how people perceive various design interventions for urban forests. While it is known that people generally prefer natural landscapes over urban landscapes, as well as built environments with natural elements over those without [11], there is a lack of understanding about people's perceptions of different types of urban forest scenes and how different design interventions for urban forests impact their preferences.

In recent years, there has been a widespread exploration of people's landscape preferences [12–15]. Understanding public preferences for landscapes is crucial for landscape design and management, as human brains respond positively to their preferred landscapes [16]. People typically prefer to spend more time in and are willing to pay more to maintain the landscapes they prefer. Moreover, studies have indicated that preferred green environments are restorative, reduce stress [17,18], provide psychological restoration [19], and enhance well-being [20]. Several studies have also established a positive relationship between landscape preferences and human health [21,22], emphasizing the role of individual preferences in encouraging visits to urban forests. Consequently, gaining a comprehensive understanding of individuals' preferences regarding their surrounding landscapes and how these preferences shape the environments is not only a demanding academic endeavor but also crucial for effective policy-making and implementation [23,24]. This knowledge plays a crucial role as it empowers planners and developers to construct urban forest landscapes that are more appealing while simultaneously enhancing ecological services. Therefore, exploring public preferences for urban forest landscapes will contribute to landscape design and management, which in turn can improve the multiple benefits of urban forests.

Furthermore, eye-tracking technology has become more affordable, accurate, and convenient in recent years, facilitating the collection of extensive data and the exploration of the relationship between eye movements and landscape preference. This technology offers a means to understand how people observe landscapes. It has been widely utilized in psychological, geographical, and landscape perception research, enabling measurements of fixation duration, number, saccade velocity, and direction. Several recent studies have suggested potential connections between landscape perceptions and eye movements [25–27]. Particularly, studies have used eye-tracking technology to investigate individuals' preferences for waterfront park landscape elements [28], ornamental features of bamboo plants [15], and landscape complexity of forest settings [12,29]. Consequently, by utilizing eye-tracking technology, we aim to expand upon previous studies on landscape preferences, providing novel insights into the visual features of preferred landscapes and their impact on eye movements.

1.1. Landscape Design Intensities and Preferences

It is widely believed that public preferences for landscapes are influenced by their characteristics. Studies have consistently shown that landscapes with a high degree of naturalness are preferred over those with a low degree of naturalness [30], across various regions and cultures [31]. Additionally, landscape attributes [32], the presence of certain elements such as water and vegetation [16,33,34], varying densities of vegetation, and visual aesthetic quality [14] all play significant roles in shaping landscape preferences. Research has also indicated strong preferences for a well-maintained and neat landscape [35], an intermediate to dense understory [36], and dense shrubby trailside vegetation [24]. However, it is important to note that these preferences are not universal. For instance, Bjerke et al. [37] found that dense understory vegetation can have a negative impact on preferences. Furthermore, some researchers have suggested that landscapes with a high degree of naturalness may evoke feelings of fear and lack of safety due to the potential presence of hidden attackers in dense, dark forests [14]. These contrasting findings can create confusion for landscape architects during the design process, as they are faced with numerous options, such as creating landscapes with well-maintained shrubbery and artificial elements, implementing minimal human intervention, or designing landscapes with a moderate level of complexity through various interventions. Current landscape preference studies still lack conclusive evidence to guide landscape designers on how to appropriately balance design interventions to elicit public preferences, particularly in the context of urban renewal. Without a thorough understanding of existing landscape preferences and the effects of different design interventions, urban forest renewal efforts may fall short and result in minimal actual improvement.

The extent of design interventions can be referred to as design intensity, a concept proposed by Xu et al. [14]. Design intensity is defined as the degree to which artificial elements are incorporated into the landscape and the extent to which the original landscape is altered through design. However, this definition may have limitations when applied to urban forest transformations. When visiting urban forests, visitors often lack knowledge of the original landscape and how it has changed. Additionally, in urban forests, the arrangement of natural and artificial elements, different planting forms, and varying maintenance requirements can also influence individuals' perception of design intensity. For example, the presence of modeled plants (such as potted plants, topiaries, and hedges) may give the impression of extensive maintenance and costs, leading to a sense of excessive design. Therefore, we have connected the extent of design intervention to the concept of design intensity, defining it as the utilization of different landscape elements, the complexity of their configuration, and the level of maintenance required in urban forest settings. Landscape design intensity plays a crucial role in biodiversity conservation and landscape perception. According to the intermediate disturbance hypothesis, a moderate level of disturbance maximizes biodiversity [38–41], and an appropriate level of design intensity not only enhances landscape quality but also promotes visual preferences. Furthermore, landscape design intensity can influence energy consumption and urban forest development. Landscapes with high maintenance requirements may incur higher costs and waste resources. Previous research [14] has examined the relationship between design intensity and visual preferences, but it has primarily focused on natural landscapes rather than urban forests, providing limited guidance for urban forest landscape design. Some other studies have investigated the design intensity of green landscapes in relation to eye movements [12,29]. However, these studies were conducted without controlling or altering the content of the elements present in the images, making it difficult to compare different forest landscape images. Manipulated images, on the other hand, allow for control over the presence or form of different elements while keeping everything else in the scene constant. For example, previous studies controlled variables such as the types of vegetation [42], livestock presence [43], or cultural elements [44]. This approach enables the isolation of variables and the assignment of a value to each factor in the landscape [45], making specific landscape patterns more visible [46]. Therefore, digital manipulation emerges as a useful step when addressing public preferences for specific forest landscape proposals. Consequently, this study employs manipulated urban forest landscape images as stimuli to investigate the relationship between landscape design intensity and visual preferences. The findings may yield new insights and design guidelines for urban forests.

1.2. Landscape Characteristics, Perception, and Eye Movements

There is evidence suggesting that different landscape characteristics can elicit distinct eye movements [47], and these eye movements are associated with landscape perceptions [48]. A pioneering eye-tracking study on attention restoration theory examined whether there were significant differences in eye movements when viewing landscapes with high and low levels of fascination or aesthetic appeal [49]. The results indicated that landscapes with low fascination triggered more exploration and a greater number of fixations compared to landscapes with high fascination. In addition to fascination, visual exploration has been found to be associated with visual landscape complexity. Dupont et al. [47] investigated the differences in visual exploration between landscapes with varying levels of urbanization and discovered a relationship between landscape complexity and urbanization level, which could potentially influence viewing behavior.

Regarding perceptions and eye movements, it has been observed that individuals tend to focus more on aspects of the landscape they are interested in or prefer [50]. Eye fixations and their duration are often indicative of the viewer's preferences, considered as a judgment of attractiveness [51,52], and can be attributed to the downstream effects of dwelling time and fixation count [53]. This behavior is likely influenced by the top-down attention process [54]. In a different context, studies on face perceptions and total fixation duration have shown that more attractive faces result in longer fixation durations and a higher number of fixations [50,55,56]. These findings suggest that a fascination with nature may enhance people's attention to natural environments [57]. However, this was not confirmed in the study conducted by Berto et al. [49], which found a lower number of fixations while viewing nature compared to urban landscapes. Considering these findings and the general preference for natural landscapes over urban settings [58], it can be inferred that individuals' preferences for natural landscapes may elicit fewer fixations. However, these contradictory results make the relationship between landscape preference and fixation patterns unclear.

Furthermore, Dupont and colleagues' findings indicated that landscapes with high complexity may result in more fixations [47]. It is possible that a high level of landscape design intensity, which is likely to be correlated with a high level of landscape complexity [12], would also lead to an increased number of fixations. However, whether design intensity influences eye movements remains unexplored. Therefore, analyzing eye movements while perceiving landscapes with different levels of design intensity may provide insights into this relationship and shed light on the contradictory findings between eye movements and landscape complexity.

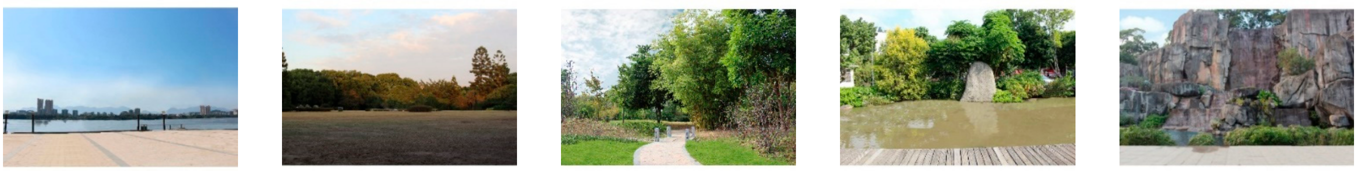
1.3. Research Question

This study aims to investigate how different levels of design intensity (low, moderate, and high) in urban forest scenes impact individuals' preferences and eye fixations using manipulated urban forest landscape images. Therefore, the research addresses the following questions: How does landscape design intensity influence preferences for urban forest scenes? Does the effect of landscape design intensity on preferences remain consistent across different urban forest scenes? How does landscape design intensity affect eye fixations? By exploring the relationship between people's landscape preferences, design intensity, and eye fixations, we can gain a deeper understanding of the factors that influence preferences for urban forest scene characteristics. This knowledge can be valuable for designers and urban forest managers in effectively incorporating public perceptions into the design and decision-making process.

2. Materials and Methods

2.1. Stimuli

Five colorful images depicting various urban forest scenes were selected as stimuli. These five landscape scenes were further classified into distinct landscape types, including a plaza setting, lawn setting, garden path setting, pond setting, and rockery setting (Figure 1). The categorization was based on their overall composition, design, and characteristics, representing broader categories that encompassed various landscape elements. For instance, a plaza, a lawn, a path, a pond, and a rockery were considered individual landscape elements contributing to the overall landscape type. These five photos were carefully chosen from a larger photo bank comprising over 345 images, all taken by some of the authors with a tripod. This approach ensured consistent shot height and similar weather and seasonal conditions across the selected images. The use of photographic images as surrogates for real landscape scenes has been shown to have good reliability [59,60] and is widely used in landscape perception research [16,19,26]. These images were carefully selected because they represent typical urban forest landscapes in China, consisting of common trees, vegetation, architectural structures, pathways, and other elements commonly found in such environments. Moreover, these images were deemed appropriate for the study's purpose as they allowed for the manipulation of specific landscape elements by adding or removing them as needed.



(**A**) (**B**) (**C**) (**D**) (**E**)

Figure 1. The selected urban forest settings. (**A**) Plaza. (**B**) Lawn. (**C**) Garden path. (**D**) Pond. (**E**) Rockery.

The selected photos were then modified with Photoshop CS6 to control the landscape design intensity. The modification process followed the visual assessment methods established by Rodiek [61] and the photomontage method, which involved adding or removing landscape elements in each image. According to the visual assessment methods, the modifications should be specific enough to create a clear contrast with noticeable changes, while still presenting main examples without an excessive number of variations. The photomontage method, on the other hand, aims to create well-integrated images by adding, removing, or composing landscape elements [62]. We created three additional gradients of design intensity for each image, resulting in five groups of images: Group A represents plaza settings beside a river, Group B depicts lawn settings, Group C showcases garden path settings, Group D presents pond settings, and Group E displays rockery settings. Each group contains four images, amounting to a total of twenty images. The images with low-level design intensity primarily focus on adding one landscape element. Based on the low design intensity picture, the images with moderate design intensity focus on adding two landscape elements (or one landscape element with increased complexity). The high-level design intensity picture includes the addition of multiple landscape elements. The selection of design intensity levels (low, moderate, high) was based on prior field observations. The landscape elements include plant elements, sculptural elements (rockeries), water elements, and more. By incorporating multiple design elements, we aimed to create a realistic simulation of actual urban forest landscape designs, reflecting the coexistence and interaction of these elements in real-life settings. During the meticulous editing process, we ensured that any modifications made adhered to principles of rationality, maintaining consistency with real-world scenarios. The authenticity of each scene was preserved, capturing essential elements of typical urban forest landscapes in China. We also considered aesthetic aspects, enhancing the visual attractiveness of the images while maintaining their authenticity and integrity. Figure 2 provides an example of a group of stimuli with different gradients of design intensity. This comprehensive approach allowed us to explore landscape preference patterns under different design intensities and analyze their effects on participants' visual attention. Consequently, there are significant differences between the images with varying design intensities within each group.

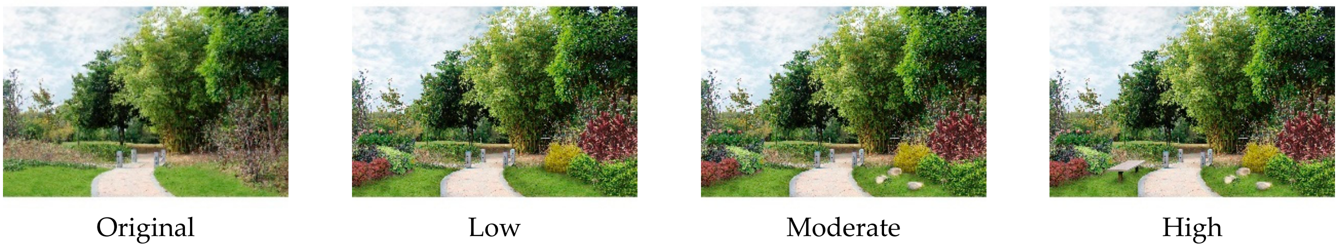


Figure 2. Sample of stimuli with four levels of design intensity (Image source: The authors).

2.2. Eye-Tracking Apparatus

The Eye-link 1000 Plus, developed by SR Research in Ottawa, ON, Canada, is an eye-tracking technology used to record eye movements. It has a high sampling rate of 1000 Hz, which means it can capture the point-of-regard of observers every millisecond. This allows for continuous monitoring of participants' eye movements while they view photographs or other visual stimuli. The technology operates by emitting low-power infrared light into the eye, which is then reflected by the cornea and retina. By analyzing the reflected signal, the Eye-link 1000 Plus can determine the exact location of the point of regard, providing horizontal and vertical coordinates. It captures the entire gaze pattern, including both stationary gaze positions and connecting eye movements. In the study, images were displayed at the center of a 19 inch LCD monitor with a resolution of 1280 $\times$ 1024 pixels. This setup ensured that participants could perceive the details of each image clearly. The participants were positioned 550 mm away from the monitor and used a chin rest to stabilize their head position. The Eye-link 1000 Plus offers various eye movement metrics that can be measured, including fixation count, fixation duration, and pupil size, among others. Fixation, which refers to the period when the eyes remain relatively still, has been found to be associated with individuals' preferences. Therefore, the present study focused on analyzing fixation count and average fixation duration as indicators of participants' preferences.

2.3. Participants

We recruited 250 university students from a single university in China to participate in our study. Previous studies have shown that individuals aged between 18 and 35 are the primary participants in forest park tourism [63]. Additionally, college students are often considered representative and convenient sample groups for visual stimuli research [64]. These participants were randomly assigned to different groups, with 50 participants in each group. Each group viewed a specific set of images. While the sample size may not be large in terms of landscape perception studies, it is considered a large sample size in the context of eye-tracking studies. This large sample size enabled us to detect significant effects effectively [65]. The sample of participants included university students from various majors and different academic years. Of the 250 participants, 118 were male and 132 were female, with ages ranging from 19 to 29. All participants had normal vision or vision that was corrected to normal with glasses or contact lenses. Before the eye-tracking experiment, participants were provided with brief practical information about the procedure without revealing the specific purpose of the research. This was completed to ensure that participants approached the experiment without any preconceived notions that could potentially influence their viewing patterns. After completing the eye-tracking experiment, participants were asked to rank the images based on their preference and perceived complexity. The decision to collect rankings after the experiment was made to avoid any potential bias or influence on participants' viewing patterns and to enhance the accuracy of the eye-tracking measurements.

2.4. Procedure

The tests were conducted individually under a controlled laboratory environment, following an identical procedure (as shown in Figure 3). Upon arrival at the laboratory, the experiment procedure and necessary precautions were explained to them in detail, and then they were asked to provide written informed consent, indicating their voluntary participation in the study. After that, participants were seated in the eye-tracking apparatus and randomly assigned to view one group of images. Prior to the start of the experiment, a 9-dot calibration procedure was performed to ensure accurate eye-tracking measurements. During the experiment, the stimuli (images) were presented in a random order, with each image displayed for a duration of 10 s. This specific duration for image presentation was determined based on previous studies that employed similar methodologies [27,66]. Participants were instructed to freely view the images without any specific guidelines or restrictions. Following the completion of the eye-tracking experiment, participants were asked to provide their preference rankings for the four images on a scale of 1 to 4, with 1 indicating the lowest ranking and 4 indicating the highest ranking. Additionally, participants were asked to provide socio-demographic information and other relevant background data. The decision to collect preference rankings after the eye-tracking experiment was made to ensure that participants' viewing patterns were not influenced in advance. This approach aimed to promote a natural and unbiased viewing experience, thereby increasing the accuracy of the eye-tracking measurements.

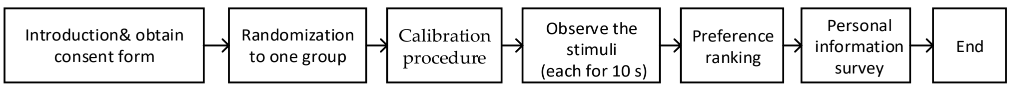


Figure 3. The flowchart of the experiment procedure.

2.5. Data Processing

A one-way analysis of variance (ANOVA) was employed to determine whether there were significant differences in preference ratings among images with varying levels of design intensity within each group. If a significant difference was detected, Tukey's honestly significant difference (HSD) test was applied to identify the specific groups that differed significantly from one another. To explore the influence of preferences for original images on the effect of design intensities, a bivariate correlation analysis was conducted. As the eye-tracking data were reported to be non-parametric, a nonparametric Kruskal–Wallis test was used to examine whether there were significant differences in fixation count and average fixation duration across the four levels of design intensity, as well as among the five groups. If a significant difference in means was observed, a post hoc Dunn's test was conducted to compare pairwise differences between the groups. Furthermore, another bivariate correlation analysis was conducted to investigate the relationship between landscape design intensity, preferences, and fixation patterns. The processing were performed in the SPSS 19.0.

3. Results

3.1. Comparison of Preferences among Different Design Intensities

Figure 4 presents the mean preference ratings for the 20 images. With the exception of the garden path group, images with high design intensity were generally preferred over their counterparts with lower design intensities in all other groups. When considering all the images collectively, those with high design intensity were also preferred over the images with lower design intensities. The one-way ANOVA analysis revealed significant differences in participants' preferences for images based on the level of design intensity within each group, as well as across all the images as a whole (F values ranged from 3.929 to 159.096). In the rockery setting, the average preference ratings for all pairwise comparisons of design intensity were significantly different. In the lawn setting, only the high design intensity and the original setting yielded significantly different preference scores. In the other settings, significant differences in preference scores were found in more than one pairwise comparison of design intensity.

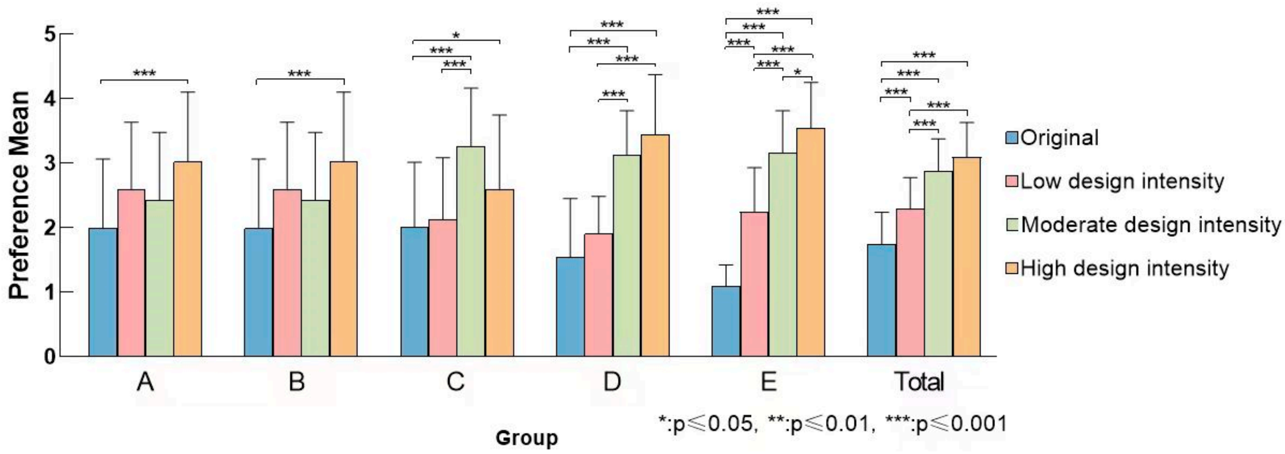


Figure 4. The preference mean value (±standard error) A: F(3,196) = 8.134 ***; B: F(3,196) = 3.929 **; C: F(3,196) = 67.978 ***; D: F(3,196) = 67.978 ***; E: F(3,196) = 159.096 ***; Total: F(3,996) = 94.023 ***.

Furthermore, preferences for images with high design intensity were significantly higher than those for images with original design intensity in each group. Additionally, in the plaza and lawn groups, although preferences for images with low design intensity were higher than for images with moderate design intensity, no significant difference in preferences was found between them. These findings suggest that higher design intensities in urban forest landscapes tend to elicit higher preferences, but the effect of design intensity on preferences may also vary depending on the specific landscape type.

3.2. Marginal Effects of Design Intensity on Preferences

To assess which design intensity has a greater impact on improving preference ratings, the marginal effects of the three design intensities were calculated for each group, as presented in Figure 5. When considering all the images regardless of landscape type, the marginal effect of the high design intensity was the lowest, with a value of 0.21, while the marginal effect of the moderate design intensity was the highest, with a value of 0.60. When examining the landscape types individually, a similar pattern was observed for the garden path, pond, and rockery images, where the marginal effect of the high design intensity was lower compared to the moderate design intensity. However, for the plaza and lawn images, the low design intensity exhibited the highest marginal effect. Furthermore, as depicted in Figure 5, the marginal effects of the low design intensity were positive for all groups. On the other hand, the marginal effects of the moderate and high design intensities were negative in some landscape types. In summary, the results indicate that overall, the moderate design intensity had a greater power to improve preference ratings. However, these findings varied depending on the specific landscape type.

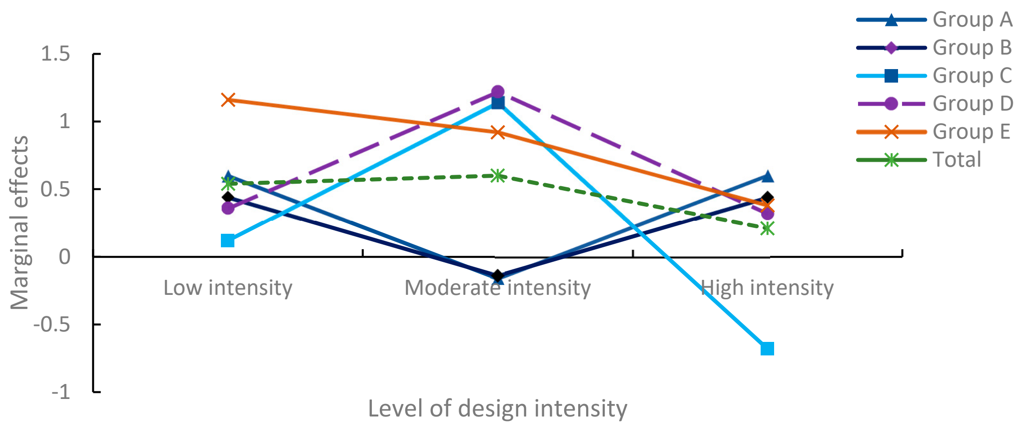


Figure 5. Marginal effects of three design intensities on preferences.

3.3. Impacts of Preference for Original Image on the Effect of Design Intensity on Preferences

To assess the impact of individuals' preferences for the original image on the effect of design intensity on preferences, the relationships between design intensity's effect on preferences and preference for the original images were calculated and are presented in Table 1. To determine the design intensity's effect on preferences, the preference scores for the images at each level of design intensity were subtracted from the preference score for the corresponding original Image. As shown in Table 1, except for the rockery setting, preference for the original image had a significantly negative impact on the effects of the three design intensities on preferences. This means that individuals who had a higher preference for the original image tended to exhibit a smaller effect of design intensity on their preferences. Although there was a non-significantly negative association between preference for the original image and the effect of low design intensity, significant negative associations were found between the preference for the original image and the effect of moderate design intensity, as well as between the preference for the original image and the effect of high design intensity. In summary, it can be tentatively concluded that preference for the original image has a significantly negative impact on the effect of landscape design intensity on preferences, although this finding also varied depending on the specific landscape type.

Table 1. Correlations between landscape preference for original image and design intensities' effect on preferences.

		Preference for Original Image	Low Design Intensity's Effect	Moderate Design Intensity's Effect
Low design intensity's effect	Group A	−0.661 ***		
	Group B	−0.666 ***		
	Group C	−0.724 ***		
	Group D	−0.918 ***		
	Group E	−0.151		
	Total	−0.707 ***		
Moderate design intensity's effect	Group A	−0.858 ***	0.298 ***	
	Group B	−0.839 ***	0.271 ***	
	Group C	−0.829 ***	0.433 ***	
	Group D	−0.889 ***	0.846 ***	
	Group E	−0.725 ***	−0.060	
	Total	−0.849 ***		
High design intensity's effect	Group A	−0.922 ***	0.456 ***	0.739 ***
	Group B	−0.935 ***	0.515 ***	0.721 ***
	Group C	−0.887 ***	0.445 ***	0.627 ***
	Group D	−0.820 ***	0.593 ***	0.515 ***
	Group E	−0.715 ***	−0.063	0.092
	Total	−0.901 ***	0.483 ***	0.666 ***

***: $p < 0.001$.

3.4. Comparison of Fixation among Different Design Intensities

The results of the Kruskal–Wallis test assessing fixation count and average fixation duration among images with different levels of design intensity in each group are presented in Table 2. In all groups, the only significant difference in average fixation duration between images with different design intensities was found in the pond setting, $\chi^2(3) = 8.075$, $p < 0.05$. The mean rank average fixation durations were 113.72 for the original image, 90.30 for the low design intensity, 87.64 for the moderate design intensity, and 110.34 for the high design intensity. However, further analysis using Dunn's test revealed that there were no significant differences in any pairwise comparisons (adjusted R between 0.146 and 1.000) in terms of average fixation duration in the pond setting. This indicates that the significant differences in average fixation duration observed between different design intensities in the pond setting were not reliable. Therefore, based on these findings, it can be concluded that neither fixation count nor average fixation duration is associated with landscape design intensity in any of the settings examined.

Table 2. The Kruskal–Wallis test results of fixation count and average fixation duration within each group.

					Mean Rank in Design Intensities					Real Mean Values			
		N	χ^2	df	Original	Low	Moderate	High	P	Original	Low	Moderate	High
FC	Group A	50	4.178	3	102.90	86.37	104.88	107.85	0.243	29.62	28.92	29.82	30.28
	Group B	50	1.315	3	103.15	98.15	106.48	94.22	0.726	28.68	27.48	28.96	27.88
	Group C	50	1.695	3	106.18	103.96	92.24	99.62	0.638	30.50	29.70	28.24	29.62
	Group D	50	1.222	3	102.56	100.03	97.80	101.61	0.978	2.63	2.48	2.36	2.53
	Group E	50	3.004	3	91.07	104.93	109.29	96.71	0.391	29.96	30.94	31.86	30.34
	Total	250	0.488	3	502.96	493.06	509.65	496.33	0.921	29.73	29.64	29.90	29.95
AFD	Group A	50	5.913	3	103.90	115.26	90.46	92.38	0.116	358.01	309.09	288.42	283.67
	Group B	50	0.656	3	99.21	100.35	96.68	105.76	0.884	310.20	409.84	332.79	321.19
	Group C	50	0.874	3	96.63	99.17	106.86	99.34	0.832	283.93	353.12	397.35	292.53
	Group D	50	8.075	3	113.72	90.30	87.64	110.34	0.044	313.90	312.35	266.28	296.18
	Group E	50	0.452	3	100.74	96.92	104.60	99.74	0.929	308.93	269.82	306.84	272.80
	Total	250	1.432	3	511.85	501.21	482.73	506.21	0.698	314.99	330.84	318.33	293.27

FC: fixation count, AFD: average fixation duration.

3.5. Comparison of Fixation among Different Landscape Types

The results of the Kruskal–Wallis test examining fixation count and average fixation duration among different landscape types for each design intensity are presented in Table 3. Regarding fixation count, significant differences were observed between different landscape settings with low design intensity ($\chi^2(4) = 9.905$, $p < 0.05$) and high design intensity ($\chi^2(2) = 13.415$, $p < 0.01$). However, further analysis using Dunn's test for low design intensity revealed no significant differences in any pairwise comparisons (adjusted *p*-values between 0.154 and 1.000). In the case of high design intensity, Dunn's test indicated a significant difference only between the lawn and pond settings (adjusted $p = 0.006$), while the difference between the plaza and lawn settings approached statistical significance (adjusted $p = 0.077$). No other significant differences were found in pairwise comparisons. Based on these findings, it can be tentatively concluded that fixation count is somewhat related to landscape type.

Table 3. The Kruskal–Wallis test results of fixation count and average fixation duration within each design intensity.

					Mean Rank in Design Intensities						**Real Mean Values**				
		N	**χ^2**	**df**	**A**	**B**	**C**	**D**	**E**	**P**	**A**	**B**	**C**	**D**	**E**
FC	Original	250	7.196	4	126.91	105.64	127.00	144.14	123.81	0.126	29.62	28.68	30.50	30.84	29.96
	Low	250	9.905	4	111.37	106.75	127.52	140.11	141.75	0.042	28.92	27.48	29.70	31.16	30.94
	Moderate	250	7.778	4	125.40	113.44	109.70	135.95	143.01	0.100	29.82	28.96	28.24	30.60	31.86
	High	250	13.415	4	134.70	96.22	120.73	145.77	130.08	0.009	30.28	27.88	29.62	31.64	30.34
AFD	Original	250	10.705	4	109.86	147.93	123.29	136.56	109.86	0.030	308.93	310.20	283.93	313.90	309.93
	Low	250	13.239	4	143.47	145.13	124.64	107.70	106.56	0.010	309.09	409.84	353.12	312.35	269.82
	Moderate	250	8.276	4	135.20	137.08	135.20	104.38	115.64	0.082	397.35	332.79	397.35	266.28	306.84
	High	250	14.970	4	105.95	154.88	125.88	131.97	108.82	0.005	269.82	321.19	292.53	296.18	272.80

FC: fixation count, AFD: average fixation duration.

In terms of average fixation duration, significant differences were found within certain groups for the original design intensity, low design intensity, and high design intensity. Dunn's test for the low design intensity revealed that the differences between the plaza and lawn settings (adjusted $p = 0.085$) and between the lawn and rockery settings (adjusted $p = 0.085$) approached marginal significance. No other significant differences were found in pairwise comparisons among different settings. For the low design intensity, the difference between the lawn and rockery settings (adjusted $p = 0.077$) and the difference between the lawn and pond settings (adjusted $p = 0.097$) approached formal significance, while no other significant differences were found. In the high design intensity, there was a significant difference between the plaza and lawn settings (adjusted $p = 0.007$) and between the lawn and rockery settings (adjusted $p = 0.014$). These results suggest that average fixation duration is likely related to landscape type. In summary, the findings indicate that fixation count and average fixation duration show some associations with landscape type, depending on the design intensity.

3.6. The Relationships between Design Intensity, Preferences, and Fixation

The results of the bivariate correlation analysis between design intensity, preference ratings, and fixation in each group are presented in Table 4. The findings revealed that individuals' preferences were positively influenced by design intensities in each setting, as well as across all settings (r ranged from 0.203 to 0.823). However, no significant associations were found between preferences and fixation (either fixation count or average fixation duration), or between design intensities and fixation (either fixation count or average fixation duration). Based on these results, it can be concluded that neither design intensity nor preference has a significant influence on fixation count or average fixation duration.

Table 4. Correlation analysis between landscape design intensity, preferences, and fixation.

	Group A		Group B		Group C		Group D		Group E		Total	
	P	DI	P	DI	P	DI	P	DI	P	DI	P	DI
FC	0.032	0.065	0.005	−0.036	−0.019	−0.061	0.052	0.041	−0.022	−0.010	0.011	−0.001
AFD	−0.06	−0.12	0.037	0.031	0.037	0.031	0.001	−0.025	0.011	0.009	0.005	−0.014
DI	0.296 ***		0.208 ***		0.287 ***		0.692 ***		0.823 ***		0.462 ***	

P: preference score, DI: design intensity, FC: fixation count, AFD: average fixation duration. ***: $p < 0.001$.

4. Discussion

This study examined the impact of landscape design intensity on visual preferences and eye fixations in urban forest settings. Using digital editing techniques, four versions of each landscape setting were created, including the original landscape and landscapes with low, moderate, and high design intensity. The findings revealed a positive relationship between landscape design intensity and visual preferences, indicating that preferences increased with higher design intensity. However, further analysis showed that moderate design intensity had the greatest influence on enhancing visual preferences. Additionally, preferences for the original landscapes negatively affected the impact of design intensity, although these relationships varied across different landscape types. Regarding eye fixations, there were no significant associations between fixation count and average fixation duration with landscape design intensity. However, significant relationships were observed between fixation measures and landscape type. Importantly, visual preferences did not show significant relationships with fixation counts or average fixation duration.

4.1. Design Intensity and Preferences

Urban forests offer opportunities for recreational experiences and close contact with nature, which have proven health benefits [5,67,68]. To attract more visitors to urban forests, landscape architects, urban planners, and urban forest managers should take into account public preferences in the design and management of these spaces. Our study's findings revealed that, in general, urban forest landscapes with higher design intensity were preferred more. This aligns with Kaplan and Kaplan's preference matrix [69], which suggests that people tend to prefer landscapes with higher coherence, complexity, mystery, and legibility. In our definition of design intensity, higher design intensity corresponds to increased landscape complexity, leading to higher preferences. Furthermore, landscapes with higher design intensity may also evoke a sense of mystery, as they tend to offer more elements to explore. Thus, it is plausible that landscapes with higher design intensity enhance visual preferences by enhancing landscape complexity and mystery.

However, our results contradict the findings of a study conducted by Xu et al., which found that moderate design intensity in natural and restored landscape settings resulted in higher aesthetic preferences [14]. Since our study focused on man-made urban forest settings specifically designed for human activities, it is possible that people prefer high design intensity in urban settings while favoring moderate design intensity in natural environments. Nevertheless, we do not assert that high design intensity is universally better for urban forest landscape design. Our results suggest a preference for moderate design intensity in garden path settings, indicating a preference for urban forests with a moderate level of design intensity. Additionally, preferences for design intensity are influenced by the specific landscape type. A similar study conducted by Suppakittpaisarn et al. [16] found a positive relationship, following a power curve pattern, between individuals' preferences and tree density and understory vegetation density, further supporting our findings.

Furthermore, our study found that, overall, the marginal effect of moderate design intensity had more power to increase visual preferences for landscapes. This finding aligns with the study by Xu et al. [14], which also observed that a moderate level of design intensity had more impact on improving landscape quality in natural and restored settings. Consistent with this, Jiang et al. [17] found that a power line model was identified as the most suitable and effective in describing the relationship between tree density and landscape preferences. The results indicated that a moderate density level exhibited the strongest ability to enhance preferences among participants.

4.2. Design Intensity and Fixation

The present study did not find any significant relationships between landscape design intensity and fixation count, or between landscape design intensity and average fixation duration. However, significant differences in fixation count and average fixation duration were observed among different landscape settings with low and high design intensities. Additionally, significant differences were found in average fixation duration when comparing the original images across different landscape types. Therefore, it can be inferred that design intensity does not significantly influence fixation count or average fixation duration, while landscape type does. Since there are limited studies exploring the relationship between landscape design intensity and eye movements, we did not find similar findings in the literature. However, a study by Dupont et al. [47] may provide some insights. They investigated the influence of urbanization level and landscape complexity on visual exploration using landscape images with varying degrees of urbanization. Their results suggested that both the urbanization level and landscape complexity can lead to extensive visual exploration, with urban landscapes eliciting more fixation counts compared to rural environments. Although we connected landscape design intensity with landscape complexity, our settings, even with different design intensities, did not exhibit significant variations in landscape complexity. Therefore, our findings regarding the lack of significant differences in fixation counts and average fixation duration between different design intensities are consistent with this reasoning. Furthermore, Franěk et al. [48] found that eye movements were fewer when viewing nature landscapes compared to ordinary urban scenes, with only minor differences observed between urban scenes and old city scenes. Thus, it is likely that eye movements are influenced more by landscape type rather than landscape design intensity.

4.3. Preferences and Fixation

Although earlier studies [50,55,56] suggested a significant relationship between landscape preferences and eye movement metrics, our findings did not support such a relationship. However, it is important to note that those earlier studies focused on preferences for beautiful human faces and may not be directly comparable to our study, which examined landscape preferences and eye movements in urban forest settings. Additionally, while studies have indicated a preference for natural landscapes [22,70], which tend to elicit lower eye movement activity [48,71], other studies suggest that old city scenes with high restorative qualities, which are also preferred by individuals [19,54,65,66], can produce a similar number of fixation counts as ordinary urban settings. Moreover, in our study, the images within each group only exhibited minor differences in terms of landscape elements. Therefore, it is possible that participants had a preference for one of the four images in each group, despite not showing significant differences in their eye movements.

4.4. Implications for Urban Forest Design

This study revealed that people generally prefer landscapes with higher design intensity, but the marginal effect of moderate design intensity has a stronger influence on improving visual preferences across multiple settings. It is important to note that high design intensity, which has been criticized in a prior study [72], may lead to over-design and wastefulness. Therefore, incorporating a moderate level of complexity in forest landscape design is likely to be more effective in enhancing individuals' preferences, offering a reliable approach to avoid excessive design. However, the specific landscape type should also be carefully considered in the design process. While determining the precise level of complexity or design intensity can be challenging, comparing different landscape proposals can help identify a proposal that strikes a balance with a moderate level of design intensity or complexity. The landscape settings with moderate design intensity used in this study can serve as valuable references for achieving this goal.

4.5. Limitations

There are several important limitations to consider in this study. Firstly, the lack of quantitative criteria to describe the levels of design intensity may reduce the practicality of our findings. Instead of using precise measurements, we categorized landscapes as low, moderate, or high design intensity based on the addition of elements to the original landscapes. This subjective categorization may introduce ambiguity and make it challenging to compare our results with other studies. Future research should aim to establish quantitative criteria for design intensity. Another limitation is the use of digital photos as stimuli. While this method allowed us to control the design intensity of the images, it may have created a sense of artificiality or lack of realism, potentially influencing participants' perceptions and preferences. Using real-life or immersive settings could provide a more ecologically valid representation of urban forest landscapes. Additionally, the fixed duration of 10 s for stimulus presentation may have imposed an artificial time constraint on participants' viewing experience. In reality, people spend varying amounts of time observing landscapes, and this fixed duration may not fully capture their natural viewing behavior. Future studies could consider implementing a more dynamic and flexible approach to stimulus presentation. Furthermore, the participant sample primarily consisted of students, which may limit the generalizability of our findings. Students may have different preferences and responses compared to other demographic groups. Including a more diverse range of participants, such as different age groups and educational backgrounds, would enhance the external validity of the results.

Despite these limitations, we believe that our findings contribute to the existing knowledge on the influence of design intensity on visual preferences in urban forest landscapes. However, further research addressing these limitations is warranted to strengthen the robustness and applicability of the findings.

5. Conclusions

This study explores the association between urban forest landscape settings, preferences, and eye movements in relation to design intensity. The findings contribute to our understanding of the impact of design intensity on eye movements and provide valuable insights for landscape architects, urban planners, and managers in creating appealing and aesthetically pleasing urban environments. It is evident that a moderate level of design intensity is more effective in enhancing landscape quality and preferences, making it a practical approach for improving urban settings. Furthermore, this study highlights the potential application of eye-tracking technology in landscape perception research, offering new avenues for studying human interactions with natural environments. Overall, these findings have practical implications for designing more livable and visually appealing urban spaces.

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References

1. Guo, X.; Liu, J.; Chen, Z.; Hong, X.C. Harmonious Degree of Sound Sources Influencing Visiting Experience in Kulangsu Scenic Area, China. *Forests* **2023**, *14*, 138. [CrossRef]
2. Hong, X.C.; Cheng, S.; Liu, J.; Dang, E.; Wang, J.B.; Cheng, Y. The physiological restorative role of soundscape in different forest structures. *Forests* **2022**, *13*, 1920. [CrossRef]
3. Hong, X.C.; Liu, J.; Wang, G.Y. Soundscape in urban forests. *Forests* **2022**, *13*, 2056. [CrossRef]
4. Roeland, S.; Moretti, M.; Amorim, J.H.; Branquinho, C.; Fares, S.; Morelli, F.; Calfapietra, C. Towards an integrative approach to evaluate the environmental ecosystem services provided by urban forest. *J. For. Res.* **2019**, *30*, 1981–1996. [CrossRef]
5. Hansmann, R.; Hug, S.M.; Seeland, K. Restoration and stress relief through physical activities in forests and parks. *Urban For. Urban Green.* **2007**, *6*, 213–225. [CrossRef]
6. Lee, J.; Park, B.J.; Tsunetsugu, Y.; Kagawa, T.; Miyazaki, Y. Restorative effects of viewing real forest landscapes, based on a comparison with urban landscapes. *Scand J. For. Res.* **2009**, *24*, 227–234. [CrossRef]
7. Karjalainen, E.; Sarjala, T.; Raitio, H. Promoting human health through forests: Overview and major challenges. *Environ. Health Prev.* **2010**, *15*, 1–8. [CrossRef]
8. Wallner, P.; Kundi, M.; Arnberger, A.; Eder, R.; Allex, B.; Weitensfelder, L.; Hutter, H.P. Reloading pupils' batteries: Impact of green spaces on cognition and wellbeing. *Int. J. Environ. Res. Public Health* **2018**, *15*, 1205. [CrossRef]
9. Jo, H.; Rodiek, S.; Fujii, E.; Miyazaki, Y.; Park, B.J.; Ann, S.W. Physiological and psychological response to floral scent. *Hortscience* **2013**, *48*, 82–88. [CrossRef]
10. Fjørtoft, I.; Sageie, J. The natural environment as a playground for children: Landscape description and analyses of a natural playscape. *Landsc. Urban Plan.* **2000**, *48*, 83–97. [CrossRef]
11. Herzog, T.R. A cognitive analysis of preference for urban nature. *J. Environ. Psychol.* **1989**, *9*, 27–43. [CrossRef]
12. Shen, Y.; Wang, Q.; Liu, H.; Luo, J.; Liu, Q.; Lan, Y. Landscape design intensity and its associated complexity of forest landscapes in relation to preference and eye movements. *Forests* **2023**, *14*, 761. [CrossRef]
13. Wang, R.; Zhao, J.; Meitner, M.J.; Hu, Y.; Xu, X. Characteristics of urban green spaces in relation to aesthetic preference and stress recovery. *Urban For. Urban Green.* **2019**, *41*, 6–13. [CrossRef]
14. Xu, W.; Zhao, J.; Huang, Y.; Hu, B. Design intensities in relation to visual aesthetic preference. *Urban For. Urban Green.* **2018**, *34*, 305–310. [CrossRef]
15. Zheng, J.; Tarin, M.W.K.; Jiang, D.; Li, M.; Ye, J.; Chen, L.; He, T.; Zhen, Y. Which ornamental features of bamboo plants will attract the people most? *Urban For. Urban Green.* **2021**, *61*, 127101. [CrossRef]
16. Suppakittpaisarn, P.; Jiang, B.; Slavenas, M.; Sullivan, W.C. Does density of green infrastructure predict preference? *Urban For. Urban Green.* **2019**, *40*, 236–244. [CrossRef]
17. Jiang, B.; Li, D.; Larsen, L.; Sullivan, W.C. A dose-response curve describing the relationship between urban tree cover density and self-reported stress recovery. *Environ. Behav.* **2016**, *48*, 607–629. [CrossRef]
18. Li, D.; Sullivan, W.C. Impact of views to school landscapes on recovery from stress and mental fatigue. *Landsc. Urban Plan.* **2016**, *148*, 149–158. [CrossRef]
19. Wang, X.; Rodiek, S.; Wu, C.; Chen, Y.; Li, Y. Stress recovery and restorative effects of viewing different urban park scenes in Shanghai, China. *Urban For. Urban Green.* **2016**, *15*, 112–122. [CrossRef]
20. Holtan, M.T.; Dieterlen, S.L.; Sullivan, W.C. Social life under cover: Tree canopy and social capital in Baltimore, Maryland. *Environ. Behav.* **2015**, *47*, 502–525. [CrossRef]
21. Staats, H.; Kieviet, A.; Hartig, T. Where to recover from attentional fatigue: An expectancy-value analysis of environmental preference. *J. Environ. Psychol.* **2003**, *23*, 147–157. [CrossRef]
22. Van den Berg, A.E.; Koole, S.L.; van der Wulp, N.Y. Environmental preference and restoration: (How) are they related? *J. Environ. Psychol.* **2003**, *23*, 135–146. [CrossRef]
23. Zheng, B.; Zhang, Y.; Chen, J. Preference to home landscape: Wildness or neatness? *Landsc. Urban Plan.* **2011**, *99*, 1–8. [CrossRef]
24. Arnberger, A.; Schneider, I.E.; Ebenberger, M.; Eder, R.; Venette, R.C.; Snyder, S.A.; Cottrell, S. Emerald ash borer impacts on visual preferences for urban forest recreation settings. *Urban For. Urban Green.* **2017**, *27*, 235–245. [CrossRef]
25. Amati, M.; Parmehr, E.G.; McCarthy, C.; Sita, J. How eye-catching are natural features when walking through a park? Eye-tracking responses to videos of walks. *Urban For. Urban Green.* **2018**, *31*, 67–78. [CrossRef]
26. Dupont, L.; Antrop, M.; Van Eetvelde, V. Eye-tracking analysis in landscape perception research: Influence of photograph properties and landscape characteristics. *Landsc. Res.* **2014**, *39*, 417–432. [CrossRef]
27. Dupont, L.; Ooms, K.; Antrop, M.; Van Eetvelde, V. Comparing saliency maps and eye-tracking focus maps: The potential use in visual impact assessment based on landscape photographs. *Landsc. Urban Plan.* **2016**, *148*, 17–26. [CrossRef]
28. Zhou, X.; Cen, Q.; Qiu, H. Effects of urban waterfront park landscape elements on visual behavior and public preference: Evidence from eye-tracking experiments. *Urban For. Urban Green.* **2023**, *82*, 127889. [CrossRef]
29. Liu, Q.; Zhu, Z.; Zeng, X.; Zhuo, Z.; Ye, B.; Fang, L.; Huang, Q.; Lai, P. The impact of landscape complexity on preference ratings and eye fixation of various urban green space settings. *Urban For. Urban Green.* **2021**, *66*, 127411. [CrossRef]
30. Ode, Å.; Fry, G.; Tveit, M.S.; Messager, P.; Miller, D. Indicators of perceived naturalness as drivers of landscape preference. *J. Environ. Manag.* **2009**, *90*, 375–383. [CrossRef]
31. Balling, J.D.; Falk, J.H. Development of visual preference for natural environments. *Environ. Behav.* **1982**, *14*, 5–28. [CrossRef]

32. Herzog, T.R.; Kropscott, L.S. Legibility, mystery, and visual access as predictors of preference and perceived danger in forest settings without pathways. *Environ. Behav.* **2004**, *36*, 659–677. [CrossRef]
33. Sullivan, W.C.; Lovell, S.T. Improving the visual quality of commercial development at the rural–urban fringe. *Landsc. Urban Plan.* **2006**, *77*, 152–166. [CrossRef]
34. Yang, J.; Zhao, L.; Mcbride, J.; Gong, P. Can you see green? Assessing the visibility of urban forests in cities. *Landsc. Urban Plan.* **2009**, *91*, 97–104. [CrossRef]
35. Nassauer, J.I. Culture and changing landscape structure. *Landsc. Ecol.* **1995**, *10*, 229–237. [CrossRef]
36. Van der Wal, R.; Miller, D.; Irvine, J.; Fiorini, S.; Amar, A.; Yearley, S.; Dandy, N. The influence of information provision on people's landscape preferences: A case study on understorey vegetation of deer-browsed woodlands. *Landsc. Urban Plan.* **2014**, *124*, 129–139. [CrossRef]
37. Bjerke, T.; Østdahl, T.; Thrane, C.; Strumse, E. Vegetation density of urban parks and perceived appropriateness for recreation. *Urban For. Urban Green.* **2006**, *5*, 35–44. [CrossRef]
38. Connell, H.J. Diversity in Tropical Rain Forests and Coral Reefs. *Science* **1978**, *199*, 1302–1310. [CrossRef]
39. Hiura, T. Gap formation and species diversity in Japanese beech forests: A test of the intermediate disturbance hypothesis on a geographic scale. *Oecologia* **1995**, *104*, 265–271. [CrossRef] [PubMed]
40. Molino, J.F.; Sabatier, D. Tree diversity in tropical rain forests: A validation of the intermediate disturbance hypothesis. *Science* **2001**, *294*, 1702–1704. [CrossRef] [PubMed]
41. Szentkirályi, F.; Kozár, F. How many species are there in apple insect communities?: Testing the resource diversity and interme diate disturbance hypotheses. *Ecol. Entomol.* **1991**, *16*, 491–503. [CrossRef]
42. Jorgensen, A.; Hitchmough, J.; Calvert, T. Woodland spaces and edges: Their impact on perception of safety and preference. *Landsc. Urban Plan.* **2002**, *60*, 135–150. [CrossRef]
43. Surová, D.; Pinto-Correia, T. Landscape preferences in the cork oak Montado region of Alentejo, southern Portugal: Searching for valuable landscape characteristics for different user groups. *Landsc. Res.* **2008**, *33*, 311–330. [CrossRef]
44. Tempesta, T. The perception of agrarian historical landscapes: A study of the Veneto plain in Italy. *Landsc. Urban Plan.* **2010**, *97*, 258–272. [CrossRef]
45. Karjalainen, E.; Tyrvainen, L. Visualization in forest landscape preference research: A Finnish perspective. *Landsc. Urban Plan.* **2002**, *59*, 13–28. [CrossRef]
46. Ramos, I.L. Exploratory landscape scenarios' in the formulation of landscape quality objectives. *Futures* **2010**, *42*, 682–692. [CrossRef]
47. Dupont, L.; Ooms, K.; Duchowski, A.T.; Antrop, M.; Van Eetvelde, V. Investigating the visual exploration of the rural-urban gradient using eye-tracking. *Spat. Cogn. Comput.* **2017**, *17*, 65–88. [CrossRef]
48. Franěk, M.; Šefara, D.; Petružálek, J.; Cabal, J.; Myška, K. Differences in eye movements while viewing images with various levels of restorativeness. *J. Environ. Psychol.* **2018**, *57*, 10–16. [CrossRef]
49. Berto, R.; Massaccesi, S.; Pasini, M. Do eye movements measured across high and low fascination photographs differ? Addressing Kaplan's fascination hypothesis. *J. Environ. Psychol.* **2008**, *28*, 185–191. [CrossRef]
50. Leder, H.; Mitrovic, A.; Goller, J. How beauty determines gaze! Facial attractiveness and gaze duration in images of real world scenes. *I-Perception* **2016**, *7*, 2041669516664355. [CrossRef]
51. Behe, B.K.; Bae, M.; Huddleston, P.T.; Sage, L. The effect of involvement on visual attention and product choice. *J. Retail. Consum. Serv.* **2015**, *24*, 10–21. [CrossRef]
52. Behe, B.K.; Huddleston, P.T.; Childs, K.L.; Chen, J.; Muraro, I.S. Seeing through the forest: The gaze path to purchase. *PLoS ONE* **2020**, *15*, e240179. [CrossRef] [PubMed]
53. van der Laan, L.N.; Hooge, I.T.; De Ridder, D.T.; Viergever, M.A.; Smeets, P.A. Do you like what you see? The role of first fixation and total fixation duration in consumer choice. *Food Qual. Prefer.* **2015**, *39*, 46–55. [CrossRef]
54. Orquin, J.L.; Loose, S.M. Attention and choice: A review on eye movements in decision making. *Acta Psychol.* **2013**, *144*, 190–206. [CrossRef]
55. Dixson, B.J.; Grimshaw, G.M.; Ormsby, D.K.; Dixson, A.F. Eye-tracking women's preferences for men's somatotypes. *Evol. Hum. Behav.* **2014**, *35*, 73–79. [CrossRef]
56. Maner, J.K.; Kenrick, D.T.; Becker, D.V.; Delton, A.W.; Hofer, B.; Wilbur, C.J.; Neuberg, S.L. Sexually selective cognition: Beauty captures the mind of the beholder. *J. Pers. Soc. Psychol.* **2003**, *85*, 1107. [CrossRef]
57. Kaplan, R.; Kaplan, S. *The Experience of Nature: A Psychological Perspective*; Cambridge University Press: Cambridge, IL, USA, 1989.
58. Femke, B.; de Kort Yvonne, A.W. Thinking of nature: Associations with natural versus urban environments and their relation to preference. *Landsc. Res.* **2019**, *44*, 374–392.
59. Nassauer, J.I. Framing the landscape in photographic simulation. *J. Environ. Manag.* **1983**, *17*, 1–16.
60. Palmer, J.F.; Hoffman, R.E. Rating reliability and representation validity in scenic landscape assessments. *Landsc. Urban Plan.* **2001**, *54*, 149–161. [CrossRef]
61. Rodiek, S.D. *Therapeutic Potential of Outdoor Access for Elderly Residents at Assisted Living Facilities*; University of Cardiff: Cardiff, UK, 2004.
62. Waldheim, C.; Hansen, A.; Ackerman, J.S.; Corner, J.; Brunier, Y.; Kennard, P. *Composite Landscapes: Photomontage and Landscape Architecture*; Hatje Cantz Verlag: Ostfildern, Germany, 2014.

63. Syed Abdullah, S.S.; Awang Rambli, D.R.; Sulaiman, S.; Alyan, E.; Merienne, F.; Diyana, N. The impact of virtual nature therapy on stress responses: A systematic qualitative review. *Forests* **2021**, *12*, 1776. [CrossRef]
64. Tabrizian, P.; Baran, P.K.; Smith, W.R.; Meentemeyer, R.K. Exploring perceived restoration potential of urban green enclosure through immersive virtual environments. *J. Environ. Psychol.* **2018**, *55*, 99–109. [CrossRef]
65. Nordh, H.; Hagerhall, C.M.; Holmqvist, K. Tracking restorative components: Patterns in eye movements as a consequence of a restorative rating task. *Landsc. Res.* **2013**, *38*, 101–116. [CrossRef]
66. Dupont, L.; Antrop, M.; Eetvelde, V.V. Does landscape related expertise influence the visual perception of landscape photographs? Implications for participatory landscape planning and management. *Landsc. Urban Plan.* **2015**, *141*, 68–77. [CrossRef]
67. Kondo, M.C.; Fluehr, J.M.; McKeon, T.; Branas, C.C. Urban green space and its impact on human health. *Int. J. Environ. Res. Public Health* **2018**, *15*, 445. [CrossRef] [PubMed]
68. Lennon, M.; Douglas, O.; Scott, M. Urban green space for health and well-being: Developing an 'affordances' framework for planning and design. *J. Urban Des.* **2017**, 778–795. [CrossRef]
69. Kaplan, S.; Kaplan, R. *Cognition and Environment: Functioning in An Uncertain World*; Preager: New York, NY, USA, 1982.
70. Bao, R. Excessive design of city landscape environment (in Chinese). *Anhui Archit.* **2006**, *13*, 24–25.
71. Hartig, T.; Staats, H. The need for psychological restoration as a determinant of environmental preferences. *J. Environ. Psychol.* **2006**, *26*, 215–226. [CrossRef]
72. Valtchanov, D.; Ellard, C.G. Cognitive and affective responses to natural scenes: Effects of low level visual properties on preference, cognitive load and eye-movements. *J. Environ. Psychol.* **2015**, *43*, 184–195. [CrossRef]