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Research article

Triggering interest with exhibition panels in zoos: do location and topic matter?

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Abstract

With their hundreds of millions of visitors worldwide, zoos are important environmental education institutions in our society. Although not every visitor participates in a conservation education program, zoos offer opportunities for all visitors to learn about animals, the environment, and species conservation through signage and informational panels. Therefore, the purpose of this study is to investigate whether the location of giraffe-themed *Giraffa camelopardalis camelopardalis* exhibition panels has an impact on how intensely visitors engage with the signs. In addition, it was investigated which thematic complexes on the signage are looked at longer by the visitors and whether there are group differences in the viewing of the exhibition. The results showed that significantly more people looked at the exhibition panels when they were placed directly in front of the giraffe house, which can potentially be explained by the situational interest triggered. The signs with general information about giraffe biology were viewed significantly longer compared to the signs with information about the habitat or species conservation. It was also found that people who viewed more signs also tended to look at them for significantly longer periods of time. Individuals with children generally had a shorter viewing time. These findings suggest that strategic placement of signage and consideration of content type can enhance visitor engagement. However, further research is needed to explore these factors in different contexts and to develop best practices for educational signage in zoos and similar settings.

Introduction

Today, zoos are magnets for hundreds of millions of visitors worldwide. The high visitor numbers indicate the potential role that zoos can play in society. For example, the Association of Zoological Gardens, with its 71 members in German-speaking countries, had more than 43 million visitors in 2018 (Kögler et al. 2020). The European Association of Zoos and Aquaria reported more than 140 million visitors in 2017 (Griffith 2017) and the World Association of Zoos and Aquariums recorded more than 700 million annual zoo visits in one year (Gusset and Dick 2011).

Zoo visits can be motivated by a variety of reasons. Many want to have an enjoyable trip with friends or family (Reade and Waran 1996; Morgan and Hodgkinson 1999; Clayton et al. 2009), often prioritizing entertainment over environmental education (Jordaan and Plessis 2014; Ballantyne and Packer 2016). Parents frequently visit zoos so their young children can see animals (Lee 2015; Knezevic et al. 2016). Despite the emphasis on entertainment, recent research indicates that zoo visitors, view environmental education, especially for school children, as the highest priority of zoos (Roe et al. 2014a). Zoos themselves consider environmental education to be one of their most important responsibilities. An analysis of mission

statements of 136 American zoos found that education (96%) and conservation (85%) were predominant themes. Major zoo accreditation organizations also set specific educational goals, underscoring the importance of education (Moss and Esson 2013). Consequently, zoos have increasingly become conservation and education centres in recent years (Rabb 2004). Additionally, legislators taken the same approach to the zoos play in education. For example, according to the Council of the European Union adopted Directive 1999/22/EC, zoos are responsible for public education on the conservation of biodiversity and for providing information to the public about animals (The Council of the European Union 1999). The large number of educational programs that have been carried out and evaluated in this context shows that zoos are fulfilling this role. It has been demonstrated that environmental education programs in zoos can have a positive impact on the connection to nature (Clayton et al. 2014; Kleespies et al. 2020), environmental attitudes (Miller et al. 2013; Collins et al. 2020), knowledge (Randler et al. 2012; Sattler and Bogner 2017) and environmental behaviour (Kemmerly and Macfarlane 2009; MacDonald 2015). Interest in environmental education (Seybold et al. 2014) or conservation learning (Jensen 2014) can also be positively influenced by zoos. Zoos have very diverse learning outcomes from their conservation education programs (Schilbert and Scheersoi 2022), such as increasing social interactions (Clayton et al. 2011) and connecting with animals (Skibins and Powell 2013).

In addition to participating in an environmental education program at the zoo, simply visiting the zoo can have positive effects on, for example, environmental attitudes (Lukas and Ross 2014; Pearson et al. 2014; Moss and Pavitt 2019). In this context, regular zoo visits can enhance the positive effect (Lukas and Ross 2005; Godinez and Fernandez 2019; Kleespies et al. 2021). However, there are also some critical voices regarding the environmental education role of zoos. It can also be assumed that not every single one of the millions of zoo visitors is educated in line with the educational goals of the zoos (Moss and Esson 2013). Also, methodological weaknesses have been found in studies investigating the success of zoo environmental education programs, such as a lack of validity of the measuring instruments or improperly used statistical evaluation methods (Malamud et al. 2010; Mellish et al. 2019). There are also examples where no positive effect was found after an environmental education program in a zoo (Bruni et al. 2008; Sattler 2016; Whitehouse-Tedd et al. 2022). Regardless of the effectiveness of environmental education programs, another issue that arises is that only a percentage of visitors participate in formal environmental education programs. Although it has been shown that even a visit without an additional program can have a positive effect (Falk et al. 2007; Clayton et al. 2009; Jensen 2014; Moss et al. 2015; Jensen et al. 2017), the goal of zoological institutions is to allow every visitor to participate in some form of environmental education. One opportunity that zoological associations such as EAZA have identified to do this is through signage or exhibition panels. According to the EAZA conservation education standards, education must be a central component of exhibit design and signs must contain scientifically accurate and relevant information about the species on display (EAZA Council 2016).

Research on zoo signage has shown varying results, but some studies have indicated that a significant percentage of zoo visitors view or read some of the signage during their visit (Derwin and Piper 1988), while another study found only a low level of engagement with signage (Ross and Gillespie 2009). Modern design elements with sounds, videos or graphics can lead to a higher level of engagement (Ogle 2016). Graphic elements, such as pictograms, can also help to ensure that information is better communicated on signs (Clara and Swasty 2017). In addition, the effectiveness of signage often depends on various design elements that attract visitors and hold their attention. Research has shown that factors such as font size, colour contrast, image use, and the positioning of signs relative to the animals can significantly influence visitor engagement (Serrell 1996; Bitgood 2000). These design elements are crucial for ensuring that signage is not only seen but also read and comprehended, thereby enhancing its educational impact.

Evidence on the effectiveness of signage varies. In a study, signs used to show where the tigers usually rest in the enclosure were only read by a few visitors (Bashaw and Maple 2001). On the other hand, signs indicating that visitors should remain quiet in the monkey house actually resulted in significant reductions in volume (Dancer and Burn 2019). While these examples focus on behavioural guidance rather than direct educational content, they illustrate the impact signage can have on visitor experience and engagement within zoo settings. Although there are examples of signage having no effect on zoo visitor behaviour (Chiew et al. 2019), a number of studies demonstrate their effectiveness. Signs can not only provide a learning effect but also have an impact on visitor behaviour (Fernandez et al. 2009; Zager and Jensvold 2021). Visitors who interact with signs show more knowledge and understanding of the topics presented (Waller et al. 2012). There is now also evidence that technical additions to the signage can further increase the positive effect on knowledge and behaviour (Perdue et al. 2012). However, signs are not perceived in the same way by every visitor group. The social factor in particular has an impact. Individuals with children or individuals who interact with their social group during their visit are less engaged with signs than individuals without social interactions (Ross and Gillespie 2009). Zoos do not always use zoo signs correctly and they are not always adequately designed (Fourage et al. 2023). Furthermore, a positive effect of signage on learning cannot always be proven (Waller et al. 2012). Despite signage being the most prevalent education communication medium used by zoos (Roe et al. 2014b), there are still unanswered questions and research gaps that this study will explore in more detail.

Three main topics will be the focus of this study. 1) Does the positioning of signage affect how intensively visitors engage with the signs? This objective compares visitor engagement at two different locations. 2) Which topics on the signage are viewed longer by visitors? This objective explores the specific content that attracts more attention. 3) Are there group differences in how people view the signage? Specifically, is there a relationship between the number of signs viewed and the viewing time of each individual sign?

Material & Methods

The study was conducted at the Opel-Zoo which is located in a suburban area outside of Kronberg in the Taunus, Hesse, Germany. Three three-sided exhibition panels, each with a focus on Nubian giraffes *Giraffa camelopardalis camelopardalis*, were created for the study. Giraffe popularity is well-documented, as they consistently rank among the top animals that attract visitor attention and interest in zoos (Moss and Esson 2010). People have been fascinated by the size and long neck of giraffes for hundreds of years, which could also be one of the reasons why giraffes are often kept in zoos (Dagg 2014).

Exhibition panels

The exhibition featured three panels, all centred around the theme of "giraffes." Each panel was three-sided, with each side dedicated to a specific topic related to giraffes. The first exhibition panel contained general information about the biology of giraffes, the second one focused on the species conservation of giraffes and the third exhibition panel addressed giraffes' habitat. The

titles of the individual sides of the exhibition panels can be found in Table 1.

The individual sides of the exhibition panels all had a similar structure and length. The topic heading and a large image served as long distance visual attractors to provide visitors with a rough overview of the content of the sign. At the top of the sign, essential information was presented in simple terms, supplemented by a special biological highlight. In smaller font, there was also detailed information with illustrative pictures.

To minimize the influence of layout and design variability across the different sets of signs, all signs were designed with a consistent layout, font, colour scheme, and image placement to ensure that differences in visitor engagement were not attributable to visual design factors. Each sign featured a similar amount of text, image-to-text ratio, and the same level of visual complexity. The format and structure of the information were also consistent. The schematic structure of such a sign is shown in Figure 1.

Locations of the exhibition

The exhibition was set up at two locations in the Opel Zoo in Kronberg (Germany) on different days. One of the locations was in front of the main entrance of the zoo (Figure 2, Position 1) and the other one in front of the giraffe house (Figure 2, Position 2). At each location, the three three-sided exhibition panels were positioned next to each other, arranged in a way that visitors could easily view all panels consecutively. Position 1 was in a walk-through area directly at the entrance of the zoo. This location was selected because it represents a high-traffic area where visitors first enter the zoo. We hypothesized that the strategic placement of signage in this prominent position could capture the attention of a broad audience, providing an opportunity to assess engagement in a setting where visitors are just beginning their zoo experience. From position 1, the zoo visitors had a view of the zoo's savannah enclosure. Position 2 was located directly at the entrance to the giraffe house with a good view of the savannah enclosure and direct access to the giraffe house. The second location was chosen due to its thematic relevance to the signage content. We anticipated that visitors' situational interest would be heightened in this area, given the direct connection between the live animals and the educational content on the signs. Both locations were outside.

Visitor observation

All observations were documented in observation sheets. During the observation, the observers kept a distance of around 10 meters from the visitors. When a person approached the exhibition within approximately 5 meters, they were observed. If the person then walked past the exhibition without looking at a sign, they were recorded as having viewed 0 sides. When the exhibition was viewed, the observers documented which individual sides of the exhibition panels were looked at and for how long. When the observed person left the exhibition, the next person was observed.

In addition, it was documented whether the person was an adult or a youth/child. For adults, it was also documented whether they visited with or without children. The observation was conducted on 18 days over a four-week period between June and July 2015. One to two trained research assistants conducted observations for approximately five hours per day. The daily start time of data collection was randomly scheduled between the hours of 0930 and 1530 hr, ensuring coverage of different times of the day.

The study was conducted with the approval of the Opel Zoo in Kronberg, Germany. Since no personal or identifiable data were collected and all observations were conducted in a public setting, the data remain entirely anonymous. Participants were only observed from a distance, without any interaction or direct involvement. According to local regulations at the time of the study, approval from an ethics committee was not required due to the non-intrusive nature of the research.

Statistical analysis

To test whether the location of the exhibition had an effect on how intensively visitors engaged with the signs, we calculated the percentage of people who viewed varying numbers of the nine exhibition panels at each location. Observed persons who walked past the exhibition without looking at least one sign were counted as 0. To examine whether there was a significant difference

Table 1. The main topic of the three exhibition panels and the title of the respective three sides, in German as well as in English.

Exhibition panels	Title (german)	Title (english)
Biology		
1	Tierisch Groß!	Incredibly tall!
2	Sturz in ein neues Leben	Fall into a new life
3	Fressen und Ruhen	Eating and resting
Species Conservation		
1	Betreten verboten!	Do not enter!
2	Hilfe für die Langhälse	Help for the long necks
3	Eine Bestandsaufnahme	An inventory
Habitat		
1	Gärtner der Baumsavannen	Gardeners of the tree savannahs
2	Kein Fleck gleicht dem anderen	No spot is like another
3	Partnersuche leicht gemacht	Dating made easy

between the two locations, the Mann-Whitney U test was performed after the Kolmogorov-Smirnov test failed to show a normal distribution (P<0.001). The Mann-Whitney U test assesses whether there is a significant difference in the number of sides viewed between the two positions of the exhibition. The test was selected because two groups are to be compared with each other, the data are not normally distributed, independent and ordinally scaled (Field 2013).

To assess whether the three exhibition topics were perceived as having different levels of interest, the time (duration) the visitors spent with each of the three exhibition panels was compared. For this comparison, only individuals who viewed at least one of the three sides of each exhibit panel were considered. The Friedman test was used to determine whether there were significant differences in the amount of time that individuals looked at each exhibition panel, after the Kolmogorov-Smirnov test could not prove a normal distribution (P<0.001). The Friedman test is used to compare ordinal scaled non-parametric data of more than 2 groups (Field 2013). A post-hoc test (Dunn-Bonferroni test) was performed for pairwise comparison. For significant results, the effect size was calculated using the formula

$$r=z/\sqrt{N}$$ (Fritz et al. 2012).

To examine the relationship between the number of signs viewed and time spent with each sign, the average viewing time of people who looked at 1 to 3 signs (n=272), people who looked at 4 to 6 signs (n=138), and people who looked at 7 to 9 signs (n=90) were calculated. To examine whether the differences between the three groups were statistically significant, a Kruskal-Wallis test was performed after the Kolmogorov-Smirnov test failed to detect a normal distribution (P<0.001). The Kruskal-Wallis test was selected because three groups are to be compared with each other, data were not normally distributed, independent and ordinally scaled (Field, 2013). Similar to the previous test, a Dunn-Bonferroni test was performed and the effect size was calculated for significant results.

Figure 1. Schematic structure of a side of an exhibition panel. 1 and 2: Long distance visual attractors (header and photo), 3: Essential information in simple terms, 4: Inset with special biological highlight, 5 and 6 detailed information with illustrating photos.

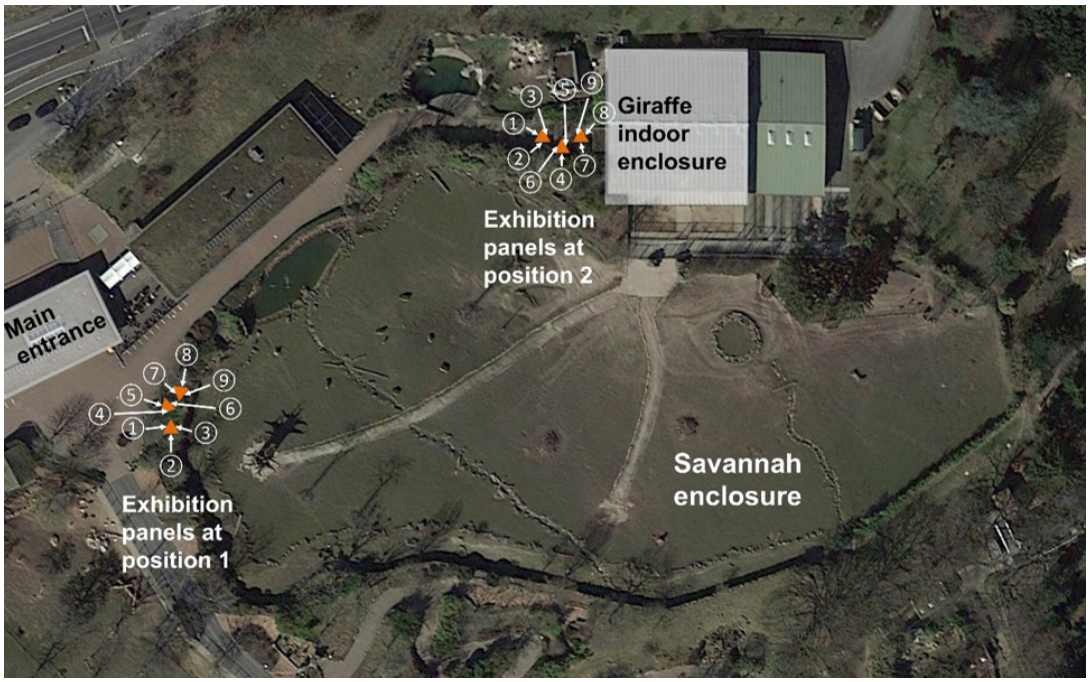

Figure 2. The two different positions of the exhibition. Position 1 was in the entrance area of the zoo, position 2 in front of the giraffe house. The numbers surrounding the exhibition panels show the positioning of the individual sides (Table 1). Image taken from Google Maps, 2024, Opel-Zoo.

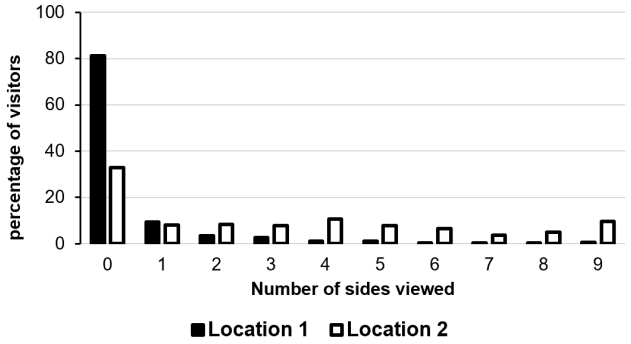

Figure 3. Comparison for location 1 (at the zoo entrance) and location 2 (in front of the giraffe house). It is shown how many visitors looked at how many exhibition sides for both locations in percent.

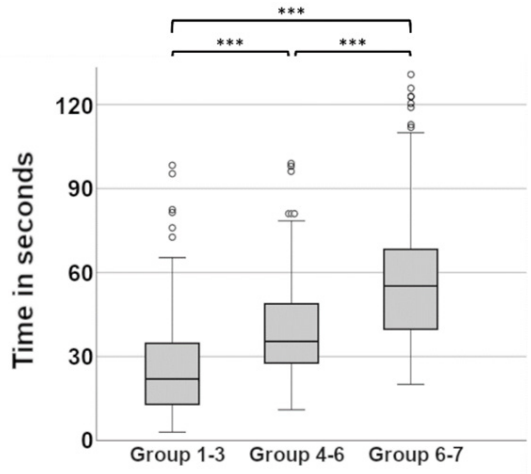

Figure 4. Time in seconds used to view one side of the exhibition panels in the three groups 1-3, 4-6 and 7-9. The number of the group indicates how many sides of the panels have been looked at. The central line within each box represents the median viewing time, while the edges of the box indicate the interquartile range, which shows the middle 50% of the data. The whiskers extend to the smallest and largest values within 1.5 times the interquartile range from the quartiles, and any data points beyond this range are considered outliers and are shown as individual points. Extreme outliers are not shown. Significant shifts are marked with *P<0.05, ** P<0.01, *** P< 0.001.

Results

A total of 1,250 people were observed. Of these, 814 observations were at location 1 and 436 at location 2. This difference in sample size occurred due to the variation in foot traffic at the two locations. Location 1, being near the zoo's main entrance, naturally experienced higher visitor traffic as all visitors passed through this area upon entering the zoo. In contrast, location 2, situated near the giraffe house, was visited by a smaller subset of visitors who chose to explore this specific area. At the first location, 18.71% (154 people) and at the second location, 67.20% (293 people) viewed the exhibition and looked at least at one sign. This means that a significantly higher percentage of visitors at location 2 engaged with the exhibition panels compared to location 1. Additionally, visitors at location 2 were more likely to view a greater number of signs (Figure 3; Table 3). The Mann-Whitney-U test revealed that there was a significant difference between the two locations (P<0.001).

Of all 1,250 people observed, 231 looked at all three exhibition panels. On average, zoo visitors spent 2:01 minutes on the "Biology" exhibition panel, 1:43 minutes on the "Species Conservation" exhibition panel, and 1:42 minutes on the "Habitat" exhibition panel. The Friedman test showed a significant difference between the viewing times of the three topics (P=0.006). The pairwise comparison revealed a significant difference between the topics "Biology" and "Species Conservation" (P=0.008; r=0.15) and between the topics "Biology" and "Habitat" (P=0.038; r=0.12). No significant difference was found between the topics "Species Conservation" and "Habitat" (P=0.608).

Visitors were grouped based on how many signs they looked at. Those who looked at only 1 to 3 of the 9 signs (group 1-3) spent an average of 26.83 (± 20.45) seconds looking at each side. Those who viewed between 4 and 6 signs (group 4-6) spent 40.60 (± 19.65) seconds, while individuals who looked at 7 or more of the nine signs (group 7-9) spent an average of 61.68 (± 30.31) seconds per sign. The Kruskal-Wallis test was able to detect a significant difference between the three groups (P<0.001). Between all three groups, the post hoc test detected significant differences (P<0.001). The effect size between group 1-3 and group 4-6 is r=0.35, between group 1-3 and group 7-9 is r=0.59, and between group 4-6 and group 7-9 is r=0.30. The results are shown in Figure 4. Of the people who viewed the exhibition, most looked at 1-3 signs. Almost half of the adults in this group had children with them. Of the group who looked at 7-9 signs, most adults did not bring children (Table 2).

Discussion

The positioning of the exhibition panels

The results show that there is a significant difference between the two tested locations. At location 2 significantly more people paid attention to the exhibition panels, while at location 1 the majority of visitors walked past and did not read or look at any of the signs. At location 2, significantly more signs were read than at location 1, showing that location has an influence on how many of the signs were looked at. But why do zoo visitors have more interest in the signs at location 2? A possible explanation is provided by the theory of interest. According to this theory, two basic types of interest can be distinguished: On the one hand the individual or personal interest, on the other hand the situational interest. Individual interest is dependent on the person themselves, while situational interest arises from a stimulus in a learning situation (Krapp 1992; Hidi et al. 2004; Schiefele 2012). Situational interest occurs spontaneously in a learning situation, depending on whether a piece of information is perceived as valuable in the current context and at that exact moment (Schraw and Lehman

Table 2. Number of people, in the three groups, with and without children or youth/children themselves.

	Adult with child	Adult without child	Youth/child	Total
Group 1-3	109	118	45	272
Group 4-6	39	83	16	138
Group 7-9	24	57	9	90

2001). In this study, the giraffes can be seen as a possible stimulus for the situational interest. Giraffes are one of the most popular zoo animals (Moss and Esson 2010), partly because of their size (Frynta et al. 2013). Unlike location 1, which was positioned in a general walk-through area, location 2 had a unique and direct connection to the giraffe exhibit. This proximity to the giraffes, likely heightened situational interest among visitors. The giraffes at location 2 can be seen as a possible trigger for the situational interest, drawing attention and encouraging visitors to engage more deeply with the educational content on the signs. In contrast, location 1 lacked such a direct connection to a specific animal exhibit, which may explain the lower level of engagement observed there. Therefore, the signs are viewed less often at this location. Another explanation could be that there are usually many visitors in the entrance area of the zoo, which can be associated with some disturbance. Research indicates that crowd density can significantly influence visitor behaviour, leading to negative visitor satisfaction and lower dwell time (Budruk et al. 2002; Ding et al. 2023). Therefore, it is possible that many zoo visitors who want to look at information signs in a quieter environment chose to walk past the signs at location 1 to avoid the large crowds. In contrast, location 2 may have offered a more suitable environment for reading and engagement due to lower crowd density in that area. Therefore, it could be that many zoo visitors who wanted to look at information signs in silence walked past the signs at location 1 to avoid the large crowds.

Topics of signage

Regardless of the location, it was found that the amount of time people spent looking at the three different topics differed. The topic "Biology" was looked at significantly longer than the topics "Habitat" and "Species Conservation". The signs on the "Biology" topic contained a lot of general information about giraffes, their physique and diet. The other signs were not as general, focusing instead on more specific topics, such as the habitat of giraffes and conservation efforts, rather than just general biological information about giraffes. Based on the data, zoo visitors spent more time engaging with signs containing general biological information about giraffes, indicating a greater interest in these topics, while information beyond this is likely to be perceived only by those with a deeper interest in the subject. This assumption can be partially supported by the study by Fraser et al. (2009). In their study, they found that specific facts about an animal and its age are of particular interest to visitors. This information can be found primarily on exhibition panel 1. Visitors found information such as the phylogeny, which was particularly detailed on exhibition panel 3, less interesting. While many visitors come to the zoo to learn something, they also come to relax or spend time with friends and family (Reade and Waran 1996; Clayton et al. 2009; Jordaan and Plessis 2014; Ballantyne and Packer 2016). This study's findings suggest that general information about animals is read more frequently than specific topics, potentially because visitors might be balancing their educational engagement with their desire for

Table 3. Sample size by signs viewed and locations

	Location 1	Location 2
0.00	660	143
1.00	76	35
2.00	28	36
3.00	21	34
4.00	9	46
5.00	9	34
6.00	2	28
7.00	2	16
8.00	2	22
9.00	5	42
Overall	814	436

leisure. It is likely that general information signs are observed first. However, further studies are needed to determine exactly which topics are perceived as particularly interesting by visitors and what the reasons for this are. In this context, it is fitting that the EAZA Conservation Education Standards also specify that general information should be integrated into the exhibition design (EAZA Council 2016). However, it should be noted that the differences in viewing times between the three topics, while statistically significant, are associated only with small effect sizes (Field 2013).

Individual viewing behaviour and number of signs viewed

Our data also confirms that there is a connection between the number of signs viewed and the viewing time. The signs usually have around 150 words. With an average reading speed of around 230 words per minute (Brysbaert 2019), it would take around 40 seconds to read each sign. As there are different paragraphs and text breaks, which also contain images and graphics, you would expect a viewing time of 1 minute per page to read and take in all information.

Group 1-3 looked at only a small number of signs and spent a comparatively short time looking at each sign. It can therefore be assumed that only parts of each sign were read and viewed. It is reasonable to assume that the images and large texts were given priority. However, further research is needed to confirm this assumption. Group 4-6 looked at the signs significantly longer (with a medium effect size), while group 7-9 not only looked at the most signs, but also spent significantly more time with each sign. Based on the amount of time group 7-9 spent in front of the signs, it can be assumed that most of the content on each sign was read and viewed.

The data collected here cannot provide any precise information about the factors that influenced the number of signs read and the time spend with each exhibition panel. However, several potential factors have been identified in the literature. These include visitor motivation (Falk et al. 2007), social dynamics within visiting groups (Packer and Ballantyne 2002), and the physical design and placement of signs (Bitgood 2000). For instance, visitors with a primary focus on education may spend more time engaging with informational content, while those focused on recreation may skim or skip signs altogether. In the context of our data, it is likely that a combination of these factors contributed to the observes variation in visitor engagement, with social dynamics and visitor motivation being particularly influential. Further research is needed to isolate and examine these variables more closely. However, the data can give one indication of a possible factor. There are significantly fewer people with children in the groups that looked at more signs for longer periods of time (group 4-6 and group 7-9) than in the group that only looked at 1-3 signs. While almost half of the visitors in group 1-3 had one or more children with them, in groups 4-6 and 7-9 it was only about 30%.This finding is consistent with findings from the literature. Parents often come to the zoo with children to see animals (Lee 2015; Knezevic et al. 2016) and spend time with family (Reading and Miller 2007). Therefore, it makes sense that this group of people would, on average, view the signs more superficially. The fact that the children would have to wait for the adult person while reading likely contributes to adults with children spending less time with the signs than individuals without children. However, further research is needed to determine what factors influence the time spent with zoo exhibition panels.

Similarly to zoos, museums and science centres often use informational panels to engage visitors. The findings suggest that positioning signage near popular exhibits or interactive elements might increase visitor engagement. Furthermore, understanding that general information attracts more attention could help in designing more effective educational displays. In outdoor settings like parks and nature reserves, where visitors may not always expect to find educational information, placing signs near key attractions or rest areas might enhance engagement. Additionally, varying the content to include both general and specific information could cater to different visitor interests, similar to what has been observed with zoo visitors. Furthermore, considering visitor density is essential; high-traffic areas can lead to distractions and decreased engagement. Therefore, placing signage in areas with fewer disturbances will be key to maximizing educational outcomes.

Limitations

This study provides valuable insights into how the location and content of exhibition panels influence visitor engagement in a zoo setting. However, several limitations should be acknowledged:

The study was conducted at only two locations within a single zoo. These locations were chosen for their differing contexts—one in a high-traffic entrance area and the other near a popular animal exhibit. However, the results may not be generalizable to other areas within the same zoo or to other zoos with different layouts, visitor demographics, or exhibit designs.

Although 1,250 observations were made, the sample size remains relatively small, particularly when considering the potential variability in visitors. Larger studies across multiple zoos and with more varied visitor samples would be needed to confirm these findings and ensure their broader applicability.

The observations were carried out on days with comparable weather conditions. However, no additional analysis was conducted to check how the weather affected the results. This variable should be taken into account in future studies.

Although the observers kept a sufficient distance to minimize their impact, the presence of observers could still have influenced visitor behaviour. Visitors may have felt observed and behaved differently than they would have if they were alone.

One limitation of this study is that we did not specifically control for the general attractiveness of the signage or other design factors such as layout, image placement, colour schemes, or font size, which are known to influence visitor engagement. While the content of the signs was standardized in terms of text length and subject matter, variations in these visual elements could have contributed to differences in visitor attention and time spent at each sign. Future research should consider these variables to better isolate the effects of content and location from those related to the aesthetic appeal of the signage.

Conclusion

The results of this study were able to demonstrate that the location of exhibition panels in the zoo might impact on how many people read the signs. It is shown that it might be better to set up the exhibits directly in view of the animals, rather than in walk-through areas. Signs with general information were looked at longer by visitors on average than signs with topic-specific content. However, almost half of the people who looked at the signs also engaged with more than one topic. Therefore, it makes sense to also provide signs with further information. The analysis was also able to demonstrate that in general individuals with children tended to look at signage only briefly, while individuals without children spent more time looking at it. With these findings, the study not only contributes to research, but also provides practical implications for zoological facilities, particularly in optimizing the placement and content of educational signage to better engage visitors. This can enhance visitor learning and overall experience, leading to more effective educational outcomes.

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