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Visitor's Responses to Living Invertebrate Displays in a Natural History Museum and Zoological Park: A Case Study

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Abstract

This observational study represents a preliminary look into visitor responses to living and nonliving invertebrate displays in a natural history museum (the Oxford University Museum of Natural History) and zoological park (the London Zoo). Basic patterns in visitor behaviour are captured, taking into account the type of display, institution and demographic variables. There was a significant effect of display type, with living exhibits attracting more visitors and holding their attention for a longer period of time than one would expect by chance. This result is consistent with the curators' anecdotal reports regarding the attractiveness of living displays and speaks powerfully to their potential as tools in attracting audiences and stimulating interest in zoology. Individuals also spent significantly longer per exhibit at the London Zoo B.U.G.S. House than the O.U.M.N.H. entomology gallery. Interestingly, demographic variables did not appear to be significant nor were their interactions with main effects.

Introduction

Our fascination with wild animals is an ancient one and collections of live animals date back as far as 3000 BC, when the first zoological gardens were created in the earliest of urbanized civilizations (although one could argue the even these were preceded by animal collections if one includes early attempts at domestication, Kisling 2001). In his history of zoological gardens, Kisling (2001) writes:

> 'Exotic animals have long been the ultimate collectibles. Exotic animals, alive, and active, have been more fascinating and exciting than natural history (museum) specimens, plants, or cultural artifacts – in part because animals are less common, more difficult to acquire, and more expensive to maintain. And then, there is the fascination, both emotional and scientific…'

This passage by Kisling captures the multifaceted attraction that the live animal has for us and it is this feature that has inspired their collection throughout history. But these live animal collections have largely occurred outside of the museum; and the history of the zoological garden runs more or less parallel to that of the natural history museum, where nonliving specimens predominate (as detailed in works by Kisling, 2001; Hardouin-Fugier and Baratay, 2003).

Despite the fact that zoos and natural history museums share a common subject and are both composed of collections of animals, the two types of institutions have traditionally differed in their cultural status. While private zoological gardens and collections have always been associated with society's most elite, the publicly accessible zoological collections have largely been regarded as a popular amusement. This comes in stark contrast to the ascendance of museums and art galleries to the realm of high culture:

> 'For the general public [zoos] were (and we would argue still are) merely places for recreation, places where one could walk and amuse oneself looking at strange and interesting animals. In an important sense they were not serious places, as for example a science museum or art gallery was' (Mullan and Marvin, 1987)

The contrast is a curious one, particularly when one compares the zoological garden to the zoological collections of a natural history museum. It is as if the preservation and encasing of the specimen in a glass cabinet awards it greater prestige or scientific merit not afforded to the same individual in life, while it is arguably more authentic in life before preservation and taxidermists have imposed their interpretation (Mullan and Marvin, 1987).

Whilst institutions such as museums and art galleries command a reverential consideration as places of culture and collections of objects requiring careful interpretation, collections of living animals are perceived as not requiring interpretation and therefore not intimidating (Mullan and Marvin, 1987):

> 'For the [zoo] visitor to have an enjoyable experience, he does not need a high level of knowledge. The important thing for him is that the simply sees the animals. Whereas museums and art galleries become involved with connoisseurship, zoos did not'

While this is seen as a source of frustration to the likes of Mullan and Marvin, the perceptions of zoos as both accessible and enjoyable, may put them in an ideal position to access audiences who might otherwise be intimidated by the more scholarly, interpretation-rich setting of the traditional natural history museum.

Indeed, when it comes to attracting visitors, zoos appear to be more successful than museums. Museums typically attract audiences that are wealthier and more educated than would be representative of their regions, while zoos attract visitors from across the socioeconomic spectrum (in the USA: Bitgood and Benefield, 1986; Hanna and West, 1989; Merriman, 1991; Falk and Dierking, 1992; in the UK: Ament, 1994; MORI, 2001; Travers, 2006; Nabola, 2008). This is quite surprising, given the high entry costs to most UK zoos and free entry to most UK museums. But with the popularity of zoos across demographics, could museums learn from zoos? Could including living displays help make museums seem more accessible? Could the inclusion of living displays within the natural history museum create help achieve the desired interactive museum experience (see discussions in Alberch, 1994; Aw, 2012)?

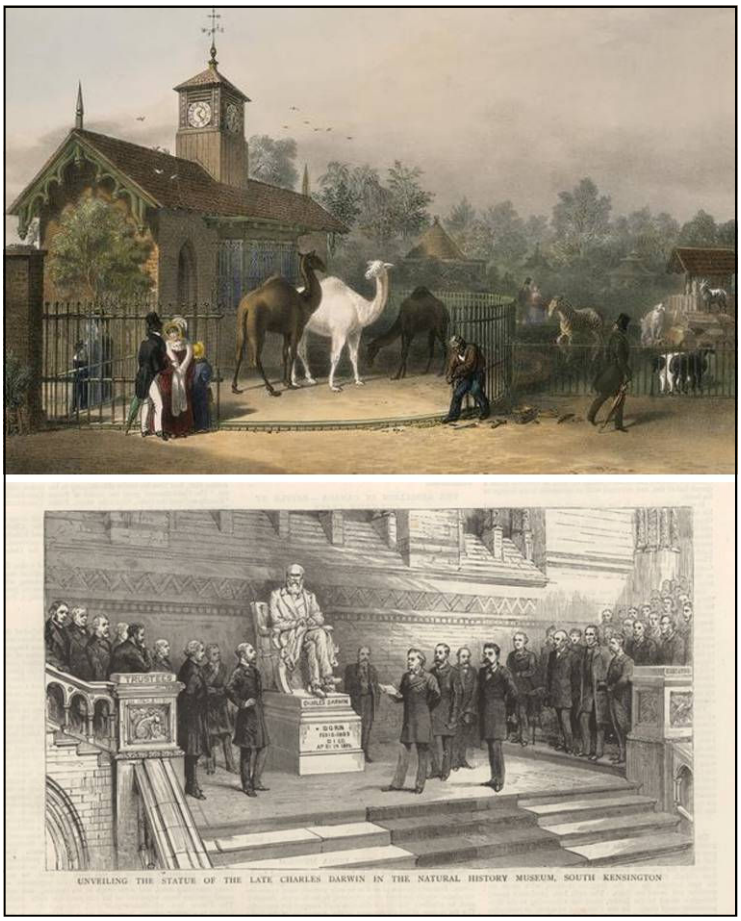


Fig. 1. Views of the London Zoo (above) and Natural History Museum at South Kensington (below) depicting the differences in cultural status of zoos and museums. The above painting shows the Zoological Gardens in Regent's Park, London, 1835. From the collection of the Museum of London, as reproduced from Wikimedia Commons (2011). The second image shows the unveiling of Darwin's statue at the Natural History Museum in 1885. The artist is anonymous. Image as reproduced from Darwin Online (2011).

The reasons why visitors come to zoos and museums may also differ. In keeping with perceptions and cultural status of zoos and museums, the goals of museum and zoo visitors also point to differences in the perceived aims of the two institutions. While museum visitors typically express learning goals as their primary motivation for visiting, zoo visitors express greater social orientation, with learning as a secondary motive (Hood, 1983; Bitgood and Thompson, 1987; Linton and Young, 1992; and review in Tunnicliffe, 1995). While zoos are also seen as places where learning occurs, they are perceived as environments which are as 'information-poor, experience-rich' in contrast to the formal classroom setting which is 'information-rich, experience-poor' (Packer and Ballantyne, 2002; Rosenfeld, 1980). Venues such as natural history museums may be situated ideally between these two experiences, as museums strive to combine the closely related activities of learning, education and entertainment (Kelly, 2007). Given these different perceptions and motivations, we might expect visitors to respond differently to similar displays in these two different contexts.

An observational study of visitor behaviour is presented in the face of both living and non-living invertebrate displays in a zoo and museum environment. Understanding how visitors respond to living and non-living displays is a first step to learning how best to use these powerful, sometimes controversial display types to maximum effect. This study represents an initial exploration into the use of life in the UK museum, that only skims the surface of a complex and controversial topic, raising as many questions as it answers. It is my hope these questions inspire further research into the presence and effects of life in the museum.

The present paper explores the behaviour of visitors in the face of living and non-living displays. This provides the first comparison of living and non-living display types in both a zoo and museum setting, exploring the amount of time visitors spend looking at exhibits according to the type of display they are viewing (living or non-living) when both display types are situated side by side in the same exhibition space. I explore visitation to different exhibition types in these two contexts and attempt to uncover the factors which influence the time individuals spend at each exhibit. This study focuses on invertebrates, as these are the taxa most frequently housed within museums (see Aw, 2012) and because focusing on invertebrates allows for a more direct comparison between the Natural History Museum and zoo settings.

Procedure

Study Sites

The Hope Entomological Collections of the Oxford University Museum of Natural History (hereafter O.U.M.N.H.) and the B.U.G.S. House (which stands for Biodiversity Underpinning Global Survival) at the London Zoo were selected as study sites. These two exhibition spaces are home to living invertebrate displays as well as non-living displays and interpretive panels. In the B.U.G.S. House, one vertebrate living display was present in the observation areas, the Naked Mole Rat, *Heterocephalus glaber* (Rüppell, 1842).However, since these mammals were housed together with crickets, the display was not coded as different from other living displays. Both living and non-living display types are housed side by side in the same exhibition spaces, facilitating comparison between the two display types. Images of some of the living displays at each site can be found in Appendices 4 and 5.

Both of the study sites represent gallery spaces which are clearly separated from other exhibits: a distinct corridor at the O.U.M.N.H. and a dedicated building at the London Zoo. At the O.U.M.N.H. this corridor has an entry and exit point at each end (see Appendix 1), while at the London Zoo, the B.U.G.S. house has a single entry and exit (see Appendix 2). This layout lends the space to observational studies, allowing us to easily alert visitors to the study taking place and monitor activity.

These galleries were divided into observation areas which were roughly equal in their physical area and number of exhibits both within and across study sites (see Appendices 1 and 2).

Participants

Participants were made aware that an observational study was in progress before entering the exhibition and had the right to exclude themselves from the study or seek more information about the project if desired. Exclusion from observations was signalled by placing a sticker or peg on their left arm.

If they did not exclude themselves, participants were observed upon entry to the gallery. The observer remained seated discreetly in the gallery with a silent stopwatch, monitoring behaviour. If more than one person entered the gallery at a same time, a focal individual was selected at random by numbering individuals and using a random number generator. To reduce pseudoreplication and confounds of interactions between members of the same group, only one individual was observed from each group of visitors. No personally identifying information was stored and no video or photographic recording of participants was conducted. As a result, this observational study is in compliance with the University of Leicester's *Research Ethics Code of Practice* (2011). The project was further approved by the ethical committees of both the London Zoo and O.U.M.N.H.

Duration of Observations

Individuals were observed in a single visible section of the gallery at a time (i.e. were not followed through the space). The observer was positioned to provide between-subjects coverage of the gallery space (see floor plans in Appendices 1 and 2). Each individual was observed up to a maximum of 20 minutes or until he or she exited the observation area. Notes were taken of the date and time during observation sessions. The following variables were recorded and a sample observation sheet can be found in Appendix 3.

Demographic variables recorded:

- Age: Under 10, 10-20, 20-30, 30-40, 40-50, 50-60, 60+
- Gender: Male/Female
- Group Size: 0, 1, 2-4, 5+
- If the individual was accompanied by a group:
    - group type: school, family (multigenerational group), adult tour, other

Observational Coding

- Exhibit Type: Living or Non-living (both locations). Non-living exhibits were further divided into Flat and Vertical at the O.U.M.N.H.
- Case Title: title of case for reference (see Appendices 1 and 2 for coding)
- Time spent at exhibit in seconds
- Revisit: Yes/No
- Notes: any additional observations, e.g. was the focal individual called to the exhibit by another group member? Was he or she called away? If facing a living exhibit, was the animal located? Did the visitor take notes? Did he or she take a photo?

Results

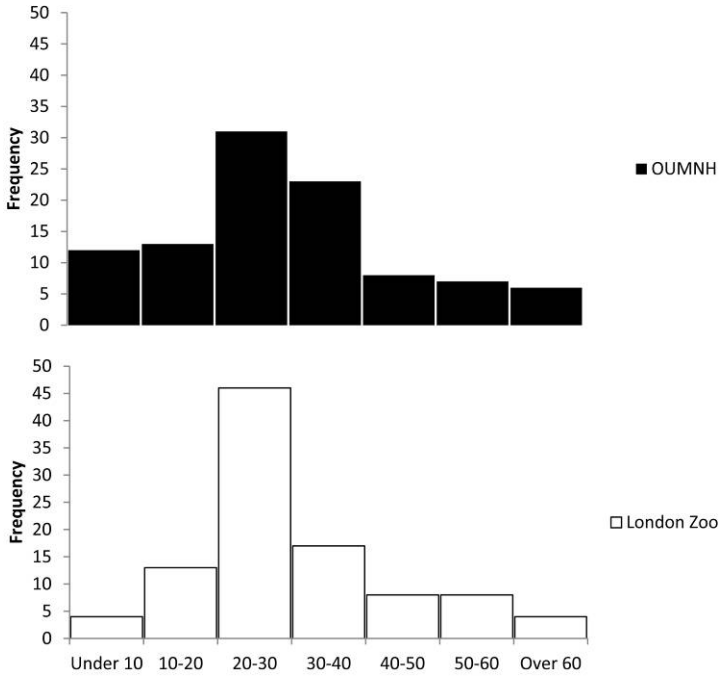
A total of 100 individuals were observed at each study site over the course of 2-3 observation days.
Data were collected at the O.U.M.N.H. on Sunday, 7 November, 2010 (58 observations), Saturday, 18 December, 2010 (8 observations) and Thursday, 6 January, 2011 (34 observations). The third day of observations was required due to inclement weather on the second day, which made it extremely difficult for visitors to access the museum. Data was collected simultaneously by two observers trained to follow the same data recording protocol. Observers were seated in the locations described in Figure 8.

Data were collected at the London Zoo on Saturday, 11 December, 2010 (100). Data were simultaneously collected by the same two observers from the O.U.M.N.H. site trained to follow the same data recording protocol. Observers were seated in the locations described in Figures 9 and 10.
No potential participants opted out of the study on any study day at either site.

Descriptive Statistics

Breakdown by age

Age was approximated by the observers in bins of 10 years. Frequency distributions of participant age can be found in Figure 2. Note that these are approximate ages of focal individuals rather than the entire population that passed through the gallery during the observation period.



	Under 10	10-20	20-30	30-40	40-50	50-60	Over 60
OUMNH	12	13	31	23	8	7	6
ZSL	4	13	46	17	8	8	4

Fig. 2. Distribution of estimated ages of focal individuals at the O.U.M.N.H. (above) and London Zoo (below). The table represents age estimated in bins of 10 years, as approximated by observers and only characterizes focal individuals (those who were observed).

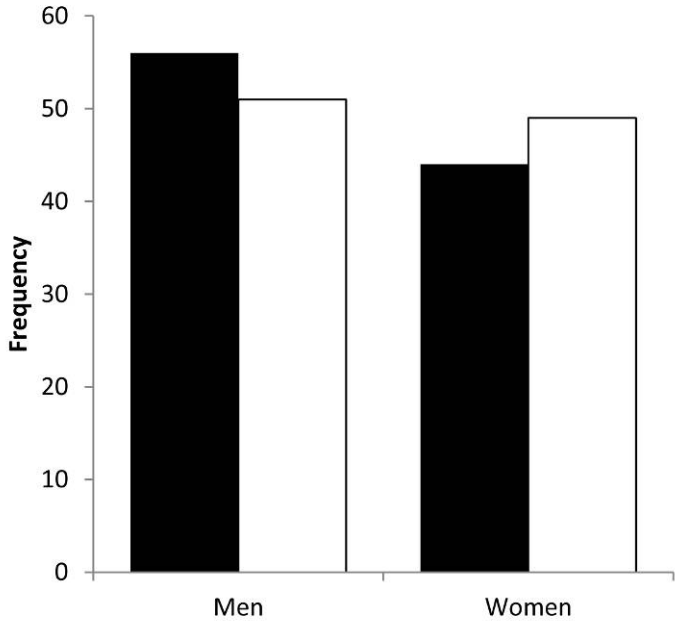


Fig. 3. Counts of focal individuals by gender at the O.U.M.N.H. (black bars) and London Zoo (white bars).

Breakdown by gender

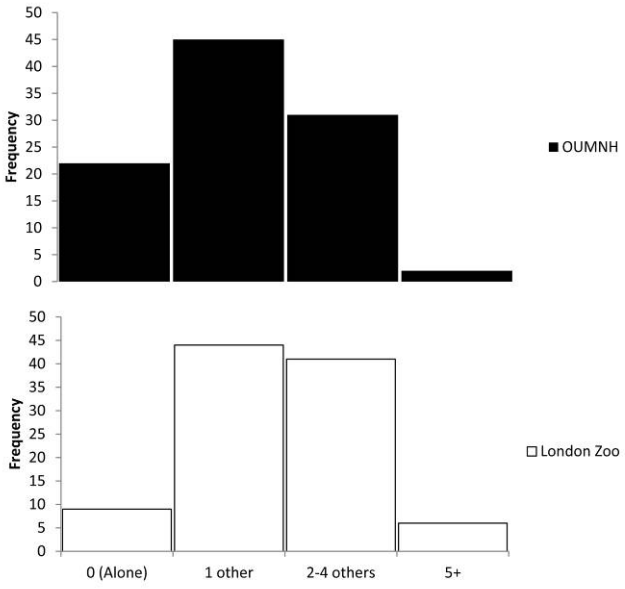
Approximately equal numbers of men and women were observed at each site (O.U.M.N.H.: 56 Men and 44 Women; London Zoo: 51 Men and 49 Women, Figure 3). Of course, these numbers are not counts of the number of individuals who visited the galleries, but counts of the focal individuals that were randomly selected to be observed.

Breakdown by Group Size and Type

Individuals were observed alone and in groups at both sites. At both O.U.M.N.H. and the London Zoo, participants were most frequently observed in pairs (Figure 4). Although not all groups were counted, this appeared to be the most common group size during the observational sessions. Groups over of 5 or more individuals were rarely observed at either location. More lone individuals were observed at the O.U.M.N.H. than the London Zoo.

Group Types

The majority of the observed groups were families (multigenerational groups). This was true of both study sites, see Figure 5. This data may have been biased by the dates of the observations, which were primarily weekends and included school holidays. Couples were the second most common group observed, but the distinction between couples and one other friend are primarily conjecture.



	Alone	1 other	2-4	5+
OUMNH	22	45	31	2
ZSL	9	44	41	6

Fig. 4. Frequency distribution of the group sizes of focal individuals at the O.U.M.N.H. (above) and London Zoo (below). Focal individuals were most commonly observed with one other group member at both locations. Solitary individuals were observed more frequently in the museum than zoo setting.

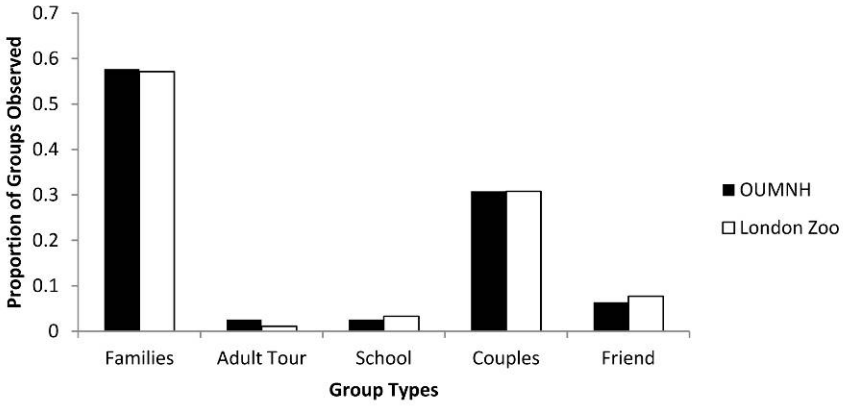


Fig. 5. Proportion of group types observed at the O.U.M.N.H. (black bars) and London Zoo (white bars). Families (defined as intergenerational groups) were the most common group type observed at both locations, accounting for over half of all groups.

	OUMNH	London Zoo
Families	45	52
Adult Tour	2	1
School	2	3
Couples	24	28
Friend	5	7
TOTAL	78	91

Time Spent in Observation Areas

All visitors spent less than 20 minutes in the observation area, and therefore no visits were artificially truncated. The longest visit occurred at the O.U.M.N.H. (15 min 24s). As durations are prone to highly skewed distributions due to the bound at 0, I will present subsequent duration data as medians rather than means. Visitors spent approximately the same amount of time under observation at the two institutions. The median time spent within an observation area at the O.U.M.N.H. was 2 min 17.5s (range 10s – 15 min 24s, n=100). The median gallery time at the London Zoo was 2 min 16s (range 5s – 9 min 34s, n=100). A histogram of visit times can be found below in Figure 6. Although this data is pooled across observation areas within each institution, areas were approximately equal in size and number of displays and these areas were taken into consideration in the analyses to follow.

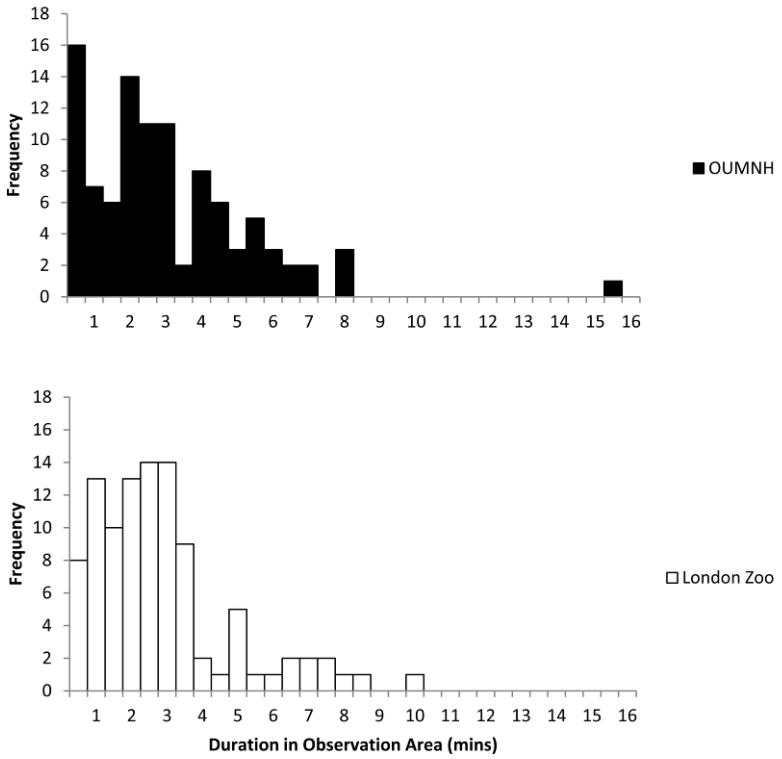


Fig. 6. Frequency distribution of duration focal individuals spent in an observation area at the O.U.M.N.H. (above) and London Zoo (below). Data are organized in bins of 30 seconds. Note the large outlier in the figure above of 15 minutes. This exceptional value was an observation in which a family were drawing the contents of several display cases.

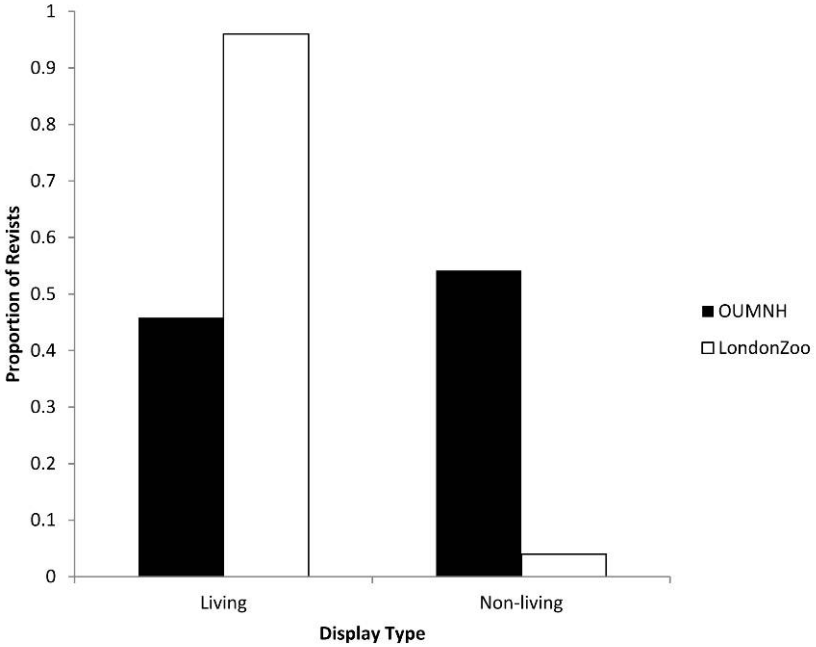


Fig. 7. Revisits made to living and non-living displays at the O.U.M.N.H. (black bars) and London Zoo (white bars). Note that these results are not scaled to the frequency of display types within the two galleries. When one takes into account the proportion of displays which include living and non-living displays, it is clear that living displays are extremely over-represented in the number of revisits they attract.

Frequency of Exhibition Types

Both the O.U.M.N.H. and London Zoo B.U.G.S. House contained both living and non-living displays. The O.U.M.N.H. observation areas contained a total of 45 actively used display cases: 41 non-living exhibits (24 flat display cases and 17 vertical display cases) and 4 living display cases. At the London Zoo's B.U.G.S. House, the observation areas contained many more living displays. Across observation areas, this came to a total of 49 active displays: 29 living and 20 non-living. The organization of these exhibitions can be seen in Figures 8-10 and Appendices 3 and 4.

Revisitation and Non-visitation

One of the greatest challenges in analyzing this data is making sense of non-visitation. Times recorded were those where individuals stopped to look at exhibits and therefore we have many instances for which we have individuals stopping to examine some, but not all of the displays in a given area.

In contrast, individuals also occasionally visit the same exhibit more than once during observation. A total of 50 revisits were observed (25 at the London Zoo and 25 at the O.U.M.N.H.). Revisits occurred to both living and non-living exhibits.

The most commonly revisited displays at the O.U.M.N.H. were the live cockroaches (6 revisits), followed by the live beetle exhibit (4 revisits) and the vertical non-living beetle display (3 revisits). At the London Zoo, revisits were made primarily to the live locust display (5 revisits), live stick insects (4 revisits) and live mantids (3 revisits).

The proportion of revisits made to living and non-living displays is certainly influenced by the number of different exhibit types present in the two museums. However, the null expectation for patterns of revisitation is less clear. Revisits mark returning to a previously viewed exhibit and to model a prediction, we would need to take into account the rate of initial visitation of each exhibit.

The small number of revisits observed, make these observations more anecdotal than representative and we lack the power required for a full analysis. However, consider the following: living displays accounted for just 9% of the displays at the O.U.M.N.H. and 41% at the London Zoo. This means that if all displays attracted visitors equally, we would predict the rate of revisitation to be the joint probability of visitation to these exhibits, meaning we would expect living exhibits at the O.U.M.N.H. to attract approximately 8.1% of revisits and those at the London Zoo to make up just 17%. The observed revisitation rates differ drastically from these predictions, with revisitation to living exhibits of 44% at the O.U.M.N.H. and 96% at the London Zoo. Thus revisits were disproportionately occurring to living over non-living displays.

Visitation by Exhibit
Understanding which particular exhibits our focal individuals visited and how long they spent at these exhibits is also an interesting opportunity provided by the dataset. The goal here is to provide a visualisation of the behaviour of observed individuals rather than analysis.

There are two elements of visitation of interest here. Firstly, the drawing power of the display (i.e. how many visitors looked at this particular display) and the holding power of that display (i.e. how long did visitors stay once attracted). To do so, I calculated the ratio of focal individuals who visited each exhibit and the number of focal individuals in the relevant zone. To capture the holding power of the exhibit, I took the median duration of the visits to that particular display. Many metrics of visit duration could have been used here. I chose median visit duration because this would minimize the effect of outliers.

I also considered looking at the ratio of the visit to the exhibit time to the individual's total time in the observation area. However, to illustrate visitation patterns, we need to generate single time-related value per exhibit. While this could be accomplished by averaging these proportions across individuals, such averaging can be misleading.

Consider the following scenario: Subject A observes 4 exhibits in a given gallery, spending a total of 100 seconds. Of this time, s/he devotes 20 seconds to Exhibit X. According to the scoring above, this would give a score of 0.2. Imagine another individual, Subject B, who spends 200 seconds in the gallery, but looks at 20 exhibits. This individual looks at the exhibit for 20 seconds. This individual would also have a score of just 0.1. Thus, if we were to average the proportions of subjects A and B, we would end with a lower score, despite the two individuals showing the same interest.

I conceived another scoring possibility, whereby the score was influenced by the number of exhibits an individual visited. The null hypothesis being that if all exhibits were equally interesting, individuals would spend the same amount of time at each. Scores would be comparisons of observed values to this assumption. If we consider subject A, we would expect him/her to spend 25 seconds at each exhibit (total time/ number of exhibits visited), but s/he only spend 20 seconds observing Exhibit A. This would result in a negative score of -5s, as the exhibit was deemed less interesting than chance.

However, there is a major flaw in this design: subjects did not visit every display. Therefore, how were non-visitations to be considered? Should all visit times be divided by the total number of exhibits? Would these all receive negative scores? Furthermore, this scoring system moves away from presenting the data and well towards analysis, comparing observed values to a possibly flawed set of expectations. For these reasons, I have chosen to represent time spent at the exhibit as median times, with the caveat that these times are not taken from equal samples, due to variation in the interests and visitation patterns of the focal individuals.

Figures 8 -10 show each observation zone and the visits and duration spent at each exhibit. The size of the mark represents the proportion of visitors who were observed in that zone who visited a given exhibit (large dots/square denoting high proportions of visitation). The fill of the dots indicate the time spent at these exhibits and is taken to be the median visit durations of those individuals who visited that exhibit, with white showing a short amount of time and black, a longer one. Scales are consistent within, but not between figures.

Non-Coded Time
Only durations spent looking at exhibits were coded. Therefore time spent travelling between exhibits or in the gallery spaces, but not attending the displays, occurred between bouts of exhibit attendance. This 'non-exhibit' time accounted for a median of 28.5 seconds at the O.U.M.N.H. (range 0 – 372 seconds) and a median of 68.5 seconds at the London Zoo (range 0 – 556 seconds). On average non-attendance time accounted for approximately 0.44 ± 0.04 proportion of all gallery time at the O.U.M.N.H. and 0.69 ± 0.03 at the London Zoo.

Time Spent Observing Living versus Non-living Exhibits
Taking the most conservative approach, I did not include non-visits in the data set for this and the following analyses. That is to say, all data points were durations of 1 or more seconds. This means that for a given individual, we do not have an observation for every exhibit within an observation area. However, the previous section does capture some of the patterns of visitor behaviour and proportion of visitors that viewed each exhibit within each observation area.

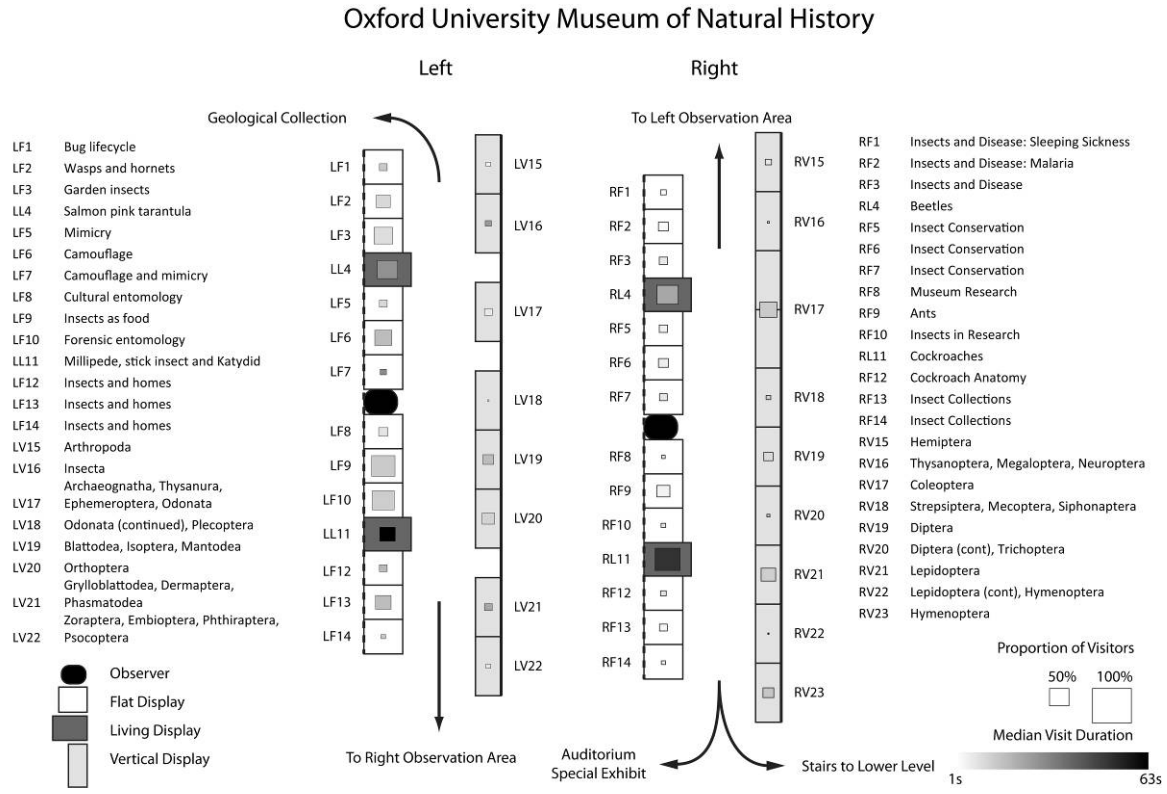


Fig. 8. A schematic of visitor behaviour within the O.U.M.N.H. in the left and right observation areas. The behaviour of focal individuals is superimposed onto the schematic of the gallery. The size of the rectangles represents the proportion of visitors attending to the display (with larger rectangles denoting higher proportions of visitors) and the darkness of the filling of these rectangles represents the median duration of this attendance (with pure white being 1s and pure black being 63s).

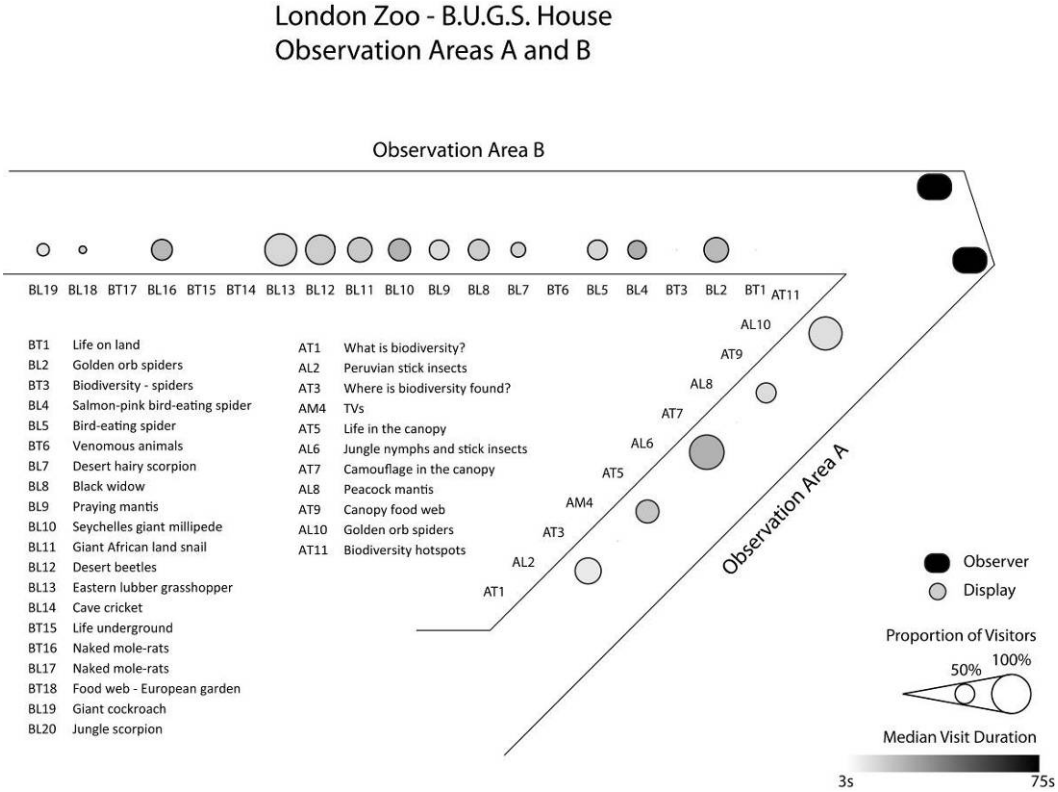


Fig. 9. A schematic of visitor behaviour within the London Zoo in Observation Areas A and B. The behaviour of focal individuals is superimposed onto the schematic of the gallery. The size of the circles represents the proportion of visitors attending to the display (with larger circles denoting higher proportions of visitors) and the darkness of the filling of these circles represents the median duration of this attendance (with pure white being 3s and pure black being 75s).

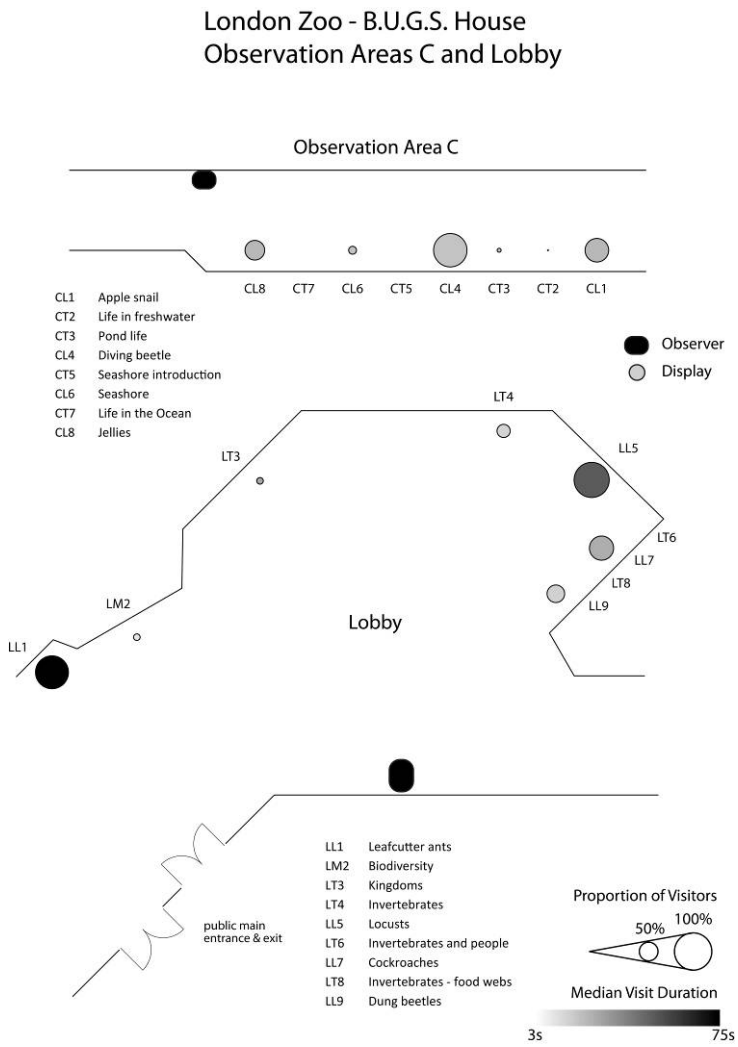


Fig. 10. A schematic of visitor behaviour within the London Zoo in the Lobby and Observation Area C. The behaviour of focal individuals is superimposed onto the schematic of the gallery. The size of the circles represents the proportion of visitors attending to the display (with larger circles denoting higher proportions of visitors) and the darkness of the filling of these circles represents the median duration of this attendance (with pure white being 3s and pure black being 75s).

Taking into consideration all observed visits, I found that visitors spent slightly longer looking at living exhibits at the London Zoo than the O.U.M.N.H. (Figure 11). Visitors spent longer looking at living displays than their non-living counterparts. At the London Zoo, visitors spent a median of 23.31 seconds observing live animal displays (range: 4 – 207.5s, n = 98) as opposed to just 13.67 seconds observing non-living exhibits (range: 2 − 162s, n = 41). At the O.U.M.N.H., visitors spent an average of 36 seconds observing living exhibits (range: 3 – 182s, n = 75) as opposed to an average of 14.84 seconds per non-living exhibit (range: 1 − 155.6s, n = 96).

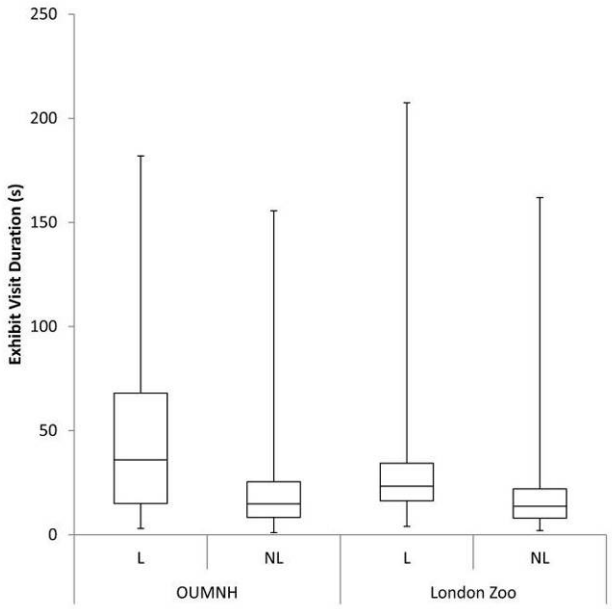


Fig. 11. Boxplot of the visit duration to living (L) and non-living (NL) exhibits at the OUMH (left) and London Zoo (right). Lines denote medians, boxes denote the interquartile range and error bars denote the ob-

Modelling Visit Durations

I wanted to understand what impact our various measures had on the duration individuals spent looking at the exhibits. The primary question is whether the content of a display (living or non-living) influences this time, but we also want to understand whether the institution, group size and characteristics of the individual (e.g. age and gender) might influence these differences. Moreover, as we have several observations from the same individual, to test these hypotheses, a model that took individual into account as well as the unbalanced design was required.

For the purposes of the models, the duration spent at a given exhibit was considered to be the total time spent by an individual in that exhibit (i.e. repeat visits to the same exhibit had their durations summed). As the duration data were highly skewed (being bound by 0), these times were transformed using a natural logarithm prior to analysis. To analyse the data, a Poisson family mixed model was fitted to the data with duration spent at the exhibit as the dependent variable. Participant identification number was entered as a random factor and fixed factors included Institution (London Zoo or O.U.M.N.H.), Display type (Living or Non-living), Age Range (Under 10, 10-20, 20-30, 30-40, 40-50, 50-60, Over 60), Group Size (0, 1, 2-4, 5 or more) and Gender (Male or Female).

The models were fitted using the glmmPQL function in MASS package of the statistical package R. This function fits a General Linear Mixed Model with Penalized Quasi-Likelihood (see R documentation, 2011). In the resulting model, the institution was a significant factor ($t = 4.96$, $p < 0.00$), as was whether the display was living or non-living ($t = -10.10$, $p < 0.00$). This implies that individuals spent longer looking at living exhibits and spent longer looking at exhibits in the London Zoo than the O.U.M.N.H. All other factors were nonsignificant, including interaction terms.

Discussion

Despite using an extremely simple methodology, the observational data forms a rich database and one which helps us start to understand the way visitors respond in galleries that contain both living and non-living displays and in both a zoo and museum context. The data collected capture the behaviour of focal individuals of both genders, from a wide range of ages and in groups of different sizes and compositions. Although the analyses presented here only begin to skim the surface of such an extremely complex and varied data set, this study represents the first direct comparison of visitor behaviour in response to living and non-living display types in more than one institution.

The dependent variable was simply the time visitors spent looking at each exhibit. However, even with this measure, we were able to observe clear effects of the content of the exhibit. The predominant result is the strong effect of display type, with living exhibits attracting more visitors and holding their attention for a longer period of time than one would expect by chance. This result is consistent with the curators' anecdotal reports regarding the attractiveness of living displays and speaks powerfully to their potential as tools in attracting new audiences and stimulating interest. The other significant effect observed, was an effect of institution, with individuals spending longer per exhibit at the London Zoo B.U.G.S. House than the O.U.M.N.H. entomology gallery. However, generalizing these findings to other zoos and museums may not be valid, as we only studied one institution of each type and further investigation of the relationship between the living and nonliving displays within each gallery and into the nature of the language and content of the surrounding interpretation and displays.

The main effects of Institution and Display Type are not entirely surprising, but the lack of significant effects among demographic variables was unexpected. I would have expected both group size and the age of the focal individual to play a more significant role in influencing duration per exhibit. However, both lone visitors and visitors in groups spent longer looking at the living displays than their non-living counterparts. As many of the groups observed were families, it is possible (and certainly anecdotally the case) that group members strongly influenced one another's behaviour. We have numerous observations in which group members were called to or away from exhibits by other members of their party; as this means behaviour was influenced by other group members of different ages, such interactions could certainly have contributed to the lack of observable effects of the age of focal individuals. It is also possible that we did not observe an effect of visitor age due to the way this was recorded. Age was approximated by the observers and may not have been accurately assigned to the bins. The choice of 10 year bins may also have contributed to the lack of an age effect.

It is important to note that the exclusion of non-visitations may also influence the results reported here. However handling nonexistent data is always problematic and conservatism is preferable over potentially falsely supporting a hypothesis with the inclusion of these points.

I have begun to explore the behaviour of individuals on an exhibit by exhibit basis, but as always with field-work, we do not have equal numbers of observations for each exhibit and collecting only equal numbers would have biased our data, forcing a structure upon observations which does not match with the actual distribution of visitors. Nonetheless, the figures showing the proportion of visitors different exhibits attracted begin to tell a story and show that there is much more to be learned about the behaviour of visitors in the gallery where living and non-living displays are included.

There are several interesting and surprising outliers in the present data that also merit further study. For example, although the stick insects in the left side gallery of the O.U.M.N.H. did not attract the most visitors in its observation zone (O.U.M.N.H. left), it did have the longest median visits. Why was this so? Did those who stopped spend longer locating the well camouflaged insects within the display?

Another interesting aspect that could be explored with this data set is the order in which exhibits were visited. For example, did visitors go straight for the living displays first, or skip ahead to get to them? Were visitors more likely to read about a taxonomic family after viewing the living specimens of that family? Did individuals move through the gallery methodically or double back on themselves? It is clear that there is much more to be explored within this data set.

A critical aspect of future research will require careful consideration of the treatment of non-visitation, which occurred in most observations within the observation areas. Any treatment of these non-visits involves imposing assumptions about the visitor's behaviour, but the patterns of non-visitation are almost certainly revealing. My hope is that the visual representations of the proportion of visitors attracted goes some way towards addressing this issue, but it remains a challenge to be carefully considered.

Despite these shortcomings, this first step into examining visitor behaviour in response to living and non-living displays captures some degree of the attraction of living displays. While further work is certainly required to uncover the nuances and reasoning behind this attraction and further exploration into the minds of visitors would contribute to our understanding of visitor behaviour, the present study suggests that living exhibits attract more visitors in both zoos and museums and hold the attention of these visitors for longer than their non-living counterparts.

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References

Alberch, P., 1994. The identity crisis of natural history museums at the end of the twentieth century. In: R. Miles and L. Zavala, eds. *Towards the Museum of the Future*. London: Routledge, London, pp. 193-198.

Ament, S., 1994. Zoo and Marketing Research. *Zoo Federation News*, 68, pp. 38-52.

Aw, J. M. 2012. Living Specimens in England's Natural History Museums: Frequency, Use and Legislation. *NatSCA News*. Issue 22. pp. 22-34.

Bitgood, S. and Benefield, A., 1986. Visitor behaviour: A Comparison Across Zoos. Center for Social Design, Jacksonville State University.

Bitgood, S. and Thompson, D., 1987. How do people perceive museums, parks and zoos? *Visitor Behaviour*, 2, 9-10.

Falk, J.H. and Dierking, L., 1992. *The Museum Experience*. Washington: Whalesback Books.

Hanna, B. and West, P., 1989. Minorities and the Detroit Zoo. In: S. Bitgood, A. Benefield and D. Paterson, eds. *Visitor Studies Conference, 4*. Dearborn, MI: Center for Social Design, pp. 149-152.

Hardouin-Fugier, E. and Baratay, E., 2003. *Zoo: A History of Zoological Gardens in the West*. London: Reaktion Books.

Hood, M., 1983. Staying away – Why people choose not to visit museums. *Museum News*, 61, 50-57.

Kelly, L., 2007. Visitors and Learning: Adult museum visitors' learning identities. In: S.J. Knell, S. MacLeod, and S. Watson, eds. Museum Revolutions: How museums change and are changed. London: Routledge, pp. 276-290.

Kisling, V.N. Jr., 2001. *Zoo and aquarium history: ancient animal collections to zoological gardens.* London: CRC.

Linton, J. and Young, G., 1992. A survey of visitors at an art gallery, cultural history museum, science centre, and zoo. *ILVS Review*, 2, 239-259.

Merriman, N., 1991. *Beyond the glass case: The past, the heritage and the public in Britain*, Leicester: Leicester University Press.
MORI, 2001. Visitors to Museums and Galleries in the UK for Resource.

Mullan, B., and Marvin, G., 1987. *Zoo Culture.* London: Weidenfeld & Nicolson.

Nabola, A., 2008. *Increasing Attendance and Participation*. [online]
Available at: <http://research.mla.gov.uk/evidence/documents/MLA%20Research%20Briefing%204%20-%20Participation%2019_01_09.pdf> [Accessed 2 February 2011].

Packer, J. and Ballantyne, R., 2002. Motivational factors and the visitor experience: A comparison of three sites. Curator, 45(3), 183-198.

R Documentation. *R: Fit Generalized Linear Mixed Models via PQL*. [online]
Available at: <http://stat.ethz.ch/R-manual/R-patched/library/MASS/html/glmmPQL.html> [Accessed 10 January 2011].

Rosenfeld, S., 1980, Informal learning in zoos: naturalistic studies of family groups. Ph.D. Thesis. University of California, Berkeley.

Travers, T., 2006. *Museums and Galleries in Britain: Economic, social and creative impacts*. [online]
Available at: <http://www.mla.gov.uk/what/publications/~/media/Files/pdf/2006/Museums_and_Galleries_in_Britain_v2.ashx> [Accessed 2 February 2011].

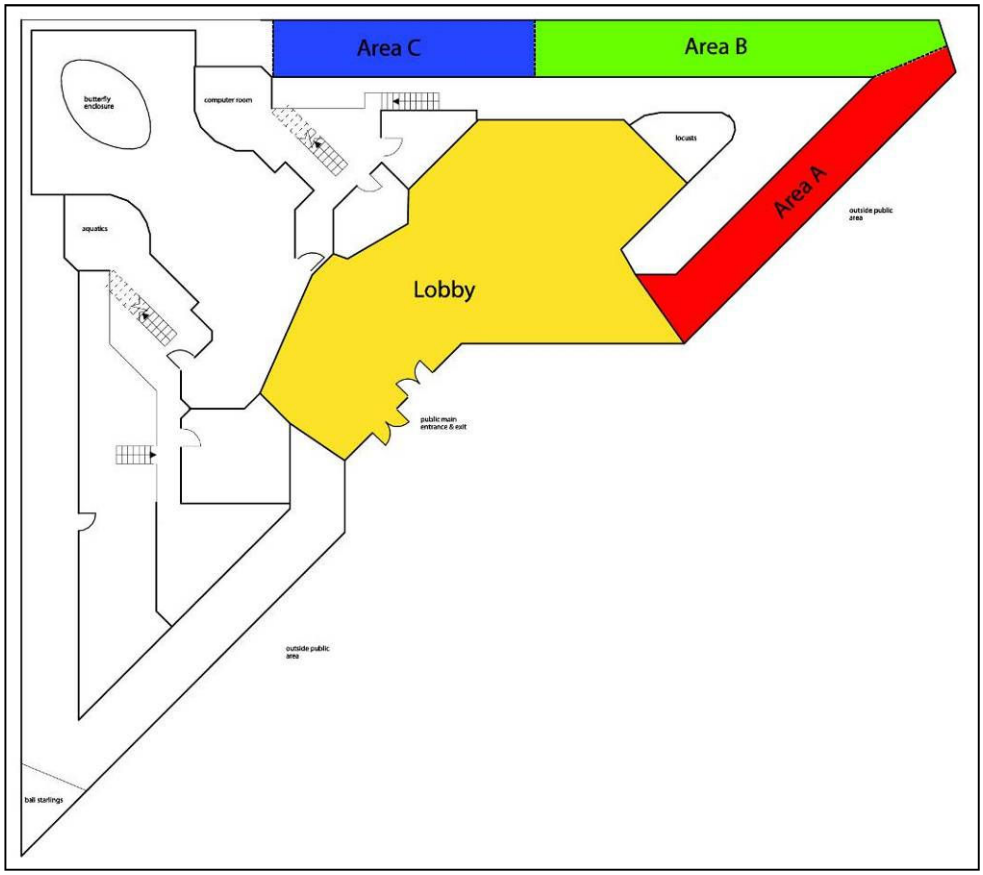
Tunnicliffe, S.D., 1995. *Talking about animals: studies of young children visiting zoos, a museum and a farm.* Ph.D. Thesis. King's College, London.

University of Leicester., *Code of Practice*.[online] Available at: <http://www2.le.ac.uk/institution/committees/research-ethics/code-of-practice>[Accessed 27 January 2012].

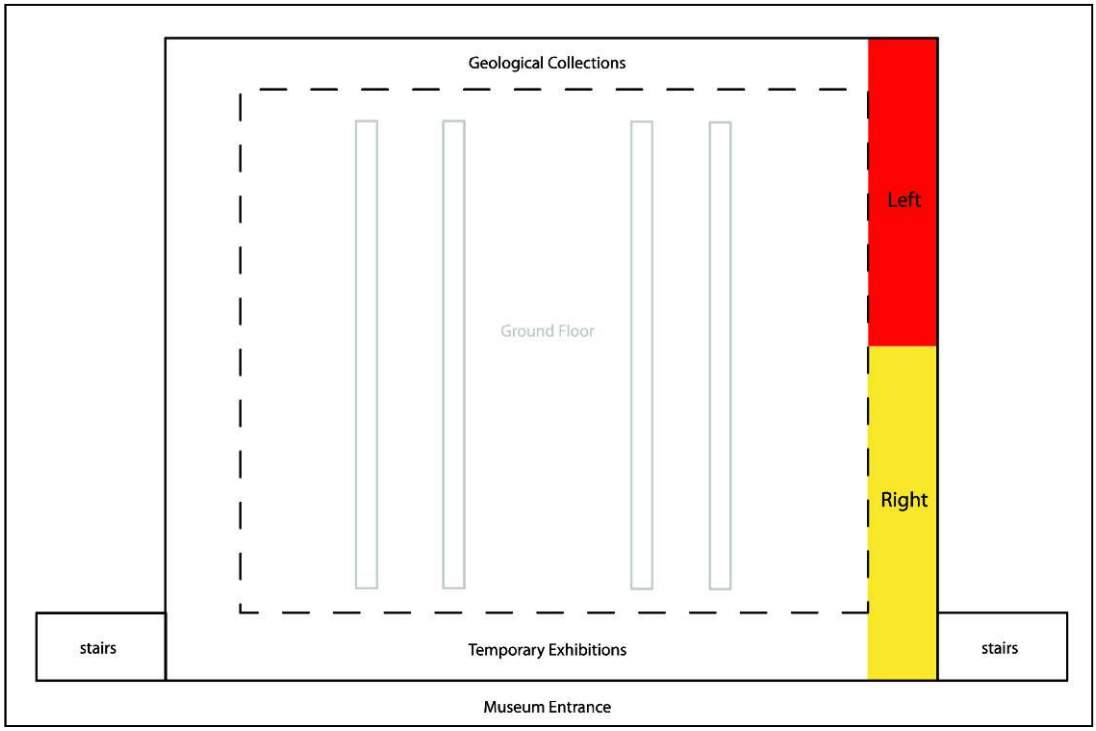
[Unveiling the statue of the late Charles Darwin at the Natural History Museum, South Kensington. The Graphic (20 June): 621-2] 1885. [image] Available at: <http://darwin-online.org.uk/content/frameset?viewtype=side&itemID=A542&pageseq=1> [Accessed 20 February 2011].

[A View of the Zoological Gardens in Regent's Park, London] 1835. [image] Available at: <http://en.wikipedia.org/wiki/File:View_of_the_Zoological_Gardens1835.jpg> [Accessed 15 February 2011].

Appendix 1: Schematic of the London Zoo B.U.G.S House showing the four observational areas.



Appendix 2: Schematic of Hope Entomological Collections at the O.U.M.N.H showing the two observation areas.



Appendix 3: Sample observation recording sheet used at both study sites.

Subject ID		Age	Under 10	10-20	20-30	30-40	40-50	50-60	60+
Date	06/11/2010	Gender	Male	Female					
Time		Group Size	0	1	2-4	5			
Gallery	O.U.M.N.H.	Group Type	School	Family	Adult Tour	Other			

Arrive	Leave	Exhibit Type	Case Title	Revisit?	Notes

Appendix 4: Images of selected living displays at the B.U.G.S House at the London Zoo.

Appendix 5: Images of selected living specimens at the Hope Entomological Gallery at the O.U.M.N.H.