
Assessing User Engagement with Library Exhibits Using Eye Tracking

Kris M. Markman
Harvard University, USA

Introduction

Brown and Power¹ note that, while exhibits have long been a primary focus of museums, this activity has historically been less common in libraries. However, they also point out the numerous advantages for library exhibits, particularly in the way that exhibits allow for opportunities for teaching and learning. Published research on library exhibits is quite sparse, with most work dedicated to how-to guides² or case studies of specific exhibits.³ Within the area of museum studies, more attention has been paid to examining visitor experience, although this research tends to be conducted through surveys and similar techniques.⁴ More recently, museum studies scholars have included observational methods as part of visitor experience research.⁵ Fouracre⁶ argues that, with the increasing use of exhibits in libraries, more evaluation of these exhibits is required. In particular, Fouracre notes that new technologies such as eye tracking have great potential for the study of visitor behavior in libraries.

This study compared two exhibits in two different Harvard Library special collections exhibit spaces. The study was exploratory in nature, designed both to explore the possibilities of using wearable eye tracking to study library exhibits and to give

some basic insights into how visitors interact with exhibits that are predominantly composed of textual objects. I chose two different exhibit spaces with two different layouts in order to gain some insight into how the physical organization of the space influences visitors' trajectories.

Background

Eye tracking technologies use infrared sensors to detect participants' pupils and track eye movements across a target, for example a computer screen. Eye tracking technology is also available in wearable form as lightweight glasses. In both types of eye trackers, proprietary software from the vendor uses algorithms to map the sensor input from the participant's eyes onto the screen, or the physical space in the case of wearable eye trackers. The software then outputs a video recording of the screen or environment, overlaid with a visualization representing the participant's gaze points as determined by the software. In the case of wearable eye tracking, the end result is a video representing the participant's visual field, and a small circle that moves across the field, indicating the participant's gaze across the environment (see Figure 1).

Figure 1. Example of output from wearable eye tracker. The circle in the upper center represents the participant's gaze.



Wearable eye trackers have been used in museum studies, and have illuminated otherwise inaccessible aspects of the visitor experience. For example, Eghbal-Azar and Widlok⁷ used wearable eye trackers to compare how novices and experts interacted with a museum exhibit. One advantage they found for using eye tracking, as opposed to in-person observation, was that the eye tracker was able to detect how visitors alternated viewing two small displays that were located next to each other. Brieber, Nadal, Leder, and Rosenberg⁸ used eye tracking glasses to compare how participants viewed artwork in a lab setting versus in a museum environment. Overall, they found that people viewed more artworks in the museum setting versus the lab, although label-viewing time did not differ between conditions. They also found that viewing time was greater when participants had more appreciation for and understanding of the artworks. Both of these studies demonstrate the promise that wearable eye tracking holds for the study of library exhibits.

Studying Exhibits at Harvard Library

Two exhibits were chosen for this study. *Opening New Worlds: The Colonial North American Project* exhibition highlighted “some of the remarkable material and work that is part of the multi-year Colonial North American Project at Harvard University.”⁹ The Colonial North American (CNA) exhibit was open from late January through

April 29, 2016, in the Lammot du Pont Copeland Gallery in Pusey Library. The exhibit *Shakespeare: His Collected Works* commemorated the 400th anniversary of Shakespeare’s death and presented “over eighty rare and unique objects—many never before seen—drawn from the Harvard Theatre Collection”¹⁰ and other departments of Houghton Library. The exhibition was open from January 19 through April 30, 2016, in the Edison and Newman Room in Houghton Library. There were several reasons that these exhibitions were chosen for this study. First, both were highly visible exhibitions on popular subjects. In addition, the Pusey and Houghton Libraries are physically adjacent in Harvard Yard (Pusey Library is underground), and both are also located in close proximity to the User Research Center at Harvard Library,¹¹ our user experience lab in which the study was based. Finally, the two libraries have very different exhibit spaces. Houghton’s Edison and Newman Room is a large rectangular room with four main floor standing exhibit cases along each side of the room. There is also additional space on wall panels to hang exhibit items. There is only one public entrance to the Edison and Newman Room. By contrast, the Copeland Gallery in Pusey Library is a long galley space with four wall mounted exhibit cases along one wall. The space then opens up into a larger area where both the Harvard University Archives and the Harvard Theatre Collection can be accessed. This

area includes wall space for mounting posters, a long floor standing exhibit case, and is open to another galley exhibit space belonging to the Harvard Maps Collection. This area in turn connects to the Lamont Library. Therefore, exhibits in the Copeland Gallery can be accessed either from the official entrance to Pusey Library, or from the other side from the Maps Collection. Thus visitors to the space may begin at the “entrance” of the exhibit or at the “exit,” depending on which library entrance they choose.

This short paper discusses findings related to two research questions out of the larger study. Specifically:

RQ1. How do users physically navigate library exhibits given different case/room layouts?

RQ3. How much time do users spend reading exhibit labels?

Data Collection

Participants were recruited through a variety of means, including through tent cards on tables in the reading rooms, through cards handed out to students who came for classes in the two repositories, and online through Facebook posts and e-mails circulated to different student distribution lists. Participants could choose to participate in either the Colonial North American exhibit study or the Shakespeare exhibit study. Participants who signed up met a research assistant at the User Research Center for the CNA exhibit or at Houghton Library for the Shakespeare exhibit, and were provided with an informed consent document. They were then brought to the selected exhibit by the research assistant. Before entering the exhibit space, participants were asked to put on the Tobii Glasses 2¹² head unit, which is connected to a battery-powered recording unit. In order to collect valid eye tracking data, the glasses must be calibrated to each new participant. In the calibration process, participants were asked to look at a small calibration card held in front of the participant for a few seconds. The research assistant then started the recording from Tobii Glasses Controller software running on a Windows tablet.

Participants were asked to walk around the exhibit space for around six minutes and look at whatever

they were interested in. This duration was chosen to facilitate scheduling and data collection. Because the Pusey Library exhibit space has two possible entry points, some participants who viewed the CNA exhibit were asked to start from the official entrance of Pusey Library, and some from the Map Collection exhibit side. For the Shakespeare exhibit, all of the participants started from the public entrance of the Edison and Newman Room on the first floor of Houghton Library. After the eye tracking portion of the study concluded, participants were given an iPad and asked to fill out a short background questionnaire that included questions about demographic information and familiarity with the exhibition (see Table 1).

Participants

There were a total of 34 participants (26 women) who completed the study and the exit questionnaire, of whom 23 had valid eye tracking data. Eye tracking data may be regarded as invalid because of one of the following reasons:

1. Calibration failed
2. Gaze sample percentage was below 75%
3. Tobii Glasses 2 suddenly disconnected from Tobii Glasses Controller software

The average age of participants was 26. There were three visitors/tourists, and all other participants were members of the Harvard community. Of their highest level of education completed, 11 had some college, 16 had a bachelor's degree, five had a master's degree, and one had a professional degree (MD, JD, etc.).

CNA participants included 15 adults, 11 of whom had valid eye tracking data. Of those 11 individuals (8 women), 10 reported being a Harvard student, faculty member, or staff member, and one was a visitor or tourist. Seven were asked to start from the entrance and four from the map collection side. Shakespeare participants included 19 adults, 12 of whom had valid eye tracking data. Of those 12 individuals (9 women), 11 reported being a Harvard student, faculty member, or staff member, and one was a visitor or tourist. Overall, participants were moderately familiar with the topics of both exhibits, and the Shakespeare exhibit received slightly higher scores on all five questions than did CNA.

Table 1. Mean scores for post-test questionnaire (5 = Strongly agree)

	CNA valid	Shakespeare valid	All participants
I am interested in the topic of this exhibit.	3.73	4.33	3.97
I am familiar with the topic of this exhibit.	2.55	3.75	3.29
I am knowledgeable about the topic of this exhibit.	2.45	3.00	2.85
I enjoyed viewing the exhibit.	3.91	4.50	4.18
I would visit another Harvard Library exhibit in the future.	4.27	4.58	4.38

Results and Discussion

For the initial data analysis, videos were coded in qualitative data analysis software NVIVO based on what participants looked at first, and then how many labels participants viewed across all of the objects in the exhibit. Label viewing was further coded for whether the label was skimmed versus read carefully.

Colonial North American

Overall for the CNA exhibit, participants noticed 52% of item labels, and of those read 27% carefully.

Each case also contained a poster, and there were several other posters mounted on the walls in the space or wrapped around support columns. Of the posters, participants noticed 65% and read 35% carefully. Figure 2 presents a summary of how participants viewed labels within each exhibit case, including complementary wall items that were included with Cases 1 through 4. In Figure 3, I present a simplified view of participants' trajectories through the exhibit, focusing on the first three objects they visited.

Figure 2. Colonial North American label viewing within cases

Case	Number of Participants	Labels read or skimmed
1. Overview	2	100%
2. The Hancocks and Harvard	9	60%
3. Politics in the Early American Republic	10	55%
4. Sermons, Religion, and Native Americans	7	51%
5. The Winthrops: Science, Mathematics, Working Women, and Family	7	60%

Figure 3. Colonial North American visitor trajectories. Superscript M indicates participants who started at the Maps Collection end of the exhibit.

	First Object	Second Object	Third Object
E01	Introduction Poster	Case 1	Ward Poster
E02	Case 1	Introduction Poster	Case 2
E03 ^M	Case 5	TV & Posters	Collection Posters
E12	Introduction Poster	Case 2	Ward Poster
E18 ^M	Case 5	TV & Posters	Case 4
E22	Introduction Poster	Case 2	Case 3
E24 ^M	TV & Posters	Case 5	
E27	Introduction Poster	Case 2	Case 3
E30	Case 1	Introduction Poster	Case 2
E35 ^M	Case 5	TV & Posters	Case 4
E36	Ward Poster	Introduction Poster	Case 2

Shakespeare

The Shakespeare exhibit had items in eight display cases, plus one additional case that contained only a copy of Shakespeare's first folio, with the exhibit introduction poster on a stand between it and Case 1. There were also two large posters and several other items mounted on wall panels around the room.

Overall for the Shakespeare exhibit, participants skimmed 46% of all labels and carefully read 23%. Participants skimmed 40% of the framed items and carefully read 19%. Figure 4 presents a summary of how participants viewed the labels within the main exhibit cases. Figure 5 presents the first three objects participants visited in the exhibit.

Figure 4. Shakespeare label viewing within cases

Case	Number of Participants	Labels read or skimmed
1. Harvard's Shakespeare	8	38%
2. Early Editions	9	54%
3. Readers and Respondents	10	41%
4. Actors	10	56%
5. Actresses	8	39%
6. Behind the Scenes	8	33%
7. Stagecraft	6	33%
8. Costume Design	6	48%

5. Shakespeare visitor trajectories

	First Object	Second Object	Third Object
E04	Caliban Poster	Case 8	Case 7
E05	Podium	Caliban Poster	Case 1
E08	Introduction	First Folio	Case 1
E09	Wall Panel 1	Case 2	Case 3
E10	Caliban Poster	First Folio	Introduction
E13	Podium	Case 8	Case 7
E14	First Folio	Introduction	Case 1
E16	Case 8	Case 7	Case 6
E21	First Folio	Case 1	Case 2
E28	Case 8	Case 7	Case 6
E33	Case 8	Case 7	Books
E37	Case 8	Wall Panel 6	Case 7

Discussion

One of the underlying motivations for this study came from conversations with curators, all of whom were interested to know if anybody actually reads

the labels that curators spend so much time carefully crafting. In this exploratory study, the answer seems to be a resounding “sometimes.” Overall, participants looked at around half of the labels, but only read

about one-quarter to one-third carefully. However, it is important to note that, while participants were not reading all of the labels, they were looking at different labels, and in this initial analysis there are no clear patterns in what participants looked at. One emerging pattern, however, is that there did seem to be participants who were more “readers,” who carefully read every label in every case they viewed, and others who were more “skimmers,” who seemed to scan the cases and then pick out only a few objects for more lengthy consideration. This suggests that curators should try to strike a balance between enough information to satisfy the “readers” without overwhelming the “skimmers.” In both of the exhibits under study, the cases were fairly densely filled. It is also possible that fewer items per case, with more space around the items, might encourage skimmers to look more closely at more items. Given that this was an exploratory study, additional research is needed.

Another interesting finding relates to how participants navigated the two exhibit spaces. Importantly, none of the CNA participants who started from the Map Collection side (the “end” of the exhibit) ended up following the exhibit order. Although this is not the “official” way to enter this space, it is nevertheless a very common way for visitors to find the Pusey exhibit space. It is also a very common traffic pattern for students, since the Map Collection hallway connects directly to the undergraduate library. It is possible that exhibit visitors may feel confused if entering from this direction, because the wall mounted cases are not clearly visible, nor is it clear that there is a formal entrance to the space. In the case of the CNA exhibit, there were two posters on either side of a TV mounted on one of the walls in the space that opens to the Map Collection. One of these posters was a duplicate of the Exhibition Introduction poster that was also mounted on the wall next to Case 1. This poster appeared helpful to participants in this study; however, it may be even more helpful to have a clear sign telling visitors that the exhibit actually starts at the other end of the galley.

Another interesting traffic pattern emerged in the Shakespeare exhibit. Even though all participants started from the same doorway, 4 of the 12 participants with valid eye tracking data started from Case 8 and did not follow the exhibit order at all. Since they did not realize that they were actually viewing the exhibit in a wrong order, there is a

high possibility that they did not notice the number signs in each case. In the case of the Shakespeare exhibit, the cases were organized thematically rather than chronologically; however, past exhibits in Houghton have relied on chronology and the order of the cases to tell their stories. Therefore, it may be worth considering whether the number sign for each case can be designed in a more obvious manner. Alternatively, if following the exhibit order is important, a more prominent “START” sign could be posted by Case 1. There was an “Exhibit Introduction” poster between the first folio case and Case 1, but many of our participants did not notice the poster and therefore may not have thought about the exhibit having an “order.”

These are a few of the initial observations from the first round of data analysis. In future work, I plan to continue to analyze the data from this study, particularly to see if there are any connections between how participants view the objects and labels and their responses to the questionnaire. I also plan to do more fine-grained analysis of participants’ viewing patterns within each case. The initial observations from this study also point to many more questions to be pursued in future research, particularly by exploring different types of exhibit spaces and different types of case arrangements.

—Copyright 2017 Kris Markman

Notes

1. Mary E. Brown and Rebecca Power, *Exhibits in Libraries: A Practical Guide*, ed. Rebecca Power (Jefferson, N.C.: McFarland & Co., 2006).
2. Ibid; Michelle Visser, “Considerations in the Preparation of Library Exhibits Featuring Rare Books and Manuscripts,” *College & Undergraduate Libraries* 11, no. 2 (2004); Freda Matassa, *Organizing Exhibitions: A Handbook for Museums, Libraries and Archives* (London: Facet, 2014).
3. Dorothy Fouracre, “Making an Exhibition of Ourselves? Academic Libraries and Exhibitions Today,” *Journal of Academic Librarianship* 41, no. 4 (2015).
4. Volker Kirchberg and Martin Tröndle, “Experiencing Exhibitions: A Review of Studies on Visitor Experiences in Museums,” *Curator: The Museum Journal* 55, no. 4 (2012).

-
5. Andrew J. Pekarik et al., "Ipop: A Theory of Experience Preference," *Curator: The Museum Journal* 57, no. 1 (2014), 5–27, doi:10.1111/cura.12048; Kali Tzortzi, "Movement in Museums: Mediating between Museum Intent and Visitor Experience," *Museum Management and Curatorship* 29, no. 4 (2014).
 6. Fouracre, "Making an Exhibition."
 7. Kira Eghbal-Azar and Thomas Widlok, "Potentials and Limitations of Mobile Eye Tracking in Visitor Studies: Evidence from Field Research at Two Museum Exhibitions in Germany," *Social Science Computer Review* 31, no. 1 (2013).
 8. David Brieber et al., "Art in Time and Space: Context Modulates the Relation between Art Experience and Viewing Time," *PLOS One* 9, no. 6 (2014).
 9. "Opening New Worlds," Harvard Library, <http://library.harvard.edu/opening-new-worlds>.
 10. Dale Stinchcomb and Debora Mayer, "Shakespeare: His Collected Works—January 19–April 23, 2016," *Houghton Library Blog*, December 23, 2015, <https://blogs.harvard.edu/houghton/2015/12/23/shakespeare/>.
 11. "Welcome to the User Research Center at Harvard University," User Research Center at Harvard Library, urc.library.harvard.edu.
 12. "Tobii Pro Glasses 2," Tobii Pro, <http://www.tobii.com/product-listing/tobii-pro-glasses-2/>.