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Bridging Perceptual Gaps: Designers vs. Non-Designers in Urban Wayfinding Signage Preferences

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Abstract: As urban environments become increasingly complex and the costs and challenges of infrastructure upgrades continue to rise, wayfinding signage has become an effective solution to cope with urban dynamics due to its low cost and high flexibility. Although the functionality of wayfinding signage has been extensively studied, the perceptual differences between designers and non-designers have not been adequately explored. Ignoring these differences may lead to the overlooking of users' real and diverse needs, resulting in suboptimal signage performance in practical applications and ultimately a reduction in the overall functionality and user experience of urban spaces. This study aims to bridge this perceptual gap. For this study, we conducted a questionnaire survey in China to compare the visual preferences of designers and non-designers regarding text, shape, color coding, and patterns. The results indicate that designers prioritize functionality and clarity to ensure the effective use of signage in complex urban environments, whereas non-designers prefer wayfinding signages that reflect local cultural symbols and characteristics. Our conclusions suggest that the public's expectations for wayfinding signage extend beyond basic navigational functions, with an emphasis on cultural expression and visual appeal. Understanding these perceptual differences is crucial in developing design strategies that balance functionality, esthetics, and sustainability, thereby facilitating the sustainable integration of signage into urban landscapes.

Keywords: sustainable urban; urban wayfinding; design preferences; visual communication; signage design

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1. Introduction

1.1. Motivation

In the accelerating process of global urbanization, urban areas are rapidly expanding, facing the multiple challenges of accommodating economic growth, population increases, and environmental sustainability. This expansion necessitates sustainable infrastructure improvements, especially to enhance the mobility and experience of pedestrians in thriving urban spaces while ensuring ecological integrity [1,2]. Consequently, it is particularly important to meet pedestrians' physical and psychological needs when designing wayfinding signage. Effective wayfinding systems not only facilitate smoother pedestrian traffic and improve accessibility but also contribute to environmental quality and ensure safety in complex urban landscapes, thus enhancing the livability and navigability of cities [3]. Thoughtfully designed wayfinding systems not only effectively guide people through urban spaces but also reduce visual pollution and enhance the esthetics and functionality of the urban environment [4,5]. However, navigating these urban environments can be challenging, and wayfinding difficulties can result in significant economic losses for institutions [6]. In rapidly urbanizing areas, these systems are especially critical, as navigating newly developed or restructured areas can be particularly challenging [7]. Research has shown that clear, strategically designed signage can significantly improve pedestrian flow and reduce navigation errors, underscoring the importance of thoughtful urban planning [8–14].

Despite extensive research on wayfinding signage, most studies have focused primarily on the efficiency and functionality of their use in urban environments, with relatively little research conducted on visual preferences and environmental impacts in wayfinding signage. Significant gaps still exist in our understanding of how people of different professional backgrounds perceive these navigational aids. Existing wayfinding signage research has primarily focused on general user groups, overlooking the unique differences in visual preferences and perceptual abilities between professional designers and non-designers. This oversight is critical, as the perception of wayfinding signage can vary widely depending on an individual's design background, which influences their familiarity with design principles [15]. For example, Buijs and Elands (2013) [16] noted that although thought processes among designers and the general public are similar, their focus diverges significantly: professionals prioritize normative meaning, whereas the public is more concerned with emotional experience [16]. Dupont et al. (2015) investigated whether professional knowledge of landscape affects how people view landscapes through eye-tracking experiments, finding that experts had more fixations and scans, allowing them to explore landscape photographs more comprehensively [17]. This suggests that differences in visual information processing between experts and laypeople might affect their understanding and use of urban wayfinding systems. Further, Xu et al. (2022) used immersive virtual environments (IVEs) and physiological measurement tools to study the differences in urban public space perception between design professionals and ordinary users [18]. The study by Gootee et al. (2010) explores how natural resource management professionals communicate information with forest owners and reveals significant differences between experts and non-experts in how they evaluate and accept information [19]. They found structural differences in how environmental features influenced their perceptions. Design professionals have higher quality standards for public spaces and are more critical of details, especially in necessary activity locations. Additionally, Suppakittpaisarn et al. (2019) emphasized the differences in preferences for green infrastructure and green stormwater infrastructure in urban landscapes between designers and the general public [20]. This further indicates that users from different backgrounds have diverse preferences and needs in urban environments. Riechers et al. (2017). contrasted different understandings of urban cultural ecosystem services between experts and laypeople, finding that experts viewed nature more practically and with a management-focused approach, while laypeople placed more emphasis on enjoying nature [21]. Thus, a deep understanding of user perspectives is one of the fundamental principles of sustainable design. Simultaneously, understanding the way in which designers think and the differences in design performance between designers and users is key to improving the effectiveness of the design process.

1.2. Visual Preferences in Urban Planning

To address these gaps, this study introduces the theory of landscape visual preferences, initially applied in natural settings but now widely used to evaluate urban amenities [17,22–24]. This theory provides insights into how elements such as color, form, and layout influence individual preferences and guide interactions with the environment. In urban environments, it has been used to assess the visual quality of public spaces and has informed design principles for creating urban areas with both esthetic and functional appeal [25]. For instance, Deghati Najd et al. (2015) conducted a survey to assess international tourists' visual preferences in Kuala Lumpur's historical center, revealing the features that affect tourist perception and providing empirical support for the balancing of urban development with heritage conservation [26]. Visual preference research methods have also been applied in the field of architectural appearance, with the finding that neoclassical style buildings with large window-to-wall ratios, small height-to-width ratios, and large open spaces in front are most favored by participants. This has provided reference points for the exterior design of Chinese court buildings, helping to determine the most popular architectural styles and design elements [27]. This paper aims to expand the application of landscape visual preference theory to urban wayfinding signage, emphasizing

the importance of fully considering user visual preferences to achieve more effective and environmentally sustainable navigation solutions. By applying this theory in the context of urban wayfinding, we seek to develop insights that can improve the functional and esthetic appeal of these systems, making them more responsive to the diverse needs of urban users

1.3. Core Elements of Wayfinding Signage

This study aims to explore and compare the visual preferences of designers and non-designers in the design of wayfinding signage in urban environments. A detailed literature review revealed that textual information, shape, color coding, and decorative patterns are four critical design elements in wayfinding signage. Numerous studies have focused on the impact of these elements on navigational efficiency and user behavior, emphasizing their functional role in optimizing information transmission and enhancing user experience, as follows.

Firstly, text information has been extensively studied in wayfinding signage research, as its clarity is directly related to the efficiency of information transmission and the navigation experience of pedestrians. Calori (2015) emphasized that clear and accurate text is fundamental in wayfinding signage, as it can reduce the cognitive load on pedestrians when interpreting information [28]. Uebele (2010) further pointed out that the readability of text is significantly influenced by its font, size, and contrast [29]. Deng et al. highlighted that clear and appropriately sized text is especially important for older users, as it can enhance their acceptance of signage [30].

Secondly, shape is also widely studied in the design of wayfinding signage because it can quickly attract the attention of pedestrians and improve navigational efficiency. Research indicates that the choice of shape not only affects the recognizability of signage but is also closely related to pedestrians' psychological perception [28]. Zhang et al. (2020) noted that distinctive signage shapes are more likely to attract attention, especially in environments like Disneyland, where architectural forms are exaggerated, and crowds are dense [31]. Ahmed's research examined the effectiveness of signage design and information delivery strategies at pedestrian and railway crossings, revealing that square signs with yellow backgrounds and black symbols are the most clear and effective for conveying safety information [32].

Next, color coding is considered a vital visual element in wayfinding signage design, guiding pedestrians by differentiating information hierarchy and highlighting key information. Rousek and Hallbeck found that high-contrast color combinations in signage are more easily recognized by individuals with normal vision and those with visual impairments, aiding smoother navigation [33]. In emergency situations, the use of specific signage colors (such as red) combined with flashing lights can convey urgency and influence pedestrians' emergency wayfinding behavior and perception. This was highlighted in a study by Olander et al., where this design effectively guided rapid evacuation [34]. In complex urban environments, pedestrians may have varying degrees of color vision, and Lee et al. proposed signage color combinations suitable for both color-blind and non-color-blind individuals, ensuring that all pedestrians could perceive the signage effectively and esthetically [35].

Finally, patterns not only enhance the esthetic value of signage but also play a significant role in information dissemination and reinforcing cultural identity. Research by Auliani Puteri Rushar et al. at the Sri Baduga Museum demonstrated the effectiveness of incorporating local cultural patterns into signage design. Their study emphasized that using decorative patterns symbolizing West Javanese culture enhanced both the visual appeal and functionality of the signage [36]. Hamhoum et al. argued that signage featuring religious symbols in specific locations has also been shown to enrich the wayfinding experience. Their study on wayfinding signage in sacred spaces integrated religious motifs into signage, effectively aiding pilgrims in navigating complex environments while enriching their spiritual experience [37].

Therefore, this study will focus on the four core elements of signage—text information, shape, color coding, and pattern, to explore the perceptual differences between designers and non-designers. The necessity of studying these differences lies in the possibility that designers and non-designers may have distinct priorities and understandings when it comes to signage design. Ignoring these potential differences may result in signage designs that fail to fully meet user needs, thereby affecting the signage's effectiveness in practical applications. For example, unclear information transmission, reduced navigational efficiency, or even user disorientation in complex environments could negatively impact the overall user experience. Such discrepancies may also increase signage maintenance costs, as repeated adjustments and improvements may be required in actual use. A thorough exploration of the visual preference differences between designers and non-designers in wayfinding signage can optimize signage design, ensuring its functionality and user-friendliness in complex urban environments. This research thus aims to support the design of more inclusive and adaptive wayfinding signage systems. To achieve this aim, the following research questions are proposed:

(1) What are the differences in text information preferences in information-dense urban environments between designers and non-designers?
(2) In complex urban environments, how do the shape preferences of designers and non-designers differ in wayfinding signage?
(3) How do designers and non-designers express different visual preferences for color coding in urban environments?
(4) When using wayfinding signage in complex urban environments, what are the differences in graphic preferences between designers and non-designers?

2. Materials and Methods

This study aims to explore the differences in visual preferences in wayfinding signage design between designers and non-designers in the complex urban environment of Nanning, China. The research is based on internet questionnaires, collecting data from designers through snowball sampling and from non-designers through random sampling in public urban areas. Given the city's population size, an appropriate sample size has been determined [38]. A total of 153 designers and 168 non-designers participated in this study, expressing their preferences for various wayfinding sign designs. The questionnaire was specifically designed with four different visual options for wayfinding signage, to investigate user preferences and inquire as to the reasons behind their preferences. Lastly, the collected data were statistically analyzed to comprehensively understand the differences in wayfinding signage design preferences between designers and non-designers in complex urban environments. This study received ethical approval from the Human Research Ethics Committee of Universiti Putra Malaysia (JKEUPM), with the approval number JKEUPM-2023-139. All participants were informed about the purpose of the study and its anonymity before filling out the questionnaire and consented voluntarily. We confirm that all research methods were carried out in accordance with the relevant guidelines and regulations set by the Human Research Ethics Committee of Universiti Putra Malaysia.

2.1. Questionnaire Design

Before its official release, the questionnaire underwent preliminary testing to ensure the clarity of its questions and the overall reliability of the questionnaire. In the first part (Table 1), based on conventional practices in previous studies [23,39–41], the questionnaire inquired about the basic demographic information and other personal details of the participants to determine whether they belonged to the designer or non-designer groups. Specifically, the questionnaire asked whether participants had received professional training in wayfinding signage design, had participated in related design projects, or were completely unfamiliar with wayfinding signage design. Based on these answers, participants were classified as belonging to the designer group (those with training or project experience) or the non-designer group (those unfamiliar with wayfinding signage

design). Additionally, the questionnaire also collected data on participants' age, gender, and education level to analyze how these individual differences might affect their preferences in urban directional signages.

Table 1. Participant information in questionnaire construction.

Information Category	Questions
Demographic information	Only received wayfinding signage course training
	Participated in wayfinding signage design projects
	Completely unfamiliar with wayfinding signage design
Personal information	Age
	Gender
	Education level

The second part of the questionnaire contained 8 questions about signage design, aimed at assessing respondents' preferences for different design elements. These questions were divided into two categories: 4 multiple-choice questions and 4 open-ended questions, focusing on text information, color coding, shape, and decorative patterns in signage. Each multiple-choice question included 4 images of simulated signage, which were meticulously designed using Adobe Photoshop 2022 and Blender 3.0 software to ensure that participants could focus on evaluating specific design features without the influence of background disturbances and other design elements. The open-ended questions required participants to elaborate on their reasons for choosing specific signage, a process that not only enhanced the interactivity of the questionnaire but also helped us to comprehensively understand the motivations behind respondents' preferences.

The first question (Figure 1) aimed to investigate the preferences of designers and non-designers for different amounts of text presentation in information-dense urban environments. Previous research suggested reducing text to provide accurate and effective information [42] and increasing the design's negative space (blank areas), to help attract user attention and improve understanding. Conversely, other studies argue that during emergency wayfinding, ample text information, especially signs providing instructions in multiple languages, can significantly shorten the time that it takes international tourists to reach shelters [43]. Another study found that wayfinding signage with ample text information had the best visual navigation capability in an indoor library environment [44]. Four simulated signage designs were developed to investigate preferences regarding text information, each containing different amounts of text information. The first image's signage information only had text and arrows. The second image had text, arrows, and English. The third image had text, English, a destination icon, and an arrow. The fourth image had text, English, a destination icon, a number, and an arrow. Participants were asked which amount of information on the signage was more suitable for placement in urban environments. The open-ended question asked participants to explain their reasons for choosing this image.

The second question (Figure 2) aimed to explore the preferences of designers and non-designers for different shapes in signage in urban environments. The shape of signage strongly influences users' perception, attention, and recognition of relevant information [45,46]. Calori (2015) emphasized that signage with unique shapes can spark user curiosity and engagement [28]. This study designed four types of signage shapes commonly seen in real urban environments: Pole Signage, Rectangular Signage, Multi-directional Signage, and Symbolic Shape Signage. Participants were asked to choose their preferred shape of signage for use in urban environments. The open-ended question asked participants to explain their reasons for choosing this shape.

1. Text and arrow.

2. Text, English, and arrow.

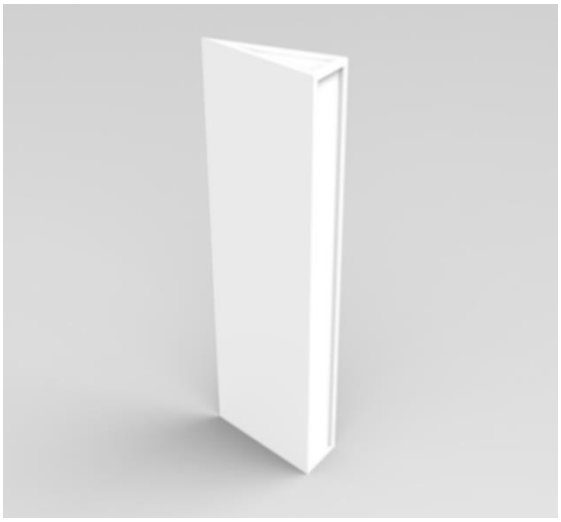
3. Text, English, destination icon, and arrow.

4. Text, English, destination icon, number, and arrow.

Figure 1. Text information on signage.

The third question (Figure 3) aimed to study the differences in preferences regarding the color coding of signage between designers and non-designers in urban environments. The color coding of signage strongly influences pedestrians' perception, attention, and recognition of relevant information [35,47,48]. Siu et al. [49] explored how children perceive the colors of signage and how they associate colors with different safety concepts and objects. Other studies suggest that in the wayfinding environment of underground transit hubs, signage at subway stations with achromatic color combinations is easier to read than that with chromatic color combinations [50]. Conversely, other research has argued that in map navigation tasks, color coding does not significantly affect performance in finding routes [51]. The current study designed four types of color coding for signage, including achromatic, monochromatic, two-color, and multicolor coding. Participants were asked to choose their preferred type of color coding for signage in urban environments. The open-ended question asked participants to explain their reasons for choosing this image.

1. Pole Signage.



2. Rectangular Signage.

3. Multi-Directional Signage.

4. Symbolic Shape Signage.

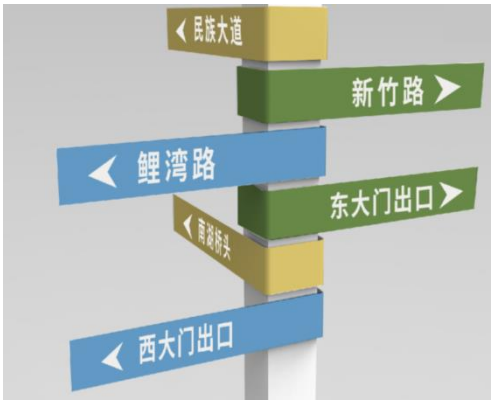
Figure 2. Shapes of signage.

The fourth question (Figure 4) aimed to understand the preferences of designers and non-designers for different patterns on signage in urban environments. The patterns on signage strongly influence users' perception of, and attention to, the environment [14,52]. For example, a study tested the patterns in hospital wayfinding signage in the USA, South Korea, and Turkey and found that people from different countries have different understandings of the specific meanings of medical patterns [53]. The current study designed four types of signage, including no decorative patterns, geometric patterns, a large number of local-meaning patterns, and a small number of local-meaning patterns. Participants were asked to choose their preferred type of signage in an urban environment. The open-ended question asked participants to explain their reasons for choosing this image.

1. No color.

2. Monochromatic coding.

3. Two-color coding.



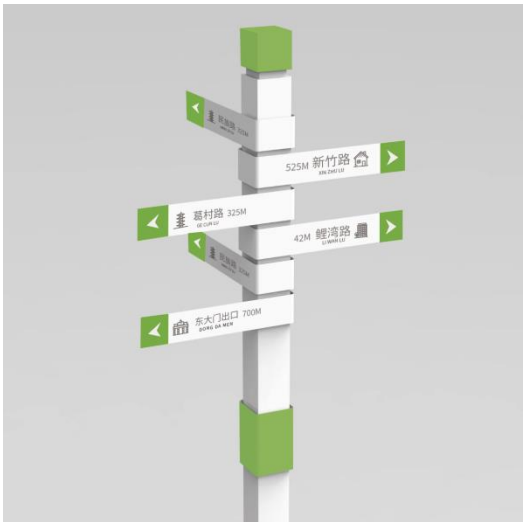
4. Multicolor coding.

Figure 3. Color coding in signage.

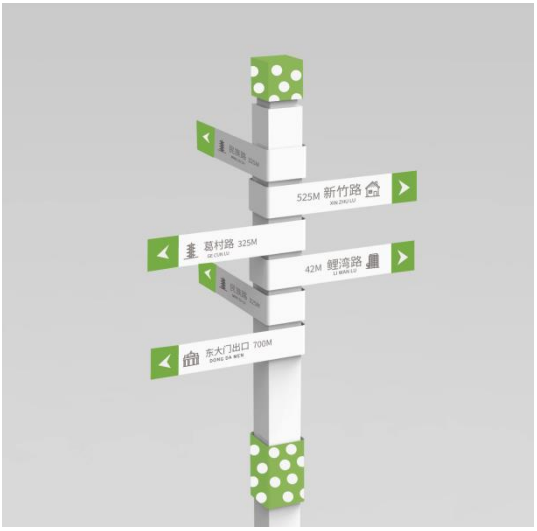
2.2. Data Collection Process

This study aimed to explore the differences in design and visual preferences between designers and non-designers within urban environments. To ensure the representativeness of the designer sample, we employed a snowball sampling method, recruiting participants from design students trained in wayfinding signage design, as well as urban designers, signage designers, and transportation planners with hands-on project experience. Snowball sampling is effective in reaching a diverse range of individuals within specialized professional fields, thereby ensuring that the sample is broad in design background and expertise and accurately reflects the typical preferences of the designer group in wayfinding signage design [54,55]. A total of 153 designers participated in this study.

For the non-designer group, we utilized a time-stratified random sampling method to ensure the broad representation of public visual preferences. Data were collected in three high-traffic public areas in Nanning, China, where diverse demographic groups were invited to participate in the survey at different times of day. This approach captured a wide range of occupations, age groups, and socioeconomic backgrounds, significantly enhancing the representativeness of the non-designer sample and making the study findings more generalizable to the wider public [56,57]. Ultimately, 168 non-designers were included in the study.



1. No patterns.



2. Geometric patterns.

3. Large number of local-meaning patterns.

4. Small number of local-meaning patterns.

Figure 4. Patterns in signage.

To further confirm the internal consistency of the data, we conducted Cronbach's Alpha reliability analysis. The results showed a Cronbach's Alpha of 0.871 for the designer group and 0.862 for the non-designer group, both exceeding the commonly accepted threshold of 0.7 in social science research, indicating high reliability and internal consistency across both groups. Through carefully designed sampling strategies and reliability validation, this study ensures data quality and representativeness, providing a solid foundation for subsequent statistical analyses. These data will support the in-depth exploration and interpretation of the underlying differences in visual preferences between designers and non-designers.

2.3. Data Analysis Process

This study employed a systematic data analysis method, classifying the collected data into two professional background groups: designers and non-designers. Additionally, to consider individual differences, participants were also categorized in detail by age, gender, and educational level. After data collection, descriptive analysis was initially

conducted using Microsoft Excel 16.90.2, followed by in-depth statistical processing using SPSS 26 software.

Data were collected by presenting four groups of wayfinding signage images and providing open-ended questions to allow participants to choose based on their visual preferences. Considering the classification of participants by professional background and personal differences, this study used chi-square tests to analyze the group data. For processing the data from open-ended questions, content analysis methods were employed, especially by identifying keywords and concepts in the text to categorize and analyze responses, helping us to comprehensively understand participants' visual preferences and the reasons behind them.

Specifically, chi-square tests were used to compare the visual preferences of designers and non-designers in terms of text information, shape, color coding, and decorative patterns on signage. Additionally, chi-square tests were also used to explore the relationships between these visual preferences and individual difference factors such as age, gender, and educational level among participants. Content analysis methods were used to analyze open-ended questions, identifying and categorizing themes and trends in responses, revealing the different reasons for visual preferences between designers and non-designers.

3. Results

This study involved a total of 321 participants (Table 2), with 153 being designers, accounting for 47.66% of the total, and 168 being non-designers, making up 52.34%. The designer group mainly consisted of professionals who had received specialized training in wayfinding signage design and had participated in related design projects. The non-designer group was composed of randomly selected citizens from various public places in Nanning, China. In terms of gender distribution, there were 46 male designers (45.54%) and 107 female designers (48.64%), and among non-designers, there were 55 male participants (54.46%) and 113 female participants (51.36%), indicating a fairly balanced gender ratio across both groups. The age structure revealed that the 19-to-39-year-old age group was the most represented, with 56.50% of designers and 43.50% of non-designers. In terms of educational levels, bachelor's degrees were the most common, comprising 68.85% of total participants, with 47.51% and 52.49% of designers and non-designers holding bachelor's degrees, respectively.

Table 2. Summary of general demographics. N = 321.

Group	**Designer (N = 153)**		**Non-Designer (N = 168)**	
	Frequency	Percentage	Frequency	Percentage
Male gender	46	45.54%	55	54.46%
Female gender	107	48.64%	113	51.36%
Aged 19 and below	20	71.43%	8	28.57%
Aged 19–39	126	56.50%	97	43.50%
Aged 40–49	1	16.67%	5	83.33%
Aged 50–59	3	11.54%	23	88.46%
Aged over 60	3	7.89%	35	92.11%
Education: high School and below	7	43.75%	9	56.25%
Education: associate's degree	28	53.85%	24	46.15%
Education: bachelor's degree	105	47.51%	116	52.49%
Education: graduate degree and above	13	40.62%	19	59.38%

Based on the data in Table 3, the internal consistency reliability (Cronbach's Alpha) for the designer group reached 0.906, clearly exceeding the conventional excellence standard of 0.8, classified as "Good" according to George and Mallery's rating system. Similarly,

when based on standardized items, the designer group's Cronbach's Alpha rose to 0.910, further affirming its high reliability. In the non-designer group, the internal consistency reliability was excellent, at 0.862, also surpassing the 0.8 standard threshold and being rated as "Good" according to George and Mallery's empirical rule. The Cronbach's Alpha based on standardized items for the non-designer group was 0.858, showing a similarly high consistency.

Table 3. Internal consistency reliability.

Non-Designers			**Designers**		
Cronbach's Alpha	Cronbach's Alpha based on standardized items	No. of items	Cronbach's Alpha	Cronbach's Alpha based on standardized items	No. of items
0.862	0.858	4	0.906	0.910	4

3.1. Initial Descriptive Statistics

In the second part of the questionnaire, participants expressed their preferences regarding four questions related to wayfinding signage (Table 4). Firstly, regarding preferences for text information on signage, option 3 (containing text, English, a destination icon, and an arrow) received the highest preference rate at 57.3%, followed by option 4 (containing text, English, a destination icon, a number, and an arrow) at 32.7%. When discussing shape preferences in wayfinding information, option 3 (directional shape) was most favored by participants at 51.1%, with option 4 (symbolic shape) receiving 34.0% support. Regarding color coding preferences, the results showed that the multicolor coding in option 4 led with a 58.6% preference rate, with option 3 receiving 26.2% support. Lastly, regarding preferences for different decorative patterns on signage, option 4 (moderate amount of local significance graphics) significantly led with a 68.8% preference rate, with option 2 (containing more graphics) garnering 20.9%. These results indicate that the majority of participants prefer design elements that combine functionality and visual effects, providing rich information and thus offering valuable empirical data for understanding the design of directional signage in urban environments.

Table 4. Summary of questions responses.

Question	**Option 1**	**Option 2**	**Option 3**	**Option 4**
Question 1: Text Information Preference in Signage				
Frequency	25	7	184	105
Percentage	7.8%	2.2%	57.3%	32.7%
Question 2: Shape Preference in Signage				
Frequency	39	9	164	109
Percentage	12.1%	2.8%	51.1%	34.0%
Question 3: Color Coding Preference in Signage				
Frequency	17	32	84	188
Percentage	5.3%	10.0%	26.2%	58.6%
Question 4: Pattern Preference in Signage				
Frequency	22	67	11	221
Percentage	6.9%	20.9%	3.4%	68.8%

In the second part of the study questionnaire, each question concerning design preferences was followed by an open-ended explanatory question aimed at delving deeper into the motives behind participants' choices. Through content analysis methods, we

categorized and coded participants' open-ended responses, and Table 5 provides a detailed analysis of these data.

Table 5. Summary of question explanation responses.

Explanation	1	2	3	4
Q1exp (Text Information Explanation)	Moderately informative	Clear and concise	Clear and concise	Graphics aid understanding
Frequency	9	59	127	126
Percentage	2.8	18.38	39.56	39.25
Q2exp (Shape Explanation)	Space utilization	Conforms to habit	Clear direction	Cultural symbol
Frequency	16	98	98	109
Percentage	4.98	30.53	30.53	33.96
Q3exp (Color Coding Explanation)	Space utilization	Clear color contrast	Clear information categorization	Attractive
Frequency	50	63	86	122
Percentage	15.58	19.63	26.79	38.01
Q4exp (Pattern Explanation)	Strong modern feel	Unique	Strong visual appeal	Cultural identity
Frequency	26	69	106	120
Percentage	8.1	21.5	33.02	37.38

In the open-ended explanations about text information preferences, 39.56% of respondents indicated that they chose the signage because it provided accurate numeric information, while 39.25% chose the design because it included graphics that helped with understanding. Regarding shape preferences, 33.96% of respondents favored designs that symbolized culture, indicating significant appeal of that shape design; another 30.53% respectively favored shapes that conformed to habit and were clear in direction, reflecting the practical importance of these designs.

In the explanations for color coding preferences, 38.01% of respondents preferred colorful designs, finding them attractive; 26.79% thought that designs with clear information categorization were ideal. Lastly, regarding preferences for decorative patterns on signage, 37.38% of respondents favored culturally identifiable patterns, believing them to be most effective in conveying information; 33.02% preferred patterns with strong visual appeal.

3.2. Designer and Non-Designer Comparison

To explore the impact of professional background on preferences in wayfinding signage design, the data from participants were analyzed and scrutinized, focusing on the differences between designers and non-designers. These data are detailed in three tables: Table 6 shows the distribution of choices for different design questions based on professional background, Table 7 provides explanations for these choices from open-ended responses, and Table 8 uses chi-square tests to compare differences between the two professional groups.

In the question about text information preferences on signage, the designer group predominantly chose option 3 (78 people) and option 4 (54 people), explained as preferring clear and concise information (61 people) and graphics that aid understanding (52 people), showing a preference for intuitive and efficient information conveyance. In contrast, the non-designer group's choices were more distributed, with options 3 and 4 selected by 106 and 51 people, respectively, mainly for the reasons of clear and concise information (66 people) and graphics that aid understanding (74 people). The chi-square test results indicated significant differences in the choices regarding text information preferences ($\chi^2 = 8.647$, $p = 0.034$) and explanations ($\chi^2 = 12.517$, $p = 0.006$) between the two professional groups.

Table 6. Summary of relation of professional background to design selection.

Question	Option 1	Option 2	Option 3	Option 4
Question 1: Text Information Preference				
Designer	18	3	78	54
Non-Designer	7	4	106	51
Question 2: Shape Preference				
Designer	26	6	79	42
Non-Designer	13	3	85	67
Question 3: Color Coding Preference				
Designer	9	19	52	73
Non-Designer	8	13	32	115
Question 4: Pattern Preference				
Designer	17	38	3	95
Non-Designer	5	29	8	126

Table 7. Summary of relation of professional background to question explanations.

Explanation	Exp 1	Exp 2	Exp 3	Exp 4
Q1exp (Text Information Explanation)	Moderately informative	Clear and concise	Highly readable	Graphics aid understanding
Designer	9	31	61	52
Non-Designer	0	28	66	74
Q2exp (Shape Explanation)	Space utilization	Conforms to habit	Clear direction	Cultural symbol
Designer	12	53	43	45
Non-Designer	4	45	55	64
Q3exp (Color Coding Explanation)	Space utilization	Clear color contrast	Clear information categorization	Attractive
Designer	29	33	40	51
Non-Designer	21	30	46	71
Q4exp (Pattern Explanation)	Strong modern feel	Unique	Strong visual appeal	Cultural identity
Designer	12	46	47	48
Non-Designer	14	23	59	72

Table 8. Statistical analysis of professional background differences.

	Text Information	Text Information Explanation	Shape	Shape Explanation	Color Coding	Color Coding Explanation	Pattern	Pattern Explanation
χ^2	8.647	12.517	10.609	8.753	14.660	4.429	13.705	12.528
p	0.034 *	0.006 **	0.014 *	0.033 *	0.002 **	0.219	0.003 **	0.014 *
Φ	0.164	0.197	0.182	0.165	0.214	0.118	0.206	0.197

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

Regarding the question about shape preferences in signage, the designer group favored option 3 (79 people) and option 4 (42 people), emphasizing clear direction (43 people) and cultural symbolism (45 people) as their main reasons. The non-designer group preferred option 4 (67 people) and option 3 (85 people), with the reasons being clear direction (55 people) and cultural symbolism (64 people). The chi-square test results showed signifi-

cant differences in the choices of shape preferences (χ^2 = 10.609, p = 0.014) and explanations (χ^2 = 8.753, p = 0.033) between the two groups.

Regarding the color coding preference question, the designer group's choices were concentrated on option 3 (79 people) and option 1 (26 people), mainly citing habit conformity (53 people) and clear direction (43 people) as their reasons. The non-designer group more frequently chose option 4 (67 people) and option 3 (85 people), with these choices mainly driven by clear direction (55 people) and cultural symbolism (64 people). The chi-square test revealed significant differences between the two groups in these choices (χ^2 = 14.660, p = 0.002), but the explanations for color coding preferences (χ^2 = 4.429, p = 0.219) did not show significant differences, indicating that preferences for color coding explanations might be similar between groups.

In response to the question about pattern preferences on signage, the designer group mainly chose option 4 (95 people) and option 2 (38 people), with the main reasons being strong visual appeal (47 people) and cultural identity (48 people). The non-designer group leaned towards option 4 (126 people) and option 2 (29 people), emphasizing cultural identity (72 people) and strong visual appeal (59 people). Chi-square testing further confirmed significant differences between the two groups in these design preferences regarding choices (χ^2 = 13.705, p = 0.003) and explanations (χ^2 = 12.528, p = 0.014).

The analysis indicates significant differences in most design elements (such as text information, shape, color coding, and decorative patterns and their explanations) between designers and non-designers, except for color coding explanations, where the preferences did not significantly differ. Designers tend to prefer concise and visually appealing designs, while non-designers focus more on cultural symbolism and a clear direction.

3.3. Individual Influences

In this study, respondents were asked to answer some questions related to personal characteristics, including gender, age, and educational background, to explore how individual differences affect preferences in wayfinding signage design. The study found significant differences in visual preferences in wayfinding signage based on gender, age, and educational background.

Gender differences analysis (Table 9) showed that, according to chi-square analysis, there were no statistically significant differences in most design elements such as text information, shape, and color coding and their explanations across genders, suggesting that the understanding of these design elements might be universal across genders. However, there were significant differences in the explanations for decorative patterns (χ^2 = 10.104, p = 0.039 *), indicating that men and women have significantly different preferences in interpreting these visual elements.

Table 9. Statistical analysis of gender differences.

	Text Information	Text Information Explanation	Shape	Shape Explanation	Color Coding	Color Coding Explanation	Pattern	Pattern Explanation
χ^2	0.629	2.846	4.355	5.549	1.427	4.999	1.869	10.104
p	0.89	0.416	0.226	0.136	0.699	0.172	0.6	0.039 *
Φ	0.044	0.094	0.116	0.132	0.067	0.125	0.076	0.177

* $p < 0.05$.

Further research explored the impact of age differences on signage design preferences (Table 10). Participants were divided into four age groups: 18–25, 26–35, 36–45, and 46 and older. The chi-square test results showed significant differences in the explanations for shape and color coding across age groups (χ^2 = 27.976, p = 0.006 ** and χ^2 = 33.52, p = 0.001 **), indicating that as age increases, people's preferences for these elements change. Additionally, decorative patterns and their explanations also showed age-related

significant differences, indicating different needs and preferences in visual preferences and information processing among different age groups.

Table 10. Statistical analysis of age differences.

	Text Information	Text Information Explanation	Shape	Shape Explanation	Color Coding	Color Coding Explanation	Pattern	Pattern Explanation
χ^2	10.211	18.466	19.044	27.976	14.807	33.52	21.387	28.901
p	0.597	0.102	0.087	0.006 **	0.252	0.001 **	0.045 *	0.025 *
Φ	0.178	0.24	0.243	0.294	0.214	0.322	0.257	0.298

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

The impact of educational background was also highlighted (Table 11), particularly in the explanations for decorative patterns, where more highly educated participants were more inclined to understand information through decorative patterns ($\chi^2 = 49.083$, $p = 0.000$ **). This reflects the preference and understanding capability of individuals with higher educational levels regarding complex or symbolic visual elements. However, there were no significant differences in text information or shape and their explanations by educational background, suggesting that the understanding of these fundamental design elements might be consistent across different levels of education.

Table 11. Statistical analysis of educational level differences.

	Text Information	Text Information Explanation	Shape	Shape Explanation	Color Coding	Color Coding Explanation	Pattern	Pattern Explanation
χ^2	9.782	10.506	9.679	11.643	16.232	13.585	6.362	49.083
p	0.368	0.311	0.377	0.234	0.062	0.138	0.703	0.000 **
Φ	0.175	0.181	0.174	0.19	0.224	0.205	0.141	0.391

** $p < 0.01$.

These findings emphasize the need to consider audience diversity in the design of wayfinding signage. Understanding how gender, age, and educational background influence visual preferences and information processing can help in the design of more inclusive and effective guidance systems, providing a scientific basis for optimizing visual design for specific groups.

4. Discussion

4.1. Discussion of Designer and Non-Designer Comparison

Overall, the research findings indicate that designers and non-designers show significant differences in their preferences and interpretations regarding the text information, shape, color coding, and patterns in wayfinding signage, with the only exception being the interpretation of color coding.

Firstly, designers and non-designers exhibit notable differences in their preferences and interpretations regarding text information. Designers tend to favor concise and straightforward text, along with graphics that aid in comprehension, indicating a preference for intuitive and clear information delivery. In contrast, non-designers' choices are more varied. This difference may be attributed to their professional training and life experience. Designers are taught through education and work to simplify information to reduce cognitive load and improve communication efficiency. This finding aligns closely with the results of Cock et al. (2022) [58]. Conversely, non-designers' diverse choices reflect a greater acceptance of various information delivery methods, as they are accustomed to assessing readability and practicality based on personal experience. This result further underscores the importance of balancing simplicity with diversity in expression in signage design to better meet the needs of different user groups. This approach not only enhances signage effectiveness but also improves user experience, especially in complex urban settings.

Secondly, there are significant differences in shape preferences and interpretations between designers and non-designers. Designers' choices are relatively varied, with a slight concentration on shapes that are highly functional and provide clear guidance (Option 4) and shapes with cultural symbolism (Option 3). In contrast, non-designers' choices are more concentrated, showing a near-uniform preference for culturally symbolic shapes (Option 3) and clear directional shapes (Option 4), reflecting their strong need for cultural symbols and directional guidance. Designers explained their choices as "Conforms to habit" and "Clear direction", likely stemming from their professional background, which leads them to focus on the practicality of signage, especially its ability to be quickly recognized and to guide pedestrians smoothly. Non-designers, however, emphasized "Cultural symbol" and "Clear direction" in their explanations, with a particular preference for cultural symbolism. This may indicate that non-designers are more concerned with whether the signage shape evokes emotional resonance and reinforces cultural identity, thereby enhancing their sense of belonging in the environment. This finding is consistent with previous research, which suggests that wayfinding signage with cultural symbolism is more attractive [36,37]. This insight has important implications for the design of urban public spaces, especially in areas like tourist sites and historic districts, where signage design should incorporate more cultural symbols to satisfy non-designers' needs for a sense of belonging and emotional connection, thereby improving the overall user experience.

Thirdly, in terms of color coding preferences, designers and non-designers display significant differences in their choices, although no difference is found in their interpretations. Designers lean toward two-color coding (Option 3) and multicolor coding (Option 4), whereas non-designers show a stronger preference for multicolor coding, with a much higher selection rate for this option than others. This suggests that non-designers favor visually rich, multicolored coding, while designers are divided between two-color and multicolor options. Although there is a preference difference in color coding choices, the interpretation remains consistent across both groups, focusing primarily on "attractiveness" and "Clear information categorization". This suggests that, regardless of professional background, users share a core requirement for color coding—namely, that it should enhance the clarity and appeal of information. This result supports previous studies indicating that signage should balance functionality and esthetics [28,29,59]. The findings suggest that user testing should be incorporated during the design phase to better understand the impact of color on different user groups. Testing can help select color combinations that align with both professional esthetics and intuitive user preferences, ensuring effectiveness in real-world settings.

Finally, regarding signage pattern preferences, designers and non-designers exhibit significant differences in both choices and interpretations. Designers' choices are relatively varied, with a slight preference for designs featuring a small number of local-meaning patterns (Option 4), while non-designers preferred more uniformly chosen designs with a small number of local-meaning patterns (Option 4), reflecting their strong desire for cultural expression within signage. Although both designers and non-designers emphasized "Strong visual appeal" and "Cultural identity" in their interpretations of signage pattern preferences, there were differences in their explanations. This discrepancy suggests that even with a shared need for "Cultural identity" and "Visual appeal", groups with different professional backgrounds have varied expectations regarding how these elements should be achieved. Therefore, signage design should account for the distinct preferences of designers and non-designers in expressing cultural elements, striking a balance between maintaining signage clarity and effectively conveying cultural symbolism.

As an exploratory study, this research confirmed the existence of significant differences in visual preferences between designers and non-designers in urban wayfinding signage design. These findings support previous research indicating that designers and non-designers have marked perceptual differences; while their thought processes may be similar, their focal points differ considerably [16,17,20]. Our results reveal that designers consistently prioritize the functionality and clarity of information in signage design to ensure effective

use in complex urban environments. In contrast, non-designers show a strong preference for wayfinding signage that reflects local cultural symbols and characteristics. This disparity suggests that the public's expectations for wayfinding signage have expanded beyond navigation, with a desire for deeper cultural expression and visual appeal.

These findings offer valuable guidance for bridging the gap between designers' and non-designers' visual preferences in signage. First, we recommend prioritizing cultural expression in signage design standards by establishing "cultural visibility" guidelines. This ensures that new signage visually presents clear cultural symbols and aligns closely with the city's unique identity. This approach not only aids designers in integrating cultural elements effectively but also enhances cultural identity through signage, encouraging pedestrian engagement. Additionally, we propose the introduction of augmented reality (AR) technology to provide pedestrians with immersive cultural experiences. For example, as pedestrians approach signage, they could access historical and cultural information about the area via their smartphones, transforming signage into an interactive medium for cultural dissemination. This design strategy balances functionality with cultural appeal, meeting users' practical needs while enhancing the acceptance and effectiveness of the signage system. Integrating functional and cultural elements into signage can foster a deeper human–place connection in urban spaces, thereby promoting sustainable urban development.

4.2. Discussion of Individual Influences

This study also examined the impact of individual backgrounds on visual preferences in wayfinding signage. The findings indicate that gender, age, and educational background significantly influence visual preferences in wayfinding signage, supporting previous research [60]. These findings highlight the importance of inclusive design in sustainable urban environments, ensuring that wayfinding signage is accessible and effective for all population groups, thereby supporting equitable social development.

Firstly, regarding gender, the study found significant differences in pattern interpretation between males and females, consistent with Zhen et al. (2020), who reported that females prefer complex and detailed designs, while males tend toward simpler visual expressions [61]. This suggests that, when designing gender-neutral wayfinding systems, these differences should be carefully considered to create a more inclusive urban space where all gender groups feel valued.

Secondly, there were significant age-related differences. With increasing age, respondents showed a preference for more conservative and traditional designs. This aligns with the findings of Herzog et al. (2000), indicating that older adults prefer traditional designs to enhance cognition and memory retention [62]. Therefore, in designing signage systems suitable for different age groups, a balance should be struck between innovation and traditional elements to satisfy the younger generation's desire for novelty while respecting older adults' preferences.

Finally, differences in educational background were evident in the interpretation of decorative patterns. Respondents with higher education levels tended to seek information through detailed text and bilingual options, whereas those with lower education levels relied more on symbols and graphics. This finding aligns with previous research, underscoring the need to balance detailed information with visual symbols in the design of public wayfinding systems to meet the needs of users from a range of educational backgrounds. This type of inclusive design can help to reduce information access inequality and promote social equity in urban areas.

Based on these differences, future wayfinding signage should, while fulfilling navigational functions and reflecting urban culture, also consider demographic characteristics contextually. For instance, in male-dominated work environments like factories, an intuitive and straightforward design style with large fonts and high-contrast colors is recommended to enhance information clarity. In areas frequented by older adults, such as retirement homes and parks, the design should focus on readability, using large fonts, simple graphics,

and warm color tones to enhance friendliness. Meanwhile, in higher-education settings like universities or cultural centers, local artistic elements and multilingual signage should be incorporated to meet the complex information needs of this demographic. These strategies not only improve the practicality and effectiveness of wayfinding signage but also strengthen cultural expression and ecological sustainability within the urban environment.

5. Conclusions

In complex urban environments, wayfinding signage serves not only as a navigational tool but also as a critical element for promoting sustainable urban development by reducing cognitive load and enhancing environmental esthetics. However, differences in visual preferences in wayfinding signage between designers and non-designers may lead to designs that fail to truly meet user needs, thereby impacting the effectiveness of the signage. This study confirmed significant visual preference differences between designers and non-designers regarding urban wayfinding signage design. The results indicate that designers generally prioritize functionality and information clarity in signage to ensure effective use in complex urban environments, whereas non-designers strongly favor signage that reflects local cultural symbols and characteristics. This preference suggests that the public expects signage to go beyond mere navigation, serving as a medium for cultural expression and visual appeal. Additionally, the study revealed that gender, age, and education level significantly influence individuals' visual preferences in wayfinding signage, implying that design solutions should account for demographic diversity to create more inclusive wayfinding systems while fulfilling basic navigational functions.

The theoretical contribution of this study lies in its in-depth exploration of how professional background influences visual preferences, providing empirical support for the design of sustainable urban wayfinding systems. Designers and urban planners should pay close attention to these differences, effectively integrating functionality and cultural expression into design to optimize the signage experience in public spaces and meet diverse user needs. Based on these findings, signage design should enhance cultural visibility while ensuring efficient information transmission. For instance, incorporating locally distinctive patterns or symbols into designs can strengthen cultural identity and encourage walking through visual appeal, thus promoting sustainable urban development. This approach not only addresses current practical needs but also establishes a deeper cultural connection between users and the environment, ensuring that urban spaces remain inclusive, functional, and livable over long-term development.

6. Limitations and Future Research Directions

Although this study employed both snowball sampling and stratified random sampling to enhance the diversity of the sample, several limitations remain. First, the sample predominantly originates from a single city and specific cultural context, potentially restricting the generalizability of the findings. Different cultural and urban environments may significantly impact visual preferences, and a single-background sample may not sufficiently represent diverse needs on a global scale. Future research could broaden the applicability of the results by incorporating participants from various geographic and cultural backgrounds, establishing a cross-cultural comparative framework to explore potential differences in signage design preferences across regions.

Secondly, while this study identifies significant differences in signage preferences between designers and non-designers, it lacks an in-depth analysis of the psychological and sociocultural roots of these differences. Designers' professional backgrounds might lead them to prioritize functionality and clarity of information in signage, whereas non-designers, potentially lacking professional training, may interpret signage more from emotional and cultural identity perspectives. Future research could adopt psychological and sociological perspectives to investigate deeper connections between professional training, sociocultural background, and visual preferences. Specifically, methods like in-depth interviews or focus group discussions could be employed to uncover the cognitive and emotional mechanisms

shaping signage preferences among designers and non-designers, thereby providing a more comprehensive theoretical foundation for wayfinding signage design.

Furthermore, this study mainly focuses on general principles of signage design and does not fully address the dynamic complexity of practical application contexts. In real-world applications, the design requirements for signage may be influenced by regional functions, user characteristics, and usage contexts. For instance, signage design for commercial districts, historical neighborhoods, and residential areas may exhibit significant differences in terms of cultural expression and functional needs. Future studies could use contextualized field experiments or user behavior tracking to examine the unique needs of different urban areas and specific user groups, ultimately proposing adaptive wayfinding signage design strategies. Such strategies would not only meet navigational requirements but also facilitate cultural transmission and emotional connection within communities and environments.

In conclusion, this study provides a foundational reference for understanding preference differences in wayfinding signage design between designers and non-designers. However, future work should delve deeper into cross-cultural samples, psychological mechanisms, and contextual adaptability. Through these efforts, wayfinding signage design could not only enhance the accessibility and inclusivity of urban environments but also promote cultural expression and urban sustainability on a broader scale.

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Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki, and approved by the Human Research Ethics Committee of Universiti Putra Malaysia (JKEUPM) (protocol code JKEUPM-2023-139, approved in 2023). All participants were informed about the purpose of the study and assured of anonymity before completing the questionnaire, and their participation was voluntary. We confirm that all research methods were carried out in accordance with the relevant guidelines and regulations set by the Human Research Ethics Committee of Universiti Putra Malaysia.

Data Availability Statement: The data underlying the results presented in this study are available from the Figshare repository at https://doi.org/10.6084/m9.figshare.27174192.v1.

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