Eye Tracking, Spatial Biases and Normative Spectatorship in Museums

MICHAEL TYMKIW AND TOM FOULSHAM

This study examines the viewing behavior of museum spectators during three eye-tracking experiments, the participants in which included wheelchair and non–chair users. The study pays particular attention to the spatial biases of spectators, such as the tendency to scan artworks from left to right or top to bottom. These spatial biases, the authors suggest, enhance our understanding of “normative spectatorship,” both by demonstrating how normative ideas about spectators’ bodies shape exhibition display practices and by revealing how display practices contribute to fostering normative viewing behavior.

While studies concerning spectatorship in museums have a long history, eye-tracking technology has opened up new opportunities for gathering empirical data about how individuals view artworks or other objects on display [1]. For example, a number of studies have used such technology to examine where participants look when viewing an artwork presented in laboratory conditions [2]. A few recent studies have also extended eye-tracking research into actual museum spaces [3]. Such studies have shed light on viewing patterns in numerous ways: for example, by demonstrating the extent to which prior knowledge may inform viewing behavior, by revealing some of the visual features within an artwork that are likely to attract a spectator’s attention or by identifying links between actual viewing patterns and influential theories about how paintings address beholders. Nevertheless, the tendency to focus on how individuals view a single artwork has meant that scholars have not fully mined the potential of eye-tracking technology for studying how display techniques shape a spectator’s viewing experience in an exhibition space containing multiple objects.

To begin probing this largely unexplored terrain, this article discusses findings from a series of eye-tracking studies conducted at three museums. Our discussion has two main aims. First, we document some general ways that display practices encourage spatial biases among spectators (i.e. the tendency to look at certain regions of space when viewing an object or a group of objects) [4]. Second, we ask how such spatial biases differ for a small group of wheelchair users across the three studies. Ultimately at stake in this discussion is a richer understanding of normative spectatorship within museums. By “normative spectatorship,” we refer both to the manner in which normative ideas about spectators’ bodies inform display practices and to the ways in which display practices elicit normative viewing behavior.

METHODOLOGY

Our project involved eye-tracking studies at three accredited museums in the greater London area. These institutions included Firstsite, a contemporary art gallery in Colchester; the Victoria and Albert Museum (henceforth V&A) in London; and the Essex Collection of Art from Latin America (henceforth ESCALA), located on the University of Essex’s campus. In total, these experiments involved 51 participants, of which 10 were wheelchair users (20%) and the remainder (80%) were not wheelchair users [5]. Further details about the participants are included in the online supplementary material.

In each of the three studies, we asked participants to browse through a gallery space however they wished while wearing a mobile eye tracker (SMI glasses from SensoMotoric Instruments). Through small cameras, this equipment captures the scene in front of a spectator while also recording an image of the participant’s eyes. Research assistants manually coded the location of each eye fixation on the objects of interest, and we analyzed the frequency of fixations in different sections of an exhibition space. Additional details about the exhibition spaces, including the range of objects on display, are described in the supplementary material.

Building on observations from the experiments at Firstsite and the V&A, our final experiment, which took place at ESCALA, more systematically examined how the sequencing of artworks within a series shaped a spectator’s spatial biases. Participants in this experiment viewed three sets of...
artworks installed in different types of serial arrangements (a grid, a single vertical row or a single horizontal row). We also changed the layout of two sets of artworks between participants to assess what bearing such changes had on viewing patterns. No wall texts or labels were included in this experiment.

After the eye-tracking experiment, participants completed a questionnaire (see supplementary materials) about the display practices and the exhibited objects they preferred.

RESULTS

One basic finding from all three studies was that the height of exhibited objects impacted the viewing patterns of both wheelchair and non–chair users. In tiered installations of two-dimensional objects, such as paintings or photographs, wheelchair and non–chair users alike spent more time inspecting objects installed roughly at eye level; however, non–chair users also spent more time looking at objects installed above and below eye level. As a case in point, consider a display of photographs at Firstsite, where we analyzed the proportion of fixations for different rows of imagery, which we divided into three tiers (Fig. 1). Whereas non–chair users looked at all tiers, with a slight preference for images at the top, chair users spent disproportionately more fixations on the bottom tier. (A chi-squared test demonstrated that the pattern of frequencies for this display was significantly different between chair users and non–chair users \(\chi^2 (2) = 39.8, p = .001\)). We observed roughly similar behavior at the V&A when three-dimensional objects were installed either high on a wall or directly on a ceiling. In an exhibit with a series of roundels by Luca della Robbia on a vaulted ceiling, for instance, nearly all non–chair users looked up at these objects whereas wheelchair users either bypassed the roundels entirely or only cursorily looked at them, opting instead to focus on objects closer to eye level (Fig. 2).

A different spatial bias concerned the depth at which objects were displayed in horizontal display cases. For example, when we counted the frequency of fixations for two display cases at Firstsite (Fig. 3), 77% of chair users’ fixations focused on the front half while non–chair users showed a much more even distribution between front (53%) and back (47%), a difference that was statistically significant \(\chi^2 (1) = 24.69, p < .001\). Qualitative questionnaire responses suggested that this difference probably occurred because items at the back were difficult to see for wheelchair users—an issue that could have been mitigated by placing objects and labels on an incline, as one respondent noted.

In contrast to our experiments at Firstsite and the V&A, where we had participants view objects in displays already configured by a museum, at ESCALA we carried out one of the first systematic eye-tracking study to control for the position of different artworks in an exhibition space (Fig. 4). One general finding: Nearly all non–chair users viewed the works by moving from left to right. This viewing pattern was also evident when participants looked at a single cluster of artworks such as the 20 identically sized photographs by Fernando Traverso, which we installed in five rows of four
images each. Some images attracted more fixations than others, presumably because of specific compositional features that captured a spectator's attention [6]. Yet regardless of such features, almost all non–chair users began by looking at the photographs on the left side and then progressively moving rightward. Wheelchair users, however, showed some deviations from these viewing patterns, with one observer tending to scan top to bottom and another neglecting the top row of images altogether. Figure 5 describes the overall distribution of fixations over time for wheelchair and non–chair users.

One notable aspect of our experiment at ESCALA was that we tested how changes in the sequencing of artworks effected spatial biases. Although all participants viewed a series of three woodcuts by Livio Abramo (Fig. 4, middle) and a trio of small paintings by María Freire (Fig. 4, right), we altered the sequencing of artworks within each series between the visits of different observers so that each image was displayed equally as often in a different position. When the three artworks from each series were displayed in a horizontal row, non–chair users almost always viewed the works from left to right, whereas chair users showed a bias toward the center but with far less consistency in their viewing patterns (Fig. 6). When the three artworks from each series were stacked vertically, non–chair users again demonstrated robust spatial biases, almost always looking at these images from top to bottom (Fig. 7). This pattern cannot be the result of the artworks' formal features, since image order was shuffled between sessions. Rather, the pattern likely reflects a preexisting spatial bias, which participants then extended to the objects on display. Notably, Fig. 7 shows that the wheelchair users tended to start by viewing the artwork lowest on the wall and then moved their gaze upward, displaying a bottom-to-top viewing pattern, but with a center bias. (See supplementary materials for additional statistics.)

DISCUSSION AND CONCLUSIONS

In what follows, we wish to consider how the spatial biases briefly described above nuance our understanding of “normative spectatorship.”

(Non-)Normate Bodies

Our results suggest that the height and depth of exhibited objects may impede a wheelchair user’s viewing experience. Our results also indicate that wheelchair users may even show different spatial biases when looking at a row or column of artworks. Among other implications, such differences raise questions about the implicit assumptions that museums make concerning the bodies of spectators. Since the passage of seminal laws, including the Americans with Disabilities Act of 1990 in the United States and the Disability Discrimination Act of 1995 in the United Kingdom, museums have made considerable strides in improving access for disabled visitors. Yet despite such efforts, exhibition spaces are often designed around the notion of a “normal” spectator: a spectator, for example, who stands at least five feet tall and possesses a reasonable degree of flexibility when moving their head and body in order to see the materials on display. In this respect, exhibition design may contribute to reinforcing what disabilities studies scholar Rosemarie Garland-Thomson has called the concept of the “normate” body—the culturally constructed notion of a “definitive human being” that, precisely due to its constructed nature and narrowly defined profile, draws attention to differences between this mythical body and an array of ostensibly “deviant others” [7].

---

**Fig. 4.** Participant at the Essex Collection of Art from Latin America (ESCALA) viewing photographs from Fernando Traverso’s series 350, Urban Intervention, Rosario (2001). To the right, works by Livio Abramo (middle) and María Freire (far right). (Photo © Ana Varas)

**Fig. 5.** Sequential viewing behavior for a grid of photographs. Heat maps (top row) show the density of fixations for each photograph (“hotter” colors indicate more fixations). Each individual fixation is shown as a dot in the rows below. Fixations are split into four equal time intervals and pooled across all participants from a given user group. (© Michael Tymkiw)
In itself, this observation is hardly a surprise, since normative assumptions about human bodies have long informed the design of the built environment. Yet as interdisciplinary scholar Aimi Hamraie has recently observed, such assumptions cannot be reduced solely to examples of omission and ignorance. Rather, they also cast a spotlight on “ways of making and unmaking the world’s inhabitants through unintentional but accumulated practices” [8]. Within a museum context, such practices manifest themselves in the often subtle display choices made by curators, designers and technicians—choices that are rarely deliberate in their exclusion of disabled visitors but, nonetheless, may result in suboptimal viewing experiences among such spectators. One example is the still-pervasive practice of displaying objects significantly above a wheelchair user’s comfortable viewing height, a practice evident both in the tiered display of photographs at Firstsite and in the V&A’s display of roundels. Another example is the widespread practice of placing multiple rows of two-dimensional materials in horizontal display cases without wedges to improve visibility, a practice that participants encountered at Firstsite.

In pointing out such display choices at Firstsite and the V&A, we by no means wish to suggest that either institution is negligent in making its exhibitions accessible to visitors with physical disabilities. To the contrary, Firstsite’s exhibition spaces are highly accessible on the whole, and the V&A remains one of the U.K.’s most forward-thinking museums for improving access. That said, such display choices do underscore the need for all museums to critically and iteratively improve their approaches for exhibiting objects so that normative assumptions about spectators’ bodies do not inadvertently hinder access for disabled visitors. While the proposal of specific solutions remains beyond this article’s scope, key components upon which any solution depends include additional resources for access initiatives, the more systematic incorporation of wheelchair users and other disabled individuals within the processes for designing exhibition spaces and more widespread sharing of best practices among institutions.

Normative Viewing

While our discussion thus far has focused on how normative ideas about spectators’ bodies contribute to suboptimal viewing experiences among wheelchair users, we now wish to turn to a different yet related aspect of normative spectatorship: the extent to which display practices foster normative viewing behavior.

Across all three sites of our study, non–chair users browsed the objects displayed on a wall or in a display case in a largely systematic manner, from left to right and top to bottom. Since such systematic viewing patterns could have resulted from the formal features of the objects on display, we tested for this issue at ESCALA by changing the position and orientation of two rows of artworks. As noted above, when the artworks were arranged in a horizontal row, the viewing patterns of non–chair users showed a clear leftward bias. In particular, the leftmost object within a given series was typically viewed first and looked at the longest, while objects on the right were more likely to be skipped altogether. While broadly consistent with the findings of previous studies, the leftward bias in this case occurred during the act of viewing a series of artworks rather than a single image or object.
the conditions under which most leftward biases have been studied [9]. As for the top-to-bottom viewing pattern that emerged among such participants when the artworks were arranged vertically, existing scholarship to our knowledge has not yet addressed the biases involved in viewing a vertical series of artworks; however, one likely explanation is that the top-to-bottom pattern reflected learned tendencies from reading and from viewing printed images, web pages and other media [10]. While our experiment at ESCALA focused exclusively on fine artworks (consistent with most previous eye-tracking studies), one question to explore in subsequent research would be whether left and top biases also exist when participants view other types of objects and other modes of installation.

While the biases mentioned above were common among non–chair-using participants, we reiterate that chair users demonstrated more heterogeneous viewing behavior. For example, wheelchair users demonstrated less systematic viewing patterns at ESCALA and the other test sites. They also tended to move around less than non–chair-using participants when viewing a group of objects. Additionally, even if wheelchair users and non–chair users alike privileged viewing objects exhibited roughly at eye level, wheelchair users spent far more time looking at objects closest to them. Taken together, these findings suggest that a spectator’s degree of mobility, viewing height and other bodily features have a considerable effect on spatial biases [11].

Our studies were limited by the sample of participants, so we are cautious in making sweeping generalizations, especially about wheelchair users who may have diverse behaviors and needs. That said, the results reported here do provide a useful point of departure for future studies by drawing some preliminary conclusions about how display practices may shape the spatial biases of spectators when viewing artworks or other objects within an exhibition space. These spatial biases, in turn, nuance our understanding of “normative spectatorship” in two ways. On the one hand, the different spatial biases among wheelchair and non–chair users suggest that normative assumptions about spectators’ bodies continue to inform display practices; on the other hand, the systematic nature of viewing artworks within a series reveals that display practices may encourage certain spatial biases, thereby contributing to normative modes of viewing.

Acknowledgments
We warmly thank all participants in our study, as well as the following staff members and students from the University of Essex who were instrumental in the project’s realization: Sebastian Bustamente-Brauning, Ryan Foutman, Emma Frost, Jana Hess, Jo Harwood, Rowena Macaulay and Ana Varas. We also are grateful to Barry Ganley, the V&A’s Disability and Access Officer, for his help in organizing an experiment at that museum.

References and Notes
1 For simplicity’s sake, we use the term “museums” to describe museums both with and without permanent collections, even if other terms are often used, such as “galleries.”
5 Although our sample size was larger than most mobile eye-tracking experiments, we remain cautious about generalizing these findings, especially given the small number of wheelchair users.
6 For example, previous eye-tracking studies of individual artworks have shown how images of human beings attract attention, as do areas of high color or luminance contrast (see [2]).

MICHAEL TYMKIW is senior lecturer in art history at the University of Essex. He completed his PhD in art history at the University of Chicago. His research focuses on modern and contemporary visual culture, with a particular emphasis on issues of spectatorship.

TOM FOULSHAM is a reader in the department of psychology at the University of Essex. He received his PhD from the University of Nottingham and conducts research into human vision and cognition.