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How Do Urban Waterfront Landscape Characteristics Influence People's Emotional Benefits? Mediating Effects of Water-Friendly Environmental Preferences

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Abstract: Landscapes in urban waterfront spaces are of high societal value as they can meet people's physical, psychological, and social needs for health and well-being, but the relationship between waterfront landscape features and public health benefits has yet to be clarified. From the perspective of blue health, this paper takes blue spaces along the Min River of Fuzhou City as the research object. It constructs the mediation model of "Waterfront landscape characteristic (WLC)→Water-friendly environmental preference (WEP)→Emotional benefit (EB)". The role of WEP in the mechanisms linking WLC and EB in different waterfront spaces was explored through the quantification of indicators, questionnaires, and physiological measurements. The main results showed that (1) the ability of different types of waterfront spaces to arouse positive emotions in the population is characterized by blue-dominated space > co-dominated space > green-dominated space, while the opposite is true in terms of inducing negative emotions; (2) green visibility, blue visibility, naturalness, water-friendliness, and openness are all significantly related to EBs and could affect positive emotions either directly or mediated by WEPs, but openness seems not to affect negative emotions through WEPs; (3) cleanliness affects the population's WEP for the coherence dimension, but has no significant role in improving EBs. This study could expand new ideas for research in habitat health, provide a reference for embodied evidence-based waterfront landscape design, and help promote the construction and development of healthy cities.

Keywords: blue health; landscape perception; restorative environment; emotional benefit; urban forests; mediating effect

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1. Introduction

The benefits to public health and well-being from blue-green spaces are central to the construction and development of urban habitats [1–3]. Globally, nature deficit disorder puts urban populations in a long-term sub-healthy state [4], while urban forests and urban watersheds provide access to nature [5]. In the meantime, as urban forests are increasingly encroached upon by construction [6], and as populations near large water bodies increase in size, urban blue spaces may become increasingly important sites for recreation. Thus, incorporating evidence on the salutogenic effects of certain exposures to blue spaces into urban planning and development of urban infrastructure could contribute to tackling critical public health challenges [7,8].

With the advancement of waterfront regeneration projects globally over the past 20–30 years, the focus of blue space landscape planning has gradually shifted from economic and ecological benefits to public health services [9,10]. The humanized experience of

sustainable pleasure becomes a long-term endogenous driving force for spatial renewal. A growing body of research confirms that natural environments repair physical and mental health in ways that include attention restoration, stress relief, emotional regulation, and physical activity [2,3,11,12], and waterfront forest environments are of special significance in improving public health and enhancing well-being [1]. However, many studies have considered urban waterfront environments only as part of the urban forest, focusing primarily on the health-promoting effects of vegetation on people [13,14], which may bring about the fact that the health benefits of blue spaces based on the water environment are often overlooked [15].

Moreover, differences in waterfront landscape character could directly affect public health and well-being. On the one hand, McDougall's findings suggest that frequently visiting rivers, canals, and the sea, but not green spaces or lakes, is associated with greater mental well-being [16]. On the other hand, Luo and Zhao found that easy accessibility to waterscape and falling blue space normally implies better mental fatigue recovery for the respondents [17,18]. Nevertheless, most existing studies confirm waterscape's unilateral impact on "public preference" or "psychological recovery", and few people correlate the two, leaving more potential influence pathways unexplored.

Most of the studies on the landscape perception and evaluation of blue space are survey-based, including self-assessment reports, questionnaires, public participation GIS-based surveys, and big data surveys [16,18–20]. Meanwhile, some studies have utilized remotely sensed data and Viewshed tools for spatial statistics and quantification [20,21], while others have used the Bluehealth Environment Assessment Tool (BEAT) and other health element evaluation systems to measure health benefits of waterfront environments [22,23]. The acquisition of data from multiple sources has provided a basis for advancing this research area, but very few of them used objective measures, such as physiological and hormonal measures, to assess the effects of mental health promotion [17].

In addition, the analytical methods for exploring blue health are more diverse, mainly regression analysis, analysis of variance, and path analysis [8–10,24]. However, most empirical studies have explored the correlation or causation between waterfront environments and mental health, and fewer studies have focused on the mediating effects of the population itself in terms of environmental preferences for sensory stimulation, motivation to visit nature, need for physical activity, and need for privacy protection [2]. Notably, it is this mediating effect that adds to the diversity of ways in which blue health is promoted, but it has not yet been clarified by existing research.

Accordingly, the blue open space along the Min River within the city of Fuzhou, China, is used as an example to explore the relationship between the waterfront landscape characteristic, the water-friendly environmental preference, and the emotional benefit. Specifically, based on analyzing the differences in population perceptions of different types of waterfront spaces, the water-friendly environmental preference is used as a mediating variable to explore the influence mechanism of waterfront landscape characteristics on emotional benefits. The research will contribute to the active development of planning and design paradigms oriented towards improving emotional benefits, promoting physical and mental health, and accurately promoting the translation of potential health benefits of urban waterfront spaces.

2. Methodology

2.1. Conceptual Framework

As shown in Figure 1, from the perspective of blue health promotion, the hypothesis path of "Waterfront landscape characteristic (WLC)→Water-friendly environmental preference (WEP)→Emotional benefit (EB)" was proposed based on the coupling of the Landscape Perception Theory (LPT) and the Cognitive Appraisal Theory (CAT). The LPT suggests that landscape perception is the process of interaction between a scene's objective features and a person's subjective preferences, which in turn triggers the person's psychological activity or behavior (outcome). Meanwhile, the CAT holds that external stimuli

affect human emotions, and the key to mood changes lies in a person's cognitive activity and appraisal process. The above two theories have been widely recognized and applied in the research fields of environmental psychology, tourism science, and landscape architecture, and their coupled relationship also provides new ideas for the study of the emotional benefits of waterfront spaces [25–27]. Therefore, the hypothesized paths in the conceptual framework could be interpreted as follows. After the aquatic landscape stimulates the senses, a person evaluates the landscape through underlying personal preferences, which in turn generates emotional benefits through psychological changes.

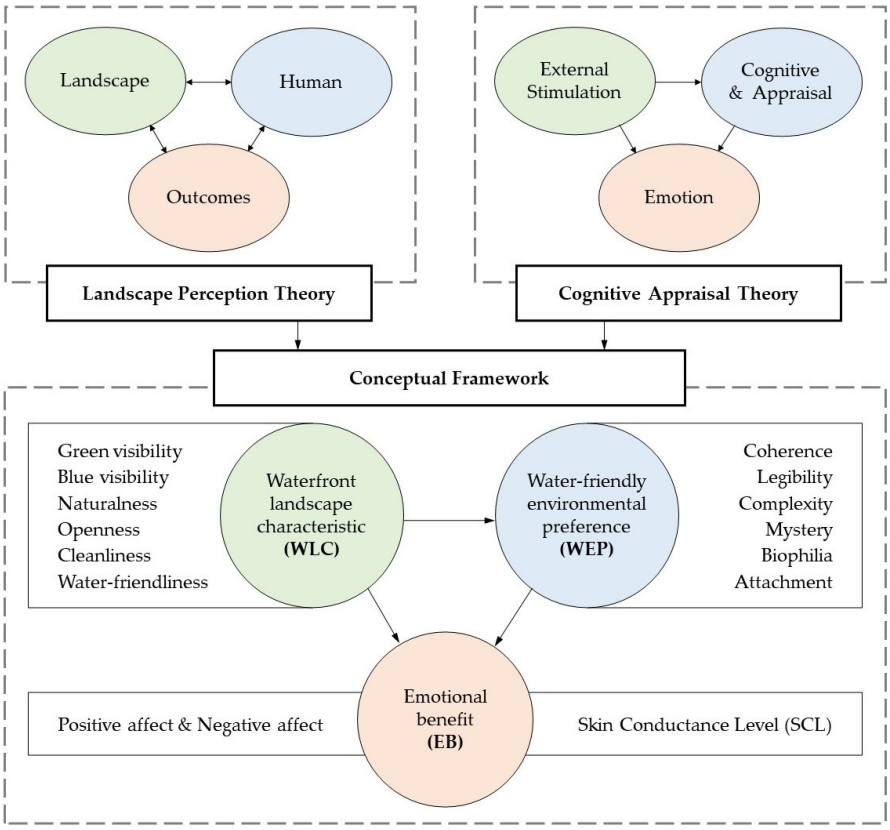

Figure 1. Research conceptual framework.

2.2. Objects and Sample Sites

The waterfront spaces of the Min River in Fuzhou, China, were selected for the study. First, Fuzhou is known as one of the most representative provincial capitals in southeastern China, with the central city along the Min River. Thus, the Min River not only drives the development of Fuzhou city, but its waterfront area is also the most crucial ecological landscape belt and recreational space for citizens. Second, since the government implemented the "Min River Landscape Enhancement Project", the waterfront space along the Min River has gradually presented a quality ecological environment and humanistic landscape atmosphere. This project has become one of the most typical cases of renewal in southeast China.

Considering the scale conditions of landscape perception, the waterfront space in this study was defined as an open space that can be used for recreational activities within the reach of human senses and behavior. Since water and vegetation are the most dominant natural elements in the waterfront space, the sample plots along the Min River were classified into three categories based on the dominance of blue and green elements: blue-dominated space (BDS), green-dominated space (GDS), and co-dominated space (CDS). Considering the typicality of the sample plots and the feasibility of the experiment, the study selected a total of 206 waterfront spaces as alternative sample sites along the Min River in the main urban area through field research. Subsequently, a stratified random

sampling method was used to select 14 waterfront spaces (42 in total) in each of the three typologies as official sample sites (Figures 2–4).

Figure 2. Photographs of sample sites of blue-dominated space (BDS).

Figure 3. Photographs of sample sites of co-dominated space (CDS).

Figure 4. Photographs of sample sites of green-dominated space (GDS).

2.3. Data Collection

2.3.1. WLC Indicator Data

The water substrate gives waterfront spaces their unique landscape attributes. Hence, green visibility, blue visibility, openness, cleanliness, naturalness, and water-friendliness are the indicators that best represent the landscape characteristics of the waterfront space [28–31], as shown in Table 1. In this case, the green visibility and blue visibility were calculated from the percentage of the number of grids with the corresponding content after the pixelization of the panoramic photo. The remaining four indicators were derived by scoring each sample site by 50 experts from landscape architecture, urban and rural planning, geography, hydrology, and other related disciplines.

Table 1. Interpretation and assessment of WLC indicators.

Indicator Name	Interpretation	Assessment
Green visibility	Percentage of plants in vision	Image Semantic Segmentation
Blue visibility	Percentage of water in vision	
Naturalness	Few artificial landscape interventions	Expert scoring and standardization
Water-friendliness	Accessibility to waterfront activities	
Openness	Visual permeability and sky exposure	
Cleanliness	Tidiness and hygiene of the environment	

2.3.2. WEP Test Data

The Environmental Preference Scale (EPS) has been used to measure individuals' sensory and use preferences for the environment, and it contains four dimensions: coherence, legibility, complexity, and mystery [32]. Since humans have innate biophilic traits and exhibit solid water environment attachment [33,34], the study supplemented the EPS with biophilia and attachment dimensions, expanding it into the Water-friendly Environmental

Preferences Scale (WEPS), as shown in Table 2. Moreover, all questions in the WEPS were contextualized around urban waterfront spaces and scored using the 5-point Likert Scale to better measure individuals' subjective and behavioral preferences in waterfront spaces.

Table 2. Dimensions and contents of the WEPS.

Dimension	Interpretation	Contents (Items)
Coherence	Extent to which scene "hangs together"	The style of the waterfront scene is very consistent. The waterfront landscape elements hang together well. It is easy to organize and structure the waterfront landscape.
Legibility	Extent to which scene is easily recognized	It is easy to find my way around this waterfront space. The waterscape helps me figure out where I am. The position of different landscape elements is very clear.
Complexity	Extent to which scene contains many elements	This scene contains a lot of elements of different kinds. This waterfront scenery is dazzling. This waterfront landscape looks changeful.
Mystery	Extent to which scene promises further information	This waterfront view looks secluded and profound. This waterscape could arouse my interest in further exploration. The setting seems to invite me to enter more deeply into it.
Biophilia	Extent to which scene is close to original nature	This waterfront landscape has a sense of vitality. The natural and artificial landscapes here are harmonious. This waterfront space allows me to get very close to nature.
Attachment	Extent to which scene creates a sense of dependence	I would like to revisit this waterfront space. Compared to other waterfront spaces, this is more suitable for me. Overall, I like this waterfront space.

2.3.3. EB Test Data

As shown in Table 3, the Positive and Negative Affect Scale (PANAS) is used to measure the emotional well-being of the population [35], and people can self-rate each emotion on the 5-point Likert Scale. Since changes in skin conductance level (SCL) are most responsive to sympathetic nerve activity and emotional arousal levels, they could be used to aid in validating changes in the emotional benefits of individuals in different types of waterfront spaces. Therefore, the Ergo LAB physiological recorder developed by Beijing Kingfar Science and Technology Co., Ltd (Beijing, China). was used to collect the SCL of the subjects in real time. When SCL values are elevated, it indicates that the individual is in a state of anxiety or alertness; conversely, it indicates a state of pleasure or relaxation [36].

Table 3. Dimensions and descriptors of PANAS.

Dimension	Descriptors
Positive affect (PA)	Enthusiastic; Interested; Active; Strong; Inspired; Alert; Determined; Excited; Proud; Attentive
Negative affect (NA)	Scared; Afraid; Upset; Distressed; Jittery; Nervous; Ashamed; Guilty; Irritable; Hostile

2.4. Experimental Process

Numerous studies in environmental psychology and sociology have concluded that the assessment results of student population samples are highly consistent with those of the general mass population [37,38]. Accordingly, 150 university students (66 males and 84 females) were randomly recruited to participate in the study, and each subject maintained a healthy physical condition and normal emotional state throughout the experiment. It should be stated that all subjects participated in this experiment voluntarily and agreed to use the questionnaire data and physiological data for scientific research and academic publication. This experiment was conducted in July this year at the Landscape Perception

Laboratory of Fujian Agriculture and Forestry University, and the panoramic photographs of each sample plot were previously projected on a large screen in the audio-visual room. The exact procedure of the experiment is as follows:

1. Prior to the start of the experiment, participants were informed of the purpose and content of the experiment and could discontinue the ongoing test at any time if they felt any discomfort during the experiment.
2. At the beginning of the experiment, the SCL baseline values were recorded while the subjects were in an emotionally calm state.
3. Subjects entered the audio-visual room of the sample site for about 5 min to experience the simulated scene, during which time SCL data were in a continuous recording state.
4. After that, subjects filled out the WEPS and the PANAS, and the experiment ended.

2.5. Data Analysis

First, in the data processing stage, outlier tests and dataset corrections were performed on the physiological data using the data analysis module built into the Ergo LAB wireless sensor system. Moreover, reliability and validity tests and normal distribution tests were performed on the data measured by the scales, and data that did not satisfy normality were transformed.

Second, in the stage of variability and correlation analysis, descriptive statistical analysis and analysis of variance (ANOVA) were used to present the variability of landscape perceptions in different types of waterfront spaces, while Pearson and Spearman correlation analyses were used to explore the correlations among WLC, WEP, and EB, as well as among the dimensions. The results of the above analysis are mainly presented in Sections 3.1 and 3.2.

Third, in the stage of hypothetical pathways and conceptual model validation, mediation regression analyses were used to investigate the mediating effect of WEP between WLC and EB, with residual tests. Categorical variables were converted to pseudo-variables for computation in the treatment process [39,40]. The results of the mediating analysis are presented in Section 3.3.

3. Results

The potential association between WLC, WEP, and EB, as well as the path of influence between their dimensions, is the key to this study. Therefore, synthesizing the above research methodology and data analysis process, the findings are analyzed and presented in terms of relationship between WLC and WEP, relationship between WLC and EB, and mediating effect of WEP between WLC and EB.

3.1. Relationship between WLC and WEP

The WEP of the population for three types of waterfront spaces showed significant differences in all dimensions ($p < 0.001$), and the degree of preference, from high to low, was as follows: CDS > BDS > GDS (Table 4). In addition, most WLCs were strongly correlated with the WEP, as shown in Table 5. Specifically, green visibility, blue visibility, naturalness, and water-friendliness could enhance people's WEP; conversely, openness exhibits a weakening effect on coherence, complexity, mystery, and biophilia, in addition to boosting legibility, and cleanliness is correlated only with coherence.

Table 4. WEP evaluation (mean ± SE) and difference of 3 types of waterfront spaces.

	Coherence	Legibility	Complexity	Mystery	Biophilia	Attachment
Blue-dominated space	3.60 ± 0.81	4.03 ± 0.61	3.07 ± 0.81	2.92 ± 1.01	3.32 ± 0.89	3.37 ± 0.81
Green-dominated space	3.44 ± 0.76	3.63 ± 0.81	2.64 ± 0.89	2.34 ± 0.85	2.27 ± 0.75	2.76 ± 0.86
Co-dominated space	4.11 ± 0.73	4.31 ± 0.61	3.37 ± 0.85	3.75 ± 0.94	4.37 ± 0.65	4.03 ± 0.68
F	9.84 ***	11.90 ***	8.31 ***	25.51 ***	80.86 ***	29.95 ***

Note: *** $p < 0.001$.

Table 5. Correlation between WLC and WEP.

	WLC Indicators	Coherence	Legibility	Complexity	Mystery	Biophilia	Attachment
Pearson	Green visibility	0.36 **	0.36 **	0.28 **	0.53 **	0.67 **	0.53 **
	Blue visibility	0.31 **	0.36 **	0.25 **	0.44 **	0.62 **	0.47 **
Spearman	Naturalness	0.34 **	0.36 **	0.32 **	0.50 **	0.73 **	0.53 **
	Water-friendliness	0.36 **	0.38 **	0.12	0.49 **	0.66 **	0.52 **
	Openness	−0.24 **	0.32 **	−0.18 *	−0.34 **	−0.36 **	−0.12
	Cleanliness	0.23 **	−0.15	−0.02	0.10	0.11	0.09

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

3.2. Relationship between WLC and EB

The ability of three types of waterfront spaces to evoke positive emotions was shown to be CDS > BDS > GDS, and the opposite was found in terms of inducing negative emotions (Table 6). Meanwhile, as shown in Figure 5, the mean value of the decrease in skin conductance level of the population showed that CDS (0.57 ± 0.19) > BDS (0.45 ± 0.21) > GDS (0.28 ± 0.18), which was in line with the trend of the evaluation results of the PANAS. Moreover, WLCs were closely related to an individual's EB (Table 7). To be specific, green visibility, blue visibility, naturalness, and water-friendliness were all significantly positively correlated with positive emotions and significantly negatively correlated with negative emotions. In contrast, the opposite was true for openness, and cleanliness was not seen to be correlated with emotional benefits.

Table 6. EB Evaluation (mean ± SE) and difference of 3 types of waterfront spaces.

	Positive Affect	Negative Affect
Blue-dominated space	3.00 ± 0.73	1.43 ± 0.51
Green-dominated space	2.89 ± 0.95	1.56 ± 0.77
Co-dominated space	3.68 ± 0.58	1.12 ± 0.28
F	10.71 ***	5.29 **

Note: ** $p < 0.01$, *** $p < 0.001$.

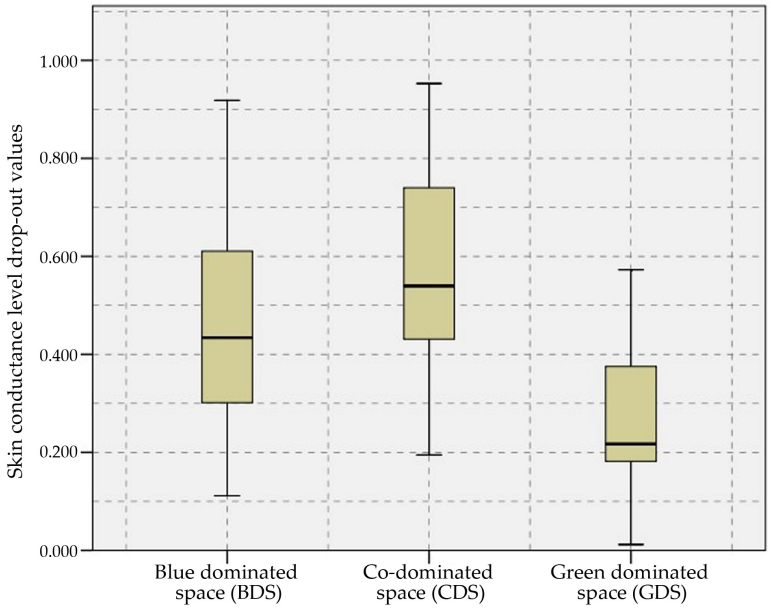

Figure 5. SCL drop-out values in 3 types of waterfront spaces.

Table 7. Correlation between WLC and EB.

	WLC Indicators	Positive Affect	Negative Affect
Pearson	Green visibility	0.35 **	−0.27 **
	Blue visibility	0.28 **	−0.28 **
Spearman	Naturalness	0.33 **	−0.26 **
	Water-friendliness	0.32 **	−0.28 **
	Openness	−0.18 *	0.19 *
	Cleanliness	0.08	0.02

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

3.3. Mediating Effect of WEP between WLC and EB

First, as shown in Table 8, all dimensions of WEP were significantly correlated with both PA and NA. Second, in the mediation model of "WLC→WEP→EB", WEP, besides cleanliness, was shown to mediate between WLCs and EB (Table 9). The results showed that green visibility, blue visibility, naturalness, and water-friendliness all influenced PA and NA through WEP, while WEP could only play a mediating role when openness affected PA, and the mediating effect on NA was not significant (Figure 6).

Table 8. Pearson's correlation between WEP and EB.

	Positive Affect	Negative Affect
Coherence	0.51 **	−0.27 **
Legibility	0.48 **	−0.29 **
Complexity	0.57 **	−0.30 **
Mystery	0.70 **	−0.39 **
Biophilia	0.70 **	−0.50 **
Attachment	0.78 **	−0.51 **

Note: ** $p < 0.01$.

Table 9. Regression analysis of the mediating model of "WLC→WEP→EB".

	X→M		X→Y_{PA}		X→M→Y_{PA}		X→Y_{NA}		X→M→Y_{NA}	
	β	t	β	t	β	t	β	t	β	t
Green visibility	0.02	7.62 ***	0.01	4.60 ***	−0.00	−1.45	−0.01	−3.38 ***	0.00	0.06
					0.72	13.83 ***			−0.31	−6.16 ***
R^2	0.28		0.12		0.62		0.07		0.26	
F	58.02 ***		21.12 ***		119.69 ***		11.44 ***		26.12 ***	
Blue visibility	0.11	6.40	0.06	3.60 ***	−0.02	−1.81	−0.39	−3.53 ***	−0.01	0.65
					0.73	14.53***			−0.29	−6.10***
R^2	0.22		0.08		0.62		0.08		0.26	
F	40.99 ***		12.98 ***		121.20 ***		12.49 ***		26.40 ***	
Naturalness	0.64	7.76 ***	0.34	4.26 ***	−0.13	−2.14 **	−0.19	−3.28 **	0.02	0.25
					0.74	14.24			−0.32	−6.23 ***
R^2	0.29		0.11		0.62		0.07		0.26	
F	60.23 ***		18.15 ***		122.89 ***		10.76 **		26.16 ***	
Water-friendliness	0.76	7.51 ***	0.39	3.99 ***	−0.17	−2.33 **	−0.22	−3.11 **	0.03	0.36
					0.75	14.47***			−0.32	−6.34 ***
R^2	0.28		0.10		0.63		0.06		0.26	
F	56.36 ***		15.95 ***		123.98 ***		9.65 **		26.20 ***	
Openness	−0.25	−4.13 ***	−0.12	−2.15 ***	0.06	1.62	0.13	1.54		
					0.71	15.13 ***				
R^2	0.10		0.03		0.62					
F	17.03 **		4.62 ***		120.35 ***					
Cleanliness			−0.07	−0.80			−0.05	−0.60		
R^2										
F										

Note: ** $p < 0.01$, *** $p < 0.001$.

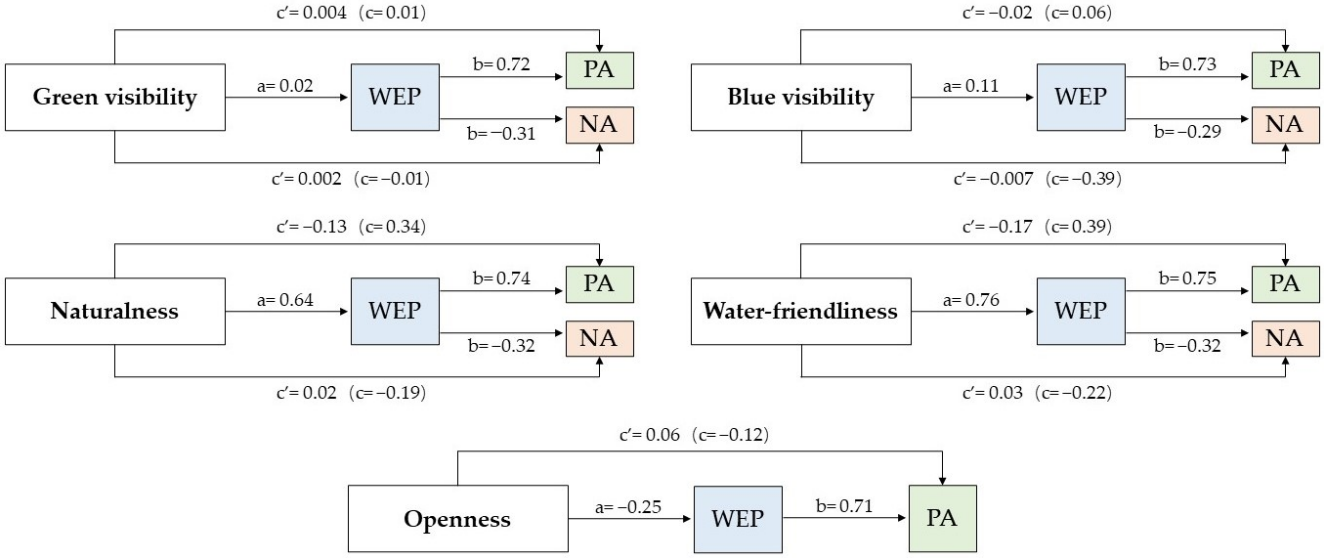

Figure 6. Mediating models of "WLC→WEP→EB".

4. Discussion

4.1. Differences of EBs in 3 Types of Waterfront Spaces

The results suggested that the population showed significantly higher water environmental preferences and elevated moods in both BDS and CDS than in GDS (Tables 4 and 6, and Figure 5). Because of the high degree of exposure to water and the natural hydrophilic conditions of BDS and CDS, which could easily trigger an individual's innate hydrophilicity, the population may be able to promote physical and mental health restoration due to the enhancement of aquaphilic perception [41]. On the contrary, when one is in a GDS, one's visual sensitivity to the waterscape is reduced due to the high visibility of the vegetated landscape, which in turn diminishes the emotional benefits produced by the water. This result also corroborates the findings that water features often produce more significant psychological restorative effects than other landscape elements [42,43].

Furthermore, the study found that the emotional benefits of CDS were slightly higher than those of BDS, given similar water-friendly conditions. Similarly, a study of preference and emotional feedback on water exposure showed that scenes containing only water were rated less positively than ones with two-thirds water and one-third green [24].

First, it has to do with the physiologically evolved human need for survival and safety. Biologists believe that humans are naturally attracted to water-rich habitats, but that their physiological adaptations to terrestrial environments dictate a degree of existential threat to aquatic environments [33,44]. Therefore, the best environment to meet the physical and mental needs of human beings is a waterfront area between land and water, but at a safe distance from the water [45]. In further research, Pitt also revealed the negative effects produced by bodies of water; when a person observes the surface of the water immediately adjacent to the riverbank, the lower visibility of the depth of the water can lead to a heightened sense of nervousness and vigilance by making the person perceive unknown risks, and even perceive threats from other species [46].

Second, the landscape elements of CDSs, which consist of both urban forests and waters, are more varied and have richer plant landscapes than BDSs, which rely solely on water. Relevant studies have also found that the coexistence of multiple landscape types can increase the complexity and mystery of the environment, and these two characteristics can better stimulate human vision, inspire the desire to explore, and awaken positive emotions [47,48]. At the same time, the emotional benefits generated by the waterscape are thought to be able to superimpose with other landscapes, such as plant communities, and another experiment confirmed that crowds prefer waterfront spaces with rich and varied vegetation [49].

4.2. Effects of Different WLCs on EBs

The correlation between WLCs and EBs showed that green visibility, blue visibility, naturalness, and water-friendliness all enhanced positive affect and diminished negative affect (Table 7). All of the above indicators reflect the keynote role played by planted landscapes and water features in the promotion of emotional benefits [24,49–51]. First of all, a waterfront space close to the natural state not only improves the microclimate and enhances physiological comfort, but also enriches the sensory experience and promotes psychological pleasure. Secondly, leisure activities near water and physical interactions with water are effective in increasing the arousal of positive affect and guiding emotional relief. Lastly, the intimate scale space delineated by vegetation and water encourages people to open up and creates more opportunities for socialization, which helps to enhance the individual's sense of self-identity. As Gidlow's study found, walking in green and blue environments could improve people's resilience and perception compared to walking in urban environments [52]. By no coincidence, Daniel identified an association between increased views of blue space and decreased psychological distress [41].

Interestingly, it was found that waterfront spaces with a high degree of openness were not only detrimental to the promotion of positive emotions, but also had the potential to trigger negative emotions. While some studies have shown that high openness of the shoreline could stimulate visual sensations, and enhance the space's vitality, which provides a reason to linger, there is no direct evidence of its effect on emotional benefits [53–55]. However, there are still related studies that showed similar results. Although the open waterfront space could give people a bright visual experience and bring them a short-lived feeling of surprise, after a period of time, this transient emotion would gradually be replaced by negative emotions such as boredom and agitation [56,57]. As some findings suggest, overly open environments tend to put people in a disturbed state of being watched and monitored by others all the time, which might lead to nervousness and restlessness [58,59].

Conversely, some studies on the openness of street space have found that open sightlines and sky visibility contribute to psychological stress relief [60], suggesting that the same landscape characteristic may be perceived more differently in environments with different attributes. Specifically, the street space itself has a more obvious sense of oppression; the openness can easily and quickly awaken people's positive emotions under the strong contrast perception. While the waterfront space has a high degree of openness on the whole, excessive openness can easily induce negative emotions due to the reduction in the sense of security and intimacy.

4.3. Paths of WLCs to EBs under the Mediating Effect of the WEP

Based on the "WLC→WEP→EB" mediation modeling, it was found that green visibility, blue visibility, naturalness, and water-friendliness all significantly enhanced people's WEP (Table 5) and were able to influence emotional benefits through the mediation of WEP (Figure 6). Similar findings showed that water-friendly landscape amenities could enhance residents' environmental preferences, which in turn influence well-being through its mediating effect [53]. The above results suggest that the demand for waterfront space is better met by an urban landscape that resembles pristine nature, rich biodiversity, and convenient access to water. By enhancing an individual's preference for water environments, these WLCs not only provide spiritual solace, inspiration, and enlightenment, but also reduce the mental rumination of past painful experiences [61], whereas waterfront landscapes with too many artificial traces of construction, lack of vitality, and poor waterplay experience do not meet the environmental preferences of the population and are more likely to trigger negative emotions that are not conducive to physical and mental health [10].

In addition, cleanliness was found to be related only to the coherence dimension of the WEP (Table 5), but not only was it not related to EBs (Table 7), but it also did not have an effect on EBs through the mediation of the WEP (Table 9). Another related experiment yielded very different results, with cluttered environments negatively affecting restorative perceptions, while environments that are relaxing are usually tidy [49,62]. The reasons for

such differences may be as follows. First, there are endogenous differences in the public's tolerance of clutter or understanding of tidiness. Second, very different experimental materials such as panoramic photographs, virtual scenes, or real environments can lead to different intensities of perception of the characteristic of cleanliness, thus yielding experimental results that are not entirely consistent.

It is worth noting that, contrary to most WLCs, openness could negatively affect positive emotions through the mediation of the WEP, and related studies have drawn similar conclusions to those above from perspectives such as ecological perception and cultural identity [63,64]. This path of influence suggests that although openness of the site can generate surprise and excitement for a short period of time, it tends to trigger psychological distance due to its overall lack of closeness and shelter. Thus, openness produces strong negative effects on the mystery and biophilia dimensions of the WEP and attenuates positive emotions through its mediating effect.

Surprisingly, there was a significant positive correlation between openness and negative affect, but there was no mediating effect of the WEP in the path of the former on the latter. This result suggests that open spaces, while prone to triggering negative emotions, are not necessarily caused by the WEP, which may be triggered by other psychological states or behaviors of the population. For example, if the landscape level is too homogeneous, it is easy to cause aesthetic fatigue of the public, while in a space with a high degree of freedom of movement, the landscape is believed to guide the mood fluctuation through the clustering and modulation of behavioral activities [56,65]. Therefore, how the openness of waterfront spaces affects the emotional well-being of individuals in multiple ways remains to be further explored.

4.4. Landscape Optimization Strategies for Urban Waterfront Spaces

Synthesizing the above findings, the study aims to enhance individuals' water-friendly environmental preferences and propose landscape optimization strategies for urban waterfront spaces that contribute to emotional benefits [10,35,49,64].

1. On the premise of meeting the needs of public activities, the greening area and water area, including three-dimensional greening and three-dimensional water features, could be appropriately increased, and rendered close to the original natural state.
2. It is desirable to reduce the hardened state of the barge area and plant aquatic plants, but the percentage of aquatic plants in the water should be controlled to avoid reducing the blue visibility due to excessive reduction in the watershed area.
3. A certain richness of landscape elements is required, but care should be taken to order the landscape and avoid over-design.
4. Based on the safety protection design, water-friendly platforms or walkways could be set up close to the water surface to shorten the distance between people and water; Water sports and recreational facilities could also be added to meet the needs of different people's water activities.
5. In open spaces with larger scales, spatial boundaries and traffic guidance should be strengthened and secondary semi-enclosed spaces should be delineated using plant groups and other landscape facilities to enhance the sense of environmental shelter and spatial domain for the crowd.
6. Water should be allowed to circulate and flow, the self-purification ability of water should be enhanced, the overall environmental hygiene and cleanliness of the waterfront space should be maintained, the daily management and maintenance of public facilities should be strengthened, and a public participation and monitoring mechanism should be established.

5. Conclusions

Taking three types of waterfront spaces along the Min River in Fuzhou, China, as an example, this study explored the differences in the EB of populations in different types of spaces, and explored the associations between different WLCs and changes in individual

EBs. Furthermore, the study attempted to analyze the mediating effect of WEPs in the process of WLCs influencing EBs, and then revealed the multiple paths of influence of WLCs on individual EBs. The main findings of the study are as follows.

1. Urban waterfront spaces could effectively improve the EBs of the crowd; CDSs were the most consistent with the population's WEPs and had the strongest effect on the promotion of positive emotions and the alleviation of negative emotions, followed by BDSs, while GDSs had the weakest effect.
2. Green visibility, blue visibility, naturalness, and water-friendliness tend to influence people's EBs both directly and through the mediating effect of WEPs; in other words, lush and orderly planted landscapes, permeable water visibility, moderate signs of man-made structures, easy access to water, and a good water experience help improve the emotional quality of the population.
3. Openness could directly affect or be mediated by WEPs to influence positive emotions, and overly open waterfront spaces are not conducive to improving the quality of emotions. Although openness has been shown to influence negative emotions, there is no evidence that the former can be mediated by WEPs, and the pathways of influence need to be further explored.
4. Cleanliness affects the coherence dimension of the WEP, but has no significant effect on the other dimensions, nor does it play a significant role in improving EBs.
5. Under the perspective of blue health, the landscape of urban waterfront spaces should be gradually optimized by enhancing the blue-green visibility, naturalness, and water-friendliness, controlling the degree of openness, and maintaining the degree of cleanliness.

In summary, the study took urban waterfront space as the object and conducted exploratory research based on the coupling of the Landscape Perception Theory and the Cognitive Appraisal Theory, providing a new idea for the correlation research between the objective characteristics of the environment and the subjective perception of individuals. However, this study still has some limitations. In the first place, since the focus has been on visual sensory stimulation in landscape perception, while auditory, olfactory, and tactile senses have not been explored, it is expected that the pathways of the influence of WLCs on EBs under different dimensions of senses will be refined in further research and practical work. In addition, due to the differences in the natural and social environments of different regions, another important in-depth study in further steps will be to distinguish the characteristics of the samples across time and space to expand the scope of application and practical significance of the mediation model.

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