buildings

MDPI

Article

Survey on the Impact of Historical Museum Exhibition Forms on Visitors' Perceptions Based on Eye-Tracking

Linhui Hu [1,2,†], Qian Shan [1,†], Lidan Chen [1], Siyin Liao [1], Jinxiao Li [1] and Guangpei Ren [1,*]

[1] School of Art and Design, Guangdong University of Technology, Guangzhou 510062, China; hlh@gdut.edu.cn (L.H.); 2112217070@mail2.gdut.edu.cn (Q.S.); dada209684@163.com (L.C.); lsy981200@126.com (S.L.); 15647192510@163.com (J.L.)
[2] Faculty of Innovation and Design, City University of Macau, Macau 999078, China
* Correspondence: ren20171220@gdut.edu.cn
† These authors contributed equally to this work.

Abstract: Exhibition design in museum space is of great significance in enhancing cultural attraction, visitor experience, and heritage conservation. With the growth of spiritual and cultural needs, the construction of museums has increased, but the quality of exhibitions has been improved to a limited extent. In order to explore visitors' perceptual experience in terms of display forms, this paper combines eye-tracking technology and subjective evaluation to select three display forms, namely, stand-alone display form, combined picture and object form, and combined 3D object and physical form, for the research. Combining field research, eye-tracking experiments, and subjective questionnaire evaluations, this study explores the relationship between visual perception and emotional experience in different display formats. The results showed that (1) the effects of different display formats differed between visual perception and emotional experience, and (2) there is some correlation between visual perception and emotional experience. Specifically, the number of fixations sessions was negatively correlated with fun, richness, comfort, and attractiveness and positively correlated with authenticity, while the average fixation time was positively correlated with the former and negatively correlated with authenticity. Combining the two dimensions, the study concluded that visitors' experience satisfaction and preference are high in response to the form combining 3D objects and physical objects; the exhibition form of combining pictures and physical objects produces a higher degree of cognition in a short period of time; and the stand-alone display form has the lowest degree of preference, with poor information retention among visitors. It is hoped that this study will provide some reference for the use of exhibition forms in historical museums.

Keywords: museum space; exhibition form; eye-tracking experiment; perceptual evaluation; semantic differential method

check for updates

Citation: Hu, L.; Shan, Q.; Chen, L.; Liao, S.; Li, J.; Ren, G. Survey on the Impact of Historical Museum Exhibition Forms on Visitors' Perceptions Based on Eye-Tracking. *Buildings* **2024**, *14*, 3538. https://doi.org/10.3390/buildings14113538

Academic Editor: Haifeng Liao

Received: 1 October 2024
Revised: 26 October 2024
Accepted: 27 October 2024
Published: 5 November 2024

Copyright: © 2024 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (https://creativecommons.org/licenses/by/4.0/).

1. Introduction

Museums play an indispensable role in the field of cultural communication as an important link between the past, present, and future [1]. According to the Blue Book of Museums, the number of historical museums in China in 2018 was 1709, accounting for 34.75 per cent of all museums, ranking second among the types of museums, marking the historical museum as an important carrier for the dissemination and transmission of history and culture.

In recent years, as people's spiritual and cultural needs have increased, museums have faced the challenge of changing with visitor preferences. Thus, how to improve the experience and attract visitors is an urgent issue that needs to be addressed [2]. In the museum space, display is a direct means for the museum to convey the content, historical information, and cultural value of the exhibits to the visitors and to realise the communication between the cultural relics and the visitors [3]. It is also the mode of experience that synthesises the material and the technological in the museum space [4]. It is used to

provide visitors with visual experience and environmental perception to stimulate emotional resonance with them [5]. However, in the past, visual perception research has mostly focused on the internal spatial organisation and spatial colour of museums [6], with less data-supported research on exhibition forms' effects on visual perception.

Therefore, this study takes the visitors as a starting point in order to understand the visitors' truest feelings. An attempt was made to explore the visual perceptual effects of three typical exhibition forms through eye-tracking techniques and a semantic differential method (SD), a combination of subjective and objective perspectives. It is expected that understanding the factors affecting visitors' viewing of museums will provide empirical evidence and strategic suggestions for museum exhibition design, and help museums to optimise the visiting experience while passing on culture, thus promoting wider and deeper cultural exchanges and dissemination.

2. Review of Literature

2.1. Forms of Exhibition in Space

Exhibition form refers to the use of certain design theories through the space for the arrangement of expression or artistic approach to performance, for the display of specific ways and means. With the development of the new museology, the concept of 'human-centred' is gradually being integrated into the design of exhibition space. J. Zhao believes that the design of exhibition forms in commercial space can create an environment for people to exchange and transmit information and stimulate people's acceptance of goods, and is an important embodiment of the 'human-centred' principle [7]. Artists also believe that museum spaces are not simply experienced as neutral white cubes [8]; J. Lorenc, L. Skolnick and C. Berger, for example, see exhibit design as creating a communicative environment [9]. This conceptual change in the museum exhibition space is reflected in the use of different forms of artefacts and vivid display connotations to form a certain viewing scene [10], thereby enhancing the cognitive experience of visitors [11]. Therefore, the study of exhibition forms is important and effective. In recent years, most domestic and foreign history exhibitions have been mainly based on physical display, and the design of static display forms such as booths and cabinets has been centred around physical objects [12]. Guo Beibei believes that past research mostly starts from the three main forms of pictures, objects, and models, and conducts classified research on the design of display equipment, artefact combinations, various types of artefact decorations, and backgrounds of museum exhibition spaces [13]. Wang Guobin believes that the traditional historical exhibition is a direct display of the object, with its expressed concept of display assisting through presentation of photographs, reproductions, pictures, charts, and other items [14]. Henderson and Ferreira argue that forms can consist of 3D drawings, colour drawings, real objects, pictures processed by Adobe Photoshop techniques, and so on [15]. J. Ichino's study concluded that the placement of forms affects people's social behaviour in a space [16]. Jing Wang analyses the scale as well as visual and psychological elements to reveal the basic characteristics of display exhibits [17]. In summary, this study was designed to be based around the independent form of exhibition of physical displays, the form combining pictures and physical objects, and the form combining 3D objects and physical objects.

2.2. Exhibition Forms and Semantic Difference Method

With the development of science and technology, emotional needs during the visiting experience are gradually being emphasised. The use of emotional semantics in this context helps to realise the fusion of spatial and emotional experience, and to realise an exhibition effect connecting emotion and reason [18]. The semantic differential method is a research method devised by American psychologist C. E. Osgood et al. [19]. It is used to quantitatively study people's impressions of evaluation objects such as words and images, and has been widely used in various fields. The evaluation can respond to people's subjective feelings to a certain extent, and it is mostly focused on assessment of the display effect composed of elements in terms of the display form. For example, Amrita Bhattacharjee

and Swati Pal showed through a questionnaire that visitors preferred higher lighting levels when viewing different exhibits and argued that viewers' preference for lighting levels is not significantly affected by the medium of painting [20]. T. Nakamura et al. used the semantic differential method to evaluate the visual effects in a dynamic display, and obtained eight categories of visual feedback impressions that users focused on most [21]. Almudena Palacios-Ibáñez argues that form induces perceptual differences in aesthetic characteristics, with the perceptual disparity being more pronounced for the two different forms of 2D display and 3D immersive [22]. It is also believed that the combination of emotional and physiological evaluations is especially helpful in discovering feature points. Therefore, in this study, the semantic differential method was used in the assessment of exhibition forms to obtain quantitative subjective evaluations.

2.3. Eye-Tracking Technology and Exhibition Formats

Eye-tracking is a technology that collects measurements from a user's eye movements. It is also possible to measure physiological data on psychological and cognitive responses [23] and determine visual perception and experience accordingly [24]. In the field of design, visual perception is one of the most important experiences people have when gathering and feeding back external information [25]. Eye-tracking technology is mostly applied by combining visual cognition with expertise experience in real environments [26] and by analysing significant differences in eye movement data and using the findings as a reference for future development interests [27]. Topics of these studies have included the tendency to allocate reading attention to exhibit information [28], patterns of perception of information related to different types of works [29], which areas of a work of art are more intuitively preferred [30], visual attention flow status [31], and cognitive preferences for the spatial layout of maps [32]. Images perceived by vision are important for the study of human emotion and visual recognition [33]. Hess believes that viewing pleasurable visual images leads to dilation of the pupils and, at the same time, a shift in mood from a state of relaxation to one of euphoria [34]. In recent years, eye-tracking technology has been extended for use in exhibition spaces, and Michael Garbutt's research suggests that eye-tracking technology can discover new ways of interacting with art and the wider visual environment [35]. L. Reitstätter et al. investigated art perception through eye-tracking and subjective mapping, suggesting that the perception of an artwork is affected by the ways in which it is presented [36]. Y. Fang showed in 2020 that eye movement data can also reflect people's preference for visual arts in space and the extent to which their interest changes [37]. However, there is still a lack of research on the use of eye-tracking for different exhibition forms in space, so this paper investigates and analyses the perceptual experience of exhibition forms using eye-tracking technology. This is complemented by analysing eye movement data to more objectively measure visitors' perceptions and preferences, and combining this with visitors' subjective evaluations [38].

Throughout the literature, in the assessment of the environment, eye-tracking experiments have been used to collect heat maps of subjects' gaze points to investigate people's visual preferences within their surroundings [39]. However, there is still a lack of content that can be applied to the exhibition form to transform people's positive emotions into design. In order to enhance visitors' visual perceptual experience in terms of exhibition form, and thus the attractiveness of historical museums, this paper uses changes in eye movement data to verify how changes in exhibition form affect visual perception. Therefore, the research questions of this paper are as follows:

(1) Is there a difference between the visual perception and the emotional experience of different scene display forms, and can we determine visitors' perceptual preference by analysing the two?
(2) Is there a correlation between visual perception and emotional experience, and what does the correlation indicate?

3. Research Methodology and Design Objectives

3.1. Research Methodology

Eye-tracking analysis and semantic analysis (SD method) were used in this study. Data collection as well as characterisation can be performed by capturing eye movement data from visitors and using the SD method to study the visitors' tendency to subjectively evaluate the sample, thus investigating the relationship between physiological and psychological responses.

3.2. Survey Respondents

In this study, 39 subjects were randomly recruited in the university to participate in the experiment, consisting of 19 undergraduates and 20 postgraduates. They all have a relevant research background in the arts, including disciplines such as architectural design, visual communication, landscape design, and industrial design. Data from three subjects were excluded because the sampling rate of eye movement data in the experimental data was less than 85%. The remaining 36 subjects were analysed, with the age range of the participants determined as between 18 and 48 years, with 20 females and 16 males. The subjects participated voluntarily, and all testers had a visual acuity of 0.1 or higher. All were informed prior to testing that their eye movement data would be recorded and that all data would be anonymised, and subjects signed a consent form for the trials ahead of the experiment. In addition, all the subjects were unfamiliar with these experimental samples, seeing them for the first time.

3.3. Experimental Equipment and Data Acquisition

The instrument used in the study was the Tobii Glasses 2 portable head-mounted eye-tracking tester, a device that collects eye-tracking data via infrared corneal reflectance technology and presents stimulus material using a 1920 × 1080 resolution display. The experiments were carried out in the laboratory of Guangdong University of Technology to ensure that the external conditions were well controlled (Figure 1). Data were collected and analysed after the test using Tobii Pro Lab software. Four eye movement indicators were selected for this study [40]: total duration of fixations, average fixation time, number of fixations, and average pupil diameter. Table 1 provides the specific meanings and definitions of these indicators.

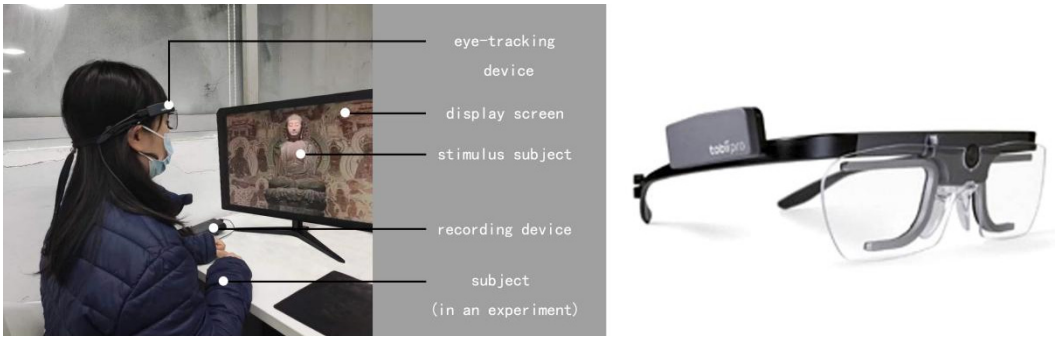


Figure 1. Experimental equipment.

Table 1. Basic meanings of eye movement indicators.

Targets	Significance of the Target
Total duration of fixations (TDOF)	Refers to the total amount of time spent gazing at the content in the area. Can reflect the cognitive difficulty level of the image.
Average fixation time (AFT)	Refers to the time spent at each gaze point, which can reflect the effort of cognitive perception of the image.
Number of fixations (NOF)	The total number of gazes in the area can reflect the importance attached to the area as well as the level of interest.
Average pupil diameter (APD)	This refers to the change in the value of the pupil diameter after receiving a visual stimulus, which can reflect cognition and emotion.

3.4. Scope of Research

The experimental samples were mainly selected from the permanent exhibits in China's first large-scale modern national museum, the Shaanxi Provincial Museum of History. The richness of the museum's exhibits and the variety of scenarios made it an ideal choice for visual perception for this study.

3.5. Research Sample

Multiple angles of different display subjects were photographed using the same imaging technique, and experts conducted a selection of display subjects, ultimately choosing a representative sculpture class for the study. According to the size of the main exhibition and the overall suitability of specific content selection [41], Zhongshan Grottoes and Terracotta Warriors were selected for display examples. After appropriate treatment of perspective and content, a final sample of six experiments was selected. The type of selection is shown in Figure 2. Figure 2A is selected as a stand-alone display form, with a black background to simulate the physical display form, to exclude other influences in the visual information. Figure 2B is in the form of a pictures–object combination, with flat images related to the content of the exhibition in the background. Figure 2C shows a combination of 3D objects and physical objects, with the background content comprising restored historical remains. All samples were selected to exclude textual information as an influencing factor, and the size of the viewfinder frame was kept constant for each scene to ensure that the image appeared in the centre area directly in front of the viewer.



Figure 2. Example diagram for comparison of experimental samples.

3.6. Experimental Process

In eye-tracking experiments, glasses need to be removed and the apparatus worn. After completing the calibration, visitors independently viewed an automatic randomised display of sample images, and silence was maintained throughout the experiment. To reduce the interference of other variables external to the experiment, visitors viewed at a distance of 75 cm and the viewing images were displayed in full-screen, with a viewing time of 10 s per image [42]. A black screen lasting for 2 s was played when the picture switched to prompt the viewer to watch the picture change. The whole process required participants to be highly concentrated on scene viewing and feeling, reducing the focus on eye movement experiments' other memory effects, emotional state, and other interfering factors in the case of attention allocation and cognitive processing processes. The entire experiment lasted about 20 min (Figure 3).

An anonymous SD questionnaire was completed by each visitor after the trial, which was ethically reviewed. Subjects were informed of the purpose of the questionnaire and that submission of the questionnaire was considered informed consent.

Among other things, the questionnaire selects adjectives from relevant research that relate to experiential evaluations and experiential preferences in the form of scenes, including how subjects felt and how they reacted to the scenes they viewed. In the end, 10 pairs of clear and understandable descriptors were selected for scoring after an expert discussion, (Table 2). Including 'Boring–Interesting', 'Unhappy–Happy', 'Unbalanced–Harmonious', 'Incompatibility–Interaction', 'Weak Cultural Atmosphere–Strong Cultural Atmosphere',

'Monotonous–Rich', 'Nervous–Relaxed', 'Fake–Real', 'Weakly Attractive–Attractive', 'Weak Sense of the Times–Strong Sense of the Times'. Descriptor scores were collected on a seven-point Likert scale. Eventually, 36 subjects completed the questionnaire, with an equal number of valid data for the eye-tracking experiments and SD analyses.

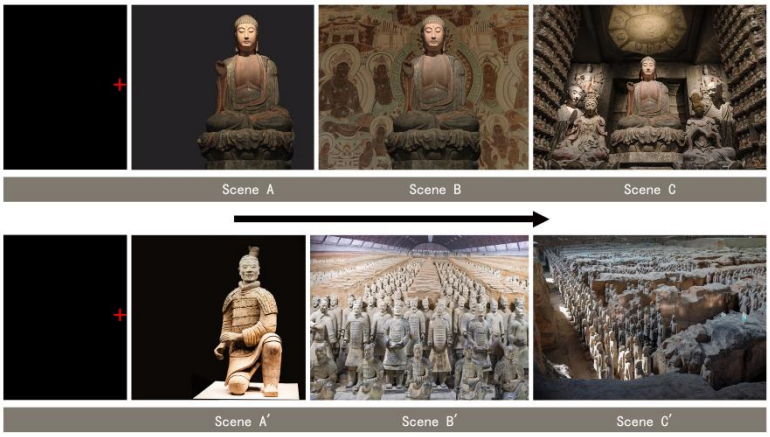


Figure 3. Flow chart of the experiment.

Table 2. SD method descriptor pair indicator selection.

Descriptor Pairs	Sources of Indicators
Boring–Interesting	[43]
Unhappy–Happy	[44]
Unbalanced–Harmonious	[44]
Incompatibility–Interaction	[45]
Weak Cultural Atmosphere–Strong Cultural Atmosphere	[45]
Monotonous–Rich	[44]
Nervous–Relaxed	[44]
Fake–Real	[43]
Weakly Attractive–Attractive	[43]
Weak Sense of the Times–Strong Sense of the Times	[44]

4. Results

4.1. Differences in Eye Movement Data Across Exhibition Formats

Data analysis was performed on 36 subjects with valid data, where eye movement data were analysed and data processed using Tobii Pro Lab (x64) for sweep paths and hotspot maps. The processed data were imported into SPSS 27 for analysis [46], and the results of data analysis were obtained.

The following four types of eye movement data were analysed using one-way analysis of variance (ANOVA): TDOF (ms), AFT (ms), NOF (N), and APD (mm). The study indicated that the use of one-way ANOVA could determine differences in eye movement data between different presentation formats [46]. We performed an ANOVA chi-squared test on the data before analysing them again, and the results were obtained with p-values greater than 0.05, proving that the different display formats have a statistically significant impact on people's vision. In the analyses, the three exhibition formats were the independent variables, and the visitors' eye movement data were the dependent variables. Descriptive statistics are shown in Table 3, where F is the ratio of mean square treatment to mean square error, and p is the significance p-value. The results showed that significant differences were observed between the different display formats in terms of TDOF ($F = 8.090$, $p < 0.001$), AFT ($F = 13.350$, $p < 0.001$), NOF ($F = 15.408$, $p < 0.001$), and APD ($F = 4.452$, $p = 0.012$) (p-values were less than 0.05).

Table 3. ANOVA results of eye movement data for different exhibition formats.

Statistical Indicators		Mean Square	F	*p*
TDOF (ms)	Intergroup data	25,103,545.73	8.090	<0.001
	Intragroup data	3,102,984.337		
AFT (ms)	Intergroup data	1,739,754.576	13.350	<0.001
	Intragroup data	130,319.002		
NOF (N)	Intergroup data	451.394	15.408	<0.001
	Intragroup data	29.296		
APD (mm)	Intergroup data	2.081	4.452	0.012
	Intragroup data	0.467		

The results of the error bar graphs and mean comparisons for the different exhibit formats are shown below (Figure 4). Eye movement metrics differed for the same viewing time. NOF of attention shows an increasing trend (13.81818N < 16.84848N < 17.93939N) for the form of stand-alone display, the form of combined picture and object, and the form combining 3D and physical objects, in that order. This indicates that subjects were less concerned with the stand-alone display format and more likely to be attracted to the 3D-object–physical combined format. AFT showed the stand-alone display format to be the longest viewed, significantly higher than the other two formats, followed by the combined 3D object and physical object format (683.61 ms > 454.55 ms > 453.45 ms). This indicates that respondents are more attentive when viewing stand-alone display formats, while the combination of picture and object formats and the 3D-object–physical combined format are more recognisable. TDOF shows that the stand-alone display format has the longest gaze time, followed by the 3D-object–physical combined format, and then the combined picture and physical object format (7527.73 ms > 6995.85 ms > 6521.15 ms). This indicates that respondents processed the stand-alone display format in more cognitive depth, and that the combined picture–object format was more cognitively understandable. APD shows that the largest pupil diameters were found in the combined picture–physical form, followed by the combined 3D-object–physical form, and finally the stand-alone display form (4.1811 mm < 4.4007 mm < 4.4549 mm). This indicates that the combined picture–object format was more visually stimulating and attractive to subjects, while the stand-alone display format was the least visually stimulating to them. In summary, the combined picture–object form is most visually appealing to the visitor's attention, with greater stimulation in a short period of time, and contains a greater amount of information and features that are easier to receive, followed by the form of combining 3D objects with physical objects, with the least appealing form being stand-alone displays.

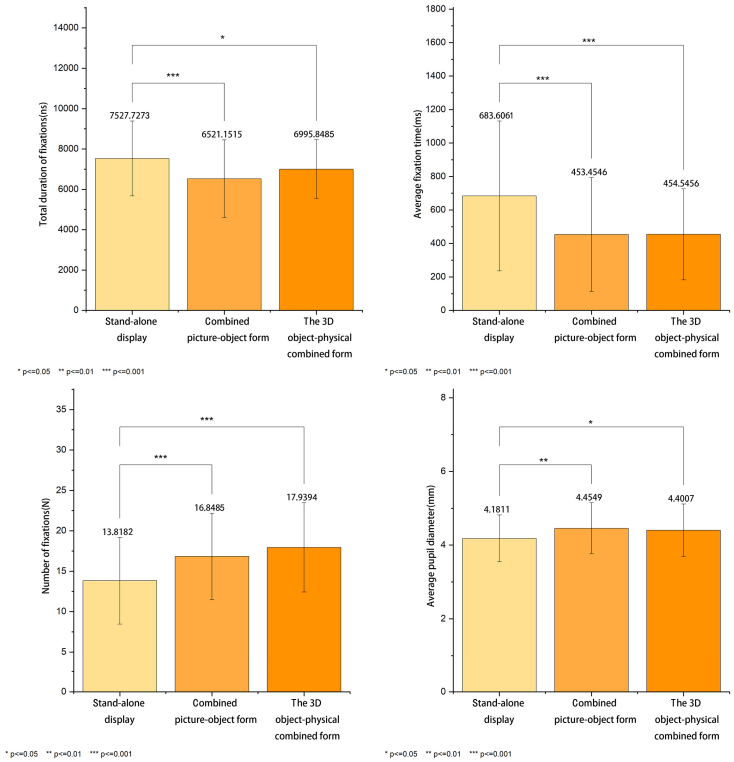


Figure 4. Comparison of mean values of eye movement data between exhibition formats with different levels of scenarisation.

4.2. Vision Data

The visual scanning path diagram shows the position and sequence of the gaze points in the sample, reflecting the path of eye movements of the visitor during viewing, where the number at the centre of the focus represents the order of the visual path. A larger radius of focus in the graph indicates a longer gaze duration and more attention of the visitor stimulated by the sample. The visual hotspot map provides a simpler and more intuitive rendering of what content is more likely to attract a subject's attention, with longer gaze durations shown in red and shorter gaze durations in green, and areas that fail to attract a respondent's attention shown as transparent. Figures 5 and 6 are selected to exemplify the results of eye movement measurement scanning path maps and hotspot maps in different exhibition formats.



Figure 5. Scanning path diagrams of different exhibition forms (example).

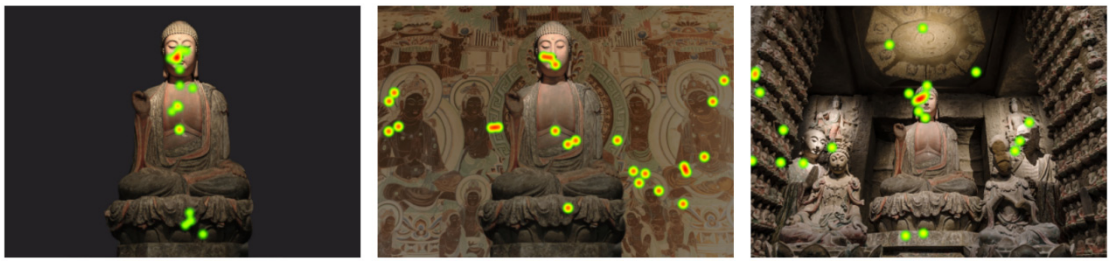


Figure 6. Hotspot map of different exhibition forms (example).

The results show that in the stand-alone display format, vision was more focused on the displayed object. The focus was distributed more evenly on the object, the radius of the focus was larger, the stimulus remained concentrated, and the gaze duration was longer. In the combined picture–object format, the visual points were more dispersed, with the focus spreading out over the 2D background screen, and the attention time at each point increased, with more red areas. The distribution of focus was more spread out in the combined 3D-object–physical display format, with shorter attention spans at each point and fewer red zones than in the semi-scene display format.

Different visual features affect subjects' perceptual preferences [47]. The focus of gaze in all three forms was on the display face area, which attracted the attention of more subjects. In addition to this, as the background of the scene form became progressively three-dimensional and spatialised, the duration of the gaze point first increased and then decreased, and the visual attention of the subjects showed the characteristics of distraction. Overall, subjects showed a high level of interest in backgrounds in the form of different scenarios, and backgrounds with more content and information attracted the attention of more subjects. These findings inform the design and management of exhibition forms, and attention should be paid to the relationship between the subject of the display and its form in order to enhance its appeal and satisfy the perceptual preferences of sensations between different subjects.

4.3. Data Feedback from SD Psychological Evaluations

A multi-method evaluation allows for a more comprehensive analysis of visitors' behaviour and cognitive processes [48]. Thus, combining eye movement data with subjective evaluations can compensate for the limitations of evaluations using eye-tracking techniques alone and better explain cognitive activities and experiences. The data collected from the questionnaire showed that 42 per cent of the respondents were male and 58 per cent were female, most of them were concentrated in the age group of 19–40 years old, and 88 per cent of them possessed a university degree, so the respondents had a high level of education and their aesthetic preferences were in line with those of the public. The questionnaire was also tested for validity to ensure that the data were statistically significant. The validity tests included reliability and validity tests, in which the Cronbach's alpha value in the reliability test was $0.964 > 0.8$, which indicates that the scale has high stability and internal consistency, and is highly reliable. The validity test showed that the KMO value of the questionnaire data was $0.908 > 0.45$, indicating that the questionnaire has good validity.

According to the survey results, the overall satisfaction mean for the three formats showed the highest satisfaction for the 3D-object–physical combined format and the lowest satisfaction for the stand-alone display format ($5.08 < 5.49 < 5.81$) (Table 4). The SD statistics showed (Figure 7) that most descriptor means correspond to folds above 4, with more positive feedback, among them the six pairs of independent display forms, namely, 'Unbalanced–Harmonious', 'Incompatibility–Interaction', 'Weak Cultural Atmosphere–Strong Cultural Atmosphere', 'Monotonous–Rich', 'Nervous–Relaxed', and 'Weakly Attractive–Attractive'. The scores for these six pairs are close to the evaluation median of 4. The fluctuation of the curve for the combined 3D-object–physical form is more gentle than that for the combined picture–physical form, with both ratings lying in the range of 6–7, suggesting a higher

consistency of subjective ratings and better ratings for the combined 3D-object–physical form. The standard deviation of all descriptor pairs was calculated, and the resulting mean was determined to be about 1.27, which is not significantly different. This result suggests that although there were some differences in how different visitors perceived the display form, their tendency to choose the same descriptors was the same. Additional insights into attentional focal aspects can thus be provided by analyses of eye movements, while SD assessments provide interpretative support for subjects' underlying preferences and perceptions.

Correlation analysis between overall satisfaction and evaluation factors using SPSS 27.0 (Table 5) revealed a correlation ($p < 0.05$) between overall satisfaction and the following factors: 'Boring–Interesting', 'Unbalanced–Harmonious', 'Incompatibility–Interaction', 'Monotonous–Rich', 'Nervous–Relaxed', 'Fake–Real', and 'Weakly Attractive–Attractive'. Thus, overall satisfaction can be further explained by combining the tendencies of these evaluation elements.

Table 4. Results of subjective questionnaire data.

Descriptor Pairs	Average of Scores for Stand-Alone Presentation Form	Average of Scores for the Combined Picture–Object Form	Average of Scores for the 3D-Object–Physical Combined Form
Boring–Interesting	5.19	5.63	5.85
Unhappy–Happy	5.22	5.56	5.78
Unbalanced–Harmonious	5.07	5.63	5.74
Incompatibility–Interaction	4.96	5.44	5.81
Weak Cultural Atmosphere–Strong Cultural Atmosphere	4.78	5.33	5.78
Monotonous–Rich	4.81	5.52	5.89
Nervous–Relaxed	4.89	5.41	5.67
Fake–Real	5.33	5.48	6.04
Weakly Attractive–Attractive	5.00	5.48	5.96
Weak Sense of the Times–Strong Sense of the Times	5.22	5.56	6.04
Overall satisfaction	5.08	5.49	5.81

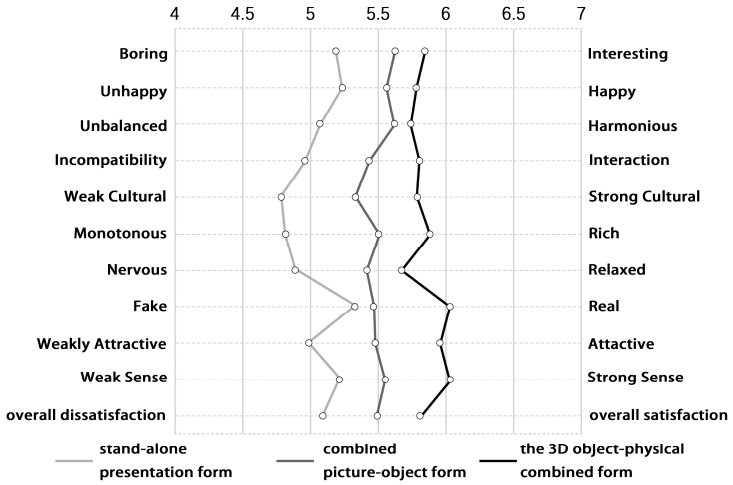


Figure 7. Mean values of subjective evaluations of the three exhibition formats of the questionnaire.

Table 5. Correlation analysis between overall satisfaction and evaluation elements.

	Boring–Interesting	Unhappy–Happy	Unbalanced–Harmonious	Incompatibility–Interaction	Weak Cultural Atmosphere–Strong Cultural Atmosphere	Monotonous–Rich	Nervous–Relaxed	Fake–Real	Weakly Attractive–Attractive	Weak Sense of the Times–Strong Sense of the Times
Overall satisfaction	0.869 **	0.183	0.866 **	0.848 **	0.043	0.793 *	0.898 **	0.874 **	0.903 **	0.148

* At the 0.05 level (two-tailed), the correlation is significant. ** At the 0.01 level (two-tailed), the correlation is significant.

The correlation results show a positive correlation between high satisfaction and positive evaluations, suggesting that fun, harmonious, relaxing, engaging, authentic, interactable, and enriching formats produce higher levels of satisfaction.

4.4. Correlations Between Visual Preferences and Psychological Perceptions

Correlation analysis between visual preference and psychological perception showed (Table 6) (Figure 8) that NOF and AFT were significantly correlated with 'Boring–Interesting', 'Nervous–Relaxed', 'Weakly Attractive–Attractive', 'Fake–Real', and 'Monotonous–Rich', respectively, at the 0.05 (two-tailed) level of significance.

Table 6. Correlation between visual and mental perception.

	Boring–Interesting	Unbalanced–Harmonious	Incompatibility–Interaction	Monotonous–Rich	Nervous–Relaxed	Fake–Real	Weakly Attractive–Attractive
NOF (N) Pearson correlation	−0.180 *	−0.046	−0.089	−0.155 **	−0.212 *	0.164 *	−0.121 *
AFT (ms) Pearson correlation	0.213 *	0.045	0.098	0.173 *	0.215 **	−0.197 *	0.124 *

* At the 0.05 level (two-tailed), the correlation is significant. ** At the 0.01 level (two-tailed), the correlation is significant.

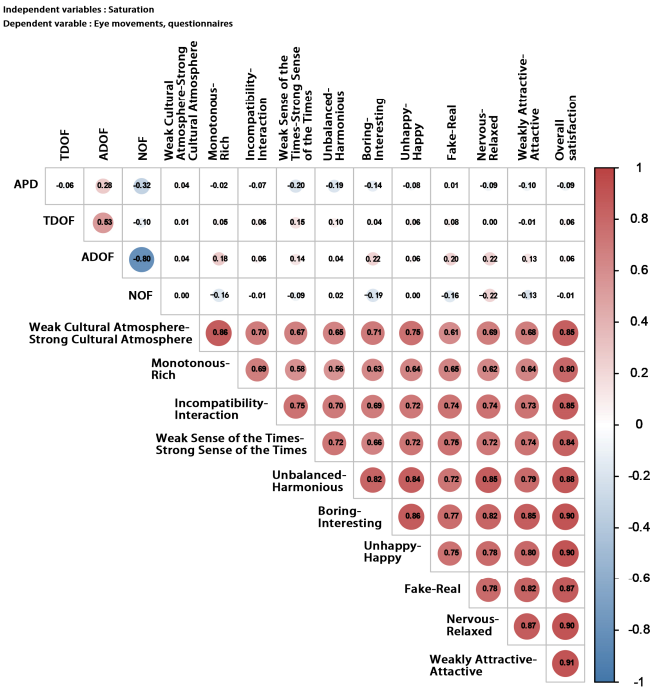


Figure 8. Relevance evaluation results.

5. Discussion

In this study, the differences in the subjects' experiences during different exhibition scene formats were examined through eye movement experiments, and eye movement indicators were extracted to analyse the relevant influencing factors.

5.1. Differences in Visual Attention in Different Exhibition Formats

Eye movement data and questionnaire evaluations for the stand-alone display format, the combined picture–object format, and the combined 3D-object–physical-object format showed differences between the visual perceptions of the different display formats(Figure 9). B. Pan, H.A. Hembrooke, et al. have shown through their research that during visual viewing, gaze is usually associated with cognitive processes of attention allocation and information processing in humans [49]. Therefore, an assessment that combines both physical and psychological dimensions provides a more objective and comprehensive picture of the visitor's results [50]. B.W. Tatler et al. suggest that the first visual focus produced by the stimulus of an eye-tracking experiment fixates on the centre of the display [51,52]. This is evidenced in the results of the comparison of the three forms of focus maps, i.e., all three forms of heat map focus points are clustered in the centre of the frame. At the same time, the area of more attention to the sculpture's face confirms the research of T. Kawagoe et al., who argued that visual images with people's faces are more attractive [53].

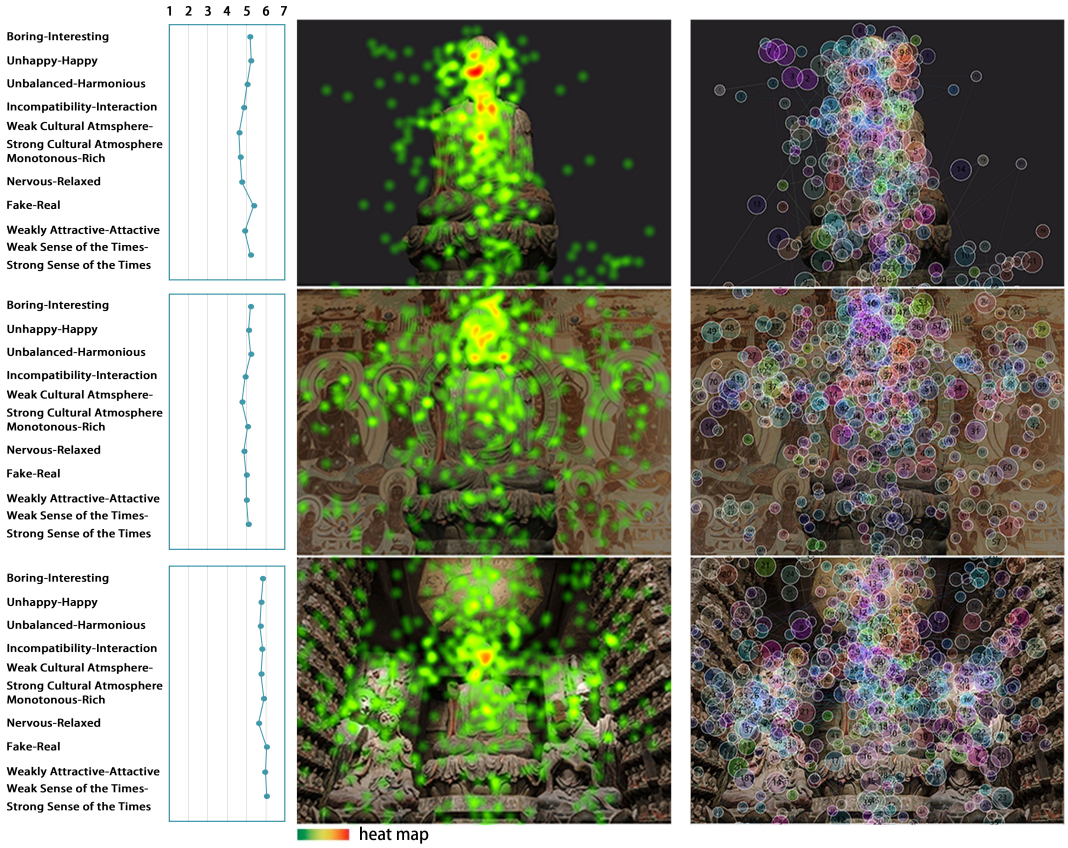


Figure 9. Coupling diagram of visual perception and emotional experience.

Satisfaction ratings were lower for the stand-alone display format, but visual focus was higher. As can be seen from the visual focus chart, there are few visual focus points within the black background area, which validates Sussman and Word's conclusion that a featureless black background does not attract visitors' attention [54]. It is also more challenging to recognise the black background as it is less semantically recognisable with the displayed items [55]. This is reflected in longer total duration of fixations, average fixation

time, and visual focus on exhibits. As this display format contains more monotonous content, the combination of smaller pupil diameter values and fewer fixations suggests that the freestanding display format provides a more focused viewing format for the visitor. However, the viewing generated a high visual cognitive challenge, which could not fully satisfy visitors' needs for visual stimulation and pleasure. In terms of emotional experience, the overall satisfaction is low and presents a weak positive tendency in terms of interaction, balance, cultural atmosphere, content richness, interest, and attractiveness. Therefore, a form requiring a high degree of concentration and cognitive processing by the visitor does not imply a good experience. This may be due to the fact that the focus is more on highlighting the aesthetic properties of the display exhibits themselves, as limited by the exhibits themselves.

Satisfaction ratings were more balanced for the combined picture–object format. This form of background is in 2D, which is less semantically coherent than live-built 3D background content, although it is relevant to the content of the display. The eye movement data showed the highest pupil diameter data values for this form, validating the idea in M. L. H. Vo's study that semantically inconsistent backgrounds attract visitors' eyes [41]. At the same time, the lower total duration of fixations shows that this form is more easily understood and recognised, probably due to the fact that the complement of 2D picture information belongs to the low-level features of the scene, which contributes to the semantic processing of the objects in complex real-world environments [41]. Due to the fact that this format is the most visually stimulating when viewed, combined with a higher average number of fixations, the pupil diameter values are the highest, suggesting that the combined picture–object form awakens the visitor's emotions more quickly [56]. It was also more easily able to capture the attention of the visitors in the display and to direct their attention to the exhibits, which is also in line with its tendency to be positively evaluated in the questionnaire. Second only to the 3D-object–physical combined form in the evaluation of affective experience, its overall evaluation was more positive, reducing perceived processing content and mobilising more energy in a short period of time. To a certain extent, it contributed to the visual cognitive and emotional experience of the respondents and was perceived as a form that was new and fresh. However, this format requires a high level of processing and selection of graphic content, and one-sided information places certain limitations on the perception of exhibits. It was also found that although the gaze points in the hotspot maps were dispersed, the visual focus in the background part mainly fell in the area parallel to the faces of the exhibits, and the pathways and distribution of the lines of sight were mostly parallel and linear, which could be attributed to the fact that the visual centre of gravity was in the faces of the sculptures.

In contrast, the combined 3D-object–physical form had the highest satisfaction ratings, which is also reflected in the eye movement data. Its background 3D dimension is semantically more consistent with the exhibits and contains rich content, while the average gaze time for this format is the shortest among the three, corroborating the research that objects presented in semantically consistent scenes are better recognised [41]. This may be due to the fact that the relationship between the display object and its scene is handled automatically. The visual focus maps showed fewer but more focused gaze points for prolonged periods of time, and selective focus on the background in four areas: centre, top, left, and right. This may be related to the habit of the vision to dwell more at the centre, but the information provided by the background does not have the more distinctive iconic features resulting from this [57]. Considering in combination the higher number of fixations, the shorter average fixation time, and the larger pupil diameter values, it can be indicated that this form elicits a strong visual interest from visitors. The questionnaire evaluation shows that the 3D-object–physical combined form has the most positive evaluation of the three forms as a whole, integrating visual perception and emotional experience, and this form can satisfy the visitors' needs for visual stimulation and experience.

From the perspective of cognitive experience, the 3D-object–physical combined form provides visitors with a rich cognitive experience through a rich and consistently featured

background. Semantic conflict in the form of a combined picture–object form is more likely to arouse emotions to perform cognitive activities and reduce cognitive load. The stand-alone format focuses on enhancing the visitor's cognitive focus, which in turn leads to an in-depth interpretation of the exhibits themselves.

Therefore, when displaying exhibits in the future, the characteristics of different exhibition forms should be considered and applied to suitable exhibits, while attention should be paid to optimising the viewing experience in order to enhance the comprehensive attraction brought by the exhibition forms to the exhibition hall.

5.2. Correlation Between Visual and Mental Perception

The necessity of eye movement experiments has led many scholars to combine subjective evaluation with eye movement analysis. R.J. Jacob [58], X. Fei [59], and others have concluded that there is a correlation between visual preference and mental perception, and demonstrated the validity of eye movement metrics in assessing cognitive depth and concentration levels. The current study demonstrated a correlation between the number of fixations and the average duration of fixations and SD descriptors, again validating that the feeling of richness of the display is related to physiological perception [60]. It was also found that the 3D-object–physical combined form was more attractive than the picture–physical-object form and the stand-alone display form, in that order. This finding is consistent with the results of the SD evaluation, suggesting that having interesting, enriching, relaxing, authentic, and engaging features in the exhibit format produces positive psychological perceptions as well as higher interest in visiting the exhibit, which is in line with the study by Fiedler et al. [61]. In other words, enhancing the fun, richness, comfort, authenticity, and attractiveness of the exhibition scenario design will increase the positive emotions of visitors and enhance satisfaction, and this understanding will help in the design and management of the exhibition scenario form.

6. Conclusions

6.1. Findings of the Study

The scenic exhibition format of a history museum conveys deep historical and cultural connotations, which are felt during the visit in the form of visual elements as well as non-visual spiritual experiences. The results of this study can provide certain design strategies and decision-making information for the display forms of sculpture-type exhibits. By understanding the differences in the visual experience between different exhibition formats, it is possible to prioritise and customise their means of display to maximise visitor satisfaction and enhance the unique cultural identity of their displays. The comprehensive 'subjective + objective' assessment framework presented in this study demonstrates a methodology that can be used to quantify the form of exhibits, and can be applied to a wider assessment of the visual experience of museum exhibit design. This approach also incorporates a qualitative approach to assessing affective perceptions, distinct from the overall situational evaluation of perceptions [62], which provides a multifaceted data base for the management and planning of museum exhibit design. The successful application of this in the exhibition format of sculptural exhibits demonstrates its potential value as well as transferability to other museum exhibition designs facing similar challenges to reduce the disconnect between homogenisation in exhibition design and visitor needs [47].

Eye-tracking experiments and SD questionnaire data were collected from 36 randomly selected visitors, and the main findings of this study are as follows:

(1) There are differences between the visual perception and emotional experience of different display forms, and there are also differences between different exhibition forms in terms of visual perception. In terms of visual perception, the stand-alone display format was more visually focused and carried a lower visual load, but the emotional experience was rated less favourably. The combined picture–object form conveyed greater visual stimulation, lower cognitive load, and faster visual browsing, and received better ratings of emotional experience. The highest cognitive load was found in the 3D-object–physical

combined form, with more attention given to overall space and the highest ratings of emotional experience. This suggests that feelings and perceptions are different aspects, and while semantically inconsistent contexts draw the visitor's eye, rich and more consistently featured contexts provide a better-rated experience. Contextualised forms of display are more cognitive for the viewer, access to information is faster, and past research has shown that meaningful scenes promote cognitive processing [63]. Therefore, it is necessary to treat different sculpture exhibits with different target orientations in display design, and promote visitors' emotional participation and cognitive absorption through appropriate display forms and content selection.

(2) There is a correlation between visual perception and emotional experience, and subjective evaluations can provide a biased and complementary explanation for differences in visitors' visual perceptions. It was found that the number of eye movements, average gaze duration results, and subjective ratings were consistent. Scenarios with a high level of satisfaction were described as having an 'interesting', 'informative', 'relaxing', 'realistic', or 'attractive' feel. This suggests that the design of exhibition scenarios should not only focus on visual effects and cognitive learning, but also on the emotional experience of visitors. It is also necessary to pay attention to the visual cognitive effect and set up appropriate display modes for the exhibits. When historical sculpture exhibits are designed for exhibition scenarios, consideration can be given to enhancing the design in terms of interest, richness, comfort, authenticity, and attractiveness.

6.2. Strategies for Optimising Visual Perception of Exhibition Forms

Based on the discussion of the results, this study analyses the visual preferences and psychological perceptions and obtains the following strategies, which we hope will help to improve the visual and experiential quality of the exhibition format and enhance the emotional experience of visitors.

(1) Evaluation data from visitors need to be collected on a regular basis to quantitatively assess the effect of the display and provide an important basis for the optimisation of the exhibition design.

(2) Importance should be attached to the design in terms of interest, richness, comfort, authenticity, and attractiveness. In the design, it is necessary to enhance the visual attraction according to the characteristics of the exhibits and the needs of the visitors, and to reduce the visual load of the visitors through the reasonable presentation of information.

(3) Different exhibition forms have different applications in the space. Adopting the 3D-object–physical combined form can enhance the emotional resonance and cognitive experience of visitors, making the exhibition environment more attractive. The use of the combined picture–object form can increase the emotional involvement of visitors through selected visual elements, enhance the visual appeal, guide and enhance the perception of visitors, and make the visual and emotional space reach a balance. The use of the stand-alone display form can highlight the exhibits and satisfy the visitors' need for in-depth exploration. The alternation or combination of the three forms in the whole venue helps to balance the perception and cognition of visitors, forming a certain viewing rhythm and reducing fatigue.

7. Shortcomings and Prospects

7.1. Selection of Participants

The present study assessed three common forms of display, but did not analyse the influence of the gender and age factors of the participants, with previous research suggesting variability in preferences between men and women [64]. Furthermore, the visitors in this case were mostly young, and the study lacked a more diverse sample of participants. Subsequent studies could therefore provide a more comprehensive assessment by examining subjects of different ages and occupations.

7.2. Selection of Exhibition Formats

This study uses sculpture as exhibition content, which has limitations in terms of display categories and cannot be generalised. With the development of technology, each form change is relatively complex, with many combinations, and subsequent research can analyse other elements in the region in a comprehensive manner. Eye-tracking experiments have only been explored in the laboratory in a visually based approach to exhibition formats, and in the future, eye-tracking data could be considered in conjunction with other physiological response measurement tools or scenario-based interactions in order to identify a more comprehensive and detailed assessment of the results. Moreover, the viewing time of this study was 10 s, which is a short-term viewing, whereas long-term viewing may lead to a high cognitive load in the 3D-object–physical combined form, resulting in physiological fatigue. Thus, the viewing experience for a longer period of time is still to be studied [65].

Enriching and improving these visitor choices, as well as the choices of exhibition formats, will help to increase the depth and accuracy of experiential assessment of exhibition formats in future research.

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

Funding: This study is funded by the Philosophy and Social Science Programme of Guangdong Province (Grant NO. GD24CYS28).

Data Availability Statement: The data presented in this study are available on request from the corresponding author. The data are not publicly available due to other, further research results.

Acknowledgments: Thanks to the support of the School of Art and Design of Guangdong University of Technology, and to all the authors for their efforts.

Conflicts of Interest: The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

1. Sharif-Askari, H.; Abu-Hijleh, B. Review of museums' indoor environment conditions studies and guidelines and their impact on the museums' artifacts and energy consumption. *Build. Environ.* **2018**, *143*, 186–195. [CrossRef]
2. Camarero, C.; Garrido, M.J.; Vicente, E. How cultural organizations' size and funding influence innovation and performance: The case of museums. *J. Cult. Econ.* **2011**, *35*, 247–266. [CrossRef]
3. Kotler, N. New ways of experiencing culture: The role of museums and marketing implications. *Mus. Manag. Curatorship* **2001**, *19*, 417–425. [CrossRef]
4. Půček, M.J.; Ochrana, F.; Plaček, M. *Museum Management*; Springer International Publishing: Berlin/Heidelberg, Germany, 2021.
5. Krauss, L.; Ott, C.; Opwis, K.; Meyer, A.; Gaab, J. Impact of contextualizing information on aesthetic experience and psychophysiological responses to art in a museum: A naturalistic randomized controlled trial. *Psychol. Aesthet. Creat. Arts* **2021**, *15*, 505. [CrossRef]
6. Medaković, J.; Atanacković Jeličić, J.; Ecet, D.; Nedučin, D.; Krklješ, M. The Interplay between Spatial Layout and Visitor Paths in Modern Museum Architecture. *Buildings* **2024**, *14*, 2147. [CrossRef]
7. Zhao, J.; Zheng, M. The Analysis of "People Oriented" in the Merchandise Display Design. In Proceedings of the 2016 6th International Conference on Advanced Design and Manufacturing Engineering (ICADME 2016), Zhuhai, China, 23–24 July 2016; Atlantis Press: Amsterdam, The Netherlands, 2017; pp. 307–310.
8. O'doherty, B. *Inside the White Cube: The Ideology of the Gallery Space*; University of California Press: Berkeley, CA, USA, 1999.
9. Lorenc, J.; Skolnick, L.; Berger, C. *What Is Exhibition Design?* RotoVision: Brighton and Hove, UK, 2007.
10. Li, Y. A Study of Scenic Display Techniques. Master's Thesis, Fudan University, Shanghai, China, 2013.
11. Biedermann, B. Vom Musentempel zur Eventwerkstätte. Am Beispiel "neuer" musealer Präsentationen. *Curiositas* **2018**, 226403321.
12. Peng, S. Research on the Design of Display Forms in Exhibitions. Master's Thesis, Beijing Institute of Printing, Beijing, China, 2022.
13. Guo, B. Research on Exhibition Design of Historic Exhibition Halls. Master's Thesis, Shenyang Architecture University, Shenyang, China, 2019.

14. Pilegaard, A. Between Bodies: Activating the space in between museum visitor and objects on display. *Interiors* **2017**, *8*, 86–109. [CrossRef]
15. Henderson, J.M.; Fernanda, F. Scene Perception for Psycholinguists. In *The Interface of Language, Vision, and Action*; Psychology Press: London, UK, 2013; pp. 1–58.
16. Ichino, J.; Isoda, K.; Ueda, T.; Satoh, R. Effects of the Display Angle on Social Behaviors of the People Around the Display: A Field Study at a Museum. In Proceedings of the 19th ACM Conference on Computer-Supported Cooperative Work & Social Computing, San Francisco, CA, USA, 27 February–2 March 2016.
17. Wang, J. Application of the Laws of Formal Beauty in Exhibition Display. Master's Thesis, Shandong Academy of Arts and Crafts, Jinan, China, 2015.
18. Sun, H.; Wang, X. Research On Digitalization Of Museum Exhibition Design Based On Image Emotional Semantics. *J. Appl. Sci. Eng.* **2022**, *26*, 737–744.
19. Osgood, C.E. *The Measurement of Meaning*; Urban III/Universit of Illinois: Champaign, IL, USA, 1957.
20. Bhattacharjee, A.; Pal, S. Preferred illumination level by the viewers for displaying paintings in exhibition space. *J. Opt.* **2021**, *50*, 289–298. [CrossRef]
21. Nakamura, T.; Miyata, K.; Yamamoto, H.; Sato, H. A Study on Scale Construction of Adjective Pairs for Evaluating Audiovisual Effects in Video Games. In *International Conference on Human-Computer Interaction*; Springer International Publishing: Cham, Switzerland, 2021; pp. 278–291.
22. Palacios-Ibáñez, A.; Navarro-Martínez, R.; Blasco-Esteban, J.; Contero, M.; Camba, J.D. On the application of extended reality technologies for the evaluation of product characteristics during the initial stages of the product development process. *Comput. Ind.* **2023**, *144*, 103780. [CrossRef]
23. Zhu, Y.; Zhai, G.; Min, X.; Zhou, J. The prediction of saliency map for head and eye movements in 360 degree images. *IEEE Trans. Multimed.* **2019**, *22*, 2331–2344. [CrossRef]
24. Duan, H.; Zhai, G.; Min, X.; Che, Z.; Fang, Y.; Yang, X.; Gutiérrez, J.; Callet, P.L. A Dataset of Eye Movements for the Children with Autism Spectrum Disorder. In Proceedings of the 10th ACM Multimedia Systems Conference, Amherst, MA, USA, 18–21 June 2019; pp. 255–260.
25. Fei, T.; Liu, Y.; Guo, J. Visual Integration Relationship between Buildings and the Natural Environment Based on Eye Movement. *Buildings* **2022**, *12*, 930. [CrossRef]
26. Stein, I.; Jossberger, H.; Gruber, H. Investigating visual expertise in sculpture: A methodological approach using eye tracking. *J. Eye Mov. Res.* **2022**, *15*. [CrossRef] [PubMed]
27. Hsieh, Y.L.; Lee, M.F.; Chen, G.S.; Wang, W.J. Application of Visitor Eye Movement Information to Museum Exhibit Analysis. *Sustainability* **2022**, *14*, 6932. [CrossRef]
28. McConkie, G.W.; Kerr, P.W.; Reddix, M.D.; Zola, D. Eye movement control during reading: I. The location of initial eye fixations on words. *Vis. Res.* **1988**, *28*, 1107–1118. [CrossRef]
29. Yi, T.; Chang, M.; Hong, S.; Lee, J.H. Use of eye-tracking in artworks to understand information needs of visitors. *Int. J. Hum.–Comput. Interact.* **2021**, *37*, 220–233. [CrossRef]
30. Massaro, D.; Savazzi, F.; Di Dio, C.; Freedberg, D.; Gallese, V.; Gilli, G.; Marchetti, A. When art moves the eyes: A behavioral and eye-tracking study. *PLoS ONE* **2012**, *7*, e37285. [CrossRef]
31. Kiefer, P.; Giannopoulos, I.; Raubal, M. Using Eye Movements to Recognize Activities on Cartographic Maps. In Proceedings of the 21st ACM SIGSPATIAL International Conference on Advances in Geographic Information Systems, Hamburg, Germany, 13–16 November 2013; pp. 488–491.
32. Ho, M.C.; Chen, J.M.; Huang, R.Y.; Shen, M.H.; Lu, M.C.; Liu, C.J. Numerical analysis on color preference and visual comfort from eye tracking technique. *Math. Probl. Eng.* **2015**, *2015*, 861610. [CrossRef]
33. Nishino, K.; Nayar, S.K. The World in an Eye [Eye Image Interpretation]. In Proceedings of the 2004 IEEE Computer Society Conference on Computer Vision and Pattern Recognition, Washington, DC, USA, 27 June 2004; CVPR 2004. IEEE: Piscataway, NJ, USA, 2004; Volume 1, pp. I–I.
34. Barreto, A.; Zhai, J.; Rishe, N.; Gao, Y. Measurement of pupil diameter variations as a physiological indicator of the affective state in a computer user. *Biomed. Sci. Instrum.* **2007**, *43*, 146–151.
35. Garbutt, M.; East, S.; Spehar, B.; Estrada-Gonzalez, V.; Carson-Ewart, B.; Touma, J. The embodied gaze: Exploring applications for mobile eye tracking in the art museum. *Visit. Stud.* **2020**, *23*, 82–100. [CrossRef]
36. Reitstätter, L.; Brinkmann, H.; Santini, T.; Specker, E.; Dare, Z.; Bakondi, F.; Miscená, A.; Kasneci, E.; Leder, H.; Rosenberg, R. The display makes a difference: A mobile eye tracking study on the perception of art before and after a museum's rearrangement. *J. Eye Mov. Res.* **2020**, *13*. [CrossRef] [PubMed]
37. Fang, Y.; Duan, H.; Shi, F.; Min, X.; Zhai, G. Identifying Children with Autism Spectrum Disorder Based on Gaze-Following. In Proceedings of the 2020 IEEE International Conference on Image Processing (ICIP), Virtual Conference, 25–28 October 2020; IEEE: Piscataway, NJ, USA, 2020; pp. 423–427.
38. Li, Z.; Sun, X.; Zhao, S.; Zuo, H. Integrating eye-movement analysis and the semantic differential method to analyze the visual effect of a traditional commercial block in Hefei, China. *Front. Archit. Res.* **2021**, *10*, 317–331. [CrossRef]
39. Ma, R.; Luo, Y.; Furuya, K. Classifying visually appealing elements in parks using social media data-assisted eye-tracking: Case study of Shinsui parks in Tokyo, Japan. *J. Outdoor Recreat. Tour.* **2023**, *44*, 100672. [CrossRef]

40. Kosmyna, N.; Lindgren, J.T.; Lécuyer, A. Attending to visual stimuli versus performing visual imagery as a control strategy for EEG-based brain-computer interfaces. *Sci. Rep.* **2018**, *8*, 13222. [CrossRef]
41. Vo, M.L.H. The meaning and structure of scenes. *Vis. Res.* **2021**, *181*, 10–20. [CrossRef] [PubMed]
42. Potter, M.C. Meaning in visual search. *Science* **1975**, *187*, 965–966. [CrossRef]
43. Ponsignon, F.; Lunardo, R.; Michrafy, M. Why are international visitors more satisfied with the tourism experience? The role of hedonic value, escapism, and psychic distance. *J. Travel Res.* **2021**, *60*, 1771–1786. [CrossRef]
44. Kang, M.; Gretzel, U. Effects of podcast tours on tourist experiences in a national park. *Tour. Manag.* **2012**, *33*, 440–455. [CrossRef]
45. Komarac, T.; Ozretić Došen, Đ. Discovering the determinants of museum visitors' immersion into experience: The impact of interactivity, expectations, and skepticism. *Curr. Issues Tour.* **2022**, *25*, 3675–3693. [CrossRef]
46. Kriz, S.; Hegarty, M. Top-down and bottom-up influences on learning from animations. *Int. J. Hum.-Comput. Stud.* **2007**, *65*, 911–930. [CrossRef]
47. Xu, X.; Dong, R.; Li, Z.; Jiang, Y.; Genovese, P.V. Research on visual experience evaluation of fortress heritage landscape by integrating SBE–SD method and eye movement analysis. *Herit. Sci.* **2024**, *12*, 281. [CrossRef]
48. Holmqvist, K.; Nyström, M.; Andersson, R.; Dewhurst, R.; Jarodzka, H.; Van de Weijer, J. *Eye Tracking: A Comprehensive Guide to Methods and Measures*; oup Oxford: Oxford, UK, 2011.
49. Pan, B.; Hembrooke, H.A.; Gay, G.K.; Granka, L.A.; Feusner, M.K.; Newman, J.K. The Determinants of Web Page Viewing Behavior: An Eye-Tracking Study. In Proceedings of the 2004 Symposium on Eye Tracking Research & Applications, San Antonio, TX, USA, 22–24 March 2004; pp. 147–154.
50. Dupont, L.; Antrop, M.; Van Eetvelde, V. Eye-tracking analysis in landscape perception research: Influence of photograph properties and landscape characteristics. *Landsc. Res.* **2014**, *39*, 417–432. [CrossRef]
51. Birmingham, E.; Bischof, W.F.; Kingstone, A. Gaze selection in complex social scenes. *Vis. Cogn.* **2008**, *16*, 341–355. [CrossRef]
52. Tatler, B.W. The central fixation bias in scene viewing: Selecting an optimal viewing position independently of motor biases and image feature distributions. *J. Vis.* **2007**, *7*, 4. [CrossRef] [PubMed]
53. Kawagoe, T.; Matsushita, M.; Hashimoto, M.; Ikeda, M.; Sekiyama, K. Face-specific memory deficits and changes in eye scanning patterns among patients with amnestic mild cognitive impairment. *Sci. Rep.* **2017**, *7*, 14344. [CrossRef] [PubMed]
54. Sussman, A.; Ward, J.M. Game-changing eye-tracking studies reveal how we actually see architecture. *Common. Edge* **2017**, *27*.
55. Mao, R.; Fu, Y. Interweaving multiple contexts for objects in museum exhibitions: A contextual approach. *Mus. Manag. Curatorship* **2022**, *37*, 491–512. [CrossRef]
56. Janisse, M.P. Pupil size, affect and exposure frequency. *Soc. Behav. Personal. Int. J.* **1974**, *2*, 125–146. [CrossRef]
57. Soomro, Y.A.; Kaimkhani, S.A.; Iqbal, J. Effect of visual merchandising elements of retail store on consumer attention. *J. Bus. Strateg.* **2017**, *11*, 21–40. [CrossRef]
58. Fei, X.; Zhang, Y.; Kong, D.; Huang, Q.; Wang, M.; Dong, J. Quantitative Model Study of the Psychological Recovery Benefit of Landscape Environment Based on Eye Movement Tracking Technology. *Sustainability* **2023**, *15*, 11250. [CrossRef]
59. Jacob, R.J.; Karn, K.S. Eye tracking in human-computer interaction and usability research: Ready to deliver the promises. *Mind's Eye* **2003**, 573–605. [CrossRef]
60. Kim, N.; Lee, H. Assessing consumer attention and arousal using eye-tracking technology in virtual retail environment. *Front. Psychol.* **2021**, *12*, 665658. [CrossRef] [PubMed]
61. Fiedler, S.; Glöckner, A. The dynamics of decision making in risky choice: An eye-tracking analysis. *Front. Psychol.* **2012**, *3*, 335. [CrossRef] [PubMed]
62. Hwang, A.D.; Wang, H.C.; Pomplun, M. Semantic guidance of eye movements in real-world scenes. *Vis. Res.* **2011**, *51*, 1192–1205. [CrossRef]
63. Castelhano, M.S.; Henderson, J.M. Initial scene representations facilitate eye movement guidance in visual search. *J. Exp. Psychol. Hum. Percept. Perform.* **2007**, *33*, 753. [CrossRef]
64. Jie, B. Research on Visual Perception and Evaluation of Traditional Village Landscape in Huizhou. Ph.D. Dissertation, Jianzhu University, Hefei, China, 2023. [CrossRef]
65. Krajbich, I.; Armel, C.; Rangel, A. Visual fixations and the computation and comparison of value in simple choice. *Nat. Neurosci.* **2010**, *13*, 1292–1298. [CrossRef]

Disclaimer/Publisher's Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.