# Study on the Influence of Different Museum Navigation Modes on School-aged Children's Attention Based on Eye-tracking

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**Abstract.** This study explores the impact of different museum navigation modes on the attention of school-aged children. Through eye-tracking experiments and observations of 7-12-year-old children during independent and parent-child visits, it was found that the parent-child visit group demonstrated better attention concentration and search efficiency than the independent visit group. Based on these findings, the study proposes strategies to improve children's museum experiences, such as designing engaging tour formats, enhancing interactivity, and strengthening parental guidance.

**Keywords:** School-aged children, Museum experience, Attention distribution, Eye-tracking, Parent-child visits

## 1 Introduction

### 1.1 Background

Museums serve as vital portals for school-age children to connect with history and culture, yet this special user group remains overlooked in museum communication strategies targeting general audiences.To transform this paradigm, we propose investigating school-age children's cognitive characteristics and attention patterns through behavioral observation and eye-tracking technology to record engagement metrics during exhibitions, followed by learning outcome analysis via questionnaires. This approach reveals how visitation methods influence children's visual attention, providing actionable insights for designing age-appropriate exhibitions, interactive learning pathways, and customized educational experiences that bridge the gap between museum offerings and children's developmental needs.

### 1.2 Literature Review

Grounding in psychological theory, attention represents a selective cognitive mechanism that filters and prioritizes environmental stimuli to generate targeted behavioral responses - a process formally termed attention allocation [1]. Within museum settings,

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school-age children (7-12 years) exhibit fundamentally distinct attentional patterns from adults, necessitating specialized application of developmental psychology in exhibition design. Literature analysis identifies critical research voids in understanding children's museum-based behavioral cognition [2], with particular deficiencies in parent-child dyadic attention dynamics - an urgent priority for developing evidence-based, child-focused museum experiences.

As the primary channel for human information acquisition, vision accounts for 80-90% of external information processing. Eye-tracking technology has become an indispensable research tool for studying visual cognition by enabling real-time recording of reading processes [3]. Previous studies have demonstrated its effectiveness in child-focused research: MASOOD et al. employed eye-tracking to evaluate usability in educational apps for preschoolers [4], while Yang Yuling's team identified optimal interface designs for children with autism through visual attention analysis [5]. Compared to conventional observation methods, eye-tracking provides significantly more precise data on school-age children's visual behavior. When combined with parent-child interaction research in museum settings, this approach offers unique insights into family dynamics and educational outcomes. Despite family visitors constituting a major museum demographic, current museum designs often overlook their specific needs [6]. This study bridges this gap by employing eye-tracking and behavioral observation to analyze how different touring methods affect attention allocation in school-age children, contributing to the development of more effective child-centered museum experiences.

# 2 Materials and Methods

## 2.1 Experiment

**Objective.**

This study investigates the impact of museum navigation modes on children's attention distribution through a multimodal approach combining eye-tracking technology, behavioral analysis, and subjective evaluation.A cohort of fourteen school-aged children (7-12 years old, demographic details in Table 1) with normal/corrected-to-normal vision and no color vision deficiencies participated in this ethically approved study. Prior to data collection, written informed consent was obtained from all guardians after full disclosure of research objectives and procedures. To quantitatively measure learning outcomes, post-visit assessments including artifact identification tasks and structured recall tests were implemented.

**Table 1.** Basic Information of Observed Subjects

| Age Group | Gender | | Average Age | Age Range |
|---|---|---|---|---|
| | Male | Female | | |
| School Stage | 7 | 7 | 9 years old | 7–12 years old |

**Experimental Setting.**

This study was conducted in the "Han Feng Tang Yun"exhibition hall of the Nanyue King Museum. The museum's collection, including terracotta figurines, architectural components, and tomb murals, provides authentic historical artifacts for investigating children's visual attention patterns toward cultural relics.The exhibition employs a chrono-thematic modular design (Fig.1), which strategically integrates standalone display cases with contextual reconstructions. This innovative spatial configuration achieves an optimal balance between experimental control and ecological validity, making it particularly suitable for visitor behavior research.

**Fig. 1.** Interior View of the Nanyue Southern Han Mausoleums Museum

The study was conducted in a controlled museum environment with stable thermal conditions (ambient temperature maintained at 22±1°C) and minimal acoustic interference (<40 dB). Participants were divided into two experimental groups:GroupA: Unassisted free exploration;GroupB: Parent-guided navigation.The predefined exhibition routes for both groups were systematically documented (see Figs. 2–3 for spatial configurations).

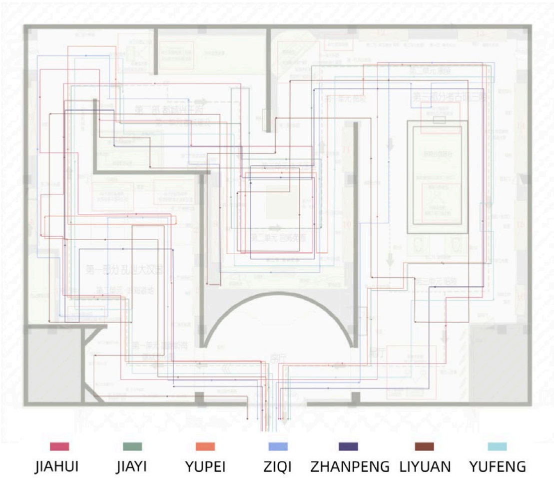


**Fig. 2.** Schematic Diagram of the Exhibition Route for Group A School-Age Children.

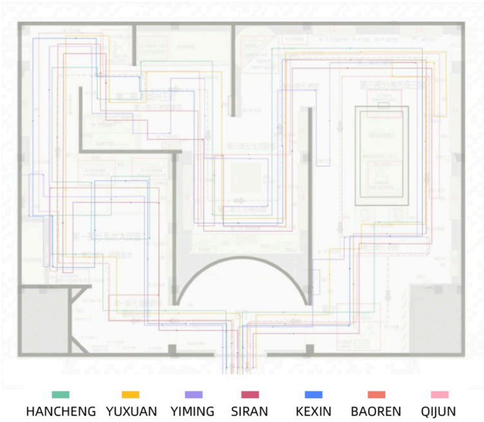


**Fig. 3.** Schematic Diagram of the Exhibition Route for Group B School-Age Children with Parental Guidance.

**Equipment.**

The study employed a Tobii Pro Glasses 3 eye tracker(Fig 4) to record fixation count (N), average fixation duration (s), and blink rate (N/s). Supplementary tools (e.g., cameras and laptops) supported data collection and analysis using Tobii Pro Lab and ErgoLAB software.

**Fig. 4.** Tobii Pro Glasses 3 Eye Tracker(Image source: Online, https://www.tobii.cn/products/eye-trackers/wearables/tobii-pro-glasses-3)

**Eye-Tracking Device.**

The Tobii Pro Glasses 3 wearable glasses, combined with the software Glasses 3, were used for the eye-tracking. The Tobii eye-tracker provides a natural usage environment while simultaneously collecting multi-channel data, such as voice, movement, and other data. The ClearView data analysis software, which comes with the device, integrates eye movement data with actual interface recordings, sounds, and user actions for comprehensive analysis.The eye-tracking indicators selected are based on the abundant data recorded by the eye-tracker. Common indicators include first fixation time, fixation count, average fixation duration, average blink rate, total fixation duration, and revisit frequency. For the purposes of this study, the final selection included fixation count (N), average fixation duration (S), and average blink rate (N/s). Fixation count refers to the number of fixations within a specific Area of Interest (AOI) and is typically used to measure attention allocation or the importance of a particular area; average fixation duration refers to the average duration of each fixation within an AOI and is commonly used to measure cognitive load or the depth of information processing [7]; blink rate is typically used to measure fatigue or cognitive load in participants.

Behavioral Observation:

Behavioral observation is an effective method for tracking the behaviors and responses of school-age children during their museum visit. Tracking and observing the children during their visit, video recordings were made to organize the time spent on each exhibit, the number of returns, and other visiting behaviors (e.g., conversations, expressions of admiration) as well as their route through the exhibition. This helped identify behavioral characteristics, responses, and motivations.

## 2.2 Questionnaire

As shown in Tables 2 and 3, after the experiment introduction, subjective questionnaires were used to collect participants' subjective perceptions following the experiment.

**Table 2.** Survey on School-age Children's Perception of Independent Museum Visits at Nanyue King Museum.

| Section | Question |
|---|---|
| Personal Information | 1. What is your age? |
| Exhibition Experience | 2. Do you enjoy visiting museums? What kind of museums do you like? |
| | 3. Have you visited this museum before? |
| | 4. If you have visited, what is your favorite cultural relic? |
| | 5. During the exhibition visit, which artifact impressed you the most? |
| | 6. When visiting the museum with your parents, do you find it easier to concentrate? |
| | 7. Do you find the museum visit interesting? |
| | 8. Do you prefer visiting the exhibition alone or with your parents? |
| Interactive Experience | 9. Do you participate in interactive activities with your parents at the museum? |
| | 10. If you have participated in interactive activities, do you find them enjoyable? |
| | 11. Would you like to have more parent-child interactive activities? If so, what types of activities would you prefer? |
| Open Suggestions | 12. Do you have any suggestions or opinions regarding museum visits? |

*Note.* Survey on Children's Museum Visiting Experience at Nanyue King Museum.Interview Time: September17/September 24, 2023 (Full Day).Interview Location: Nanyue King Museum, Han Style and Tang Elegance Exhibition Hall.

**Table 3.** Survey on School-age Children's Parent-Child Museum Visiting Experience at Nanyue King Museum

| Section | Question |
|---|---|
| Personal Information | 1. What is your age? |
| Exhibition Experience | 2. Do you enjoy visiting museums? What kind of museums do you like? |

| | |
|---|---|
| | 3. Have you visited this museum before? |
| | 4. If you have visited, what is your favorite cultural relic? |
| | 5. During the exhibition visit, which artifact impressed you the most? |
| | 6. Do you find the museum visit interesting? |
| | 7. When visiting the exhibition alone, do you feel bored or tired? |
| Interactive Experience | 8. Have you participated in interactive activities at the museum? |
| | 9. If you have participated in interactive activities, do you find them enjoyable? |
| | 10. Would you like to have more interactive activities? If so, what types of activities would you prefer? |
| Open Suggestions | 11. Do you have any suggestions or opinions regarding museum visits? |

*Note.* Survey on Parent-Child Visitors' Perception of Museum Tours at Nanyue King Museum.Interview Time: September 17 / September 24, 2023 (Full Day).Interview Location: Nanyue King Museum, Han Style and Tang Elegance Exhibition Hall.

### 2.3 Experimental Procedure

The experiment consisted of two stages: eye-tracking data collection and subjective questionnaire surveys. Participants were guided to the experimental area—the "Han Wind and Tang Charm" exhibition hall at the Nanyue Southern Han Mausoleums Museum. Before starting, the experimenter briefed participants on the purpose, procedures, requirements, and precautions. Next, the eye-tracker, data collection equipment, and synchronization software were calibrated to ensure proper signal functionality. Participants were then familiarized with the experimental protocol, and the experimenter assisted them with eye-tracker calibration.

Once the experiment began, participants entered the Han Wind and Tang Charm exhibition hall through the main entrance for a free exploration session. Throughout this phase, the eye-tracker automatically recorded their gaze patterns and behavioral data, while the experimenter observed and documented the children's actions in real time. The entire process was video-recorded for further analysis. After completing the exploration, participants were interviewed or surveyed about their experience. Once finished, the next participant proceeded with the test (Fig 5).

**Fig. 5.** Experimental Site of School-age Children's Tour in the Han Style and Tang Elegance Exhibition Hall.(Image Source: Captured by the Experimental Team)

# 3 Results

## 3.1 Experimental Data

In this experiment, data were collected from 14 participants. Group A consists of school-age children visiting the "Han Wind and Tang Charm" exhibition hall at the Nanyue Southern Han Mausoleums Museum alone, while Group B consists of school-age children visiting the exhibition hall with their parents. The experiment collected eye-tracking physiological data related to both groups. This study calculated three key indicators: fixation count (N)(Fig 6), average fixation duration (S)(Fig 7), and average blink rate (N/s)(Fig 8). The eye-tracker data analysis provided the values for these indicators, and the median values for each group were calculated (Table 4).

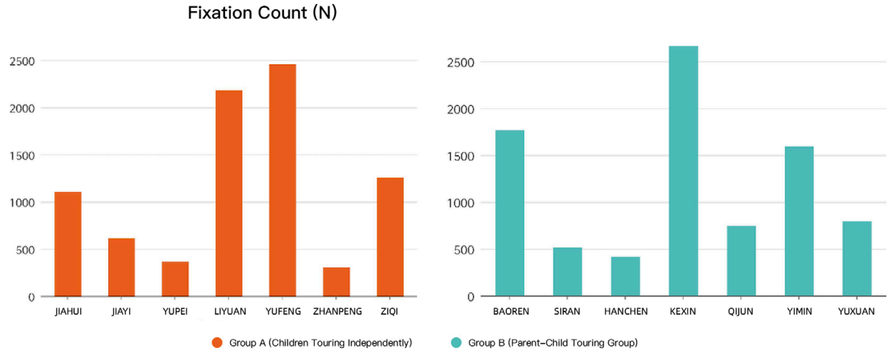


**Fig. 6.** Data on fixation count (N) for school-age children in Group A,Group B.

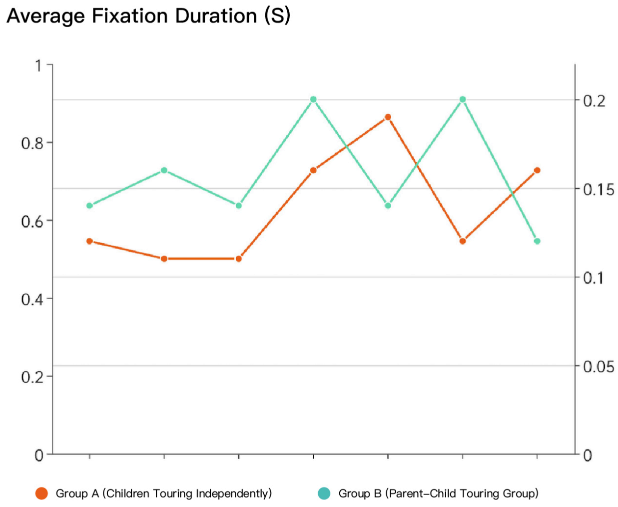


**Fig. 7.** Average fixation duration (S)for school-age children in Group A,Group B.

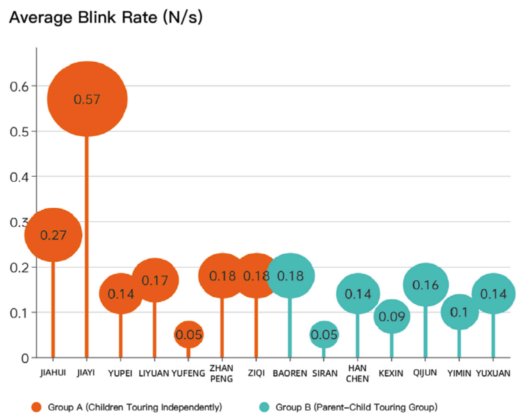


**Fig. 8.** Average blink rate (N/s)for school-age children in Group A,Group B.

**Table 4.** Statistical results of fixation count (N), average fixation duration (S), average blink rate (N/s), and median values for Group A (children touring alone) and Group B (parent-child touring group).

| Category | Group A | | | | | | |
|---|---|---|---|---|---|---|---|
| Name | JIAHUI | JIAYI | YUPEI | LIYUAN | YUFENG | ZHANPENG | ZIQI |
| Fixation Count (N) | 1105 | 613 | 366 | 2182 | 2456 | 304 | 1255 |
| Median | 1105 | | | | | | |
| Average Fixation Duration (s) | 0.12 | 0.11 | 0.11 | 0.16 | 0.19 | 0.12 | 0.16 |
| Median | 0.12 | | | | | | |
| Average Blink Rate (N/s) | 0.27 | 0.57 | 0.14 | 0.17 | 0.05 | 0.18 | 0.18 |
| Category | Group B | | | | | | |
| Name | BAOBEN | SIRAN | HANCHEN | KEXIN | QIJUN | YIMIN | YUXUAN |
| Fixation Count (N) | 1765 | 515 | 418 | 2663 | 746 | 1593 | 795 |
| Median | 795 | | | | | | |
| Average Fixation Duration (s) | 0.14 | 0.16 | 0.14 | 0.20 | 0.14 | 0.20 | 0.12 |
| Median | 0.14 | | | | | | |
| Average Blink Rate (N/s) | 0.18 | 0.05 | 0.14 | 0.09 | 0.16 | 0.10 | 0.14 |

*Note.* To assess data normality, the Shapiro-Wilk test was employed given the small sample size (n<50). At a significance level of $\alpha = 0.05$, the results ($P > 0.05$) confirmed normal distribution of fixation count data (Table 5). Subsequent normality and homogeneity of variance tests validated the parametric assumptions for conducting an independent samples t-test using SPSS (Table 6).

**Table 5.** Normality Test of Eye-Tracking Data

| | | Kolmogorov-Smirnov (V)a | | | Shapiro-Wilk | | |
|---|---|---|---|---|---|---|---|
| | | Statistic | df | Significance | Statistic | df | Significance |
| Fixation Count (N) | A | 0.181 | 7 | 0.200* | 0.894 | 7 | 0.294* |
| | B | 0.266 | 7 | 0.144 | 0.886 | 7 | 0.253 |
| Average Fixation Duration (S) | A | 0.271 | 7 | 0.130 | 0.871 | 7 | 0.189 |
| | B | 0.239 | 7 | 0.200* | 0.888 | 7 | 0.264 |
| Average Blink Rate (N/s) | A | 0.311 | 7 | 0.039 | 0.802 | 7 | 0.043 |
| | B | 0.222 | 7 | 0.200* | 0.946 | 7 | 0.649 |

*Note.* * Lower bound of true significance    a Lilliefors significance correction

The homogeneity of variance was confirmed through F-tests, with results showing satisfactory variance equality across all measures: fixation count (F=0.002, p=0.964), average fixation duration (F=0.050, p=0.827), and average blink rate (F=3.06, p=0.106). All p-values significantly exceeded the 0.1 threshold (p>0.1), thereby validating the homogeneity of variance assumption and meeting all necessary preconditions for subsequent parametric statistical analyses.

**Table 6.** Results of Independent Samples T-Test for Eye-Tracking Data

| Levene's Test for Equality of Variances | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | Fixation Count (N) | | Average Fixation Duration (S) | | Average Blink Rate (N/s) | |
| | | Assumed Homogeneity of Variance | Non-Assumed Homogeneity of Variance | Assumed Homogeneity of Variance | Non-Assumed Homogeneity of Variance | Assumed Homogeneity of Variance | Non-Assumed Homogeneity of Variance |
| F | | 0.002 | | 0.050 | | 3.064 | |
| Significance | | 0.954 | | 0.827 | | 0.106 | |
| T-Test for Equality of Means | | | | | | | |
| | | Fixation Count (N) | | Average Fixation Duration (S) | | Average Blink Rate (N/s) | |
| | | Assumed Homogeneity of Variance | Non-Assumed Homogeneity of Variance | Assumed Homogeneity of Variance | Non-Assumed Homogeneity of Variance | Assumed Homogeneity of Variance | Non-Assumed Homogeneity of Variance |
| t | | -0.068 | -0.068 | -1.005 | -0.068 | 1.552 | 1.552 |
| Degrees of Freedom | | 12 | 11.982 | 12 | 11.982 | 12 | 6.857 |
| Sig. (Two-Tailed) | | 0.947 | 0.947 | 0.335 | 0.947 | 0.147 | 0.166 |
| Mean Difference | | -30.571 | -30.571 | -0.017320326 | -0.17320326 | 0.1005301385 | 0.1005301385 |
| Standard Error Difference | | 448.767 | 448.767 | 0.0172354453 | 0.0172354453 | 0.0647822889 | 0.0647822889 |
| 95% Confidence Interval of the Difference | Lower Bound | -1008.352 | -1008.518 | -0.054873136 | -0.054873152 | -0.054873136 | -0.054873152 |
| | Upper Bound | 947.209 | 947.375 | 0.0202324830 | 0.0202324994 | 0.2416786206 | 0.2543658049 |

*Note.* This study conducted independent samples t-tests to compare visual attention metrics between Group A (individual exploration) and Group B (parent-child exploration). All data met parametric assumptions (normality, homogeneity of variance, no significant outliers). Results revealed: Group A demonstrated significantly higher cognitive load (blink rate: 0.22±0.17 vs 0.12±0.04; mean difference=0.10, 95%CI[0.06,0.10], $p<0.05$) but comparable attention engagement(fixation count: 1183.00±855.84 vs 1213.57±822.97; MD=-30.57[-1008.35,947.21]) and slightly shorter information processing depth (fixation duration: 0.14±0.03s vs 0.16±0.03s; MD=-0.02[-0.05,0.02]) compared to Group B.

## 3.2 Behavioral Observation

**Behavior Observation.**
In this children's exhibition experiment, a total of 14 valid samples were collected. The observation of school-age children's exhibition behavior primarily recorded two behavioral data points: the number of multimedia interactions (N1) and the duration of stay at real-world exhibits (S1) (Table 7).

The number of multimedia interactions quantifies participants' active engagement behaviors (e.g., button clicks, page navigation, Q&A participation, whiteboard usage), reflecting their interest intensity and involvement level. The duration of real-world scene engagement measures time spent on specific multimedia content, indicating content attractiveness and focused attention during learning.

Real-world scenes engage multiple sensory channels, including visual, auditory, and tactile elements, which help school-age children develop a more comprehensive understanding of the content. Behavioral observations from both Group A and Group B reveal that Group A interacted with multimedia content more frequently (N1), but spent significantly less time in real-world scenes (S1) compared to Group B.

**Table 7.** Statistical Results of Multimedia Interaction Frequency and On-Site Stay Duration During Exhibition for Group A (Individual Exploration) and Group B (Parent-Child Exploration)

| Group A | | | | | | | |
|---|---|---|---|---|---|---|---|
| name | JIAHUI | JIAYI | YUQIE | LIYUAN | YUFENG | ZHANPENG | ZIQI |
| Number of Multimedia Interactions (N1) | 24 | 70 | 10 | 57 | 46 | 60 | 15 |
| Duration of Stay at Real-World Exhibits (S1) | 0 | 0 | 0 | 0 | 0 | 0 | 0.25 |
| Group B | | | | | | | |
| name | BAOREN | SIRAN | HANCHEN | KEXIN | QIJUN | YIMIN | YUXUAN |
| Number of Multimedia Interactions (N1) | 50 | 13 | 6 | 35 | 40 | 26 | 41 |
| Duration of Stay at Real-World Exhibits (S1) | 1 | 0 | 0 | 0.5 | 0.5 | 0.75 | 0.5 |

**Questionnaire Survey.**

A total of 14 valid samples were collected in this interview with school-age children. The following interview records represent typical participants (Table 8). Based on the interview and behavioral observation results, the following conclusions were summarized:

**Table 8.** Statistics of Selected Questionnaire Results After the Exhibition for Group A (Children Touring Alone) and Group B (Parent-Child Touring)

| Category | Group A | | | Group B | | |
|---|---|---|---|---|---|---|
| name | JIAYI | ZHANPENG | ZIQI | SIRAN | HANCHEN | YUXUAN |
| Age (Years) | 9 | 9 | 10 | 7 | 10 | 10 |
| Exhibition Status | Exhibited a serious attitude during the visit, but the exhibition route was lengthy. After getting lost midway, the participant exited the exhibition hall and re-entered from the opposite direction. | Completed the entire visit quickly (≤4 min) with little interest in the exhibition content. | Exhibited a relatively serious attitude but got lost upon entering the hall, starting the visit from the exit. | Exhibited a relatively serious attitude, with parents providing full guidance and frequent interactions, mainly through questions. | Completed the entire visit quickly (≤4 min) with minimal parental guidance and little interest in the exhibition content. | Exhibited a very serious attitude throughout the visit. |
| Interview Summary | Did not find any artifacts particularly impressive but did not feel bored when visiting alone, preferring a guided tour by a docent. | Did not find any artifacts particularly impressive but did not feel bored when visiting alone, though they did not enjoy the interactive activities in the museum. | The most memorable aspect of the exhibition was the interactive screens. Frequently visits museums, enjoys independent exploration, or following a docent-led tour. | Could recall the names of the most impressive artifacts but found museum visits somewhat dull. Enjoys parent-child visits. | Believes that parents cannot keep up with their pace and dislikes parent-child visits (self-reported: "Because they are always on their phones"). | Could recall three to four memorable artifacts and enjoys parent-child visits (self-reported: "I like discussing with my mom"). |

1) Motivation for Visiting: The motivation for visiting is primarily driven by parents who bring their children to learn about history and culture. There is almost no motivation from the children themselves to visit the museum.2) Knowledge Acquisition: Group B showed better overall learning outcomes compared to Group A. Most children in Group B were able to clearly identify the names and appearances of the artifacts, whereas most children in Group A did not have a strong memory of the artifacts after the visit.3) Parent-Child Interaction: Observations and interviews of children in Group B revealed that the more interaction there was within the parent-child pairs, the better the children's learning state, emotional condition, and knowledge acquisition, compared

to parent-child pairs with less interaction.4) Interaction with Multimedia Screens: The more frequently children interacted with the multimedia screens, the stronger their willingness to engage in active exploration during the exhibition. The longer children stayed in front of real-world scenes, the better their sensory experience during the visit.

## 4 Discussion

Based on the analysis and comparison of eye-tracking data, the following findings were observed: Group A exhibited a higher fixation count but shorter average fixation duration compared to Group B, suggesting that children in Group B demonstrated both greater attentional focus and higher search efficiency. Fixation duration showed a significant positive correlation with knowledge retention ($r = 0.62$, $p < 0.05$), aligning with prior studies linking prolonged gaze to enhanced information encoding [8]. Recognition tasks further supported this relationship, with children displaying longer gaze durations recalling exhibit details more accurately. Additionally, Group B's higher average blink rate indicated stronger concentration, potentially attributable to parental scaffolding behaviors (e.g., explanatory language, pointing gestures) consistent with social constructivist learning theory [9]. Future research should systematically code parent-child interactions to clarify how scaffolding enhances focus and comprehension, with parental input quantified as mediating variables to validate these observed attentional advantages.Additionally, behavioral observation data revealed:Multimedia Interaction: Group A interacted with multimedia screens more frequently than Group B. A higher frequency of multimedia interaction was associated with a stronger willingness for active exploration during the visit.On-Site Stay Duration: Group A spent less time in real-life exhibition areas than Group B. A longer stay in front of real exhibits correlated with a better sensory experience. Furthermore, children who frequently engaged with the real artifacts also showed stronger subsequent recall, suggesting that deeper on-site attention may support more robust encoding of museum content.A discrepancy exists between conventional museum designs and children's actual engagement patterns. Research reveals that children frequently overlook high-budget design features, as their cognitive needs diverge significantly from adults'. Key observations include:1)All 14 observed participants completed the exhibition route, with no statistically significant difference in directional compliance between groups.2)Strikingly, only 1 child in Group A viewed all display cases versus 4 in Group B, suggesting that parent-guided visits foster more comprehensive learning and systematic knowledge acquisition compared to independent exploration.

In conclusion, children who visit museums under parental guidance develop a deeper understanding of the exhibits compared to those who explore independently. Parent-child museum visits enrich the cognitive experience through interaction, education, sensory engagement, emotional connection, and mutual learning.To foster a more positive learning experience, it is essential to propose design strategies for school-age children's museum visits. These strategies, grounded in eye-tracking data collection, behavioral observation analysis, and the perspective of parent-child interaction, can provide new insights for designers and museums to enhance children's museum experiences.1) Establish Highly Engaging Tour Design and Interpretation.Develop exploratory tour methods with high entertainment value, enabling children to deeply engage with museums through games, interactive maps, and reward mechanisms. Integrate educational significance into children's cultural experience design to promote a museum experience that combines education with entertainment (edutainment) for young audiences.2) Enrich Interactive Screen Functions for Enhanced Engagement.While digital interactive technologies hold strong appeal for children, existing museum interactive screen installations lack sufficient engagement. Diversify interaction formats by incorporating gamified (cultural relic) displays and immersive activities to significantly boost children's participation and interest.3) Strengthen Parent-Child Guidance During Visits.Parental guidance proves critical in family museum visits. Analytical findings indicate that parents who pose museum-related questions or engage in knowledge-sharing dialogue with children can effectively enhance children's concentration and stimulate intellectual curiosity.4) Systematize Children's Museum Experience Design Framework.Develop standardized experience design protocols tailored to school-aged children's attention patterns and behavioral characteristics. Employ perceptually stimulating design strategies to capture children's focus, facilitating joyful learning through the integration of cultural knowledge frameworks with multisensory experiential interactions.

# 5 Conclusion

This study investigates how different museum navigation modes affect school-aged children's attention and learning outcomes. The results indicate that children visiting museums with parents show better attention and retention compared to those visiting independently. Based on these findings, four strategies are proposed to enhance children's museum experiences: 1) Develop engaging tour designs, 2) Improve interactive screen functionality, 3) Strengthen parental guidance, and 4) Establish a systematic experience design framework.

The results reveal significant differences in visual attention patterns between parent-child groups and independent child visitors. We acknowledge that our questionnaire was not a standardized scale, potentially limiting its psychometric reliability. However, we mitigated this by triangulating the self-reported impressions with our eye-tracking and observational data. Future studies could integrate validated scales to further strengthen the assessment of children's museum experiences. Children accompanied by parents demonstrated deeper cognitive engagement with exhibits compared to those exploring independently. However, this study acknowledges limitations: the impact of exhibition route design on children's attention and learning outcomes remains underexplored. Due to children's underdeveloped spatial reasoning abilities and lower cognitive comprehension levels relative to adults, route selection may critically influence attention continuity and systematic knowledge acquisition. Future research should rigorously examine how spatial layouts and navigation logic affect children's experiential coherence in museums.

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## References

1. Ma Lichao, Jiang Fan. Policy Attention Allocation Bias and Its Optimization for the Quality and Balanced Development of Compulsory Education—Based on the "Space, Process, and Elements" Three-Dimensional Framework Textual Coding Analysis [J]. Modern Education Management, 2021, (12): 29-38. DOI: 10.16697/j.1674-5485.2021.12.004.
2. Zhang Luze, Zhu Shangshang, Dong Yenan, et al. Research on Parent-Child Museum Visit Experience Design Strategies from the Perspective of Parent-Child Interaction [J]. Packaging Engineering, 2024, 45(12): 137-146. DOI: 10.19554/j.cnki.1001-3563.2024.12.014.
3. Liberman L, Dubovi I. The Effect of the Modality Principle to Support Learning with Virtual Reality: An Eye-Tracking and Electrodermal Activity Study [J]. Journal of Computer Assisted Learning, 2023, 39(2): 547-557.
4. MASOOD M, THIGAMBARAM M. The Usability of Mobile Applications for Preschoolers [J]. Procedia-Social and Behavioral Sciences, 2015, 197: 1818-1826.
5. Yang Yuling, Zhang Bingchen, Li Xun, et al. Research on Navigation Interface Design Evaluation of ASD Children's Intervention APP Based on AHP-Entropy Method [J]. Packaging Engineering, 2022, 43(12): 165-173.
6. Zhao Ruixuan. Research on Family Visitors in Museums [J]. Cultural Relics Appraisal and Appreciation, 2021, (17): 117-119.
7. Ozcelik, E., Arslan-Ari, I., & Cagiltay, K. (2010). Why does signaling enhance multimedia learning? Evidence from eye movements. Computers in Human Behavior, 26, 110–117.
8. Rojas J C, Marín-Morales J, Ausín Azofra J M, et al. Recognizing decision-making using eye movement: a case study with children[J]. Frontiers in psychology, 2020, 11: 570470.
9. Palincsar A S. Social constructivist perspectives on teaching and learning[J]. Annual review of psychology, 1998, 49(1): 345-375.

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