

Article

Exploring the Link Between Social Media Engagement, Social Anxiety, and Environmental Preferences in University Students

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Abstract: As mental health issues become increasingly prominent, social anxiety is prevalent among university students and significantly affects their social behaviors and environmental preferences. With the increasing reliance on social media, understanding how these behaviors shape preferences for physical social environments is crucial for designing supportive campus spaces. This study investigates the relationship between social anxiety, social media usage, and environmental preferences in campus settings. We aim to identify the key environmental factors that can promote healthier social interactions for students with varying levels of social anxiety and social media use. Data were collected from university students through a structured questionnaire assessing demographic characteristics, online and offline behavior, social media usage intensity, social anxiety level, and environmental preferences. Using K-means clustering, participants were grouped into four clusters based on their social media usage and social anxiety levels. ANOVA and Multivariate Multiple Regression (MMR) were conducted to examine differences in environmental preferences across these clusters. Significant differences in environmental preferences were observed across the four clusters. Gender and grade influenced social anxiety levels, with females and undergraduate students reporting greater anxiety. Individuals with high social media use, regardless of their anxiety levels, generally exhibited stronger preferences for various environmental dimensions, including openness, convenience, facility provision, safety/comfort, and cultural landscape. However, individuals with higher social anxiety tended to prefer enclosed, facility-rich, and more controlled environments. The relationship between social anxiety and preferences for convenience, safety/comfort, and cultural landscape was minimal or non-significant. This study highlights the importance of considering both behavioral and psychological factors when designing university social environments. By identifying specific environmental preferences of students with high social anxiety, the findings offer evidence-based recommendations for creating more inclusive and supportive campus spaces that promote positive social interactions and well-being.



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Keywords: social anxiety; social media; social behavior; environmental preferences; supportive campus spaces

1. Introduction

The World Health Organization defines health as “a state of complete physical, mental, and social well-being”, encompassing physical, mental, and social dimensions [1]. Social health specifically involves possessing good social adaptability, which entails an individual’s ability to adapt to social life, play social roles, and fulfill social functions positively [2]. The college stage is a critical period for individual socialization, where the myriad of complex social activities often induces feelings of anxiety and unease among students [3]. As a vulnerable group to social anxiety, college students often exhibit heightened interpersonal sensitivity during this stage, frequently experiencing elevated levels of social

anxiety [4]. Social anxiety among college students adversely affects their health and hinders societal development.

With the prevalence of smartphones and the advancements in internet technology, the use of social networks has transformed traditional face-to-face social interaction patterns [5]. As the primary users of social networks, college students benefit from the convenience and immediacy of online social interaction, leading to the gradual digitalization of social interactions [6]. However, excessive use of social networks may negatively affect college students, leading to psychological issues [7–9]. These issues reduce the initiative for real-life social interactions and impair their social interaction abilities. Social interaction ability is essential for college students to adapt to social development. Therefore, creating a supportive campus environment and guiding college students to engage in healthy social behaviors are crucial for cultivating their social interaction skills and alleviating social anxiety.

This study investigates the relationship between social anxiety, social media use, and environmental preferences in campus settings, understanding online and offline social behavior among college students. We aim to identify the key environmental factors that can promote healthier social interactions for students with varying levels of social anxiety and social media use. The findings offer evidence-based recommendations for creating more inclusive and supportive campus spaces that enhance occupants' health and well-being.

1.1. Social Anxiety and Cognitive Behavioral Therapy (CBT)

Social anxiety (SA) is a prevalent psychological condition characterized by an intense fear of social interactions, often driven by concerns about negative evaluation and judgment by others [10]. Individuals with SA tend to avoid social situations, which reinforces their anxiety and leads to a cycle of avoidance and isolation [11–13]. Social anxiety frequently emerges during adolescence and early adulthood, particularly during transitional periods such as the college years, when students face heightened social and academic pressures [14]. These pressures can make college students especially vulnerable to social anxiety, affecting their ability to form relationships, participate in academic activities, and adapt to new environments [15,16].

Research into social anxiety has identified several key factors that contribute to its development and persistence. Genetic predisposition and temperamental traits such as behavioral inhibition are well-documented predictors of social anxiety [17,18]. However, environmental factors play an equally critical role, especially school environment [19]. Studies show that early negative social experiences, peer rejection, and bullying during adolescence are strongly associated with the development of social anxiety [20–22]. In particular, experiences that undermine an individual's self-esteem or lead to feelings of exclusion tend to heighten sensitivity to social scrutiny [23].

Cognitive Behavioral Therapy (CBT) is widely recognized as one of the most effective treatments for social anxiety [24,25]. The core principle of CBT is that thoughts, emotions, behaviors, and physical sensations are interrelated. Exposure therapy, a key component of CBT, involves gradually confronting feared social situations in a safe and controlled environment [26]. By progressively exposing individuals to these situations, CBT helps reduce the overwhelming anxiety associated with them, allowing the individual to develop more adaptive social behaviors [27]. Therefore, supportive campus environments—those that provide opportunities for peer support, collaboration, and inclusive social activities—can mitigate social anxiety by promoting positive social experiences.

1.2. The Impact of the Built Environment on Mental Health and Well-Being

Environmental psychology explores the dynamic relationship between humans and their physical environments [28], focusing on how perception, cognition, and behavior are influenced by environmental factors, and how individuals in turn affect their surroundings (Figure 1). There is an increasing body of research examining the role of the built environment in promoting mental health and well-being. Much of this research has focused on

how environments can alleviate mental health issues such as stress and depression [29,30]. Access to natural environments and green spaces has been shown to reduce stress and enhance emotional well-being [31,32]. Studies have also highlighted the role of spatial design in reducing symptoms of depression by promoting light exposure, creating open areas for movement, and encouraging social interaction [33]. To our knowledge, there is little empirical investigation into connections between environments and social anxiety, which is crucial for promoting healthier social engagement among socially anxious individuals. Given the pervasive impact of social anxiety, particularly among college students, understanding the environmental preferences of socially anxious individuals represents a critical gap.

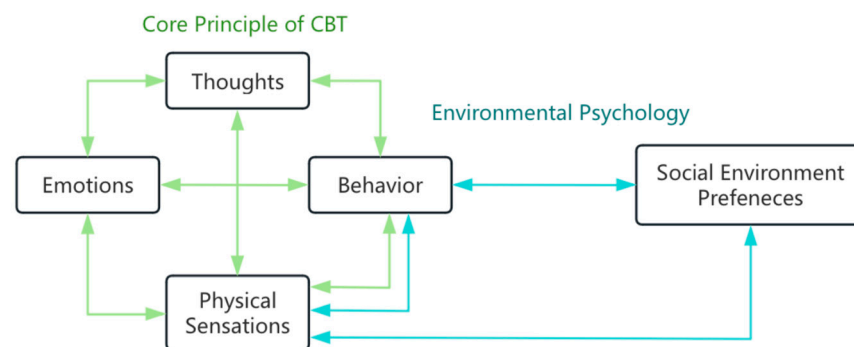


Figure 1. The correlation between CBT and environmental psychology.

1.3. The Role of Social Media in Shaping Social Anxiety and Environmental Preferences

The rise of social media has not only transformed the way people communicate but has also influenced how individuals interact with physical environments [5]. Social media allows users, especially those with social anxiety, to engage in social interactions without the immediate pressures of face-to-face encounters, offering an alternative platform for communication. While this digital interaction provides convenience [6], it also has implications for how individuals perceive and prefer their real-world social environments. Research indicates that social network use can maintain group relationships, promote group identity [34], and deepen offline social interactions [35]. This use fulfills personalized psychological needs and positively impacts college students' psychological well-being and socialization processes [36]. However, over-reliance on social media may lead to psychological issues such as loneliness, low self-esteem, and depression [7–9]. Additionally, Studies indicate that excessive use of social media—especially behaviors like social comparison, passive consumption, and the fear of missing out—can exacerbate social anxiety [37,38]. In this sense, a thorough comprehension of college students' social behaviors, particularly their engagement with social media, is essential for elucidating their social anxiety and preferences regarding social environments.

1.4. Campus Third Places and Environmental Preferences

The concept of third places, introduced by sociologist Ray Oldenburg, refers to informal public spaces beyond work and home, such as streets, street parks, retail, dining, leisure, and entertainment facilities [39]. These spaces are essential for promoting social interaction and enhancing community cohesion [40,41]. Third places are known to support the development of weak ties—social connections with acquaintances or neighbors—which play a significant role in individuals' self-rated health and well-being [42–44].

In the context of universities, campus third places serve as crucial venues for student interaction and social engagement. Defined as informal public spaces on university campuses, separate from classrooms, self-study areas, and residential spaces, these environments facilitate social interaction, fostering a vibrant and dynamic campus atmosphere. Current research suggests that high-quality third places contribute to the psychological well-being of students, offering restorative benefits and opportunities for social participa-

tion [45]. Despite their importance, the formal classification of campus third places in the literature remains limited, with most studies focusing on their function and the types of activities they support [46–48]. This study categorizes campus third places into five types based on their purpose of use and management:

- (1) Public Open Spaces: accessible to all students and the public, including campus squares and green areas, providing open areas for relaxation and informal social activities.
- (2) Campus Service Spaces: managed by the university to deliver services such as cafeterias, student activity centers, and library atriums; these spaces support administrative, educational, and recreational functions.
- (3) Dining Commercial Spaces: operated by businesses offering dining options such as cafes and restaurants; these spaces provide essential services while fostering social interactions.
- (4) Creative, Athletic, and Entertainment Spaces: these venues cater to students' cultural, athletic, and leisure pursuits, including gyms, game rooms, and art centers, promoting both physical and social activities.
- (5) Personal Service Spaces: providing convenience services such as barbershops and convenience stores; these spaces address students' personal needs while offering additional opportunities for social engagement.

Research on public spaces emphasizes their role as central venues for social interaction, with key influencing factors including accessibility, the volume and variety of people and activities, and the duration of social engagements [46,49]. The quality of these spaces is often assessed based on inclusiveness, meaningfulness, safety, comfort, and pleasurability [50].

Demographic factors shape individuals' spatial needs and perceptions. For instance, males tend to prioritize environmental features and design, while females value accessibility and safety [3,51]. Enhanced accessibility is believed to foster positive lifestyles, while attributes such as safety, aesthetics, convenient facilities, cleanliness, and comfort impact behaviors and contribute to the health and well-being of users, including adolescents and older individuals [52].

Studies on public space utilization show that factors like shading [53], thermal comfort [54], spatial openness, material appearance [55], and cultural elements [56] play significant roles in influencing users' behaviors. The richness of greenery, its layout, and the quality of sports, lifestyle, and convenience facilities [57–60] also determine how well these spaces are utilized, particularly by adolescents, who are drawn to areas that offer recreational opportunities [61].

On university campuses, public spaces serve as crucial venues for student interaction, contributing to the overall vibrancy of the campus environment [62,63]. Research in this domain focuses on aspects such as thermal comfort [64–66], spatial configuration [2,67], health benefits [68–71], and user behavior [72]. The environmental quality of these spaces is generally assessed based on physical/ecological, behavioral/functional, and aesthetic/visual components [73], with important design principles like openness, accessibility, spatial hierarchy, comfort, and participation influencing social interactions [74–76].

This literature provides a solid foundation for understanding the environmental factors that influence social interactions in public spaces, particularly within university campuses. The selection of these indicators is grounded in the established research on public space quality and user behavior, ensuring that the study is based on well-documented factors that are essential for fostering healthy social environments.

1.5. Current Study

This study integrates the core principle of Cognitive Behavioral Therapy (CBT) and Environmental Psychology as its theoretical framework, emphasizing a comprehensive approach that considers both behavioral and psychological factors (Figure 2). By focusing on how social media use and social anxiety interact with social environment preferences, this research aims to understand the differences in environmental preferences among individuals with varying levels of social media use and social anxiety. The study addresses how these factors shape preferences for physical environments and offers insights into how cam-

pus environments can be designed to promote healthy social interactions, particularly for students experiencing social anxiety. The study focuses on the following research questions:

- (1) What is the current state of social behavior and social anxiety among college students?
- (2) What are the differences in social environment preferences among individuals with varying levels of social media use and social anxiety?
- (3) How does social media use influence social environment preferences?
- (4) How does social anxiety affect social environment preferences?

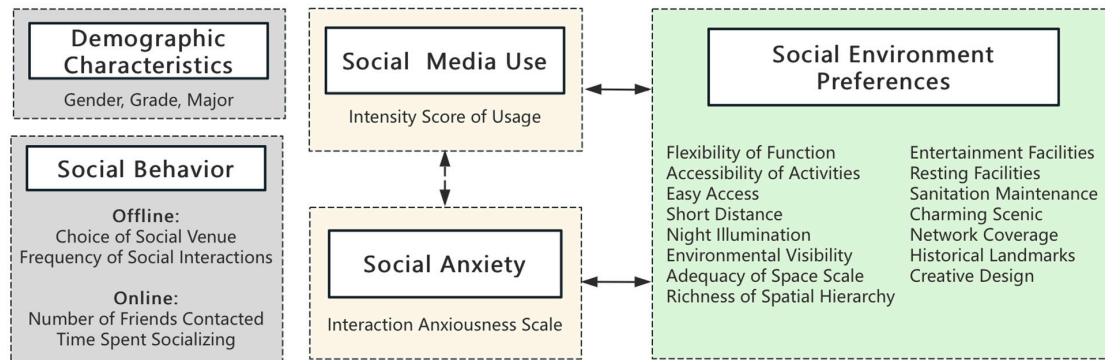


Figure 2. Study variable selection and hypothesis.

2. Materials and Methods

2.1. Research Design

This study employs a quantitative research approach to investigate the relationship between social media usage, social anxiety, and social environmental preferences (Figure 3, see Supplementary File for details). The questionnaire survey method was selected as the primary data collection technique because it provides a standardized means of gathering data from a large sample. This method is widely used in studies that aim to quantify psychological and behavioral traits like social anxiety and environmental preferences. Furthermore, surveys are effective in capturing self-reported data, which is essential for understanding individual perceptions of social spaces and personal social media usage.

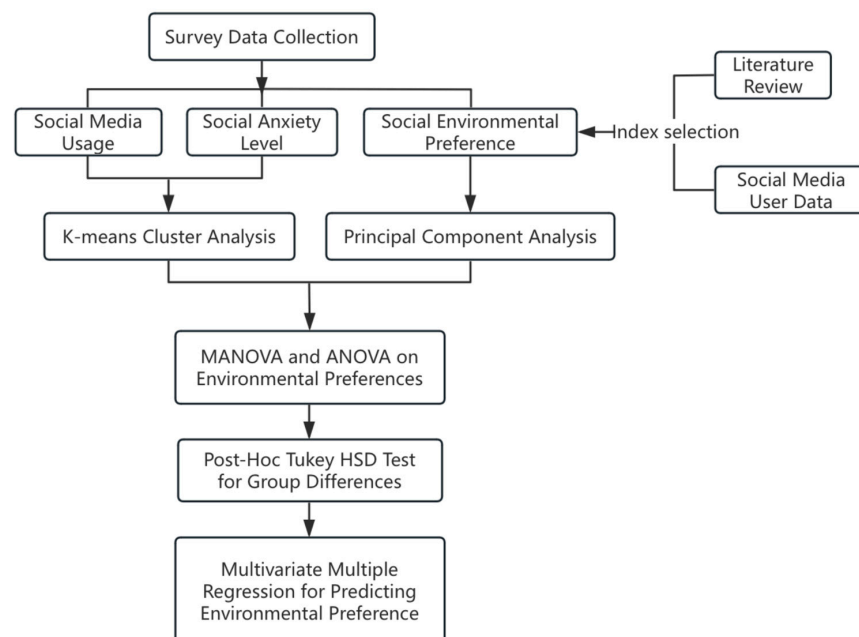


Figure 3. Research design diagram.

2.2. Participants

This study was conducted at Wuhan University, involving undergraduate, master's, and doctoral students. As a top-tier comprehensive university in China, Wuhan University boasts outstanding faculty, excellent academic resources, and a rich campus culture, providing students with a favorable learning and living environment. The student body is diverse, representing various backgrounds from across the country. Additionally, Wuhan University's abundant campus facilities and beautiful landscapes offer a diverse social environment. Therefore, selecting students from Wuhan University as research subjects enables a comprehensive understanding of social behavior and social anxiety among Chinese university students.

Participants in this study were recruited through an online survey from October to December 2023. Informed consent was obtained from all participants before they filled out the questionnaire, and all responses were anonymized to ensure confidentiality. A total of 385 questionnaires were distributed, with 359 deemed valid. The questionnaire consisted of five parts: demographic characteristics, usage of campus third places, usage of social media, preferences for social environments, and degree of social anxiety.

2.3. Measures

2.3.1. Interaction Anxiousness Scale

To accurately measure the level of social anxiety among university students, this study employed the Interaction Anxiousness Scale, revised and validated by Leary and subsequently by multiple scholars [77–79]. This scale has been demonstrated to effectively assess the subjective feelings of interpersonal anxiety among Chinese university students [80]. The scale comprises 13 items (Table 1), including 2 reverse-scored items. Each item is rated on a 5-point Likert scale (1 = “strongly disagree” to 5 = “strongly agree”). After reverse scoring the appropriate items, the average score across all items is calculated, with higher scores indicating higher levels of social anxiety.

Table 1. Measure of social anxiety level.

Items	Options
You often feel nervous, even at informal gatherings.	1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree; Including two reverse questions, after converting the reverse questions, the average score of all items is calculated. The higher the score, the higher the level of social anxiety.
You usually feel uncomfortable around a group of people you do not know.	
You usually feel uncomfortable talking to someone of the opposite sex.	
You feel nervous when you have to talk to your teacher or supervisor.	
Parties often make you feel anxious and uncomfortable.	
You often feel nervous when talking to someone of the same sex you do not know very well.	
You feel nervous during a job interview.	
In social situations, you rarely feel anxious.	
Generally speaking, you are a shy person.	
You often feel nervous when talking to an attractive person of the opposite sex.	
You are usually nervous when calling someone you do not know very well.	
You feel nervous when talking to authority figures.	
Even if you are in a group of people who are very different from you, you still feel relaxed.	

2.3.2. Social Media Usage Intensity Scale

To measure online social behavior among university students, this study utilized the Facebook Intensity Scale [35], which is widely used in studies examining university students' social media behaviors and has been proven to be reliable in assessing intensity of use [81]. Additionally, the scale was translated and revised by other researchers [82] to ensure it is well-suited for Chinese students. The scale comprises 8 items (Table 2), with

the first 2 measuring the number of friends and time spent on social media platforms, and the remaining 6 items assessing the emotional connection with social media and its integration into individuals' lives. Responses are scored on a 5-point Likert scale (1 = "strongly disagree" to 5 = "strongly agree"), with higher scores indicating greater intensity of social media usage. In this study, social media refers to online platforms in China that allow users to create, share, and communicate information, including text, images, audio, and video, such as WeChat, QQ, Weibo, and LittleRedBook.

Table 2. Measure of social media usage intensity.

Items		Options
Number of Friends Contacted Per Day		One or two Three to five Six to ten More than ten
Time Spent Socializing Per Day		Less than 1 h 1–2 h 3–4 h More than 5 h
Intensity Score of Usage	Using social media is part of your life.	1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree; calculate the average score of all items. The higher the score, the higher the intensity of social media usage.
	You are proud of using social media.	
	You spend most of your time on social media.	
	When you are not on social media, you feel lonely.	
	You feel a strong sense of identification with social media communities.	
Turning off social media can make you feel bad and sorry.		

2.3.3. Social Environmental Preferences

The environmental preference data were collected via a 15-item questionnaire developed through a review of literature and analysis of user social media data. Responses were recorded on a 5-point Likert scale (1 = very unimportant, 5 = very important).

To tailor the indicators to the unique culture and circumstances of Wuhan University, relevant social media data were crawled and analyzed. Using the keyword "Wuhan University", notes from LittleRedBook (a social media platform) were collected. After removing advertisements and promotional content, 995 valid data points were obtained. ROST CM6 (5.8.0.603) software was employed to segment the text and manually input specific terms related to Wuhan University, such as "Plum Garden" and "Sakura Castle". After merging synonymous terms, a word cloud was generated to visualize high-frequency words (Figure 4). High-frequency words such as "canteen", "playground", "sunset", and "delicacies" reflect popular activity locations and types on campus. The appearance of high-frequency words like "Old Dormitory", "Sakura Castle", "history", and "art" indicates the unique historical and cultural heritage of Wuhan University, suggesting that the cultural aspects of the campus environment may be significant for students' social interactions. The analysis of social media data served as validation and supplementation of existing environmental factor indicators. Ultimately, the environmental preferences were comprised of 15 items, which were later reduced to 5 dimensions using Principal Component Analysis (Table 3).

2.4. Statistical Analyses

2.4.1. Principal Component Analysis (PCA)

To ensure the internal consistency of the questionnaire items, reliability tests were conducted (see Table A1 in Appendix A). The obtained Cronbach's alpha values were all greater than 0.7, indicating good reliability of the questionnaire.

PCA was conducted to reduce the 15 environmental indicators into 5 key dimensions (see Table A2 in Appendix A), identifying composite variables that reflect the original data and making the data more manageable for further analysis. The KMO (Kaiser–Meyer–Olkin) value suggested the suitability of the data for factor analysis. The cumulative variance contribution of the factors indicated that the new variables could effectively reflect the information of the original variables. Using principal component analysis and varimax rotation to generate factor loadings, the results showed that all factor loadings were greater than 0.5, meeting the requirements [83]. The extracted components were used in subsequent analyses to examine their relationship with social media use and social anxiety.

2.4.2. K-Means Clustering

Based on social media usage and social anxiety levels, participants were grouped into four distinct clusters using K-means clustering. The clustering process grouped students into four quadrants reflecting high/low social media usage and high/low social anxiety levels. The optimal number of clusters was determined by evaluating the elbow plot and silhouette score. The clustering revealed meaningful subgroups, which were used for comparison in later analyses.

2.4.3. MANOVA and ANOVA

Multivariate Analysis of Variance (MANOVA) was conducted to examine differences in environmental preferences across the identified clusters. In addition, a series of one-way ANOVA tests were performed for each environmental preference dimension to explore significant differences among the groups. This approach enabled us to identify which environmental factors varied significantly among individuals with different social media use and social anxiety profiles.

2.4.4. Post-Hoc Tukey HSD Test

Following the ANOVA results, Post-hoc Tukey HSD tests were applied to further investigate group differences in environmental preferences. This post-hoc test helped clarify the specific group-level variations in each environmental dimension and ensured that the differences were statistically significant.

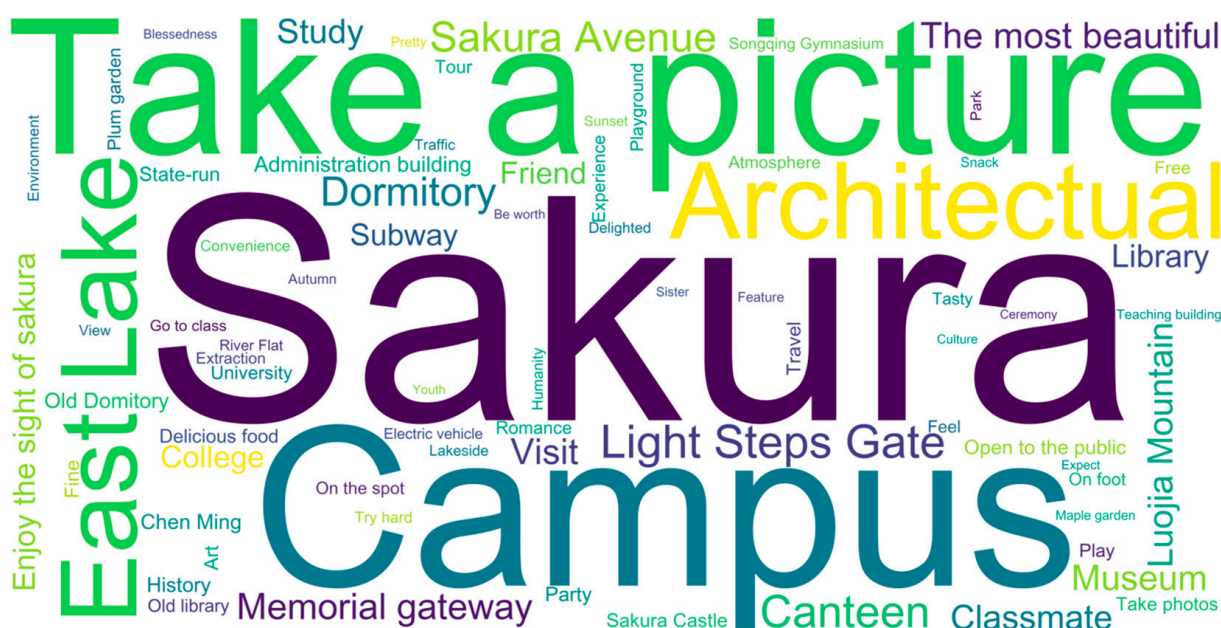


Figure 4. Word cloud of high-frequency words.

Table 3. Measure of social environmental preferences.

Items	Explanation	Source	Options
Flexibility of Function	Adaptability of a space to accommodate various activities.	Literature Review	1 = Very Unimportant, 2 = Not Important, 3 = Neutral 4 = Important, 5 = Very Important
Accessibility of Activities	How easily individuals can engage in diverse activities within the environment.	Literature Review, Social Media	
Easy Access	Convenience of reaching and entering the space from various points.	Literature Review, Social Media	
Short Distance	Proximity between different areas or facilities within the environment.	Literature Review, Social Media	
Night Illumination	Adequacy and quality of lighting in the environment during nighttime, affecting safety and usability.	Literature Review, Social Media	
Environmental Visibility	Clarity with which the surroundings can be seen and perceived from different vantage points.	Literature Review	
Adequacy of Space Scale	Dimensions and layout of the space are sufficient for its intended functions and user capacity.	Literature Review	
Richness of Spatial Hierarchy	Variety and complexity of spatial arrangements and levels within the environment, contributing to a dynamic experience.	Literature Review	
Entertainment Facilities	Availability and quality of recreational and leisure facilities.	Literature Review, Social Media	
Resting Facilities	Presence and quality of areas designed for relaxation and repose.	Literature Review, Social Media	
Sanitation Maintenance	Cleanliness and upkeep of the environment, contributing to overall hygiene and user comfort.	Literature Review, Social Media	
Charming Scenic	Aesthetic appeal and visual attractiveness of the environment, enhancing its pleasantness and allure.	Literature Review, Social Media	
Network Coverage	Extent and reliability of wireless network connectivity available.	Social Media	
Historical Landmarks	Presence and significance of culturally or historically important features.	Literature Review, Social Media	
Creative Design	Originality and innovativeness in the design elements and aesthetics of the environment.	Social Media	

2.4.5. Multivariate Multiple Regression (MMR)

To predict environmental preferences, a Multivariate Multiple Regression analysis was conducted, with the five PCA-derived environmental dimensions (openness, convenience,

safety and comfort, facilities, and cultural landscape) as the dependent variables. Social media usage and social anxiety levels were included as independent variables. This allowed us to examine how these psychological and behavioral factors influence different environmental preferences.

2.4.6. Statistical Software

All statistical analyses were conducted using Python 3.9 and the following libraries: Pandas, Scikit-learn, Statsmodels, and Matplotlib.

3. Results

3.1. Descriptive Analyses

The survey yielded a total of 359 valid responses, with 166 (46.2%) from male participants, and 193 (53.8%) from female participants. The academic level distribution included 148 (41.2%) undergraduate students, 152 (42.3%) master's students, and 59 (16.4%) doctoral students. These proportions closely align with the overall student distribution at the university.

3.1.1. Usage of Campus Third Places

Regarding the usage of third places (Table 4), campus service facilities were the most popular social venues, with a selection rate of 81.6% ($n = 293$). Public open spaces followed closely with a selection rate of 65.7% ($n = 236$). Dining commercial spaces had a selection rate of 42.1% ($n = 151$), ranking third. In terms of social frequency, the majority of students socialized weekly: 31.5% ($n = 113$) socialized 3–5 times per week, and 36.2% ($n = 130$) socialized 1–2 times per week. However, 13.3% ($n = 48$) of students socialized only 1–2 times per month or less.

Table 4. Descriptive statistics of usage of third places.

Variables		<i>n</i>	%
Choice of Social Venue	Public open spaces	236	65.7
	Campus service facilities	293	81.6
	Dining and commercial establishments	151	42.1
	Creative sports and entertainment venues	74	20.6
	Personal service establishments	59	16.4
Frequency of Social Interactions	Almost everyday	68	18.9
	3–5 times per week	113	31.5
	1–2 times per week	130	36.2
	1–2 times per month or even less	48	13.3

3.1.2. Usage of Social Media

Regarding social media usage (Table 5), 53.8% ($n = 193$) of students contact 3–5 friends daily through social media, while 30.6% ($n = 110$) contact 1–2 friends daily. A smaller proportion ($n = 56$, 15.6%) contacts more than 6 friends daily. In terms of daily usage time on social media, 30.1% ($n = 108$) of students spend 1–2 h, 38.4% ($n = 138$) spend 3–4 h, and 24.3% ($n = 91$) spend over 5 h. The average intensity of social media usage is 20.3 (Table 6), with no significant gender difference. However, there were significant differences by academic grade (F-statistic = 4.723, $p < 0.001$), with freshmen reporting the highest mean use at 21.9. Additionally, a significant difference was found by major (t-statistic = 3.551, $p < 0.001$), with students in Humanities and Social Sciences using social media more intensively (mean = 21.4) compared to those in Science and Engineering (mean = 19.8).

Table 5. Descriptive statistics of usage of social media.

Variables		<i>n</i>	%
Number of Friends Contacted Per Day	One or two	110	30.6
	Three to five	193	53.8
	Six to ten	32	8.9
	More than ten	24	6.7
Time Spent Socializing Per Day	Less than 1 h	22	6.1
	1–2 h	108	30.1
	3–4 h	138	38.4
	More than 5 h	91	24.3

Table 6. Descriptive statistics of usage intensity score.

Variables			Mean	Chi-Square Test
Intensity of Social Media Use	Total		20.3	—
	Gender	Male	20.2	t-statistic = -0.691 p -value = 0.490
		Female	20.5	
	Grade	Freshman	21.9	F-statistic = 4.723 p -value < 0.001
		Sophomore	19.8	
		Junior	21.1	
		Senior	18.6	
		Graduate	20.9	
		Doctoral	18.9	
	Major	Humanities and Social Science	21.4	t-statistic = 3.551 p -value < 0.001
		Science and Engineering	19.8	

3.1.3. Social Anxiety

The analysis of social anxiety levels across demographic variables revealed notable differences (Table 7). The mean social anxiety level for males was 39.6, compared to 43.4 for females. A t -test revealed a significant difference, with females exhibiting higher levels of social anxiety ($t = -3.376$, $p < 0.001$). Social anxiety levels varied significantly by grade level ($F = 2.609$, $p = 0.025$). Undergraduate students have higher average scores than master's (41.6) and doctoral students (39.4). No significant difference was found between majors. Students in Humanities and Social Sciences had an average social anxiety level of 40.6, while those in Science and Engineering reported an average of 42.1 ($t = -1.173$, $p = 0.242$).

Table 7. Descriptive statistics of social anxiety level.

Variables			Mean	Chi-Square Test
Social Anxiety Level	Total		41.6	—
	Gender	Male	39.6	t-statistic = -3.376 p -value < 0.001
		Female	43.4	
	Grade	Freshman	41.5	F-statistic = 2.609 p -value $= 0.025$
		Sophomore	38.8	
		Junior	44.5	
		Senior	45.2	
		Graduate	41.6	
		Doctoral	39.4	
	Major	Humanities and Social Science	40.6	t-statistic = -1.173 p -value = 0.242
		Science and Engineering	42.1	

3.2. K-Means Clustering

K-means clustering analysis was conducted to classify participants into distinct groups based on their social media usage and social anxiety levels. The optimal number of clusters was determined using the elbow method (Figure 5), where the within-cluster sum of squares (WCSS) was plotted against the number of clusters, revealing a noticeable “elbow” at $k = 4$ clusters. This indicated that the optimal number of clusters for segmentation was 4:

Group 0: low social media use/high social anxiety ($n = 103$).

Group 1: high social media use/low social anxiety ($n = 107$).

Group 2: low social media use/low social anxiety ($n = 88$).

Group 3: high social media use/high social anxiety ($n = 61$).

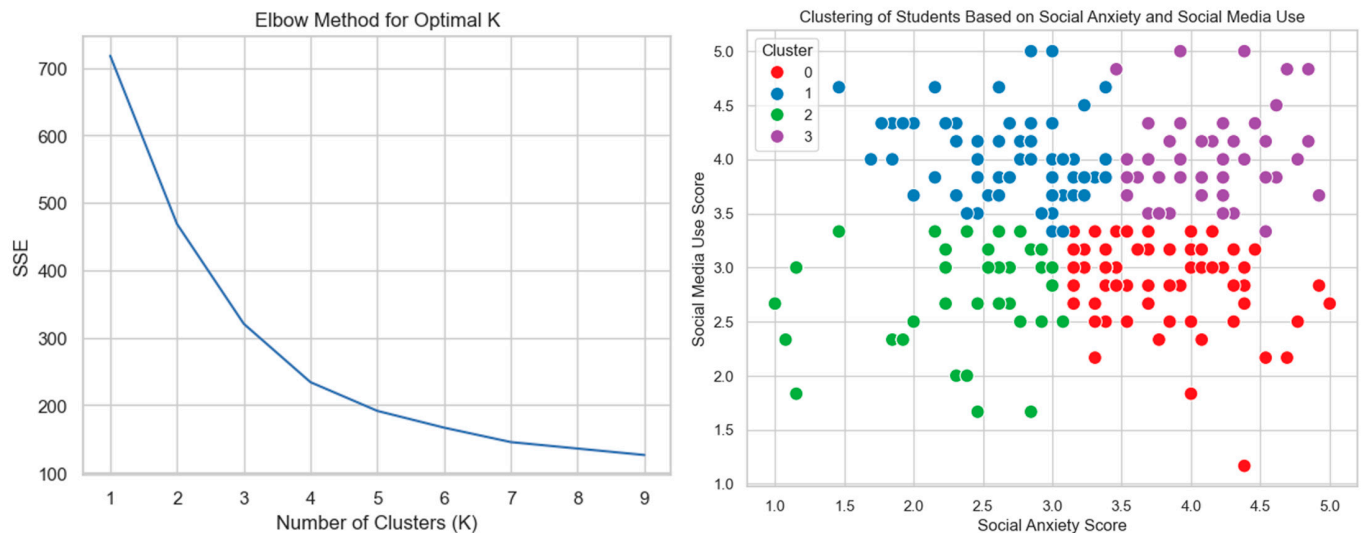


Figure 5. Results of K-means clustering.

3.3. MANOVA and ANOVA

The MANOVA test was conducted to assess whether there were significant differences in the environmental preferences (openness, convenience, safety and comfort, facility provision, and cultural landscape) across the four groups. The results indicated a significant multivariate effect of group membership on environmental preferences, Wilks' $\lambda = 0.9679$, $F(5, 353) = 2.3443$, $p = 0.0410$, suggesting that the four groups differ in their combined environmental preferences.

To further investigate the differences for each environmental preference dimension, individual one-way ANOVAs were conducted for each of the five dimensions (Table 8). These ANOVA results suggest significant differences between clusters in their preferences for openness, convenience, safety, and facility provision. However, for cultural landscape, while significant differences were found, the F-value was lower, indicating a weaker effect.

Table 8. ANOVA results.

Environmental Preference	Group 0: Low SMU, High SA	Group 1: High SMU, Low SA	Group 2: Low SMU, Low SA	Group 3: High SMU, High SA	ANOVA F-Value	p-Value
Openness	3.835	4.224	3.955	4.279	8.162	0.000
Convenience	4.165	4.371	4.008	4.388	6.174	0.000
Safety and Comfort	4.070	4.275	3.839	4.292	6.174	0.000
Facility Provision	3.956	3.981	3.341	4.254	16.501	0.000
Cultural Landscape	3.366	3.514	3.250	3.601	3.486	0.160

3.4. Post-Hoc Test

A Tukey HSD post-hoc test was conducted to further explore the specific group differences for each environmental preference (Table 9).

Table 9. Post-hoc test results.

Environmental Preference	Group A	Group B	Mean Difference	p-adj	95% CI (Lower)	95% CI (Upper)	Significance (Reject)
Openness	0	1	0.3893	0.0004	0.1400	0.6387	TRUE
	0	3	0.4437	0.0006	0.1519	0.7356	TRUE
	1	2	−0.2698	0.0386	−0.5297	−0.0098	TRUE
	2	3	0.3241	0.0291	0.0232	0.6251	TRUE
Convenience	1	2	−0.3631	0.0012	−0.6136	−0.1127	TRUE
	2	3	0.3800	0.0044	0.0904	0.6704	TRUE
Safety and Comfort	1	2	−0.4361	0.0000	−0.6804	−0.1919	TRUE
	2	3	0.4533	0.0003	0.1704	0.7359	TRUE
Facility Provision	0	2	−0.6154	0.0000	−0.9337	−0.2971	TRUE
	2	3	0.9132	0.0000	0.5479	1.2785	TRUE
Cultural Landscape	2	3	0.3511	0.0251	0.031	0.6712	TRUE

For openness, Group 0 (Low SMU/High SA) significantly preferred more openness compared to Group 1 (High SMU/Low SA) and Group 3 (High SMU/High SA), with meandiffs of 0.3893 ($p = 0.0004$) and 0.4437 ($p = 0.0006$), respectively.

In terms of convenience, Group 1 significantly differed from Group 2 (Low SMU/Low SA) with a meandiff of −0.3631 ($p = 0.0012$), and Group 2 differed significantly from Group 3 with a meandiff of 0.3804 ($p = 0.0044$).

Similarly, in the safety and comfort dimension, Group 1 significantly differed from Group 2 with a meandiff of −0.4361 ($p < 0.001$), and Group 2 differed significantly from Group 3 with a meandiff of 0.4532 ($p = 0.0003$).

For facility provision, Group 0 (Low SMU-High SA) significantly differed from Group 2 (Low SMU/Low SA) with a meandiff of −0.6154 ($p < 0.001$), and Group 2 differed significantly from Group 3 with a meandiff of 0.9132 ($p < 0.001$).

Lastly, in cultural landscape, Group 2 and Group 3 significantly differed with a meandiff of 0.3511 ($p = 0.0251$).

These post-hoc results help clarify where the significant differences exist among the clusters for each environmental preference dimension, providing a clearer understanding of how different levels of social media use and social anxiety relate to environmental preferences.

3.5. Multivariate Multiple Regression

The multivariate multiple regression (MMR) analysis was conducted to examine the simultaneous effects of social media use and social anxiety on the five environmental preference dimensions: openness, convenience, safety and comfort, facility, and cultural landscape (Table 10). The results highlight the distinct relationships between these psychological factors and various aspects of environmental preferences.

Table 10. Multivariate multiple regression results.

Dependent Variables	Independent Variables	Coefficient	Standard Error	t-Value	p-Value	R ²
Openness	Social media use	0.2912	0.053	5.544	0.000	0.091
	Social anxiety	−0.1156	0.044	−2.614	0.009	
Convenience	Social media use	0.2023	0.051	3.951	0.000	0.055
	Social anxiety	0.0843	0.043	1.955	0.051	
Safety and Comfort	Social media use	0.2185	0.050	4.338	0.000	0.059
	Social anxiety	0.0670	0.042	1.580	0.115	
Facility Provision	Social media use	0.2525	0.064	3.919	0.000	0.129
	Social anxiety	0.3164	0.054	5.832	0.000	
Cultural Landscape	Social media use	0.2601	0.056	4.665	0.000	0.060
	Social anxiety	0.0282	0.047	0.600	0.549	

3.5.1. Openness

The MMR results for openness indicated a statistically significant model ($F(2, 356) = 17.88$, $p < 0.001$, $R^2 = 0.091$), meaning that 9.1% of the variance in openness could be explained by the independent variables. Social media use had a significant positive effect ($\beta = 0.2912$, $p < 0.001$), suggesting that higher social media engagement is associated with a greater preference for open environments. In contrast, social anxiety showed a significant negative effect ($\beta = -0.1156$, $p = 0.009$), indicating that individuals with higher levels of anxiety tend to prefer less open spaces.

3.5.2. Convenience

For convenience, the model was also significant ($F(2, 356) = 10.29$, $p < 0.001$, $R^2 = 0.055$), explaining 5.5% of the variance in preferences. The results showed a positive relationship between social media use and preference for convenient environments ($\beta = 0.2023$, $p < 0.001$). The effect of social anxiety was marginally significant ($\beta = -0.0843$, $p = 0.051$), suggesting that higher social anxiety might be associated with a preference for convenience, although this effect was not as strong.

3.5.3. Safety and Comfort

The regression model for safety and comfort was statistically significant ($F(2, 356) = 11.18$, $p < 0.001$, $R^2 = 0.059$), explaining 5.9% of the variance. Social media use had a significant positive effect on safety and comfort preferences ($\beta = 0.2185$, $p < 0.001$), indicating that individuals who engage more with social media are likely to prefer safer and more comfortable spaces. However, social anxiety did not significantly influence preferences for safety and comfort ($\beta = 0.0670$, $p = 0.115$).

3.5.4. Facility Provision

The MMR model for facility provision showed the highest explanatory power ($F(2, 356) = 26.37$, $p < 0.001$, $R^2 = 0.129$), with 12.9% of the variance explained. Both social media use ($\beta = 0.2525$, $p < 0.001$) and social anxiety ($\beta = 0.3164$, $p < 0.001$) had significant positive effects on facility preferences, suggesting that individuals who use social media frequently and experience higher social anxiety are more likely to value environments with comprehensive facilities.

3.5.5. Cultural Landscape

The regression model for cultural landscape was also significant ($F(2, 356) = 11.30$, $p < 0.001$, $R^2 = 0.060$), explaining 6% of the variance. Social media use was positively associated with a preference for cultural landscapes ($\beta = 0.2601$, $p < 0.001$), indicating that individuals who are active on social media prefer environments with rich cultural features. However, social anxiety had no significant effect on this dimension ($\beta = 0.0282$, $p = 0.549$).

4. Discussion

4.1. Offline and Online Social Behavior

The findings show that university students favor campus service facilities and public open spaces for offline interactions, with many engaging in social activities several times a week. In contrast, online behaviors reveal a moderate to high level of social interaction, with most students contacting 3–5 friends daily and spending 3–4 h on socializing.

Regarding social media use, students show a moderate level on average. There was no significant gender difference in social media use, aligning with the findings of prior research [84]. However, grade played a significant role in determining usage intensity. Freshmen reported the highest level of social media use, which may be due to their need to find campus events and establish social networks in the early stages of university life [85]. Significant differences in social media usage were also found by major. Students in Humanities and Social Sciences were more intensive users of social media compared to those in Science and Engineering. This difference may reflect the different academic cultures

and communication needs of these disciplines, with humanities students potentially relying more on social platforms for networking and collaboration [86,87].

When examining social anxiety, the results reveal significant demographic variations. Females reported higher levels of social anxiety compared to males. This finding aligns with existing research [88,89], which can potentially be explained from a “vulnerability-stress perspective” [90]. Exposure to variable psychosocial stressors and an increased biological and psychological vulnerability towards anxiety in females may explain the sex differences in anxiety [91]. Significant differences were also found based on grade level. Undergraduate students exhibited higher social anxiety levels than master’s and doctoral students, possibly due to the accumulation of social experience and skills as students progress through their academic years [92]. Interestingly, no significant differences were observed between students from different majors.

4.2. Environmental Preferences of Different Groups

The cluster analysis identified four distinct groups based on their levels of social media use and social anxiety. Each group displayed unique environmental preferences, reflecting the complex interactions between their psychological characteristics and spatial needs.

4.2.1. Group 0: Low Social Media Use/High Social Anxiety

Individuals in Group 0 showed a marked preference for more enclosed and private environments. Their high levels of social anxiety may explain their inclination towards spaces that provide a sense of safety and comfort, as these environments can minimize social interaction and reduce stress. This finding aligns with previous studies that link social anxiety to avoidance behaviors in public settings [93].

4.2.2. Group 1: High Social Media/Low Social Anxiety

In contrast, Group 1 exhibited a strong preference for open and interactive spaces. Their low levels of social anxiety, coupled with high social media engagement, may contribute to a greater comfort level in environments that encourage social interactions. These individuals likely perceive open spaces as opportunities for socialization and exploration, aligning with their communication capacity and higher self-confidence [94]. Additionally, Group 1’s preference for convenience-oriented spaces could be attributed to their need for accessible and efficient environments that support an active lifestyle.

4.2.3. Group 2: Low Social Media Use/Low Social Anxiety

Group 2, characterized by both low social media use and low social anxiety, shows a moderate to lower preference for most environmental factors compared to the other groups. This group seems less concerned with convenience, safety, comfort, and facility provision, suggesting that they may prefer more minimalistic or functional environments that do not require many amenities or high levels of comfort.

4.2.4. Group 3: High Social Media Use/High Social Anxiety

Group 3 exhibits strong preferences across all environmental dimensions. They prioritize openness, convenience, safety and comfort, facility provision, and cultural landscapes. Their heightened preference for these features suggests that they seek environments that not only meet practical needs but also provide emotional comfort and relief from the pressures of social anxiety. This group may benefit most from environments designed to reduce stress and promote well-being through functional, accessible, and aesthetically pleasing spaces.

4.3. Impact of Social Media Use and Social Anxiety on Environmental Preferences

4.3.1. Openness

Individuals who are more active on social media tend to favor open, flexible environments that encourage interaction and social engagement. This association suggests that frequent social media users, accustomed to open and accessible virtual spaces, seek similar

qualities in their physical surroundings [95]. In contrast, social anxiety was negatively associated with openness, indicating that individuals with higher levels of social anxiety prefer more enclosed, private environments that limit exposure to uncomfortable social situations [96,97]. This aligns with previous research showing that anxious individuals often engage in avoidance behaviors when faced with large, unbounded spaces where they feel vulnerable to social interactions they cannot control [93].

Altman defines privacy as an active process of boundary regulation used to control interactions [98], which allows individuals to manage their exposure to others in social settings [99,100]. In the context of campus third places, maintaining a balance between openness and privacy is essential for creating environments that meet the diverse needs of individuals with different levels of social comfort. To address these needs, public open spaces like campus squares and green areas can incorporate vegetation arrangements and landscape elements to establish spatial hierarchies and provide a sense of territoriality and privacy [101]. This would allow students with higher social anxiety to engage in social interactions while maintaining control over their personal space. Similarly, in campus service facilities such as cafeterias and library courtyards, flexible partitions and spatial enclosures can be used [102], allowing for a range of social interactions while also ensuring that individuals can regulate their exposure to others.

4.3.2. Facility Provision

Both social media use and social anxiety had significant positive effects on preferences for facility-rich environments. High social media users may value spaces with diverse facilities due to their need for versatile, adaptable settings that support their social and recreational activities. Likewise, individuals with higher social anxiety may also favor such environments as they offer a range of options for engagement while potentially providing opportunities for avoidance or withdrawal if needed. Therefore, enhancing facility amenities tailored to different types of places is essential for promoting social interactions among university students. For public open spaces like campus squares and green areas, additional amenities such as seating, shade structures, and artistic installations can increase attractiveness and comfort [103,104]. For campus service facilities such as cafeterias, playgrounds, and library courtyards, incorporating recreational facilities like art corners and communal areas can diversify functionalities and boost utilization rates [73,105,106]. For dining and commercial establishments, as well as personal service establishments, enhancing the provision of office and study discussion facilities can create more comfortable and convenient spaces for students to share and communicate [107,108].

4.3.3. Convenience: Safety/Comfort and Cultural Landscape

Social media use consistently exhibited a positive relationship with preferences for convenience, safety and comfort, and cultural landscape, while the influence of social anxiety on these environmental preferences was either minimal or non-significant.

Overall, individuals with high social media use, regardless of their anxiety levels, generally exhibited stronger preferences for various environmental dimensions, including openness, convenience, and facility provision. This suggests that higher social media users may have greater expectations for their physical environments, seeking spaces that are adaptable, engaging, and conducive to both social and personal activities. The demands of their digital lifestyles may translate into a heightened need for environments that support flexibility, connectivity, and aesthetic appeal, reflecting their online behaviors in the real world.

In contrast, social anxiety appears to shape environmental preferences in a more protective manner. Individuals with higher social anxiety tended to prefer enclosed, safe, and more controlled environments, which likely serve as a refuge from potentially overwhelming or anxiety-inducing social encounters. Their lower preference for openness and social interaction indicates that their primary concern is minimizing social discomfort in public spaces.

4.4. Limitations and Future Directions

This study relied on self-reported survey data, which may introduce subjective bias. The lack of a significant correlation between self-reported social anxiety and preferences for safety/comfort, convenience, and cultural landscape may be due to the subjective nature of these concepts, which are influenced by individual differences. However, as safety is a fundamental need in Maslow's hierarchy of needs, it remains essential for campus environmental design [109]. Future research should employ more precise measurement methods to better assess the relationship between social anxiety and perceptions of environmental safety and comfort.

Additionally, this study focused on demographic characteristics, online and offline social behaviors, social media usage, environmental preferences, and social anxiety levels. However, research suggests that biological, psychological, and family social environmental factors also play a role in shaping social anxiety [18,110,111]. Future studies should consider incorporating these additional variables and exploring their potential mediating effects on the relationship between environmental preferences and social anxiety.

5. Conclusions

The findings of this study highlight the significant influence of both social media use and social anxiety on environmental preferences among university students, revealing distinct patterns across different user groups. Individuals with high social media use, regardless of their anxiety levels, generally exhibited stronger preferences for various environmental dimensions, including openness, convenience, facility provision, safety/comfort, and cultural landscape. Conversely, individuals with higher social anxiety tended to prefer enclosed, facility-rich, and more controlled environments. The relationship between social anxiety and preferences for convenience, safety/comfort, and cultural landscape was minimal or non-significant, highlighting the need for further investigation.

The study underscores the importance of considering both modern behaviors and psychological traits when designing campus environments. By addressing these diverse psychological needs, we can design more inclusive and adaptive public spaces that cater to both the connectedness of social media users and the psychological well-being of socially anxious individuals.

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Appendix A

Table A1. Reliability analysis of constructs.

Variables	Number of Questions	Cronbach's Alpha
Social Media Usage Intensity	6	0.754
Social Anxiety Level	15	0.854
Social Environmental Preferences	13	0.924
Overall Reliability	34	0.879

Table A2. Principal component analysis of social environmental preference variables.

Common Factor	Category	Factor (Loading)
X1: Facility Availability	Entertainment facilities	0.797
	Resting facilities	0.755
X2: Openness	Flexibility of function	0.861
	Accessibility of activities	0.780
X3: Convenience	Easy access	0.778
	Short distance	0.686
	Network coverage	0.731
	Night illumination	0.815
X4: Safety and Comfort	Environmental visibility	0.624
	Adequacy of space scale	0.704
	Richness of spatial hierarchy	0.615
	Sanitation maintenance	0.579
X5: Cultural Landscape	Historical landmarks	0.87
	Creative design	0.667
	Charming scenic	0.635
KMO (Kaiser–Meyer–Olkin) Measure		0.832
Cumulative Explained Variance (%)		68.033

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