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Differences in Environmental Information Acquisition from Urban Green—A Case Study of Qunli National Wetland Park in Harbin, China

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Abstract: (1) Environmental education in an urban setting is crucial in terms of building a harmonious relationship between man and nature. As a kind of special ecological habitat, urban wetland parks provide convenience to enhance education on the natural environment. (2) In this study, we chose Harbin Qunli National Wetland Park in China as the subject, and analyzed the visual attention area with eye tracking to explore the differences in obtaining information about the natural environment in tourists with varying degrees of environmental concern and purposes of visit. A model connecting the perception preference and factors that affect visual attention of tourists was constructed. (3) Studies have shown that eco-society-hedonic tourists, who focus on parent–child activities, tend to pay more attention to wetland plants and prefer exploratory paths, while eco-hedonic tourists, whose main purposes are to relax and exercise, are more concerned about explanatory signs and enjoy flat scenic paths more. In addition, social tourists, who pay their visit for social activities, would care more about bird watching structures. (4) This research aims to assist in improving the legibility of environmental education space through the planning, design, and management of urban wetland parks, and explore the potential of landscape elements in enhancing public awareness.

Keywords: environmental education; urban green; visual behavior; environmental concern; wetland park

1. Introduction

1.1. Research Problem

Natural environment education refers to the integration of environmental knowledge and the establishment of a connection with nature, forming an ideology of caring for and protecting nature as well as fostering responsible behaviors for the environment [1,2]. As urbanization and industrialization proceed, urban residents are gradually being separated from the natural environment, with few opportunities to interact with it [3,4]. In addition, environmental problems in cities have reduced the natural resources that can be integrated into educational activities. Therefore, strengthening natural environmental education in urban areas is essential for sustainable development [5].

The attention area of the natural environment is very important to how effective natural environmental education can be and their degree of awareness of the natural environment [6,7]. The composition and characteristics of landscape elements affect the people's perception preference on the natural environment, and data about visual gazes can help determine the impact of natural elements on the perception of urban residents [8]. Dobbie analyzed people's preference of wetlands in the State of Victoria, indicating that several landscape elements, namely brown grasslands, green grasslands,

emergent vegetation, tall trees, and open water, could enhance the aesthetic appreciation for wetlands in the general public [9]. Dupont studied the impact of landscape features on visual perception and found that closed landscape elements are easier to identify than their opening counterparts, while heterogeneous features are more attractive than homogeneous ones [10]. Zahra showed that in summertime, visitors' visual preference is in a positive correlation with the number of flowers and percentage of canopy cover [11].

The areas preferred by the tourists can provide more natural knowledge information [12], and previous studies have found that the aesthetic preference for wetland aquatic plants affects people's perception of the ecological value of wetlands as a whole [13]. People's perception of biodiversity and life-sustaining services are strongly related to vegetation cover [14]. Cottet explored the impact of landscape elements in a wetland on its aesthetics and people's perception of its health through questionnaires and photos. The results showed that aspects such as the degree of transparency and color of water, the presence and appearance of aquatic vegetations, as well as the presence of sediments, are influential on people's awareness in the environment, ecology, and aesthetic value [13]. In addition, studies have shown that the scenic environment plays a vital role in promoting tourists' environmental awareness [15]. The perceived environmental quality is an important prerequisite to affect tourists' attitudes towards environmentally responsible behaviors [16].

The environmental resources in urban wetland parks provide convenience to develop natural environmental education [17]. Urban wetland parks contain special values in ecology, culture, aesthetics, and biodiversity, which are good materials for education [18,19]. In addition, as the major space for sightseeing, leisure, and science education, the wetland parks provide the possibility for environmental education [20]. However, the quality of current urban wetland parks fails to meet the tourists' needs for environmental education, which are short in landscapes that could effectively transmit information to enhance tourists' understanding of the ecological environment. Therefore, it is necessary to understand how to use environmental resources in urban wetland parks as teaching materials to promote citizens' ecological literacy through tourist activities and experiences.

1.2. Goals and Research Questions

All these studies showed that there may be a connection between the visual attention of landscape elements, the visitors' perception preference, and their understanding of the environmental information. The purpose of this research is to study the different visual concerns on urban wetland parks by people of diversified environmental concerns, quantify tourists' perception of different landscape elements based on visual attractiveness, and explore the potential in these elements to enhance people's understanding of environmental information and promote public awareness. Figure 1 illustrates the conceptual framework of the article. The conclusions of the current research can assist in wetland management and design (including education programs), therefore, improving the parks' function of environmental education. In other words, this research investigates the following research questions (RQ):

- RQ1: Is there a certain correlation between tourists' perception preferences and their visual attention to landscape elements?
- RQ2: In a wetland park, what are the differences in the visual perception preferences of the environmental elements among people with different environmental concerns?
- RQ3: For tourists with varied purposes of visiting, which way is easier to obtain information about the natural environment?

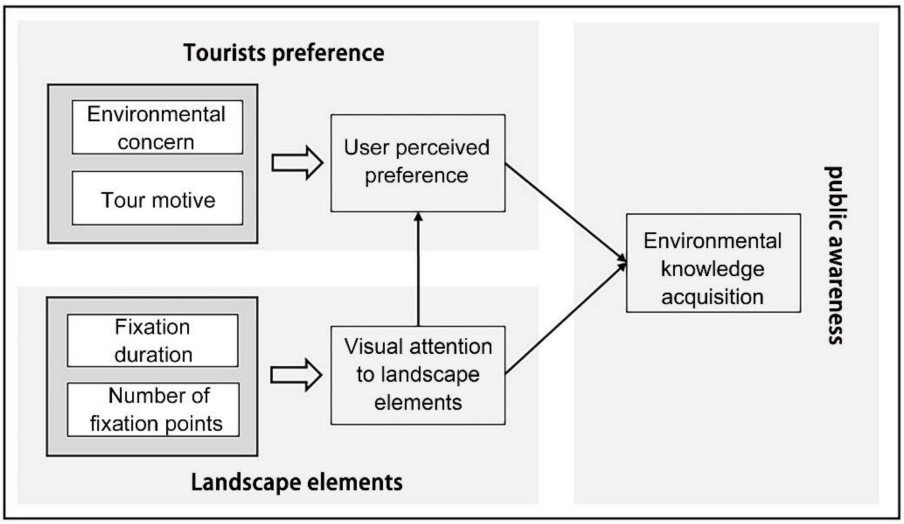


Figure 1. Our conceptual framework.

2. Materials and Methods

2.1. Study Area

Qunli National Wetland Park is located at the center of Qunli New District, Harbin, China. It was acknowledged as one of the sixth batches of National Urban Wetland Parks and won the 2012 ASLA Professional Award. It covers an area of 303,000 square meters (Figure 2). Qunli National Wetland Park plays a demonstrative role in the construction of national parks and nature reserves.

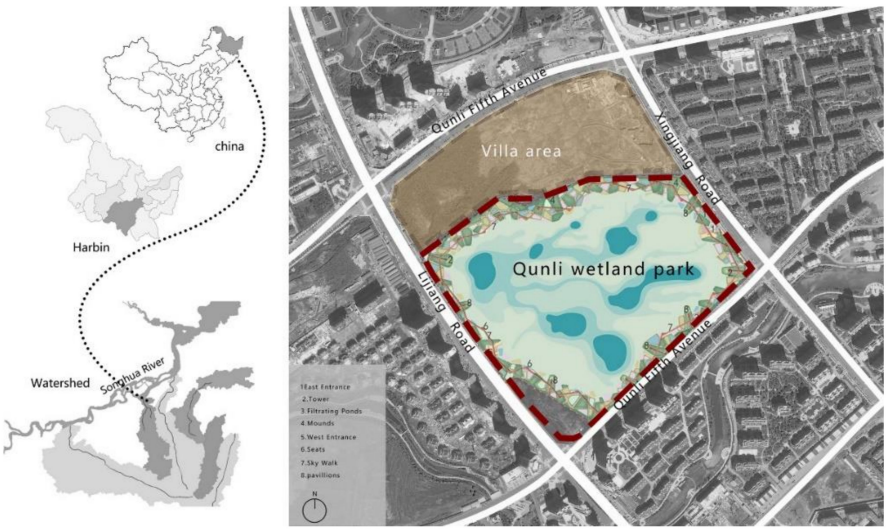


Figure 2. Location of the study area: Harbin City, Heilongjiang Province, China; Source: According to Harbin administrative location self-painting.

The transportation system inside the park consists of upper, lower, and vertical traffic layers. The upper-level traffic is an aerial trestle that spans around the outer boundary of the artificial wetland, linking towers, boxes, and platforms for viewing together. The lower traffic is a ridge system that bridges between wetland and topographic bubbles inside the man-made wetland, serving as a recreational trail for people to experience the wetland up close. The vertical system is a winding road on the several spots of wetland bubbles, connecting the trestle bridge with the lower trail for a smoother vertical transport between the upper and lower layers.

2.2. Materials and Experiments

This study adopts a design of exploratory sequential research, which includes qualitative and quantitative data collection and analysis. The research design of mixed approaches helps to provide a deeper understanding of the research topics, since qualitative results demonstrate in-depth personal views while quantitative ones reveal trends and relations. It consists of three stages: Questionnaire survey and analysis, qualitative analysis through eye movement observation experiments, and semi-structured interviews [21].

The first stage is to specify the basic information, purpose of visit and attitude toward environmental issues of the visitors to the wetland park through questionnaire surveys and analysis afterwards. The questionnaire survey was conducted in Qunli National Wetland Park, Harbin, from March to June 2020. First, a pilot study was initiated and the questionnaire was revised based on the feedback. The final version, whose link was sent to the park visitors for them to fill in, was distributed online through questionnaire survey services. To ensure the authenticity and reliability of the survey results, we distributed and did surveys on the questionnaires both on weekdays and weekends, respectively. The distribution happened five times in each time period, and a total of 200 questionnaires were distributed, 190 of them were valid for research purposes. The questionnaire was distributed simultaneously with the wetland park photos collected, and the important landscape nodes in the tour route in the Qunli Wetland Park were taken as the materials for eye movement experiments in the second stage. The photos were shot with consistent composition and landscape only. All photos were taken by the same one person.

In the second stage, an eye tracking experiment was conducted. Eye tracking is an experimental method of recording eye motion and gaze location across time and task [22]. It is a common method for observing the allocation of visual attention. We randomly selected 30 people who took part in the questionnaire interviews to participate in the experiment, of which 13 were males and 17 were females. After a careful selection, 32 pictures describing the wetland park nodes were selected, which included different forms of tourist routes as well as various environmental elements, such as interpretive signs, bird watching structures, plants and animals, and climate information. In addition, we used the Tobii Pro Glass 2 eye tracker to record the eye movement data of the participants looking at the landscape picture. During the experiment, 32 experimental pictures were presented randomly, and the total experiment time was 25 min. In the final stage, semi-structured interviews were carried out with the participants, and we formulated a series of open questions to ask them, including their feelings when visiting, their perceptions of the park's ecological functions. By doing this, we hoped to explore the wetland park visitors' attitudes towards issues related to the environment and ecological education within.

2.3. Measure Instruments

In the questionnaire section, the tourists' attitudes towards the environment are evaluated by the environmental concern scale proposed by Schultz as an experimental measurement tool [23]. The scale consists of three interrelated dimensions, namely Biospheric Concerns, Egoistic Concerns, and Altruistic Concerns. It is made up of a total of 12 questions, applying the Likert scale from "least important" to "most important". (Please refer to the attached Tables A1 and A2 in the Appendix A for details of the environmental concern scale).

We chose four variables as the indicators for the eye movement, which are first fixation time, fixation time, average fixation time, and the number of fixations. The first variable reflects the degree of attention priority to a certain area. The shorter it is, the easier the information can be identified [24]. Fixation duration refers to the period within which gaze is held within a certain position. If the sum of all fixation durations directed at a certain area were longer than those directed at other areas, this would suggest a deeper level of processing of the regional information. The average fixation duration refers to the average time taken by the participants for each fixation. When participants had no specific task and watched freely, the longer it is, the more attractive the element is and the more

interested the participants are. As a fourth metric, the number of fixations can also be used as an indicator of efficiency: The higher the number of fixations in a certain area, the less efficient a person was in searching for the relevant information, as they had to fixate additionally [25].

In order to study the influence of environmental factors on fixation behaviors, we defined an area of interest (AOI) in the picture view (Figure 3). We defined eight types of objects and digitized them, which are travel paths, plants, bird-watching structures, interpretive signs, surrounding buildings, weather, protective and recreational facilities in particular. By analyzing the eye movement data on different environmental elements, we can look into the subjects' characteristics of visual perception and information recognition of the wetland park environment.

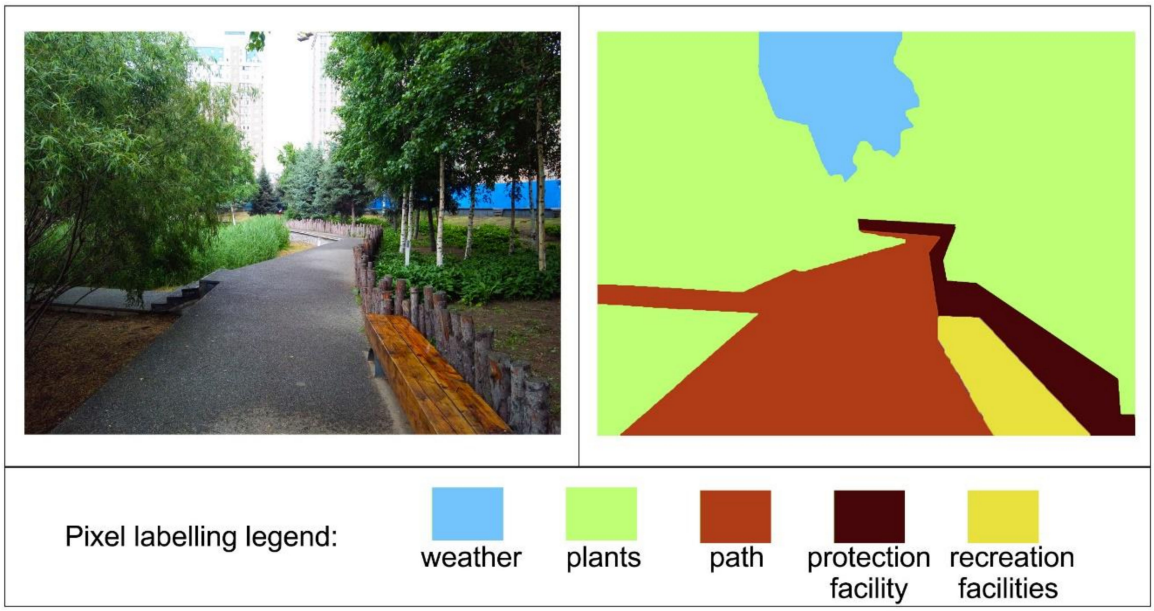


Figure 3. Interest area division.

3. Results

3.1. Differences in Environmental Awareness of Different Tourist Purposes

We conducted an in-depth collection of the visitors' personal information, purposes of visit, and environmental awareness in the wetland park through questionnaires. A total of 203 participants completed the survey, with 190 of them being valid for research. Among the participants, 86 were male and 104 were female. Tourists aged 26–35 accounted for more than half of the overall sample, while those ranging between 36 and 45 ranked the second. Those with a bachelor's degree or above account for about two-thirds of all the research samples, demonstrating a high degree of education in general, making their answers highly valuable for reference.

The tourists' purposes of visit could be divided into four main types: Daily exercise, social activities, parent–child activities. and personal relaxation. Among them, we made further divisions within the types of social activities and parent–child activities based on the number of companions. It turns out that more people come to the wetland park for parent–child activities, followed by double tours and individual relaxations. A cross-analysis based on age groups found that double tours are more popular among participants aged 18–25, and most tourists aged 26–45 pay their visits for parent–child activities, and most visitors who come to the park for daily exercise are 45 years old and above (Figure 4a).

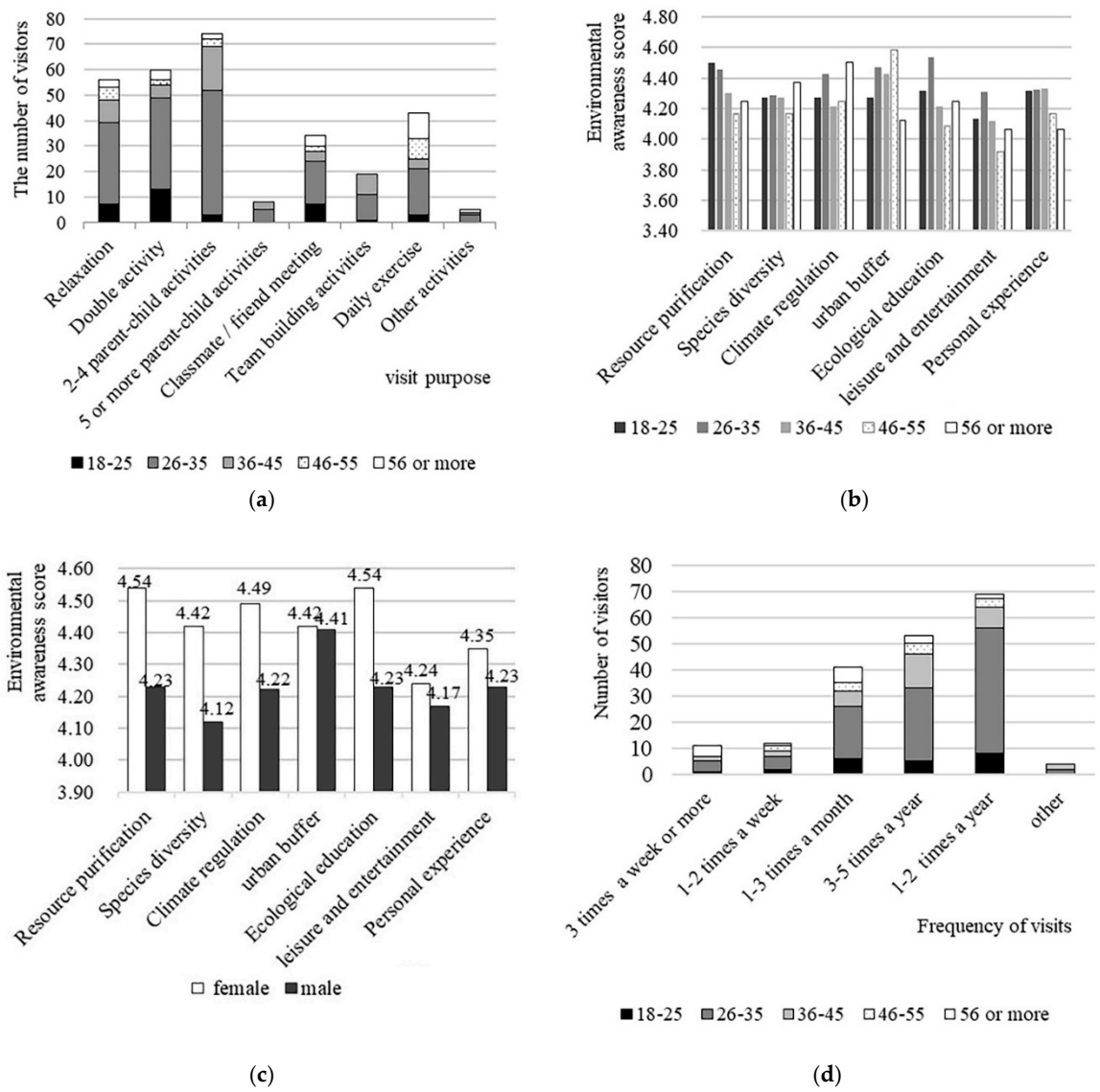


Figure 4. Socio-demographic profile of the tourist: (**a**) Number of visitors of different ages for different purposes, (**b**) number of visitors of different age with different tour frequencies, (**c**) environmental awareness scores for visitors of different genders, (**d**) environmental awareness scores of visitors of different age.

After analyzing the statistics of the visit frequency to Qunli Wetland Park, we found that most tourists visit 1–2 times a year, and those who visit 3–5 times a week are the fewest. In addition, there was a negative correlation between the visit frequency and the corresponding proportion in the total sample. A cross-analysis based on the age of tourists found that tourists aged 56 years and above visit significantly more frequently than those of other age groups, while those aged 45–55 visit slightly less frequently than the others (Figure 4b).

A quantitative analysis of the environmental awareness of the samples found that women scored higher than men on all environmental concerns (Figure 4c). Middle-aged people seem to believe that the function of ecological education wetlands is very important (Figure 4d). The environmental awareness scores of the respondents for different purposes are as shown in Table 1, the mean value is presented. Most tourists reckon that urban wetlands are very important to urban buffering, climate regulation, ecological education, resource purification, species diversity, leisure and entertainment, as well as personal experience. Among them, people whose main purposes are to relax and exercise think that the roles of resource purification and urban buffering are extremely important, while functions of

leisure and entertainment are relatively insignificant (Table 1). People who focus on double tours or parent–child trips have strong environmental awareness and a more balanced understanding of the seven functions of wetland parks, believing that they are all important (Table 1). The people who aim at gatherings and teamwork construction are more concerned about the role of environmental education compared to recreational ones (Table 1).

Table 1. The environmental awareness scores of the respondents.

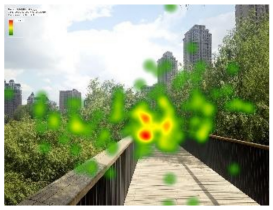
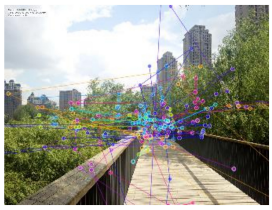
	Frequency / Factors	Grade (1- Least Important, 5- Most Important)					Mean
		1	2	3	4	5	
eco- hedonic tourist (Relaxation, Daily exercise)	Resource purification						4.53
	Species diversity						4.39
	Climate regulation						4.51
	urban buffer						4.57
	Ecological education						4.47
	leisure and entertainment						4.12
	Personal experience						4.31
eco-social-hedonic tourist (Double activity, 2–4 parent–child activities, 5 or more parent-child activities)	Resource purification						4.30
	Species diversity						4.36
	Climate regulation						4.32
	urban buffer						4.42
	Ecological education						4.38
	leisure and entertainment						4.37
	Personal experience						4.30
social tourist (Classmate/friend meeting, Team building activities)	Resource purification						4.21
	Species richness						4.17
	Climate regulation						4.33
	urban buffer						4.45
	Ecological education						4.46
	leisure and entertainment						4.05
	Personal experience						4.25

3.2. *Differences in Environmental Information Acquisition on Three Tour Routes*

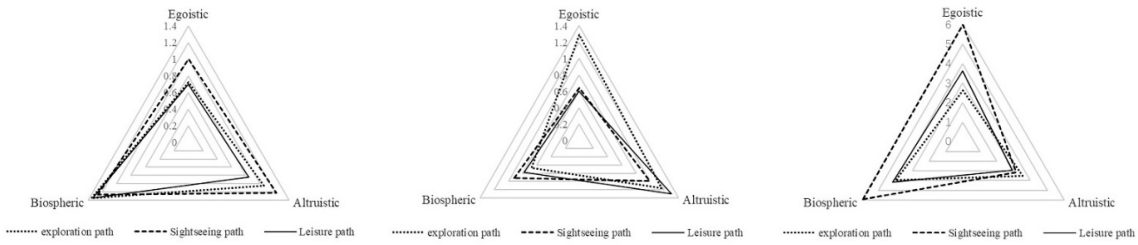
The wetland park contains three types of tour paths, namely exploration path, sightseeing path, and leisure path, respectively. A visualization of the fixation point and time was applied to obtain the heat map and trajectory map for eye movement. We define the superimposed dark color in the heat map to indicate areas that have been looked at more times and for a longer time period, while the lighter color represents a reduction in the time of being gazed at and the gaze time period. After a comparison of the fixation duration, the number of fixation points, the first fixation time, and pictures

of the heat map and trajectory map (Table 2) of these three, it was found that the former two variables for the wooden plank roads in the sightseeing path and the trails in the leisure path trail are higher than the average value, while for the winding mountain trails in the exploration path, both of them end up to be the lowest. The first fixation time on the wooden plank roads is the shortest, and much longer than the average for flat leisure paths. The results indicate that in the wetland park setting, the sightseeing path is rather attractive and people can quickly identify environmental information within. On the other hand, the exploration path is less tempting, leading to more difficulties in retrieving environmental information.

Table 2. Eye movement data of different tour routes.

	Leisure Path	Sightseeing Path	Exploration Path
heat map			
trajectory map			
Fixation duration	1.03	1.38	0.97
Number of fixation points	3.6	4.5	3.3
First fixation time	0.85	0.87	1.02

The fixation data of people concerned with different environments on threes tour routes are shown in Figure 5. Generally speaking, for both egoistic and altruistic concern, they both exhibit the longest fixation time on the wooden plank in the sightseeing path with the shortest first fixation time, indicating the path can quickly arouse the attention from such people. Those with their strongest concerns on the biosphere spend the longest time looking at the winding trails in the exploration path with the shortest first gaze time, demonstrating more visual attention. In addition, the fixation points of people with biosphere concerns on the winding trails are more divergent, and the subjects generally consider the exploration path to be more mysterious.



(a) **(b)** **(c)**

Figure 5. Eye movement data of different tour routes: (**a**) fixation duration, (**b**) first fixation time, (**c**) number of fixation points.

3.3. Differences in Visual Attention among Visitors' Different Environmental Concern

Environmental elements in the wetland park consist of tourist pathways, plants, bird-watching structures, interpretive signs, surrounding buildings, weather environment, as well as facilities for protection and leisure. Based on the comparison results of the first fixation time on each environmental element, we discover that time on plants, bird-watching structures, and interpretive signs is shorter, but with a longer fixation time period (Figure 6). Therefore, it is fair to say these elements in the wetland setting are easier to identify. However, the number of fixation points on plants is the largest with a random distribution, indicating that the search efficiency for plant information here is low and lacks intercorrelation.

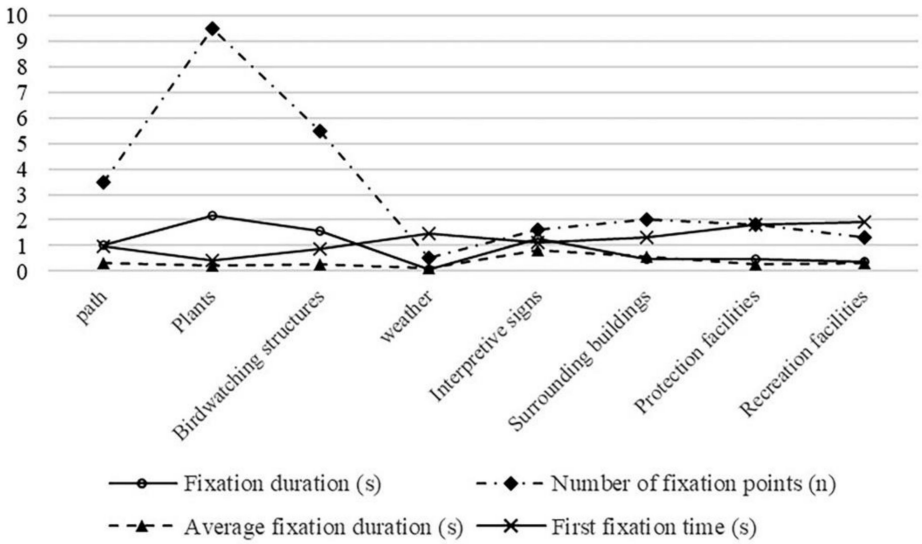


Figure 6. Eye movement data of different environmental factors.

From the trajectory map and the heat map, the fixation points are mainly concentrated on the junction between the horizon and the road in the pictures, the bird-watching structures with significant morphological characteristics or the interpretive signs with sharp contrast in colors. The fixation points of those with an altruistic concern about the environment are scattered, and they put strong attention to the weather, interpretive signs, facilities for breaks. On the other hand, visitors with egoistic and biospheric concern exhibit a more concentrated pattern of fixation points, with the former on bird watching structures and the latter on plants. The former type of visitors have the longest fixation period and the biggest amount of fixations on the bird-watching structures, indicating that they are more concerned about them (Figure 7). Those with an altruistic concern show a short first fixation time for interpretive signs with a large number of fixations, and the information is captured quickly. Compared with those with egoistic and altruistic environmental concerns, visitors with biospheric concern gaze longer and more frequently at roadside plants and trails.

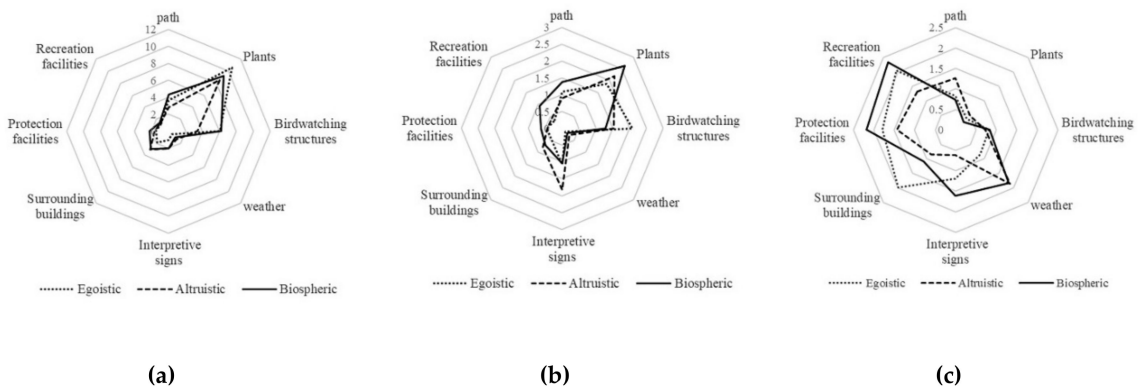


Figure 7. Eye movement data of subjects with different environmental concerns: (**a**) Fixation duration, (**b**) first fixation time, (**c**) number of fixation points.

4. Discussion

This study shows that tourists' motivation and environmental concerns affect tourists' visual preferences for the environment. Combining the analysis of motivation and environmental awareness, we identified three types of tourists, namely eco-social-hedonic tourists, eco-hedonic tourists, and social tourists. Among them, eco-social-hedonic tourists are the most common, while social tourists are the least in numbers. Eco-society-hedonic tourists consist of mostly middle-aged people for parent–child activities, and they come to the park more frequently. Falk shows that people who like to travel with their families pay more attention to the environment [26]. We found that these tourists attach great importance to the ecological functions of the wetland parks. Crompton showed that attitudes influence tourists' choices of destinations, and the intrinsic motivation of tourists' values and interests can generate higher intention to visit a destination [27,28]. Suziana also showed that biosphere-centered people have an active visual preference for biodiversity [29]. We found that eco-society-hedonic tourists pay more attention to the biosphere environment and have a strong visual preference for wetland park plants. Therefore, natural environmental resources in wetland parks, such as plants, can be used for nature education activities, such as those fostering science awareness and enhancing parent–child relationships in nature, as well as research trips.

Eco-hedonic tourists are mostly the middle-aged and the elderly. Their main purpose of visiting is either to relieve stress or to exercise, with more concerns on the urban buffering and resource purification functions of wetland parks. Wolf shows that trails with interpretive signs have a stronger attracting and holding powers to attract visitors who like nature and enhance their experience [30]. We found that eco-hedonic tourists have a visual preference for interpretive signs with significant contrast in colors and ornamental paths in wetland parks. Dobbie suggested providing on-site explanations and educational programs to improve wetland familiarity [9]. In addition, tourists pay strong visual attention to the turning and the finale points of the ornamental paths. Therefore, we can design some ornamental paths in the wetland park, and integrate innovative signs of interpretive signs across the tour paths by setting most of them at the ends or turning points of the roads or important scenic spots along the road to build a perfect system for outdoor recreation and interpretation.

Social tourists mostly focus on gatherings and activities of team building. Consequently, their focuses are the wetlands' educational functions, and their visual preference is for bird-watching structures. Therefore, we can start more activities that display and introduce knowledge about the environment in the wetland park. Moreover, by organizing wetland-related activities, such as human–bird interactions, like bird-watching and feeding, on bird-watching structures or bird-feeding, we can promote the degree of participation and enrich the whole experience in ecological education activities.

5. Conclusions

All in all, perceptual preference and the area of visual attention are correlated. Tourists in the urban green space are different in terms of the landscape elements they pay attention to due to their variances in travel purposes and environmental concerns. Eco-society-hedonic tourists who focus on parent–child activities are generally more concerned about the biosphere environment, especially plants and exploratory paths. Most eco-hedonic tourists come for the purposes of relaxation and fitness. These tourists pay more attention to the altruistic environment and have a strong focus on interpretive signs and ornamental paths. Finally, social tourists who visit for social activities are mainly concerned about the egoistic environment, with a high degree of attention to bird watching structures. In the education setting for the natural environment in cities, reasonable design of tourist routes and educational activities based on the visual preferences of different environmentally concerned people and the purposes of visiting can promote ecological literacy of the public and sustainable evolution of the city.

The research method and results can be further applied in the following situations: Through the overlap between environmental education and design disciplines, we explored the differences in the visual attention areas of tourists with different tourism purposes and entertainment preferences, and enhanced the potential of landscape elements in enhancing environmental awareness. In addition, they can set up the foundation for the planning, design, and management of wetland parks, so as to achieve their significance in environmental education.

The research method we applied was conducted with certain limitations. We used laborator eye-tracking equipment with a pre-determined viewing angle and observation range to collect photos. Consequently, we failed to comprehensively consider the effect of peripheral objects and information in the real environment on the observational experiments, leading to deviations in results. Therefore, the characteristics and differences of the visual behaviors between the actual scene environment and their photos is a topic worthy of further discussion. In addition, the landscape space inside a wetland park is relatively simple, which is conducive to the exploration of travel paths, but it may be necessary to perform a thorough investigation of the landscape elements in integrated urban green spaces.

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

Appendix A

1. Please fill in the following information.

Table A1. Personal information.

Questionnaire Number:.		**Date:**
Gender	**Male** □ **Female** □	**Age**
Type of residence	Urban □ Counties □ town □ rural □	
Education level	Primary school and below □ Junior high school □ High school □ University □ Master's degree and above □	
Socioeconomic status	Low □ medium □ High □	
Environmental knowledge level	Low □ medium □ High □	

2. Measuring environmental motives: Items in English.

People around the world are generally concerned about environmental problems because of the consequences that result from harming nature. However, people differ in the consequences that concern them the most. Please rate each of the following items from 1 (not important) to 7 (supreme importance) in response to the question:

Table A2. Measuring environmental motives.

		1	2	3	4	5	6	7
1	Marine life							
2	Birds							
3	Plants							
4	Animals							
5	Future generations							
6	People in my country							
7	All people							
8	Children							
9	My health							
10	My future							
11	My lifestyle							
12	Me							

3. Please answer the following questions.

1. Have you ever been to Qunli Wetland Park? Do you know this place?
2. What is the general purpose of going to the Wetland Park?
3. Which season do you like to go to the Wetland Park? Why?
4. Which kind of trail would you choose when you go to the Wetland Park?
5. What is your impression of the existing landscape in the wetland park? Please describe according to your real thoughts

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