forests

MDPI

Article

Effects of Deciduous Forests on Adolescent Emotional Health in Urban Areas: An Example from the Autumn Ginkgo Forest in Chengdu

Linjia Wu [1], Shixian Luo [2], Di Li [3], Qibing Chen [4,*], Jingting Li [1] and Jiacai Wen [1]

[1] College of Art, Sichuan Tourism University, Chengdu 610100, China; wulinjia@sctu.edu.cn (L.W.); 0000120@sctu.edu.cn (J.W.)
[2] Graduate School of Horticulture, Chiba University, Chiba 263-8522, Japan; 19hd4106@student.gs.chiba-u.jp
[3] Geophysical Exploration Brigade of Hubei Geological Bureau, Wuhan 430100, China
[4] College of Landscape Architecture, Sichuan Agricultural University, Chengdu 625014, China
* Correspondence: cqb@sicau.edu.cn

Abstract: Many studies have shown that urban green spaces can promote emotional health. Deciduous forest is an important landscape and ecological resource of the city. However, the emotional impact of different behavior patterns in this kind of natural space with obvious seasonal changes are rarely discussed. This study explores the emotional feedback of two typical behavior patterns within an urban landscape forest in autumn: sitting and walking. We recruited 80 volunteers and divided them into a sitting viewing group (group S) and a walking viewing group (group W). On the premise of gender balance, they were randomly assigned to a natural path under a *Ginkgo biloba* forest in autumn for 15 min of viewing. Physiological and psychological indicators were used for monitoring. Blood pressure, heart rate and electroencephalography (EEG) were used for physiological indicators, and a POMS questionnaire was used for psychological indicators. A paired *t*-test and one-way ANOVA were used to analyze the physiological parameters of the two experimental groups, and a paired Wilcoxon signed-rank sum test was used to analyze the differences in psychological indexes between the two behavior groups. The results showed that the diastolic blood pressure and pulse of the sitting group decreased significantly under the seasonal deciduous forest, and the walking group attained higher "Engagement", "Excitement", and "Relaxation". In the absolute α and β waves, there were significant differences in the parietal P8 channels between the sitting and walking groups, and significant differences in the RAB indicators of the AF3, F7, P7, FC5, FC6, F3 and T7 channels. The two behavior patterns can effectively reduce negative mood, and the "Vigor" mood in the walking group was significantly increased, which was significantly better than that of the sitting group in reducing negative mood. These results enrich research on the influence on emotional health in the field of seasonal green-space restoration. The differences of different behavior patterns can provide guidance for planning urban landscape forest construction and activity facilities.

Keywords: urban landscape forest; seasonality; blood pressure; EEG; POMS; teenagers; mood

check for updates

Citation: Wu, L.; Luo, S.; Li, D.; Chen, Q.; Li, J.; Wen, J. Effects of Deciduous Forests on Adolescent Emotional Health in Urban Areas: An Example from the Autumn Ginkgo Forest in Chengdu. *Forests* **2023**, *14*, 1099. https://doi.org/10.3390/f14061099

Academic Editor: Arne Arnberger

Received: 25 March 2023
Revised: 17 May 2023
Accepted: 18 May 2023
Published: 26 May 2023

1. Introduction

Emotional stress in urban environments is a constant, urgent problem in urban public health [1,2]. Neurological diseases and burnout from attention consumption and mental fatigue [3,4] are increasing among youths [5] in high-density physical environments. Teenagers are an active group in the city and are more likely to experience emotional disorders caused by academic and social pressures during their growth [6,7]. Effective emotional regulation strategies can help teenagers develop adaptive responses and reduce the risk of emotion-related physical and psychological diseases [8–10]. Research on urban green spaces and public health under the interdisciplinary trend of urban planning shows that green space plays an important role in health promotion and improving well-being [11,12]. Although the environment itself cannot cure a disease, spending time in natural environments may increase positive emotions [13]. Researchers have previously conducted empirical and differential explorations of the physiological and psychological improvement effects of experiencing green environments on adolescents, including studies on landscape categories [14], changes in structural elements [15], and different sensory stimuli [16,17]. In addition, studies on land restoration and preferences showed the significant influence of seasonal characteristics on the appearance of landscape structure [18], visual preference [19], and landscape stress recovery quality [20]. However, discussion on landscape forests, an important part of urban natural capital, is lacking, especially landscape forests affected by seasons [21,22]. In addition, i in terms of exploring the impact of the forest environment on health, previous studies have confirmed that terpene structures in forest environments may be the reasons for positive health effects [23]. Larger parks such as forests have better health outcomes [24], and further explored self-reported and simple physiological measurements of meditation behavior patterns. The complexity of landscapes necessitates more accurate measurement tools to study the effects of landscapes on emotions. Therefore, it is necessary to conduct more accurate measurements based on applied scientific test validation to provide more scientific and effective guidance for urban forest construction.

Behavior is an important link between humans and green space [25]. Positive emotions have important effects on human health and well-being, and the biological state of emotion is related to the nervous system [26]. There is a close relationship between participants' behavioral responses and emotions [27]. Emotional activity is also a common aspect widely considered in green-space research [25]. Even in the same environment, different behavior patterns generate different emotional feedback [28]. Previous studies have used a combination of physiology [17,29] and psychology [30–32] to measure the emotional feedback of participants. For example, walking in the forest has a relaxing effect on young people [33], and observing nature can increase satisfaction [34]. Regarding emotional differences, there is a significant negative correlation between meditation, emotion and behavioral responses [27]. Walking in green space is more conducive to decompression, while sitting is more conducive to recovering attention [25]. Different behavior patterns in urban natural environments can induce or trigger emotions to some extent. However, most of these studies are based on the green and vibrant natural environment, and the influence of different behavior patterns on recreational benefits is not addressed. Because the season has been found to have an important impact on people's mood in stress recovery experiments [35], especially in an urban natural environment with obvious seasonal changes, basic research on spontaneous behavior and health in seasonal green spaces is of great value in the construction of urban natural environments.

In addition, in the discussion of emotions in relation to urban forests, the healthy development of an urban landscape forest has always been considered conducive to human health, including the positive emotions obtained through contact with nature [36]. Seasonal trees can affect visual preferences [19], and these trees can undergo subtle to obvious visual changes throughout seasonal changes [37]. Some patients with psychosis show more positive facial expressions when viewing green trees than when viewing tree images with autumn colors [38], and golden leaves cause positive psychophysiological reactions [39], which may indicate the potential for seasonal urban landscape forests to improve moods as a public health resource. Although any behavior conducted while being exposed to such resources may have health promotion effects, it is still worth exploring the additional emotional promotion benefits obtained by determining different behavior patterns in urban seasonal landscape forests.

Purpose and Assumptions

The purpose of this study was to explore the influences and differences of two different behavior modes of experiencing seasonal urban landscape forests—sitting and walking—on emotional indicators in adolescents. This study aimed to provide a reference for seasonal behavior induction and a health basis for urban green-space construction. Based on existing studies, we used comprehensive physiological and psychological indicators to evaluate the emotional state of volunteers. The physiological indicators were blood pressure (diastolic and systolic), heart rate and EEG. We used three emotional indicators provided or calculated by Emotiv EPOC+. The first is the six neuroemotional parameters "engagement", "excitement", "stress", "relaxation", "interest" and "focus". The second is the RAB index, which was found to be closely related to behavior in previous studies [40]. The third comprises 14 channels in which the characteristic parameters evaluated by specific stimuli [41,42] are presented as widely used α and β waves. The psychological indicators were calculated using the POMS scale. The key objectives of the study were (1) to explore the differences in different behavior patterns in seasonal urban landscape forests by comprehensively assessing physiological and psychological indicators; (2) to identify significant differences between the two behavioral patterns discussed in the study and the reasons for these differences; and (3) based on the above two issues, provide a theoretical basis for urban forest design, management and activity strategy planning.

2. Materials and Methods

2.1. Study Site and Participants

The experimental site is located in the largest ginkgo garden in Chengdu, Sichuan Province (103°86′44″ E and 30°58′50″ N). The ginkgo garden is part of an artificial plantation in which over 13.33 hectares of ginkgo trees of different ages are planted. *Ginkgo biloba* L. is a unique deciduous tree in China and a representative urban deciduous tree species in Chengdu. The leaf shape is beautiful, and its color changes from green to golden yellow in autumn. *Ginkgo biloba* L. is China's most important and common urban greening material and can eliminate the effects caused by unfamiliar environments. Our experimental site is an important urban viewing place in the city. The research area provides a realistic experience since tourists and footpaths can be seen in the park. A forestland with a relatively uniform stand, a canopy density of 0.45 and a relatively quiet environment (noise value range: 59.91 ± 10.48–64.38 ± 5.82, noise meter CEN-TER322) was selected as the experimental site. Wheelchair accessibility [43] and general accessibility [44] can affect emotional responses in natural environments. To facilitate an emotional impression of the natural environment as a pure forest, we chose a common green space similar to downstream forest trails (general trail width 1.5–3 m) with ginkgo biloba trees on both sides as the candidate for the experimental site; such areas have been confirmed as effective in previous studies. The final section of the experimental site has a natural path. A U-shaped footpath with an average width of 3.2 m and a total length of 166 m was the experimental area used to assess emotional influence (Figure 1).

Since there is no specific sample size stipulated for EEG experiments, we referred to the minimum sample size requirement [15] and recruited 80 young adults (40 males and 40 females, average age (23.42 ± 1.03), from Sichuan Agricultural University through campus posters and online advertising. After the experiment, they received corresponding compensation (RMB 30). We divided the participants into the sitting (Group S) and walking (Group W) groups according to their behavior patterns, with twenty men and twenty women in each group. Before the experiment, the study staff sent the detailed experimental process to the volunteers. All subjects were required to be right-handed [45] and have no history of long-term drug and alcohol abuse, to prevent differences in brain hemispheres from influencing the results. Drinking alcohol, strenuous exercise and taking drugs were prohibited on the day before the experiment to ensure the accuracy of the experiment.

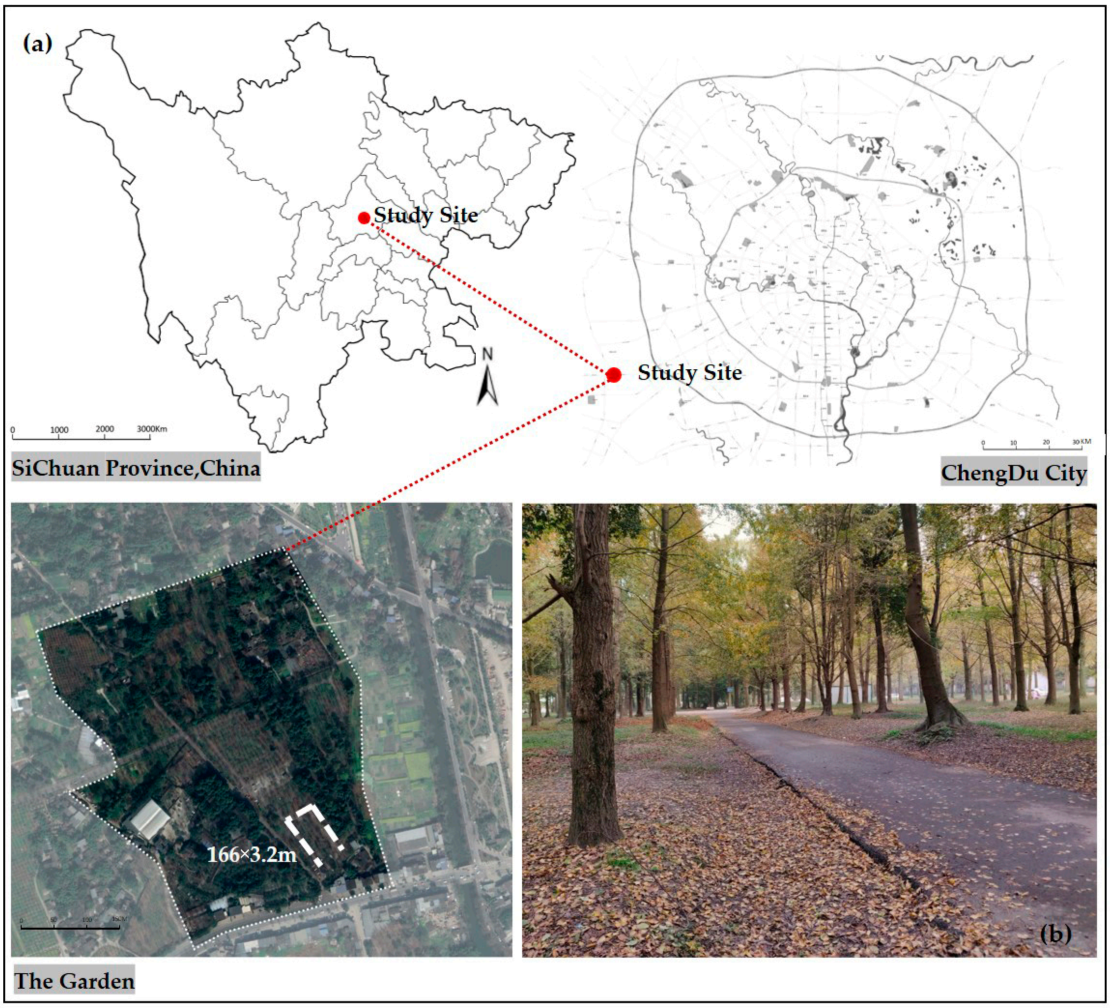

Figure 1. Study site. (**a**) Map of the experimental location and of the studied sites. (**b**) Current situation map of the experimental site.

2.2. Measure

2.2.1. Physiological Measurement

Physiological indices: Blood pressure, pulse and EEG were used to observe the physiological differences between the two behavioral groups. Blood pressure, including systolic (mmHg) and diastolic (mmHg), and pulse rate (bmp) were measured using a sphygmomanometer (Omron, HEM-6322T, Omron, Tokyo, Japan). Systolic and diastolic blood pressure increase when a person is stressed and decrease when he or she is relaxed, while the pulse rate increases when the body is in motion or emotionally excited. EEG is a common method widely used to evaluate the effect of forest therapy [31,46,47]. EEG records changes in electrical waves during brain activity. The instrument is noninvasive and has the practical advantages of being low-cost and quick, without the need for conductive gel [48]. Wearing the EEG equipment provides data from four brain lobe regions (namely, i.e., the frontal, temporal, parietal and occipital lobes). Fourteen channels (AF4, AF3, F3, F4, F7, F8, FC5, FC6, T7, T8, P7, P8, O1 and O2) were recorded. The data were analyzed using Affective, the EEG equipment's software suite, which assigns and defines six emotion parameter labels; each individual's data can be standardized on a scale of 0 to 1 [45].

2.2.2. Psychometrics

The Profile of Mood States (POMS) psychological questionnaire was used to measure the participants' psychological state. The abbreviated POMS is another reliable and valid instrument for measuring mentality, including 40 adjectives rated on a 0–4 scale (0 = not at all; 4 = extremely). These adjectives can be consolidated into seven effective dimensions: Tension-Anxiety (T-A), Depression (D), Anger-Hostility (A-H), Vigor (V), Fatigue (F), Confusion (C) and Self-esteem (S). Three psychological indicators can also be obtained: positive, negative, and total mood (TMD) [49].

2.3. Experimental Procedure

This research is divided into two stages. The first stage consisted of the indoor parts, where volunteers at Sichuan Agricultural University completed the questionnaire in a classroom (temperature 22–26 °C, humidity 49%–55%). The questionnaire included social demographic characteristics and an informed consent form provided to the volunteers after the staff transported them to the experimental site, which was a ~30 min drive away. Outdoor measurements (outdoor temperature: 15.44 ± 1.14 °C, outdoor humidity: 75.92 ± 4.40%) were then taken. After reaching the experimental site, the volunteers sat quietly with their eyes closed for 5 min to reduce external influences, such as artifacts. The volunteers were then led to the experimental path, where they would be fitted with the EEG device. The EEG instrument was installed on the volunteer's head. While wearing the device, the volunteers were instructed to feel the environment quietly and were not permitted to talk, eat, or use mobile phones. The volunteers were instructed to sit or walk for 15 min in different groups wearing the emotiv-EPOC+. The staff left after turning on the emotiv-EPOC+ devices to record the EEG data. After the experiment ended, the staff removed the instrument and instructed the volunteers to rest for 5 min before returning to school (Figure 2). The staff grouped all subjects to conduct the experiment sequence, in which Group S and Group W participated simultaneously. The experiment took place in November 2020 over three days from 9 am to 6 pm each day. The experimental procedure was conducted in accordance with the ethical standards of the National Research Council and the Herkey Declaration and was approved by the local Ethics Committee of the College of Landscape Architecture, Sichuan Agricultural University.

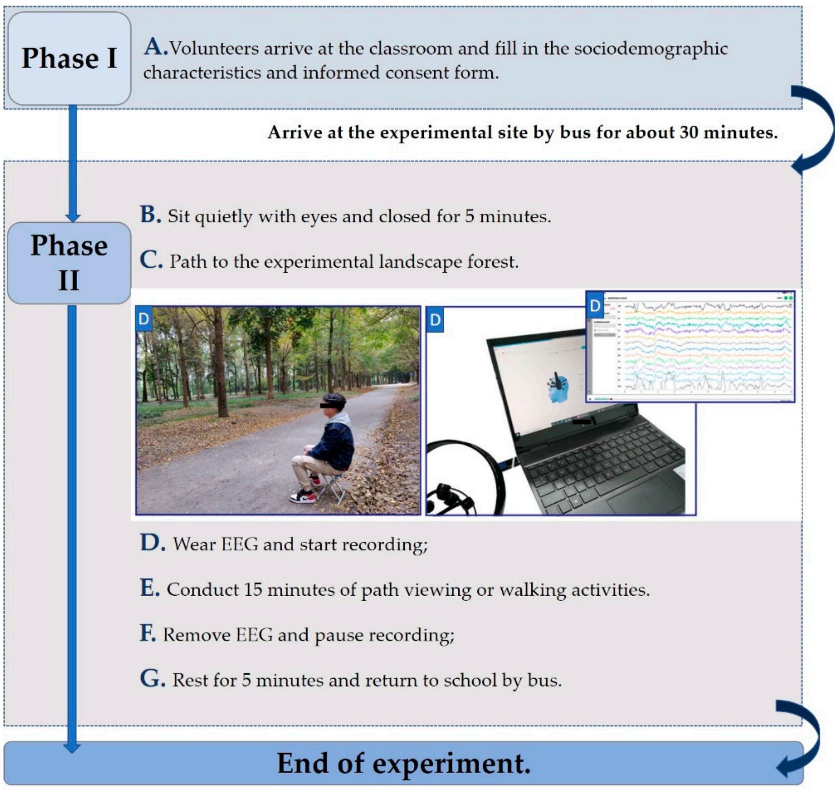

Figure 2. Experimental procedure.

2.4. Data Statistics and Analysis

Statistical and data analyses were conducted using Excel 2016 and SPSS 20.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics and chi-square tests were used to test the differences in the sociodemographic characteristics of the study samples, and paired t-tests were used to compare the average physiological parameters of the two behavioral groups and explore their significance level. EEG data were processed under the conditions of normal distribution and compliance with normal distribution; a one-way analysis of variance (ANOVA) was used to evaluate the significance of the six mood indicators and RAB indicators. The paired Wilcoxon signed-rank sum test was used to analyze the difference in psychological indicators between the two behavioral groups.

3. Results

3.1. Physiological Results

3.1.1. Blood Pressure, Pulse Rate

Table 1 shows the changes in blood pressure and heart rate before and after the two behavior modes. As shown, no significant changes in systolic blood pressure were observed in Group S (113.80 ± 14.94 pre and 114.10 ± 13.64 post, $p > 0.05$). The diastolic blood pressure decreased significantly (78.02 ± 11.99 pre and 72.27 ± 10.06 post, $p < 0.01$) by 5.76. The pulse rate was significantly decreased (81.37 ± 14.77 pre and 77.44 ± 9.89 post, $p < 0.05$) by 3.93. There were no significant changes in diastolic (112.63 ± 15.80 pre and 111.75 ± 13.10 post, $p > 0.05$) or systolic (76.41 ± 9.94 pre and 74.86 ± 9.61 post, $p > 0.05$) blood pressure or pulse (77.68 ± 12.30 pre and 75.72 ± 11.38 post, $p > 0.05$) in Group W. As shown in Figure 3, no significant difference was observed between the two behavioral groups in diastolic blood pressure, systolic blood pressure, and pulse before and after viewing (paired t test, $p > 0.05$).

Table 1. Changes in blood pressure and pulse rate before and after in Group S and Group W.

Group S						
Physiological Indexes	**Pre-Test**		**Post-Test**		**Rate of Change**	***p***
	Mean	**S.D.**	**Mean**	**S.D.**		
Systolic blood pressure (mmHg)	113.80	14.94	114.10	13.64	0.29	0.897
Diastolic blood pressure (mmHg)	78.02	11.99	72.27	10.06	−5.76	0.008 **[1]
HR (bpm)	81.37	14.77	77.44	9.89	−3.93	0.024 *[2]
Group W						
Variable	**Pre-Test**		**Post-Test**		**Rate of Change**	***p***
	Mean	**S.D.**	**Mean**	**S.D.**		
Systolic blood pressure (mmHg)	112.63	15.80	111.75	13.10	−0.88	0.925
Diastolic blood pressure (mmHg)	76.41	9.94	74.86	9.61	−1.55	0.374
HR (bpm)	77.68	12.30	75.72	11.38	−1.97	0.134

**[1] $p < 0.01$. *[2] $p < 0.05$.

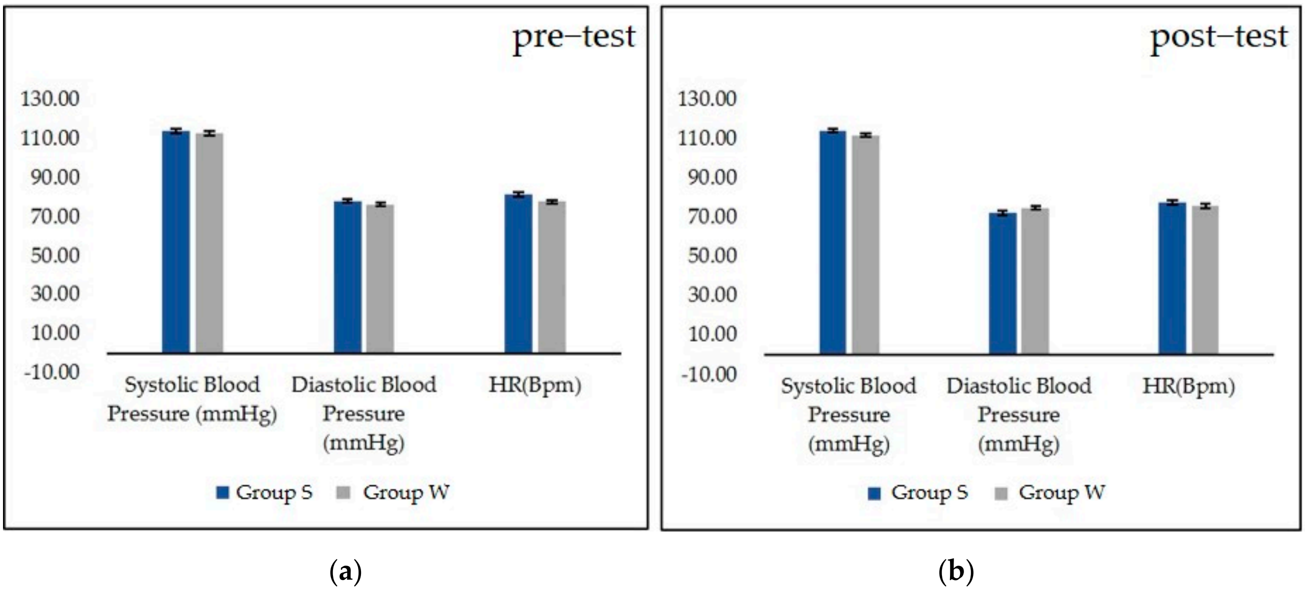

Figure 3. Difference test of Group S and Group W paired samples. (**a**) Differences in paired samples of pre−test between S and W groups. (**b**) Differences in paired samples of post−test between S and W groups.

3.1.2. Emotional indicators

Figure 4 shows six emotional parameter values for two behavior patterns. As shown, the "engagement" and "excitement" (0.60 ± 0.08 and 0.32 ± 0.16, respectively) levels of Group S were significantly lower than those of Group W (0.67 ± 0.09; 0.44 ± 0.13). Among the "Relaxation" emotional parameters, the levels of Group W (0.40 ± 0.07) were significantly higher than those of Group S (0.28 ± 0.07; $p = 0.000$), and the levels of the "Interest" emotional parameter in Group S (0.58 ± 0.06) were significantly higher than those in Group W (0.53 ± 0.04; $p < 0.01$). No significant differences in the "Stress" and "Focus" emotional parameters were observed between the two groups.

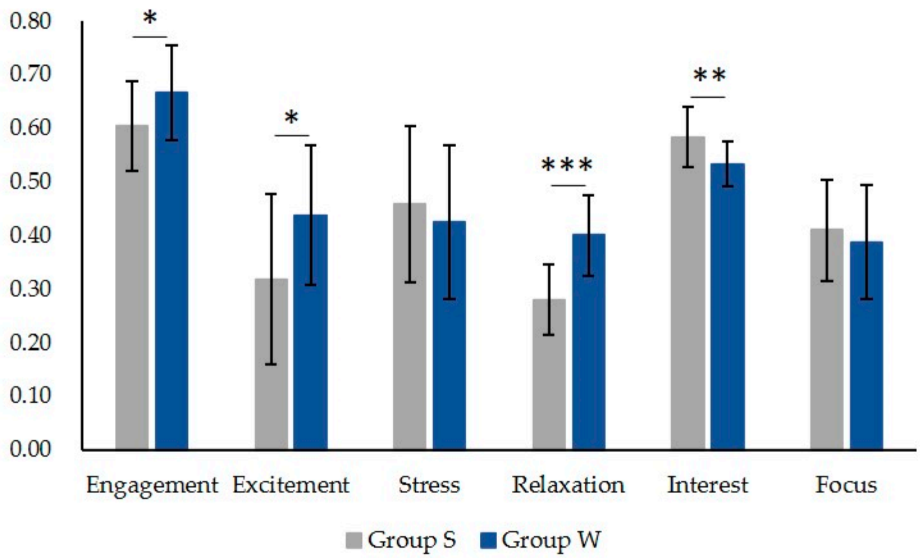

Figure 4. Six emotional parameter values of Group S and Group W (*** $p < 0.001$. ** $p < 0.01$. * $p < 0.05$).

Figure 5 shows the difference in RAB index values of the 14 channels in the four brain regions, mainly distributed in the frontal, temporal, and parietal lobes. Specific differences were observed in the AF3, F7 and P7 changes, which were significantly lower in Group S than in Group W ($p < 0.01$). The FC5, FC6, F3 and T7 channels showed significant differences between the behavior patterns ($p < 0.01$), and the RAB index values for Group S were significantly lower than those for Group W in the above four channels. There were no significant differences in the O1 and O2 channels of the occipital lobe.

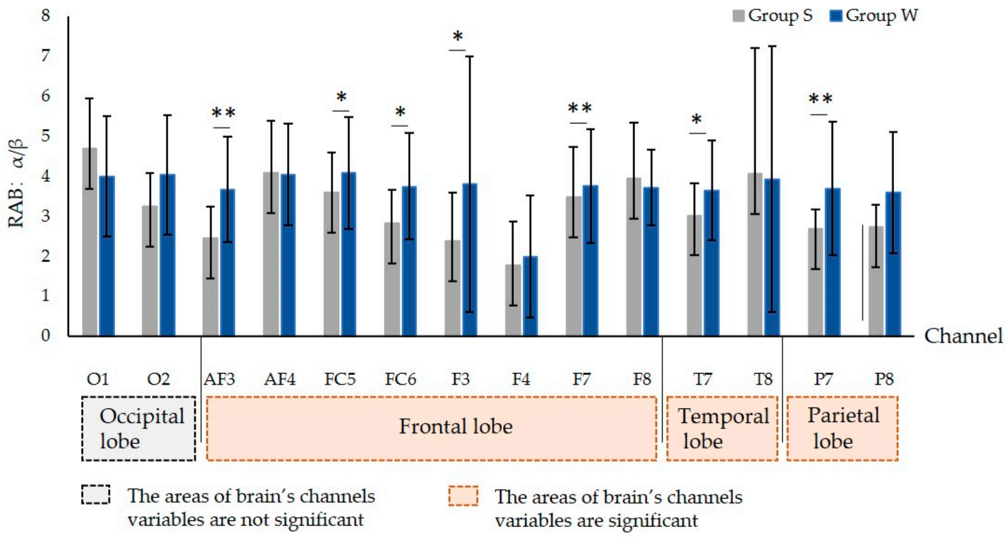

Figure 5. The corresponding RAB index values of the 14 brain channels of the Group S and Group W participants (** $p < 0.01$. * $p < 0.05$).

Table 2 shows the absolute α and β waves for the 14 electrodes under different behavioral patterns in an urban seasonal landscape forest. As shown in the table, the O2 and P8 electrodes in the occipital and parietal lobes, respectively, showed significant differences in the absolute α wave ($p < 0.05$). In the absolute β wave, the FC6, F4 and P8 electrodes showed significant differences ($p < 0.05$). These electrodes were located in the frontal and parietal lobes. There was no difference between the two groups of electrodes in the temporal lobe region of the brain.

Table 2. Absolute α and β wave values in different behavior patterns.

The Areas of Brain	Electrodes	α Wave					β Wave				
		Group S		Group W		Sig.	Group S		Group W		Sig.
		Mean	SD	Mean	SD		Mean	SD	Mean	SD	
Occipital lobe	O1	7.98	1.90	13.27	3.00	0.55	1.70	3.35	3.32	1.68	0.39
	O2	5.82	2.28	14.36	2.37	0.026 *	1.80	2.20	3.56	7.10	0.30
Frontal lobe	AF3	2.07	2.35	20.43	1.33	0.06	0.84	0.66	5.57	1.47	0.05
	AF4	8.28	1.02	34.62	1.03	0.08	2.03	2.60	8.56	14.90	0.06
	FC5	4.13	1.10	15.02	3.96	0.10	1.15	2.14	3.69	8.42	0.20
	FC6	4.39	2.85	24.35	1.48	0.04	1.55	1.36	6.50	10.50	0.043 *
	F3	1.94	1.18	10.46	2.85	0.13	0.81	0.86	2.75	5.46	0.13
	F4	6.35	1.06	7.60	3.28	0.28	3.59	2.11	3.82	7.81	0.035 *
	F7	4.68	2.85	14.14	2.43	0.14	1.35	1.96	3.77	5.81	0.09
	F8	11.16	1.81	10.11	1.40	0.84	2.83	3.14	2.72	3.27	0.91
Temporal lobe	T7	2.49	0.03	18.00	3.19	0.08	0.83	0.68	4.93	9.48	0.06
	T8	14.97	2.59	33.26	2.92	0.18	3.69	5.31	8.47	3.03	0.14
Parietal lobe	P7	1.06	1.99	11.28	2.82	0.10	0.39	0.64	3.05	6.17	0.06
	P8	6.27	5.92	21.33	2.40	0.031 *	2.29	1.97	5.93	1.56	0.03 *

* $p < 0.05$.

3.2. Psychometric Results

Pretest and posttest comparisons were made according to the seven emotional states in the POMS scale. As shown in Figure 6, Group S can effectively improve "Tension-Anxiety" (0.66 ± 0.56 pre and 0.37 ± 0.39 post, $p < 0.05$), "Depression" (0.36 ± 0.45 pre and 0.13 ± 0.26 post, $p < 0.05$) and "Fatigue" (0.92 ± 0.55 pre and 0.56 ± 0.57 post, $p < 0.05$) emotions. The mood of "depression" (0.57 ± 0.64 pre and 0.17 ± 0.32 post, $p < 0.05$), "Anger-Hostility" (1.38 ± 1.75 pre and 0.48 ± 0.46 post, $p < 0.05$), "Fatigue" (1.09 ± 0.78 pre and 0.59 ± 0.44 post, $p < 0.05$) and "Self-Esteem" (0.84 ± 0.78 pre and 0.29 ± 0.31 post, $p < 0.05$) in Group W decreased significantly, whilst the mood of "Vigor" (2.17 ± 0.70 pre and 2.65 ± 0.86 post, $p < 0.05$) increased significantly.

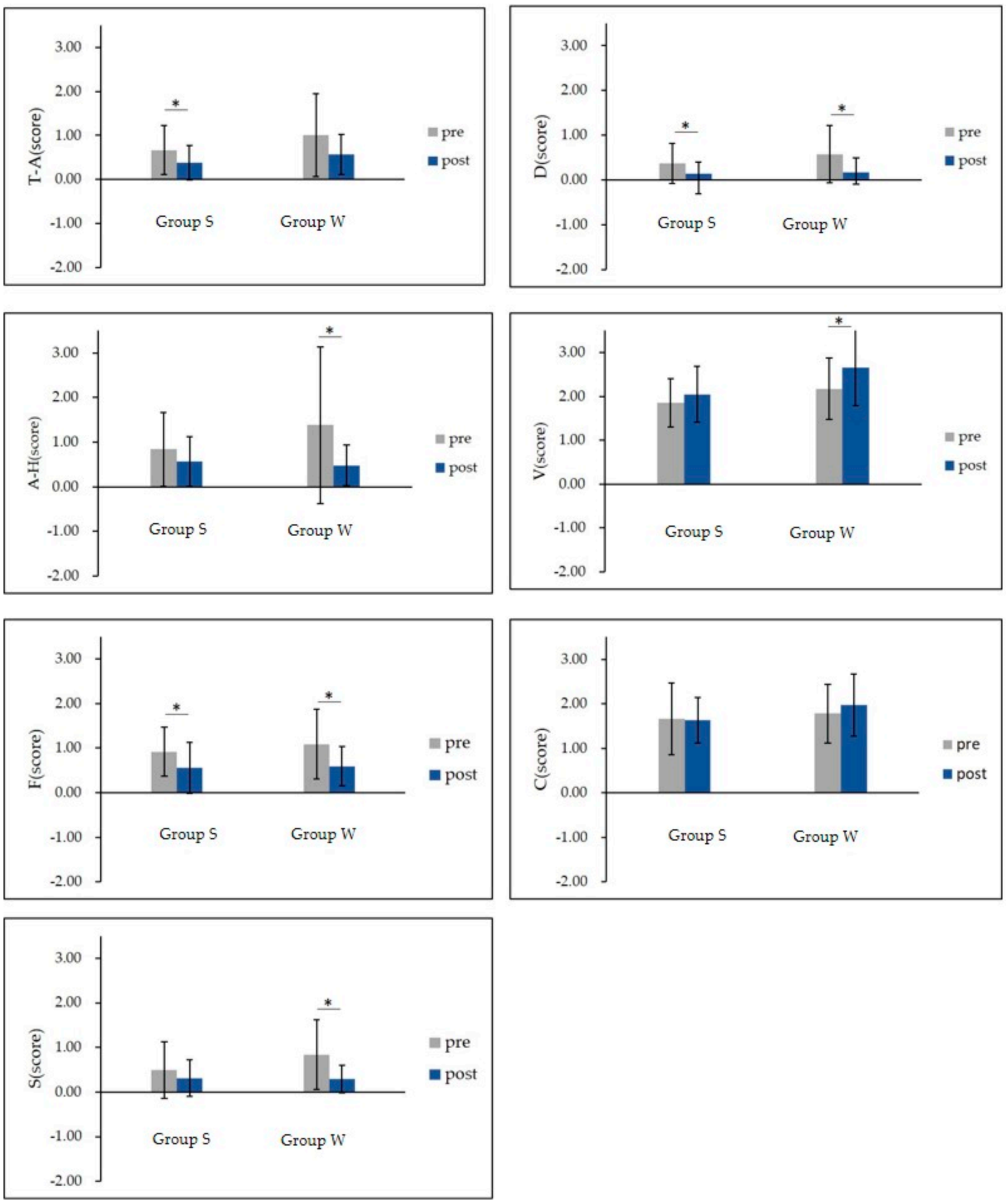

Figure 6. Emotional states in Group S and Group W (T−A: T scores for tension-anxiety; D: depression; A−H: anger−hostility; V: vigor; F: fatigue; C: confusion; S, self−esteem; * $p < 0.05$).

As shown in Figure 7, negative moods were significantly reduced in Group W (27.40 ± 14.66 pre and 11.70 ± 5.62 post, $p < 0.05$) in comparison with Group S (18.30 ± 15.99 pre and 10.70 ± 6.50 post, $p > 0.05$). The TMD of the two behavior groups decreased significantly before and after (Group S 98.90 ± 18.30 pre and 90.25 ± 7.30 post, $p < 0.05$, Group W

105.45 ± 16.25 pre and 85.90 ± 9.88 post, $p < 0.05$), and there was no significant change or difference in promoting positive emotion ($p > 0.05$).

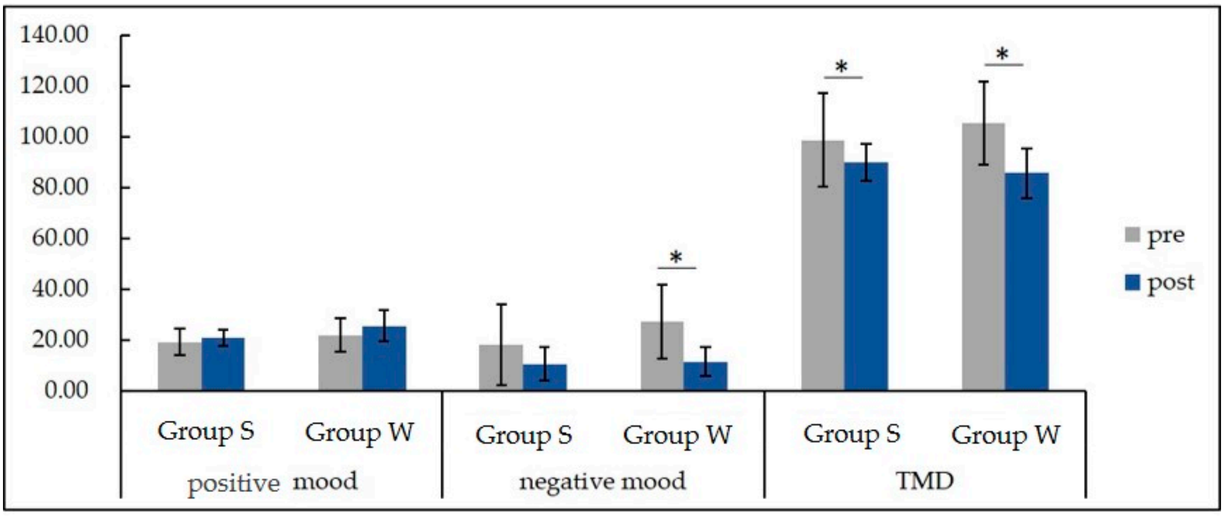

Figure 7. Mood state values in Group S and Group W (* $p < 0.05$).

4. Discussion

4.1. Physiological Index Influence

Adolescents are more likely to experience emotional problems characterized by emotional disorders in their daily lives [50,51]. Given the significant healthy-life-promoting effect of green space [52], it is of great significance to study the differences between emotion induction strategies in green spaces in terms of physiological responses. The results showed that the diastolic blood pressure and pulse of Group S decreased significantly ($p < 0.01$), while the systolic blood pressure, diastolic blood pressure and pulse of Group W did not change ($p > 0.05$). When excluding environmental differences, different behavior patterns produced different physiological feedback, consistent with the findings of Chorong, S [53], Ulrich [54] and others. In addition, compared with Group W, Group S demonstrated increased parasympathetic nerve activity and inhibited sympathetic nerve activity, and their heart rates tended to be flat, which is more conducive to the reduction of pulse and pressure symptoms. Previous studies have proven that observing nature can increase satisfaction, and walking can increase vitality [28]. We studied older adolescents; in comparison with younger people, this group shows more attention to and awareness of landscape changes, and the season significantly impacts the pressure-relieving effects of the landscape [35]. The behaviors participated in by Group W resulted in their exposure to a continuously changing landscape, while Group S remained in one place; Group W communicated the effects of the activity on their senses to the volunteers and described a positive relationship with the environment [55]. Some studies have shown that the possibility of conflict and social interaction while walking can reduce the stress-relieving effects. This potentially explains why the three physiological indicators in Group W did not significantly decrease in this experiment.

We analyzed behavioral differences across six emotional parameters. The results show that "engagement" and "excitement" were significantly lower in Group S than in Group W. In previous EEG studies, "engagement" was defined as directional attention and immersion or interest [56], and "excitement" was defined as high arousal [45]; thus, cognitive attention is higher when walking in a seasonal urban landscape forest than when sitting. This may be because walking provides more visual stimuli and changing landscape images. The emotional differences between the two groups are in contrast with the findings from a previous study [25], in which no significant difference in "engagement" or "excitement" were observed between walking and sitting in an urban green space. We found significant differences in the emotional parameters between Group W and Group S. We believe that this may be related to the experimental environment and the "completely green" environment in the city. Some studies have reported significant seasonality results using quantitative brain wave data [35], and the seasonality of leaves plays an important role in the perception of, and physiological states induced by, forest landscape aesthetics [57]. We chose autumn due to the obvious seasonal environmental variation; the plant used (ginkgo) undergoes significant leaf color changes in the process of changing to yellow; thus, the landscape's spatial structure and color change. Volunteers in an environment with a high wavelength color (such as yellow) can experience more excitement [58]; thus, their brain functions are more active [59]. It follows that this explains the discrepancies in the findings of our study versus those of the aforementioned study.

In addition, in the study of spatial benefits, attention recovery theory (ART) emphasizes distance as a main component [60]. Group S occupied a relatively independent space without being disturbed, and Group W experienced a continuously changing space during walking. A stable and coherent space is conducive to attention recovery to obtain a sense of relaxation [25]; however, the boredom resulting from prolonged sitting can reduce spatial communication and relaxation. In our study, using a large area of yellow as the main landscape color is more likely to cause relaxation and vigilance [61]. This environment may trigger greater EEG sensitivity to emotion; thus, the "relaxation" emotional parameters in the walking group were significantly higher than those in the sitting group. In addition, the microscale landscape in the study was easy for participants to interact with [29], meaning that volunteers found it easy to observe and experience the surrounding environment. Volunteers in Group S were more willing to pay attention to a favorite part of the landscape in the experiment, which can explain the significantly higher "interest" emotional parameter of Group S versus Group W. Regarding the RAB index values, the two viewing behavior patterns showed significant differences in EEG channels AF3, F7, P7, FC5, FC6, F3 and T7. Because the decrease in RAB power induced by visual stimulation mainly occurred in the occipital lobe, and the decrease in RAB power induced by auditory stimulation mainly occurred in the parietal and temporal lobes, there was a negative correlation between the decrease in RAB ability and stimulus-specific information [40]. Our study revealed significant differences in the seven channels for the two behavioral patterns in the frontal, parietal, and temporal lobes but no differences in the occipital lobe. Hence, the information specificity of our experimental environment's characteristics is insufficient to induce different RAB index values between the two groups. We also found that the O2 channel of the occipital lobe and P8 channel of the parietal lobe showed significant differences in the absolute α wave values, and the FC6 and F4 channels of the frontal lobe showed significant differences in the absolute β wave values. α waves indicate relaxation and β waves are expressions of positive thinking and attention [62]. Because teenagers' brains are more susceptible to negative emotional stimuli and the β wave is more dominant in the relaxed state, Group W obtained a higher level of relaxation and greater thinking ability. The occipital and parietal lobes were involved in activation. Zanzotto et al. [63] found that α and β waves are most visible in the parietal and occipital lobes and are similar.

4.2. Psychological Index Influence

There is a close relationship between GSB and psychological feedback. The results revealed significant differences in some psychological indicators of negative emotions between the two behavioral groups before and after the test. Group S and Group W demonstrated improved "tension-anxiety", while Group W showed improved "depression", "anger-hostility" and "self-esteem". We noticed that "vigor" (vitality and energy) increased significantly in Group W and was the only significant increase in the emotion index calculated from the self-report questionnaire. We speculate that this finding is related to the behavioral variables investigated by the research institute. The landscape stimuli that the experimenter is exposed to during walking and observing are more diverse than the relatively stable landscape observed while sitting. Some studies also show that the elements of natural change can arouse a sense of wildness, and walking and watching in nature can enhance vitality [28]. This visual psychological effect has been found to occur after five seconds [30]. The continuously changing visual stimulus feedback significantly increased the "vigor" mood in Group W. In addition, the research results showed that walking significantly reduced negative moods in comparison with sitting, while there was no significant effect on positive moods. Numerous cross-sectional studies have proven the positive effects of entering green space and walking [55], such as a reduction in negative emotions and anxiety [53], to be consistent with the results of this study, which further confirmed the mental health benefits of walking. It is believed that walking outdoors in nature has a greater impact on vitality and more effectively reduces negative emotions than sitting.

4.3. Suggestions for Urban Landscape Forest Planning Based on Different Emotional Feedback

The reduction in interaction time between humans and the natural environment has led to the need for effective green-space guidance to improve emotions [64]. The research results first further emphasize the impact of sitting and walking activities in seasonal landscape forests on the emotional health of adolescents. Our study showed that sitting in an autumn deciduous forest can help achieve better recovery, stress, and relaxation effects, manifesting as a significant decrease in systolic blood pressure and heart rate. Sitting in silence is more conducive than walking to generating "interest" emotions among adolescents. Understanding the promoting effect of spatial capacity building on human health [65], we can use landscape strategies to activate these conditions. First, the transformation of a space to provide environmental conditions and the reasonable use of different plant color combinations in landscape forests guide the generation of sitting, viewing, and staying behaviors, thereby achieving the goal of relaxation and interest activation. Studies have shown that golden plants trigger a warm and bright feeling in space [39], while red plants trigger high arousal [66]. These spatial landscape color combinations are used to increase landscape appeal and extend stay time.

The charm of forests lies in the unpredictability of the experiences they provide [67], especially the different landscape elements present during seasonal changes. These visual stimuli may induce users to engage in spontaneous activities, such as walking or sitting, and participants in the forest pay more attention to unique or interesting elements in the space [68]. In urban landscape forest planning, combinations of wild elements, such as berries, butterflies, and birds, are added. The creation of fish habitats enhances enjoyment of the area, and these naturally changing elements can also evoke a sense of wildness and friendliness [69], maximizing the benefits of biodiversity in the natural environment [70]. Second, abundant sitting facilities can be provided, including creating a quiet plant space and an appropriate number of recreational facilities, such as pavilions and chairs, to provide teenagers with a better interactive experience when observing the surrounding environment. According to the positive psychological and emotional feedback obtained from individuals engaging in the two behaviors in the autumn landscape forest environment in this study, the walking and viewing group showed a significant decrease in negative emotions and an increase in "vigor". We advocate the construction of trails in landscaped forests to maximize the comprehensive health benefits; additionally, the function of the trails should be improved to support multiple active travel purposes, such as walking and cycling [71], in order to stimulate positive emotions, such as user vitality. Simultaneously, the planning strategy of increasing entry and contact makes it easier for individuals to use the trail and connect with other green space areas and promotes the right to the fair use of nature.

5. Limitations

This study has several limitations. Firstly, our experimental environment was a real environment, and the emotional feedback results generated comprehensively reflect various sensory stimuli that may be particularly sensitive to emotions [72]. Emotional regulation varies over time [6], and EEG analysis alone is insufficient to obtain an accurate explanation. Future studies should combine EEG with multiple indicators for a comprehensive analysis. Second, the multielement changes in natural environments are seasonal, and many studies have shown that the mechanism of environmental characteristics may be of great significance to the beneficial effects of bottom-up attention. Although selecting a pure forest path environment reduced interference, the differences in vegetation density, vegetation location [73], and vegetation composition [29] and structure [74] require further longitudinal analysis. In addition, we focused on only two behaviors in our sample of teenagers: sitting and walking. However, the findings cannot be generalized due to the small sample size. Moreover, the cross-sectional approach provides limited time observation feedback, and data were only collected from individuals in autumn landscape forests. In the future, in addition to expanding the sample size, it is necessary to consider cross-longitudinal experiments with multiseason comparisons, population age diversity, and behavioral variables, audiovisual environment variables [75] to promote research on outdoor spatial health activities. Finally, numerous studies have demonstrated the difference between typical urban spaces (such as commercial and square spaces) and green spaces in promoting health. This experiment only involves different behavioral pattern controls, and it is necessary to include urban environmental control samples for a more comprehensive empirical study.

6. Conclusions

Focusing on green space as a health intervention, this study obtained profound information about how different behaviors in seasonal green environments can promote adolescent emotional health. This study provides strategies and references for improving the spiritual and cultural effects of urban landscape forests through relevant guiding actions and plans for green space activities. According to the differences in the physiological and psychological indicators shown in the results, we believe that sitting in an urban forest can promote relaxation, recovery and calmness, and walking can promote "interest", and "vigor" and decrease negative emotions. We further analyzed 14 electrode channel α differences from β waves and RAB indicators. The channel showed differences in the absolute α and absolute β waves in the P8 electrodes in the parietal lobe, indicating the activation of spatial processing in the corresponding parietal lobe of the brain. The O2 channel of the occipital lobe and FC6 and F4 of the right frontal lobe α and β waves showed significant differences. Group W obtained higher relaxation levels and thinking abilities than Group S. We suggest that urban environmental planning managers should use landscape strategies that activate corresponding behavioral conditions, paying attention to the guidance related to different behavioral patterns in the formed environment to achieve green spaces with better emotional impact. Considering the results of combining natural elements and different characteristics, recreational facilities and trails should be added to encourage natural viewing, participation, and interaction in scenic urban forests. Although the relationship between more diverse emotional needs and behavioral patterns in urban landscape forests remains to be explored, this study provides a research reference for urban green-space planners, namely, guidance related to behavioral patterns in green spaces, including the need for a focus on seasonal changes.

Author Contributions: Conceptualization, L.W.; methodology, L.W.; software, L.W.; validation, L.W.; formal analysis, L.W.; investigation, L.W. and S.L.; resources, L.W. and S.L.; data curation, L.W.; writing—original draft preparation, L.W. and Q.C.; writing—review and editing, Q.C., J.L., D.L., J.W. and S.L.; visualization, L.W.; supervision, L.W. and Q.C.; project administration, Q.C.; funding acquisition, L.W. and Q.C. All authors have read and agreed to the published version of the manuscript.

Funding: Evidence-based studies on the spatiotemporal coupling mechanism of the ecological healthcare benefits of Bambusa emeiensis landscape forest (3227140499).

Data Availability Statement: Not applicable.

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

References

1. Xie, J.; Luo, S.; Furuya, K.; Sun, D. Urban Parks as Green Buffers during the COVID-19 Pandemic. *Sustainability* **2020**, *12*, 6751. [CrossRef]
2. Tsunetsugu, Y.; Lee, J.; Park, B.-J.; Tyrväinen, L.; Kagawa, T.; Miyazaki, Y. Physiological and psychological effects of viewing urban forest landscapes assessed by multiple measurements. *Landsc. Urban Plan.* **2013**, *113*, 90–93. [CrossRef]
3. Lyu, B.; Zeng, C.; Xie, S.; Li, D.; Lin, W.; Li, N.; Jiang, M.; Liu, S.; Chen, Q. Benefits of A Three-Day Bamboo Forest Therapy Session on the Psychophysiology and Immune System Responses of Male College Students. *Int. J. Environ. Res. Public Health* **2019**, *16*, 4991. [CrossRef] [PubMed]
4. Peschardt, K.K.; Stigsdotter, U.K. Associations between park characteristics and perceived restorativeness of small public urban green spaces. *Landsc. Urban Plan.* **2013**, *112*, 26–39. [CrossRef]
5. Jiang, B.; Zhang, T.; Sullivan, W.C. Healthy Cities: Mechanisms and Research Questions Regarding the Impacts of Urban Green Landscapes on Public Health and Well-being. *Landsc. Archit. Front.* **2015**, *3*, 24–35.
6. Yang, M.; Deng, X.; An, S. The Immediate and Lasting Effect of Emotion Regulation in Adolescents: An ERP Study. *Int. J. Environ. Res. Public Health* **2021**, *18*, 10242. [CrossRef]
7. Restubog, S.L.D.; Ocampo, A.C.G.; Wang, L. Taking control amidst the chaos: Emotion regulation during the COVID-19 pandemic. *J. Vocat. Behav.* **2020**, *119*, 103440. [CrossRef]
8. Cracco, E.; Goossens, L.; Braet, C. Emotion regulation across childhood and adolescence: Evidence for a maladaptive shift in adolescence. *Eur. Child Adolesc. Psychiatry* **2017**, *26*, 909–921. [CrossRef]
9. McLaughlin, K.A.; Hatzenbuehler, M.L.; Mennin, D.S.; Nolen-Hoeksema, S. Emotion dysregulation and adolescent psychopathology: A prospective study. *Behav. Res. Ther.* **2011**, *49*, 544–554. [CrossRef]
10. Lennarz, H.K.; Hollenstein, T.; Lichtwarck-Aschoff, A.; Kuntsche, E.; Granic, I. Emotion regulation in action: Use, selection, and success of emotion regulation in adolescents' daily lives. *Int. J. Behav. Dev.* **2019**, *43*, 1–11. [CrossRef]
11. Espinosa, P.; De Meulder, B.; Ollero, A. River Restoration and Rehabilitation as a New Urban Design Strategy: Learning to Re-see Urban Rivers. *Int. J. Constr. Environ.* **2016**, *7*, 57–73. [CrossRef]
12. Wolch, J.R.; Byrne, J.; Newell, J.P. Urban green space, public health, and environmental justice: The challenge of making cities 'just green enough'. *Landsc. Urban Plan.* **2014**, *125*, 234–244. [CrossRef]
13. DuBose, J.; MacAllister, L.; Hadi, K.; Sakallaris, B. Exploring the Concept of Healing Spaces. *HERD Health Environ. Res. Des. J.* **2018**, *11*, 43–56. [CrossRef] [PubMed]
14. Velarde, M.; Fry, G.; Tveit, M. Health effects of viewing landscapes—Landscape types in environmental psychology. *Urban For. Urban Green.* **2007**, *6*, 199–212. [CrossRef]
15. Kim, S.; Park, H.; Choo, S. Effects of Changes to Architectural Elements on Human Relaxation-Arousal Responses: Based on VR and EEG. *Int. J. Environ. Res. Public Health* **2021**, *18*, 4305. [CrossRef] [PubMed]
16. Deng, L.; Luo, H.; Ma, J.; Huang, Z.; Sun, L.X.; Jiang, M.Y.; Zhu, C.Y.; Li, X. Effects of integration between visual stimuli and auditory stimuli on restorative potential and aesthetic preference in urban green spaces. *Urban For. Urban Green.* **2020**, *53*, 126702. [CrossRef]
17. Song, C.; Ikei, H.; Miyazaki, Y. Effects of forest-derived visual, auditory, and combined stimuli. *Urban For. Urban Green.* **2021**, *64*, 127253. [CrossRef]
18. Kuper, R. Here and Gone: The Visual Effects of Seasonal Changes in Plant and Vegetative Characteristics on Landscape Preference Criteria. *Landsc. J.* **2013**, *32*, 65–78. [CrossRef]
19. Zhao, J.; Xu, W.; Li, R. Visual preference of trees: The effects of tree attributes and seasons. *Urban For. Urban Green.* **2017**, *25*, 19–25. [CrossRef]
20. Paddle, E.; Gilliland, J. Orange Is the New Green: Exploring the Restorative Capacity of Seasonal Foliage in Schoolyard Trees. *Int. J. Environ. Res. Public Health* **2016**, *13*, 497. [CrossRef]
21. Giergiczny, M.; Czajkowski, M.; Żylicz, T.; Angelstam, P. Choice experiment assessment of public preferences for forest structural attributes. *Ecol. Econ.* **2015**, *119*, 8–23. [CrossRef]
22. Norouzi, N.; Fani, M. Comparison of weak and strong theories of environmental sustainability in the conceptual context of sustainable development. *Trends J. Sci. Res.* **2021**, *1*, 108–122. [CrossRef]
23. Dudek, T.; Marć, M.; Zabiegała, B. Chemical Composition of Atmospheric Air in Nemoral Scots Pine Forests and Submountainous Beech Forests: The Potential Region for the Introduction of Forest Therapy. *Int. J. Environ. Res. Public Health* **2022**, *19*, 15838. [CrossRef] [PubMed]
24. 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] [PubMed]
25. Lin, W.; Chen, Q.; Jiang, M.; Tao, J.; Liu, Z.; Zhang, X.; Wu, L.; Xu, S.; Kang, Y.; Zeng, Q. Sitting or Walking? Analyzing the Neural Emotional Indicators of Urban Green Space Behavior with Mobile EEG. *J. Urban Health* **2020**, *97*, 191–203. [CrossRef]
26. Wei, H.; Hauer, R.J.; Guo, S. Daytime dynamic of spontaneous expressions of pedestrians in an urban forest park. *Urban For. Urban Green.* **2021**, *68*, 127326. [CrossRef]
27. Chang, W.-Y.; Lo, M.-T.; Huang, C.-F. The Influence of Emotional Environmental Pictures on Behavior Intentions: The Evidence of Neuroscience Technology. *Int. J. Environ. Res. Public Health* **2019**, *16*, 5142. [CrossRef] [PubMed]

28. Kobayashi, H.; Ikei, H.; Song, C.; Kagawa, T.; Miyazaki, Y. Comparing the impact of forest walking and forest viewing on psychological states. *Urban For. Urban Green.* **2020**, *57*, 126920. [CrossRef]
29. Wu, L.; Dong, Q.; Luo, S.; Jiang, W.; Hao, M.; Chen, Q. Effects of Spatial Elements of Urban Landscape Forests on the Restoration Potential and Preference of Adolescents. *Land* **2021**, *10*, 1349. [CrossRef]
30. Lin, W.; Chen, Q.; Zhang, X.; Tao, J.; Liu, Z.; Lyu, B.; Li, N.; Li, D.; Zeng, C. Effects of Different Bamboo Forest Spaces on Psychophysiological Stress and Spatial Scale Evaluation. *Forests* **2020**, *11*, 616. [CrossRef]
31. Yu, C.-P.; Hsieh, H. Beyond restorative benefits: Evaluating the effect of forest therapy on creativity. *Urban For. Urban Green.* **2020**, *51*, 126670. [CrossRef]
32. Janeczko, E.; Bielinis, E.; Wójcik, R.; Woźnicka, M.; Kędziora, W.; Łukowski, A.; Elsadek, M.; Szyc, K.; Janeczko, K. When Urban Environment Is Restorative: The Effect of Walking in Suburbs and Forests on Psychological and Physiological Relaxation of Young Polish Adults. *Forests* **2020**, *11*, 591. [CrossRef]
33. Hassan, A.; Tao, J.; Li, G.; Jiang, M.; Aii, L.; Jiang, Z.; Liu, Z.; Chen, Q. Effects of Walking in Bamboo Forest and City Environments on Brainwave Activity in Young Adults. *Evid.-Based Complement. Altern. Med.* **2018**, *2018*, 9653857. [CrossRef] [PubMed]
34. Mehdipanah, R.; Israel, B.A.; Richman, A.; Allen, A.; Rowe, Z.; Gamboa, C.; Schulz, A.J. Urban HEART Detroit: The Application of a Health Equity Assessment Tool. *J. Urban Health* **2021**, *98*, 146–157. [CrossRef] [PubMed]
35. Wang, Y.; Xu, M. Electroencephalogram Application for the Analysis of Stress Relief in the Seasonal Landscape. *Int. J. Environ. Res. Public Health* **2021**, *18*, 8522. [CrossRef] [PubMed]
36. Gerstenberg, T.; Baumeister, C.F.; Schraml, U.; Plieninger, T. Hot routes in urban forests: The impact of multiple landscape features on recreational use intensity. *Landsc. Urban Plan.* **2020**, *203*, 103888. [CrossRef]
37. Kuper, R. Preference and restorative potential for landscape models that depict diverse arrangements of defoliated, foliated, and evergreen plants. *Urban For. Urban Green.* **2020**, *48*, 126570. [CrossRef]
38. Paraskevopoulou, A.T.; Kamperi, E.; Demiris, N.; Economou, M.; Theleritis, C.; Kitsonas, M.; Papageorgiou, C. The impact of seasonal colour change in planting on patients with psychotic disorders using biosensors. *Urban For. Urban Green.* **2018**, *36*, 50–56. [CrossRef]
39. Guo, L.N.; Zhao, R.L.; Ren, A.H.; Niu, L.X.; Zhang, Y.L. Stress Recovery of Campus Street Trees as Visual Stimuli on Graduate Students in Autumn. *Int. J. Environ. Res. Public Health* **2019**, *17*, 148. [CrossRef]
40. Griffiths, B.J.; Mayhew, S.D.; Mullinger, K.J.; Jorge, J.; Charest, I.; Wimber, M.; Hanslmayr, S. Alpha/beta power decreases track the fidelity of stimulus-specific information. *eLife* **2019**, *8*, e49562. [CrossRef]
41. Zangeneh Soroush, M.; Maghooli, K.; Kamaledin Setarehdan, S.; Nasrabadi, A.M. A Review on EEG Signals Based Emotion Recognition. *Int. Clin. Neurosci. J.* **2018**, *4*, 118–129. [CrossRef]
42. Kim, Y.J.; Shin, D.J.; Kim, J.Y. A Study on the Characteristics on Brain Wave of Indoor Space Lighting by EEG Experiment. *J. Korean Inst. Spat. Des.* **2019**, *14*, 71–80.
43. Abraham, A.; Sommerhalder, K.; Abel, T. Landscape and well-being: A scoping study on the health-promoting impact of outdoor environments. *Int. J. Public Health* **2010**, *55*, 59–69. [CrossRef] [PubMed]
44. Li, H.; Zhang, X.; Bi, S.; Cao, Y.; Zhang, G. Psychological benefits of green exercise in wild or urban greenspaces: A meta-analysis of controlled trials. *Urban For. Urban Green.* **2022**, *68*, 127458. [CrossRef]
45. Neale, C.; Aspinall, P.; Roe, J.; Tilley, S.; Mavros, P.; Cinderby, S.; Coyne, R.; Thin, N.; Bennett, G.; Thompson, C.W. The Aging Urban Brain: Analyzing Outdoor Physical Activity Using the Emotiv Affectiv Suite in Older People. *J. Urban Health Bull. N. Y. Acad. Med.* **2017**, *94*, 869–880. [CrossRef]
46. Ochiai, H.; Ikei, H.; Song, C.; Kobayashi, M.; Miura, T.; Kagawa, T.; Li, Q.; Kumeda, S.; Imai, M.; Miyazaki, Y. Physiological and psychological effects of forest therapy on middle-aged males with high-normal blood pressure. *Int. J. Environ. Res. Public Health* **2015**, *12*, 2532–2542. [CrossRef]
47. Lee, M.S.; Lee, J.Y.; Park, B.J.; Miyazaki, Y. Interaction with indoor plants may reduce psychological and physiological stress by suppressing autonomic nervous system activity in young adults: A randomized crossover study. *J. Physiol. Anthropol.* **2015**, *34*, 21. [CrossRef]
48. Ramirez, R.; Palencia-Lefler, M.; Giraldo, S.; Vamvakousis, Z. Musical neurofeedback for treating depression in elderly people. Frontiers in Neuroscience. *Front. Neurosci.* **2015**, *9*, 354. [CrossRef]
49. McNair, D.M.; Lorr, M.; Droppleman, L.F.; EdITS. *Manual for the Profile of Mood States Manual (POMS)*; Educational and Industrial Testing Service: Princeton, NJ, USA, 1992.
50. Profile of Mood StatesForbes, E.E.; Dahl, R.E. Neural systems of positive affect: Relevance to understanding child and adolescent depression? *Dev. Psychopathol.* **2005**, *17*, 827–850.
51. Andersen, S.L.; Teicher, M.H. Stress, sensitive periods and maturational events in adolescent depression. *Trends Neurosci.* **2008**, *31*, 183–191. [CrossRef]
52. Sallis, J.F.; Owen, N.; Fisher, E. Ecological models of health behaviour. *Health Educ. Behav.* **2002**, *4*, 116.
53. Song, C.; Ikei, H.; Igarashi, M.; Takagaki, M.; Miyazaki, Y. Physiological and Psychological Effects of a Walk in Urban Parks in Fall. *Int. J. Environ. Res. Public Health* **2015**, *12*, 14216–14228. [CrossRef] [PubMed]
54. Ulrich, R.S.; Simons, R.F.; Losito, B.D.; Fiorito, E.; Miles, M.A.; Zelson, M. Stress recovery during exposure to natural and urban environments. *J. Environ. Psychol.* **1991**, *11*, 201–230. [CrossRef]

55. Li, H.; Dong, W.; Wang, Z.; Chen, N.; Wu, J.; Wang, G.; Jiang, T. Effect of a Virtual Reality-Based Restorative Environment on the Emotional and Cognitive Recovery of Individuals with Mild-to-Moderate Anxiety and Depression. *Int. J. Environ. Res. Public Health* **2021**, *18*, 9053. [CrossRef] [PubMed]
56. Aspinall, P.; Mavros, P.; Coyne, R.; Roe, J. The urban brain: Analysing outdoor physical activity with mobile EEG. *Br. J. Sport. Med.* **2015**, *49*, 272–276. [CrossRef] [PubMed]
57. Zhang, X.J.; Chen, J.; Li, Q.Y.; Liu, J.C.; Tao, J.P. Color quantification and evaluation of landscape aesthetic quality for autumn landscape forest based on visual characteristics in subalpine region of western Sichuan, China. *J. Appl. Ecol.* **2020**, *31*, 45–54.
58. Gotts, Z.M.; Ellis, J.G.; Deary, V.; Barclay, N.; Newton, J.L. The Association between Daytime Napping and Cognitive Functioning in Chronic Fatigue Syndrome. *PLoS ONE* **2015**, *10*, e0117136. [CrossRef]
59. Jang, H.S.; Kim, J.; Kim, K.S.; Pak, C.H. Human brain activity and emotional responses to plant color stimuli. *Color Res. Appl.* **2014**, *39*, 307–316. [CrossRef]
60. Kaplan, R.; Kaplan, S. *The Experience of Nature: A Psychological Perspective*; Cambridge University Press: Cambridge, UK, 1989; pp. 9–11.
61. Xie, J.; Liu, B.; Elsadek, M. How Can Flowers and Their Colors Promote Individuals' Physiological and Psychological States during the COVID-19 Lockdown? *Int. J. Environ. Res. Public Health* **2021**, *18*, 10258. [CrossRef]
62. Sanei, S.; Chambers, J.A. *EEG Signal Processing*; John Wiley & Sons Ltd.: Hoboken, NJ, USA, 2007; pp. 1–13.
63. Ramirez, R.; Vamvakousis, Z. Detecting Emotion from EEG Signals Using the Emotive Epoc Device. In Proceedings of the 2012 International Conference on Brain Informatics, Macau, China, 4–7 December 2012; Volume 7670, pp. 175–184.
64. Pergams, O.R.; Zaradic, P.A. Zaradic Evidence for a fundamental and pervasive shift away from nature-based recreation. *Proc. Natl. Acad. Sci. USA* **2008**, *105*, 2295–2300. [CrossRef] [PubMed]
65. Hartig, T.; Staats, H. The need for psychological restoration as a determinant of environmental preferences. *J. Environ. Psychol.* **2006**, *26*, 215–226. [CrossRef]
66. Elliot, A.J. A Historically Based Review of Empirical Work on Color and Psychological Functioning: Content, Methods, and Recommendations for Future Research. *Rev. Gen. Psychol.* **2019**, *23*, 177–200. [CrossRef]
67. Gao, Y.; Zhang, T.; Sasaki, K.; Uehara, M.; Jin, Y.; Qin, L. The spatial cognition of a forest landscape and its relationship with tourist viewing intention in different walking passage stages. *Urban For. Urban Green.* **2021**, *58*, 126975. [CrossRef]
68. Gao, Y.; Zhang, T.; Zhang, W.; Meng, H.; Zhang, Z. Research on visual behavior characteristics and cognitive evaluation of different types of forest landscape spaces. *Urban For. Urban Green.* **2020**, *54*, 126788. [CrossRef]
69. Zhang, H.; Chen, B.; Sun, Z.; Bao, Z. Landscape perception and recreation needs in urban green space in Fuyang, Hangzhou, China. *Urban For. Urban Green.* **2013**, *12*, 44–52. [CrossRef]
70. Kexiu, L.; Elsadek, M.; Liu, B.; Fujii, E. Foliage colors improve relaxation and emotional status of university students from different countries. *Heliyon* **2021**, *7*, e06131. [CrossRef]
71. He, D.; Lu, Y.; Xie, B.; Helbich, M. Large-scale greenway intervention promotes walking behaviors: A natural experiment in China. *Transp. Res. Part D Transp. Environ.* **2021**, *101*, 103095. [CrossRef]
72. Li, Z.; Kang, J. Sensitivity analysis of changes in human physiological indicators observed in soundscapes. *Landsc. Urban Plan.* **2019**, *190*, 103593. [CrossRef]
73. Kabisch, N.; Püffel, C.; Masztalerz, O.; Hemmerling, J.; Kraemer, R. Physiological and psychological effects of visits to different urban green and street environments in older people: A field experiment in a dense inner-city area. *Landsc. Urban Plan.* **2020**, *207*, 103998. [CrossRef]
74. 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]
75. Chen, Z.; Zhu, T.-Y.; Liu, J.; Hong, X.-C. Before Becoming a World Heritage: Spatiotemporal Dynamics and Spatial Dependency of the Soundscapes in Kulangsu Scenic Area, China. *Forests* **2022**, *3*, 1526. [CrossRef]