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Inclusive museum audio guides: 'Guided looking' through audio description enhances memorability of artworks for sighted audiences

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Inclusive museum audio guides: 'Guided looking' through audio description enhances memorability of artworks for sighted audiences

Museums aim to offer engaging and memorable visitor experiences, but their visuo-centric bias can prove challenging for people both with and without sight. Audio Description was developed to convey visual information through verbal description to blind and partially sighted audiences. However, cognitive psychology suggests it could enhance memorability for sighted visitors by stimulating 'guided-looking'. In this study, three groups of participants viewed nine photographs from the Museum of London's collections, with either no audio, a standard audio guide or an audio descriptive guide. Enjoyment and emotional responses were similar for all groups. However, one month later, audio participants recalled more photos and were more likely to have re-engaged with the collection. Crucially, audio descriptive guide participants recalled most details about the photos. This suggests that inclusive audio descriptive guides could enhance access and memorability for sighted visitors, as well as expanding crucial access provisions for blind and partially sighted people.

Inclusive design, museums, access, interpretation, memory, visual impairment

Introduction

Museums in the twenty-first century are seeking to become outward looking, visitor focused institutions that engender audience empowerment (Sandell, 2003). As such, they strive to facilitate positive change through social inclusion, at an individual, community and societal level (Sandell, 2003). Despite these ambitious aims, museums are perceived by many as elite cultural institutions which fail to be relevant or representative (Mendoza, 2017). In order to succeed, museums arguably not only need to broaden their audiences to include all sectors of society, but they also need to provide their visitors, both new and existing, with an engaging and memorable experience. It is therefore crucial for museums to expand the ways in which they engage with new and existing audiences in order to meet their social inclusion agendas.

Visitors with disabilities may feel particularly excluded when it comes to museum visiting. Although museums are bound by legislation to offer access to culture (e.g. Americans with Disabilities Act, 1990; UK, Equality Act, 2010), where there is any access provision at all, it often invites disabled visitors to attend specific timetabled access events. This not only requires people with disabilities to present themselves as 'special patrons' (Renel, 2019), it also fails to facilitate independent visiting. Consequently, many disabled people still feel that museums are unwelcoming and largely inaccessible (McMillen & Alter, 2017). One solution is removing the necessity of 'special' provision. Rather, the possibility of creating and embedding inclusive design solutions should be explored. A potential example of this is inclusive audio descriptive guides (Eardley et al., 2017; VocalEyes, n.d.), which draw on the principles of audio description, a practice originally designed for the communication of visual information to people who are blind or partially sighted (BPS), in which visual information is translated into a rich auditory experience through the use of multisensory imagery, spatial positioning and historical context.

For museums to provide a rich and rewarding experience, they must engage visitors who come with a wide range of existing knowledge and interests, preferred ways of experiencing a museum, and varying sensory, cognitive and physical abilities. Nevertheless, despite increasing research and practice interest in the multisensory museum (Levent & Pascual-Leone, 2014), the majority of museums still attempt to engage their visitors through an environment that is primarily visuo-centric. Much museum interpretation is provided in the form of written information in the form of gallery text or artwork labels (Whitehead, 2011) and accompanies the act of looking at a work of art or an object. This reliance on the visual sense has obvious drawbacks for

BPS visitors. However, it also presents challenges for sighted visitors that are two-fold: *where* to look and *how* to look.

Knowing where to direct one's visual attention is challenging in a museum environment which will typically present an array of visual stimuli and stands to overwhelm the visitor (Bitgood, 2013). This tends to lead to what can be characterized as browsing behaviour, where people spend only a very short time in front of any one exhibit or artwork (Smith & Smith, 2001). Smith & Smith's (2001) research in art museums has shown that, even where people have physically stopped at a work of art to look at it, the average time spent looking is only around 17 seconds. This suggests that for many visitors, a visit consists of many quick glances at artworks, rather than a lengthy contemplation of fewer pieces. Smith, Smith, & Tinio repeated this study in 2017, reporting a median view time of 21 seconds. These findings raise the question of how much meaningful engagement can take place in such a short time. Researchers have advocated reducing the number of exhibits that are visible at any one time, to encourage selection, and to urge a general 'controlling of visual access' in exhibition design (Bitgood, 2013, p.164). There is a growing interest in slow looking workshops, which encourage visitors to look closely at just two or three works, allowing them to see things that they might otherwise miss (Brown, 2018; Roberson, 2011; Rosenbloom, 2014; Tishman, 2017). Nevertheless, such slow-looking workshops are currently a specialist rather than a mainstream offering.

Even when a visitor does stop to look at an exhibit, there is variation in people's knowledge about art and objects, and how to explore them visually. Research comparing viewing patterns of visitors who are art experts and non-experts has shown that art experts may scan for composition and form, whereas visitors with little knowledge of art are more likely to be drawn to recognisable features (Koide et al,

2015). As such, although visitors with sight can see a work of art, they may not know how to use that vision to look in ways that draw out its specific cultural or artistic significance, context, or meanings (Koide et al., 2015; Vogt & Magnussen, 2007). It has been recognised that interpretation can support the visitor in recognising significance and deriving meaning from an experience, and that without this support, fulfilment is likely to be low (Bauer-Kroesbacher, 2013). Some visitors may require more support than others. Museum interpretation may be missing out on the opportunity to fully engage the visitor, if it assumes that sighted visitors have the visual literacy needed to direct their attention, in order to access what they are seeing (Eardley et al., 2017).

The function of museum interpretation is to offer support to visitors in their exploration of collections by communicating what curators consider to be significant information about the artwork, the artist, or the cultural context in which it was produced (Serota, 1996). Interpretation should support engagement with collections by inviting audience participation, arousing curiosity and helping visitors connect to meanings (Gross & Zimmerman, 2010). Ultimately, it should link tangible displays (that can be perceived) to intangible meanings, and help people to learn new things or to confirm things they already think they know (Bitgood, 2013), as well as developing thoughts and ideas (Gross & Zimmerman, 2010).

Audio interpretation, in the form of audio guides, is one form of interpretation that does not expect visitors to rely entirely on vision. Audio guides are available in nearly all mid-size and large museums, either built into the ticket price or for an additional cost (Proctor & Tellis, 2003). Conventional audio tours provide short bursts of information, typically 180 seconds per ‘stop’ (Aoki et al., 2003), and they have been shown to impact positively on visitor behaviour. Empirical studies with quantitative measures are rare, but one such study compared the behaviours of 42 students, half of

whom visited the museum with an audio guide and half with no supplementary materials (Sung, Yeo-Ting; Chang, Kuo-En; Lee, Yi-Hsuan; Yu, 2008). Observational data showed that the students with the guide stayed longer at exhibits and displayed more inquisitive behaviours than those without. Researchers have also observed that audio guides can help to draw attention to aspects of a display or setting that may otherwise go unnoticed, with one study observing that visitors crossed a large room to examine a detailed carving on a fireplace that was mentioned on the guide (Woodruff, Aoki, Hurst, & Szymanski, 2001).

Psychological theories of levels of processing (Craik, 2002; Craik & Lockhart, 1972; Ekuni, Vaz, & Bueno, 2011) may help to explain some of the benefits of audio guides to visitors. Processing of a stimulus can occur at different levels, ranging from 'shallow' processing, which is based on the perceptual experience (colour, form, brightness, loudness etc) to 'deep' processing, whereby the stimulus incites personal analysis of meaning, inference and implications (Craik, 2002). Deeper processing is associated with increased memorability of the stimulus, both in working memory and autobiographical memory (Ekuni et al., 2011). In the museum context, perceptual presentation only (visual exploration) may result in 'shallower' processing. Conversely, where interpretation is provided, the user may be able to interweave information about the stimulus with their existing knowledge, thereby resulting in semantic or 'deeper' levels of processing.

However, audio guides have also been subjected to various criticisms. Headsets are said to impede the visitors' interaction with companions and with the museum environment (Aoki et al, 2002). This has historically led to concerns that audio tours can lock visitors into isolated experiential 'bubbles' (Aoki et al, 2002). Other criticisms have been raised regarding audio guides and their isolating effect (Aoki et al., 2003;

Bauer-Krösbacher, 2013; Lee, 2017) and it has been suggested that they hamper the visitor's ability to enjoy the exhibits with full independence of thought (Bauer-Krösbacher, 2013). Audio guides have also been criticised for being too detailed or distracting (Bauer-Kroesbacher, 2013).

Furthermore, standard audio guides do not provide adequate access for BPS visitors, because there may be limited description of the visual details of the object or artwork. Access is typically provided instead through audio description (AD), either in the form of a recorded guide or delivered in a live tour. AD has been defined as a verbal commentary which provides visual information for those unable to perceive it for themselves (Fryer, 2016). In museums, AD describes the visual appearance of artworks and objects, including information such as colour, contrast, shape and form. It may also provide factual, contextual or historical information to accompany and enrich the description of visual features. The key difference between audio description and a standard audio guide is that the audio description systematically describes visual elements and the spatial relationships between them in order that a blind user may create mental images of the object. In contrast, while audio guides may refer to prominent visual aspects of the work they are addressing, they do not systematically guide the user's eyes from one detail to the next. Analysis has shown that the prevalence of spatial and visual positioning words is correspondingly lower in audio guide texts compared to AD texts (Jiménez Hurtado & Soler Gallego, 2015). Correspondingly, practitioners distinguish between audio guides and audio descriptive guides, emphasising that their content differs (VocalEyes, n.d)

There are compelling reasons why AD may provide benefits to sighted museum visitors, a possibility which is as yet unexplored through empirical research, although practitioners report benefits (Eardley et al., 2017). Functioning as a kind of 'guided

looking' (Eardley et al., 2017), AD may help people to direct, and importantly, prolong their visual attention. Traditional audio guides may require the visitor to attend to competing visual and auditory information, thereby raising the possibility that they divide attention and increase cognitive load. In contrast, AD could provide congruent visual and auditory stimuli to sighted people, as the nature of audio description would mean that users' eyes would be guided to a visual feature by way of the verbal explanation, which is delivered aurally. This may reduce cognitive load, enhancing memorability, as congruent stimuli are known to increase later recall (Kim, Seitz, & Shams, 2008). Indeed, psychologists advising museum practice have emphasised the importance of semantic congruence in museum interpretation (Ward, 2014).

There are other features of AD which suggest it could stimulate engagement levels even above and beyond those of traditional guides. Firstly, AD has the potential to create a multisensory experience through its use of rich sensory imagery (Hutchinson & Eardley, in press.), which would stand to increase memorability in sighted and blind people alike (Eardley & Pring, 2006). Secondly, it could provoke emotional and cognitive responses not only through the information it presents, but also its use of cognitive prompts and narrative (Hutchinson & Eardley, in press.). Creating a story is known to help recall of content (Bellezza, Richards, & Geiselman, 1976), as this is thought to help to organise ideas during encoding (Craik, 2002). In short, the techniques inherent to AD and its potential effect on sighted visitor attention might impact positively on the nature and level of engagement for sighted visitors, and the resulting memorability of the experience.

This study therefore sought to compare three ways of experiencing an exhibition of photographs taken from the Museum of London's collections. Firstly, through vision only, with minimal text labels, thereby replicating a typical experience of a museum's

permanent collections. Secondly, through viewing the artworks whilst listening to a standard audio guide (SAG), which provides factual and contextual information. Thirdly, through viewing the artworks with an audio descriptive guide (ADG), which guides the viewer's attention around the image, builds a narrative, employs multisensory imagery and also provides semantic information. This study takes a longitudinal approach and uses memorability as a basis for exploring impact. In so doing, it builds on the literature that explores museum memories as a means to evaluate the museum experience (Anderson, Storksdieck, & Spock, 2007; Anderson, 2003; Anderson & Shimizu, 2007b, 2007a; John Falk & Dierking, 1990, 1997; Hutchinson, Loveday, & Eardley, 2020; Medved, Cupchik, & Oatley, 2004; Medved & Oatley, 2000). It also employs multiple measures to address engagement, such as attention, enjoyment, interest, and emotion.

Participants' experience and levels of engagement are thus evaluated both immediately after the event (time A) and one month later (time B). Furthermore, participants' memories of the artworks are evaluated in order to compare the number and richness of the memories that result from the three different exhibition experiences. The study brings these aspects together in order to address the following research questions: firstly, whether audio interpretation (SAG and ADG) would have an impact on the experience and engagement of sighted people, and secondly, whether AD would have a different impact compared to SAG. Impact is evaluated through a series of enjoyment, interest, attention, emotion and memorability measures.

Methods

Design

This was a longitudinal study (time A, time B) with an independent groups design. The

independent variables were time (exit, 1 month) and exhibition experience: no audio (NA); standard audio guide (SAG); audio descriptive guide (ADG). The dependent variables were measures of attention, enjoyment of the experience, desire to reengage with the material and actual reengagement, emotion, memories evoked during the exhibition, audio evaluation measures (for SAG and ADG participants), recall of the photos and richness of recall. Photo recall texts were coded to provide counts for various content detail categories, which were as follows: visual, spatial, event/activity/movement, emotion (perceived emotion of photo subjects) and atmosphere (including nonvisual imagery), participants' reactions (emotions, thoughts, and memories mentioned during photo recall), and semantic recall (socio-historical information/context and information about the photographer). The data were analysed using ANOVAs, but where the data distribution of the DVs was not normal, and normality could not be achieved using transformations, nonparametric tests were applied.

Participants

149 participants were recruited via the University of Westminster's Psychology Research Participation Scheme; the University of the Third Age (U3A), the Museum of London's Friends of the Museum mailing list, and through snowball sampling. Participants were approximately matched for age and gender, and then randomly allocated to one of three conditions: no audio, SAG, and ADG (see Table 1).

	No audio	SAG	ADG
N	52	47	49
Age (mean, SD)	50.29 (25.65)	52.74 (24.76)	52.68 (19.90)
Gender	11 males, 41 females	14 males, 33 females	17 males, 32 females

Table 1: Age, gender, and number of participants (time A), by participant group

A one-way between subjects ANOVA confirmed that there was no difference in age across groups (F (2, 142) =.17, p=.84).

Materials

Photographs

Photographs were selected from the Museum of London's Henry Grant archive in collaboration with their Curator of Photography. Nine photos were chosen that were all: a) taken between 1950 and 1970; b) taken outside; c) black and white; d) containing people, but with a clear focal point (e.g. crowd scenes were avoided); e) considered optimal for the use of multisensory imagery in the texts of the audio descriptions. The photo shown below is an example of one of the 9 selected:

Children playing in the Lido in Parliament Hill Fields, Hampstead Heath, 1957.

© Henry Grant Collection/Museum of London.

Audio Guides

SAGs and ADGs were produced for the study, in consultation with the Museum of London's Curator of Photography and VocalEyes. Both guides included an audio introduction with some biographical information about the photographer and his practice. An excerpt of this information was summarised and presented on the initial slide for the 'no audio' condition. Both SAGs and ADGs provided factual and contextual information. This information was given in a more expanded form in the SAG and was condensed for the ADG, but wherever possible, the same semantic information was presented in both texts. The SAGs referred to some visual features of the photos but they did not systematically guide visual attention in the way that the ADG texts did. All texts were professionally recorded and voiced by a professional audio describer.

The mean (SD) durations in seconds were as follows: SAG: 2 minutes 35 seconds (17.8 seconds), ADG: 3 minutes 41 seconds (26.8 seconds). The ADG texts were necessarily longer than the SAG texts, to allow for the provision of the description as well as equivalent semantic information.

All 9 photographs were presented in a fixed order to participants in a PowerPoint presentation on a laptop or desktop computer with a minimum screen size of 13.5 inches. One photograph was shown per slide. The time participants spent on each slide was logged. For the audio conditions, an embedded Mp3 file accompanied each photo, and commenced playback automatically as the slide was reached. Participants listened through headphones.

Questionnaires

Two questionnaires (time A, time B) were designed for the experiment. One was administered in person after the participants had viewed the photos. The second was emailed one month later, and was completed via a link to the questionnaire hosted on the Qualtrics platform. The questionnaire at both times A and B addressed the participant's experience and engagement levels, with the questionnaire at time B also addressing memorability for the photos.

Demographic information

The questionnaire collected basic demographic information: age, gender, level of education, whether English was their first language. Where English was not their first language, participants were asked to rate their level on a 4-point Likert Scale where 1=beginner/basic, 2=intermediate, 3=competent and 4=fluent. Participants rated their frequency of museum visits over the last 5 years on a 6-point Likert scale where

1=never, 2= once every few years, 3= once a year, 4= once every six months, 5=once a month and 6=once a week or more.

Experience and engagement measures

Levels of enjoyment and engagement were measured through the 7-item motivation scale of the Intrinsic Motivation Inventory (IMI) (Ryan, 1982). Participants also gave likings ratings for the photos on a 7-point Likert Scale, where 1=hated it and 7= loved it. Participants' emotional response was addressed by asking them if they experienced emotion for their favourite photo, and to select emotions from a list, if applicable. They were asked to rate emotions for valence and strength on ten-point Likert scales (where 1= negative and 10=positive for valence, and 1=barely noticeable and 10=as strong as I have ever felt, for strength). The listening experience was assessed through participants (SAG, ADG) evaluating their experience of the audio by rating 4 items about the audio guides on ten-point Likert Scales (1=really hated it, 10=really loved it), namely information, delivery, speed and their enjoyment of it. These audio evaluation measures were repeated at time B.

Memories, Memory Vividness and Mental Imagery

Participant rated their mental images of the photos at time A for clarity on a ten-point Likert scale (1= no image, just know I am thinking about it, and 10= as clear as if I were actually looking at the photo). They also described any memories evoked during the exhibition, and rated their vividness, again on a ten-point scale.

Memorability

The Time B questionnaire asked participants to recall the photos by describing them,

giving as much information as they could. Responses were coded for content (see Design). For example, the memory ‘People enjoying themselves by the river. Tranquillity in the middle of the city’ would receive 2 counts for visual (people, river), one count for emotion/atmosphere (enjoying themselves) and one count for participant reaction (tranquillity in the middle of the city).

Procedure

Participants were all tested in a quiet room with no external distraction, either at the Museum of London, a laboratory at the University of XXX, or in their own home. For the SAG and ADG conditions, participants were invited to check the headphone volume was comfortable, then they were asked to open the PowerPoint presentation when they were ready and to move on to the next image once the audio had completed playback. Participants in the no audio condition were invited to look at the images for as long as they would like to, before moving on to the next. All participants were told that they would have the chance to look again at any of the images at the end of the presentation, and the final slide contained thumbnails of all 9 images which they could use to navigate the photos as they wished. No time limit was set for their exploration of the images.

Once they had indicated that they had seen enough, participants completed a paper questionnaire about their experience. They were then thanked for their time, and reminded that they would receive a link by email in a month’s time to the follow up questionnaire, after which time they would be debriefed.

Results

Participant demographics and time taken to follow up

One hundred and twenty-seven participants responded to both stages of the experiment: no audio=44, SAG=38, ADG=45. Their demographic information is presented below in Table 2:

	No audio	SAG	ADG
N	44	38	45
Age (mean, SD)	51.75 (25.09)	48.79 (25.03)	51.43 (19.95)
Gender	9 males, 35 females	11 males, 27 females	15 males, 30 females
Years of Education: mean (SD)	15.14 (3.98)	15.39 (3.77)	16.33 (3.33)
% of non-native speakers of English	13%	32%	18%
Levels of English of non-native speakers: median (range)	4 (3)	4 (1)	4 (2)
Frequency of museum visits in the last 5 years: median, range)	5 (4)	5 (3)	5 (3)

Table 2: Number of participants and demographic information, by participant group

A one way between subjects ANOVA confirmed no difference in age between groups: (F (2, 122) =.19, p=.83), or number of years of education: (F (2, 120) =1.28, *p*=.29). Kruskal Wallis tests confirmed there was no difference between groups in terms of the level of English of non-native speakers: (chi sq=0.42, df=2, NA N=5, SAG=12, ADG=8, *p*= .81), nor in their frequency of museum visits over the last 5 years: (chi sq= 3.44, df=2, NA N=27, SAG N= 22, ADG N=32, p=.18).

The mean (SD) number of days between times A and B was as follows: NA=32.70 (4.96), SAG=31.61 (4.25), ADG=32.53 (5.61). A Kruskal Wallis test confirmed no differences between groups for the time taken to follow up: (chi sq= 1.26, df=2, NA N=44, SAG N= 38, ADG N=45, p=.53)

Experience and engagement

Participants in the audio groups listened for the duration of the audio introduction and photo descriptions; 25 minutes 18 seconds for the SAG and 35 minutes 10 seconds for the ADG. Participants in the NA group (N=43) spent a mean time of 2 minutes 50 seconds (SD=1 minute 23 seconds) looking at the photos in the first instance (total view time). The frequency of participants who chose to continue to browse the photos is shown in Table 3:

	NA *N=44*	SAG *N*=38	ADG *N*=45
Chose to look again	77% (34)	29% (11)	18% (8)

Table 3: Decision to look further and additional browse time (seconds), by participant group

A series of experience and engagement measures were taken as shown in Table 4 below:

	NA *N=44*	SAG *N*=38	ADG *N*=45
Intrinsic Motivation Inventory scores: mean, (SD)	35.34 (14.84)	38.37 (8.56)	38.31 (9.42)
Likings ratings for the photos: mean, (SD)	5.27 (0.58)	5.43 (0.68)	5.43 (0.66)
Desire to see more photos: median, (range)	4 (probably) (2)	4.5 (2)	5 (definitely) (2)
% of participants who reported experiencing emotion	88%	95%	87%
Number of emotions recorded: mean, (SD)	2.7 (1.42)	3.14 (1.84)	3.19 (1.72)

Table 4: Experience and Engagement Measures, by participant group

Analysis revealed that the three participant groups had broadly similar experiences, in terms of their enjoyment of the photos and their emotional responses and levels of initial engagement. Kruskal Wallis tests confirmed no differences between participant groups in either IMI scores: (chi sq=1.35, df=2, NA N=44, SAG N=38,

ADG N=45), p=.51.); liking ratings for the photos (chi sq=0.089, NA N=44, SAG N= 38, ADG N=45 df=2, p=.64); or desire to see more photos (chi sq= 1.50, df=2, NA N=42, SAG N= 38, ADG N=45, p=.47). A one -way ANOVA confirmed no significant differences between groups for the number of emotions recorded for the favourite photo: (F (2, 116) =1.04, p=.36).

Audio Evaluation measures are presented in table 5 below:

	NA *N=44*	SAG *N*=38	ADG *N*=45
Audio Evaluation Measures (information, delivery, speed, enjoyment), time A: mean, (SD) (maximum score=40)	-	29.66 (8.21)	31.79 (6.76)
Audio Evaluation Measures, time B: mean, (SD)	-	25.22 (9.22)	28.26 (7.91)

Table 5: Audio Evaluation Measures, by participant group

For the Audio Evaluation measures, a mixed 2 (time A, time B) x 2 (participant group SAG, ADG) ANOVA showed a main effect of time: (F (1, 78) =37.64, p<.001), but no main effect of participant group (F (1, 78)=2.05, p=.16), and no interaction effect (F (1,78) =0.219, p=.64), demonstrating that the evaluation scores were lower at Time

B, but there were no differences between SAG and ADG participants in their ratings of the audio guides.

There was, however, a difference in subsequent re-engagement as measured at time B. Participants were asked whether they had thought about the photos or talked to anyone about them since, if they had tried to find out any further information, or engaged further with the museum. In the NA group, 40% gave a positive response to this question, compared to 68% in the SAG group and 60% in the ADG group. A multi-dimensional chi-sq test confirmed that there was a relationship between participant group and follow-up engagement: (chi sq (2, N=125) = 7.37, p=.025), suggesting participants who listened to a SAG or ADG were more likely to have engaged with the content between times A and B.

Memories, Memory Vividness and Mental Imagery

Participants' memories, memory vividness and clarity of mental images were recorded and are shown in table 6:

	NA *N=44*	SAG *N*=38	ADG *N*=45
% of participants who reported memories being evoked	91%	97%	95%
Number of memories evoked: mean (SD)	1.55 (1.55)	1.37 (1.26)	1.73 (1.71)

Memory vividness: median, (range)	8 (9)	9 (5)	8 (8)
Mental image clarity for favourite photo: median, (range)	8 (6)	8 (9)	9 (4)

Table 6: Evocation of memories, memory vividness and mental image clarity, by participant group

Kruskal-Wallis tests confirmed no differences between participant groups for the number of memories evoked (chi sq=0.51, df=2, NA N=44, SAG N=38, ADG N=45, p=.78) or their vividness (chi sq= 0.24, df=2, NA N=38, SAG N= 37, ADG N=41, p=.89).

A Kruskal-Wallis test confirmed there was a significant difference between groups for mental image clarity for participants' favourite photo: (chi sq= 8.15, df=2, NA N=44, SAG N= 38, ADG N=45, p=.017), suggesting that ADG participants reported clearer mental images.

Memorability

The mean (SD) number of photos recalled was as follows: NA: 3.86 (2.10), SAG: 5.46 (2.06), ADG =5.58 (2.37). A one-way ANOVA on photo recall confirmed a significant effect of exhibition experience: (F (2, 123) =8.27, p<.001). Bonferroni corrected post hoc comparisons confirmed a difference between both SAG and NA: mean difference= 1.60, (95% CI: 0.41, 2.78), p=.001, and ADG and NA: mean difference= 1.71, (95% CI: 0.59, 2.84), p<.001). There was no difference between SAG and ADG (p=.808).

The photo recall texts were coded for content details and the mean total details recorded. 10% of the sample was coded by a second, independent rater. The second-coder was given detailed instructions, including examples (available from the corresponding author, upon request). Inter-rater agreement was 92.17% for the sample. Three participants in the NA group followed up but did not recall any photos and so were excluded from the content analysis. The mean (SD) total details recalled were as follows: NA (N=41) 25.24 (17.49), SAG (N=38) 39.45 (22.32), ADG (N=45) 57.31 (43.39). A square root transformation was conducted on the total details variable to render it suitable for analysis by means of a one-way ANOVA, which confirmed a significant effect of exhibition experience: $F(2, 121) = 11.14$, $p < .001$. Bonferroni-Holm corrected pairwise comparisons on the square root transformed variable confirmed that ADG participants recalled more details compared to NA participants, mean difference 2.29 (95% CI: 1.33, 3.25), $p < .001$. ADG participants also recalled more details than SAG participants: mean difference 1.05 (95% CI: 0.7, 2.03), $p = .036$. More details were also recalled by SAG participants compared to NA participants: mean difference 1.24 (95% CI: 0.24,2.24), $p = .032$.

Finally, participants' recall of the photos were scored for detail types. Mean counts by participant group are presented in Figure 1:

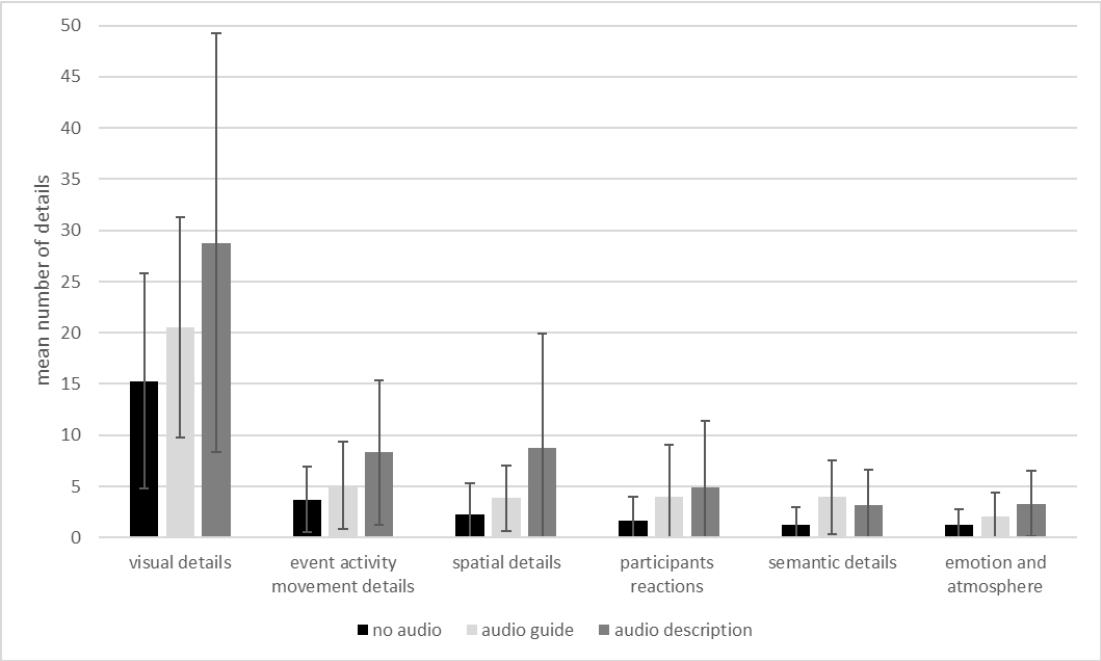

Figure 1: Mean (SD) frequencies of detail types recalled by participant group, at Time B

Figure 1 suggests that content related details (visual details) was the most salient category for all participant groups, with the other categories being comparable in size.

To address the possibility that the richer recall with AD was due to the fact that participants spent longer listening to the ADG than the SAG, a correlation analysis was conducted on the total time spent looking at the photos and the number of details recalled at time B for ADG and SAG participants. It confirmed there was no significant relationship: r_s =0.038, N= 78, p=.74. Therefore, ADG participants' recall of more details could not be attributed to the fact that the ADG audio files were longer in duration.

Discussion

This study sought to explore the impact of AD on the experience of sighted participants, within a museum exhibition context. The study was lab-based, meaning that it did not evaluate AD in an in-situ museum experience. Rather, AD was evaluated in the context

of the experience of an exhibition. Running the study this way allowed us to control the setting and thereby facilitate a deep exploration of AD and its impact when contrasted to standard audio guides or no audio interpretation at all.

Overall, results indicated that the participants' enjoyment and emotional response was broadly similar, regardless of the experience group (NA, SAG, ADG) in which they took part. In other words, neither of the audio experiences enhanced or impinged on enjoyment or emotional engagement. However, memorability findings revealed that participants who listened to audio interpretation in either form recalled more photos than those who just looked. Furthermore, participants who experienced the photos with ADG had richer memories of the photos, compared to either those who had no audio, or the standard audio guide. It is therefore important to explore both the impact of a) listening to audio (either SAG or ADG) and b) the impact of AD specifically.

Standard audio guide, audio descriptive guide or visual exploration alone: similarities and differences in experience, engagement and memorability

At time A, levels of engagement were broadly similar for all participants, regardless of which groups they were in. Enjoyment of the photos and, where applicable, the audio, was similar across groups, as was the desire to re-engage with the subject matter, with all groups expressing a relatively high interest in returning to the subject matter ('probably-definitely'). This is indicative of a broadly consistent level of initial interest across the three participant groups.

It was also evident from the emotional responses to the artworks and the evocation of autobiographical memories that the experience had stimulated cognitive and emotional engagement in the participants across all three groups. The emotional response to the photos and the numbers of autobiographical memories recorded was

similar in all three groups. There were also no differences in the level of vividness of these memories, suggesting that the audio was not interfering with the experience of reminiscing. Thus, these findings do not support contentions in the research literature that audio guides impede independence of thought (Bauer-Krösbacher, 2013).

At time B, it was notable that the pattern of content in the photo recall was broadly similar across groups, with visual details being the most salient. The presence of thoughts, emotions and the recall of semantic information indicated that a level of cognitive engagement took place across all three participant groups. This suggests that a certain level of engagement was possible through visual exploration alone, but this should be contextualised with the fact that an audio experience of the photos impacted more on the lasting memories of the artworks.

The key differences between the participants who listened to audio and those who did not were revealed through the measures of attention, memorability and subsequent engagement (between times A and B). Firstly, the NA group's average interaction with the photos was brief: a mean time of 18 seconds per image at first viewing, which is consistent with observations of museum visitors in situ (Smith & Smith, 2001; Smith et al., 2017). Seventy-seven per cent of 'no audio' participants subsequently wished to look again at the photos, compared to 29% of SAG and 18% of ADG participants. Taken alone, this measure could suggest higher levels of interest in the photos amongst NA participants. However, when considered in conjunction with the other measures, it rather suggests that the initial visual encounter with the photos was felt to be in some way insufficient when it was not supported by audio interpretation. It is possible that the initial brief glance was not enough to access meaning, or a sense of having fully engaged with the photos. This would be consistent with the concept that processing based purely on perceptual experience is a shallower level of processing

(Craik, 2002). The attention data are therefore in accordance with previous research that demonstrated that audio guides help to hold attention, causing visitors to spend longer in front of exhibits (Sung, Yeo-Ting; Chang, Kuo-En; Lee, Yi-Hsuan; Yu, 2008), and that looking alone results in a short viewing time only (Smith & Smith, 2001; Smith et al., 2017). It therefore seems likely that the use of audio altered participants' patterns of attention, as they were encouraged to attend to the images for longer, and that the prolonged attention increased the opportunity to activate representations in memory (Renninger & Hidi, 2015).

Correspondingly, the use of audio interpretation resulted in higher recall of the photos at time B. It could therefore be suggested that the increased recall in the audio groups was due to the increased looking time. However, there was no significant correlation between details recalled and time spent looking. Levels of processing research has shown that further 'shallow' processing (for example, allowing more time on shallow processing tasks) does not increase recall (Craik, 2002). This suggests that it was the depth of processing permitted by the audio guides rather than the sheer time spent that was important. Depth of processing was not measured in this study, except indirectly, through memory. However, increased recall of the photos is suggestive of deeper processing at the time of encoding, and it seems reasonable to suggest that the semantic and narrative information provided in the guides would have supported the creation of connections and meaning, thereby forming memory traces (Ekuni et al., 2011). A more deeply encoded stimulus, involving more memory traces, would provide more opportunities for cues to stimulate later recall (Ekuni et al., 2011; Ward, 2014). Furthermore, the audio guides, through provision of information, would help to integrate the stimulus of the photos into participants' knowledge structure about the world and about themselves. This suggests the possibility that the use of audio could

support processes of elaboration, whereby multiple aspects of meaning of an item are activated and thereby linked into the existing network of semantic associations (Bartsch, Singmann, & Oberauer, 2018).

Furthermore, there were differences between the no audio, SAG and ADG groups in terms of the amount of engagement that took place between times A and B. Participants in the no audio group were less likely than the SAG and ADG participants to have come back to the photos, either in terms of their thoughts, conversations or follow up research. This suggests that additional interpretation increased the chances of sufficient interest developing for participants to later re-engage with the artworks. In other words, this later engagement is indicative of the triggering of interest during the initial encounter with the photos at time A. This is consistent with the literature on the triggering of interest and its relationship with the development of engagement (Renninger & Bachrach, 2015; Renninger & Hidi, 2015), as well as the importance of supporting content for the development of interest (Renninger & Hidi, 2011). It is also consistent with recognition in museum practice that meaning-making, or making sense of experience, is to be achieved through the process of interpretation (Hooper-Greenhill, 2000). It is possible that the re-engagement measures suggest higher levels of interest and curiosity in participants who listened to audio, thereby influencing future behaviour between times A and B. If this were the case, then it may also have contributed to the enhanced memorability, as increased interest is known to enhance memory (McGillivray, Murayama, & Castel, 2015; Renninger & Hidi, 2015), and curiosity has been associated with increased memorability for novel information (Kang et al., 2009).

The impact of AD on the participant experience, engagement and memorability: similarities and differences between SAG and ADG

While the use of audio interpretation (both SAG and ADG) had an impact on the

participants' assimilation over the month between times A and B, it is important to understand where there are similarities and differences between the standard audio guides and the audio descriptive guides, in order to understand fully the potential for AD as inclusive design.

Firstly, the concerns regarding audio guides were not borne out in these findings, as the guides did not have any negative impact on enjoyment. Rather, they appeared to enhance interest as indicated by later re-engagement. Furthermore, the experience measures were broadly similar for SAG and ADG participants. This suggests that using audio descriptive techniques in audio interpretation would create more inclusive materials and that this would not have any negative impact on visitors' enjoyment of the resources.

There were, however, important differences between the SAG and ADG with regards to memorability. While SAG and ADG participants recalled similar numbers of photos, the ADG participants had richer memories of what they had seen, with higher numbers of details. As the correlation analysis demonstrated, the richer memories with ADG cannot be attributed to longer looking time. Rather, there are multiple possible reasons why presentation of the photos with ADG was more memorable than the standard audio guide.

The increased richness of memories may have been related to the 'guided looking' element of the ADG experience. It is possible that the congruent nature of the perceptual information and the semantic information delivered by the guide was able to support recall, with congruence in the presentation of stimuli being known to be important in supporting recall in levels of processing tasks (Craik, 2002). In contrast, traditional guides may stand to present competing auditory and visual information, which differs from the congruence of the ADG experience. Dividing attention is known

to result in shallower encoding, as deeper encoding requires more attention (Craik 2002). This limitation of traditional guides could have led to the SAG texts in this study having less of an impact on memorability than the ADG texts.

Furthermore, when asked to rate their mental images of their favourite photos at time A, there was a difference in clarity ratings between participant groups, with participants in the ADG group reporting a higher average rating. This suggests that there was enhanced initial mental imagery formation in the ADG group. As visual imagery is known to be a predictor for memorability (Greenberg & Knowlton, 2014), this may also have contributed to the increased memorability in the ADG group. Exactly why AD should have led to the formation of clearer visual images initially cannot be determined, but it is possible that the guided looking allowed for a deeper assimilation of the visual content of the photos.

Other, linguistic features of the AD may have impacted positively on memorability, such as multisensory imagery, narrative, and cognitive prompts. These techniques are important in AD (Hutchinson & Eardley, in press.) and were accordingly foregrounded in the creation of the ADG texts for this study. The fact that the AD was embedded with multisensory imagery may have had a part to play in enhancing recall (Chu & Downes, 2000; Eardley & Pring, 2006; Gottfried, Smith, Rugg, & Dolan, 2004). The formation of mental imagery has also been employed as an elaboration strategy to enhance learning (Bartsch, Singmann, & Oberauer, 2018; Dunlosky & Kane, 2007). It is therefore possible that the use of multisensory imagery helped to create a richer imaginary landscape, with more images and associations that could later cue recall of the photo's appearance, content or socio-historical context.

The use of narrative was also important in the AD. Whilst narrative was to some extent present in both sorts of audio texts, the SAG texts focused more on the provision

of semantic information, whereas the ADG focused more on the imagined experience of the photos' subjects, in order to build a story. It is possible that this use of narrative, alongside the use of cognitive prompts in the audio descriptions, may have aroused curiosity or interest, again with positive implications for memorability (Kang et al., 2009). In the museum literature, narrative is understood as storytelling which evokes feelings, memories and curiosity, thereby creating engagement (Nielsen, 2017). It is therefore consistent with such definitions that the provision of narrative and cognitive prompts would be associated with curiosity, increased engagement and memorability in these findings.

This study does not dissociate between the effects of AD on attention ('guided looking') and the features of AD and its language (multisensory imagery, narrative and cognitive prompts), therefore it is difficult to draw any conclusions about which aspects were most important for memorability. It is therefore possible that recall was stimulated in any individual instance by the image alone, the words of the AD, or the image and words in conjunction. However, in terms of developing inclusive museum resources, this question is of theoretical rather than practical importance. As has been observed in the museum literature, the very purpose of meaning-making through interpretation is to create a memory (Nielsen, 2017). These findings suggest the ability of AD to do so to an extent previously untapped by standard audio guides.

Conclusion

This study was the first investigation of the impact of museum AD on the experience of sighted participants. The findings present a positive picture for the future use of inclusive AD in museums for sighted as well as blind visitors, suggesting a strong case

for museums both to increase their audio resources and to incorporate AD in their creation. Making use of audio description techniques in preparation of audio resources would not only adhere to inclusive design principles, and thereby help to create a more inclusive museum environment, but it would also stand to enhance the long-term impact of the museum visit for many visitors. This study looked at recorded AD, but there is also scope to explore the use of audio descriptive techniques in live tours. If AD also has benefits for sighted visitors when delivered live, then its potential as inclusive interpretation would be increased even further. As the museum sector seeks to meet the changing needs of visitors in a post Covid-19 world, these findings have important implications for the creation of online resources. As museums and galleries develop and adapt their online resources to connect with visitors who may be unable or reluctant to return to the museum, using AD as inclusive interpretation could help to ensure that both blind and sighted visitors are given optimal ways to engage and to form lasting memories of their experiences.

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References

Anderson, D., Storksdieck, M., & Spock, M. (2007). Understanding the Long-term Impacts of Museum Experiences. In J. Falk, L. Dierking, & Foutz, S. (Eds.), *In Principle, In Practice: Museums as Learning Institutions* (pp. 198–215). Lanham, MD: AltaMira Press.

Anderson, D. (2003). Visitors' Long-term Memories of World Expositions. *Curator: The Museum Journal, 46*(4), 401–420. https://doi.org/10.1111/j.2151-6952.2003.tb00106.x

Anderson, D., & Shimizu, H. (2007a). Factors shaping vividness of memory episodes: visitors' long-term memories of the 1970 Japan World Exposition. *Memory, 15*(2), 177–191. https://doi.org/10.1080/09658210701201312

Anderson, D., & Shimizu, H. (2007b). Recollections of Expo 70: Visitors' Experiences and the Retention of Vivid Long-Term Memories. *Curator: The Museum Journal, 50*(4), 435–454. https://doi.org/10.1111/j.2151-6952.2007.tb00284.x

Aoki, P. M., Grinter, R. E., Hurst, A., Szymanski, M. H., Thornton, J. D., & Woodruff, A. (2003). Sotto voce. *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, (pp. 431-438). https://doi.org/10.1145/503453.503454

Bartsch, L. M., Singmann, H., & Oberauer, K. (2018). The effects of refreshing and elaboration on working memory performance, and their contributions to long-term memory formation. *Memory and Cognition, 46*(5), 796–808. https://doi.org/10.3758/s13421-018-0805-9

Bauer-Krösbacher, C. (2013). Mobile interpretation at cultural attractions: insights into users and non-users of audio-guides. In R. Raj, K. Griffin, N. Morpeth (Eds.), *Cultural tourism* (pp. 64–73). https://doi.org/10.1079/9781845939236.0064

Bellezza, F. S., Richards, D. L., & Geiselman, R. E. (1976). Semantic processing and organization in free recall. *Memory & Cognition, 4*(4), 415–421. https://doi.org/10.3758/BF03213198

Bitgood, Stephen. (2013). *Attention and Value: Keys to Understanding Museum Visitors*. Walnut Creek, CA: Left Coast Press. https://doi.org/10.4324/9781315433455

Brown, M. (2018). Tate recommends 'slow looking' at major Pierre Bonnard exhibition. Guardian. https://www.theguardian.com/artanddesign/2018/jul/23/tate-modern-slow-looking-pierre-bonnard-exhibition-2019

Chu, S., & Downes, J. J. (2000). Odour-evoked Autobiographical Memories: Psychological Investigations of Proustian Phenomena. *Chemical Senses, 25*(1), 111–116. https://doi.org/10.1093/chemse/25.1.111

Craik, F. I. M. (2002). Levels of processing: Past, present ... and future? *Memory, 10*(5-6), pp. 305–318. https://doi.org/10.1080/09658210244000135

Craik, F. I. M., & Lockhart, R. S. (1972). Levels of processing: A framework for memory research. *Journal of Verbal Learning and Verbal Behavior*, *11*(6), 671–684. https://doi.org/10.1016/S0022-5371(72)80001-X

Dunlosky, J., & Kane, M. J. (2007). The contributions of strategy use to working memory span: A comparison of strategy assessment methods. *Quarterly Journal of Experimental Psychology*, *60*(9), 1227–1245. https://doi.org/10.1080/17470210600926075

Eardley, A., Fryer, L., Hutchinson, R., Cock, M., Ride, P., & Neves, J. (2017). Enriched Audio Description: Working towards an inclusive museum experience. In L. C. Halder, Santoshi, Assaf (Ed.), *Inclusion, Disability and Culture: An Ethnographic Perspective Traversing Abilities and Challenges.* (pp. 195–207). Springer International Publishing. doi:10.1007/978-3-319-55224-8

Eardley, A., & Pring, L. (2006). Remembering the past and imagining the future: A role for nonvisual imagery in the everyday cognition of blind and sighted people. *Memory*, *14*(8), 925–936. https://doi.org/10.1080/09658210600859582

Ekuni, R., Vaz, L. J., & Bueno, O. F. A. (2011). Levels of processing: The evolution of a framework. *Psychology and Neuroscience*, *4*(3), 333–339. https://doi.org/10.3922/j.psns.2011.3.006

Falk, John, & Dierking, L. D. (1990). The effect of visitation frequency on long-term recollections. In S. Bitgood (Ed.), *Proceedings of the Third Annual Visitor Studies Conference* (pp. 94–104). Jacksonville: Center for Social Design.

Falk, John, & Dierking, L. D. (1997). School field trips: assessing their long-term impact. *Curator*, *40*(3), 211–218. https://doi.org/10.1111/j.2151-6952.1997.tb01304.x

Fryer, L. (2016). *Introduction to audio description*. Abingdon: Routledge.

Gottfried, J. A., Smith, A. P. R., Rugg, M. D., & Dolan, R. J. (2004). Remembrance of odors past: human olfactory cortex in cross-modal recognition memory. *Neuron*, *42*(4), 687–695.

Greenberg, D. L., & Knowlton, B. J. (2014). The role of visual imagery in autobiographical memory. *Memory & Cognition*, *42*(6), 922–934. https://doi.org/10.3758/s13421-014-0402-5

Gross, M. P., & Zimmerman, R. (2010). Park and Museum Interpretation: Helping Visitors Find Meaning. *Curator: The Museum Journal, 45*(4), 265–276. https://doi.org/10.1111/j.2151-6952.2002.tb00064.x

Hooper-Greenhill, E. (2000). *Museums and the Interpretation of Visual Culture*. London: Routledge.

Hutchinson, R., & Eardley, A. (in press.). Towards the Accessible Museum: Understanding International Audio Description Practices in Museums. *Journal of Visual Impairment and Blindness*.

Hutchinson, R., Loveday, C., & Eardley, A. F. (2020). Remembering Cultural Experiences: lifespan distributions, richness and content of autobiographical memories of museum visits. *Memory 28*(8), 1024-1036, DOI: 10.1080/09658211.2020.1811874

Jiménez Hurtado, C., & Soler Gallego, S. (2015). Museum accessibility through translation: A corpus study of pictorial audio description. In J. Diaz Cintas, J. Neves, & D. Sanchez (Eds.), *Audiovisual Translation: Taking Stock*. Newcastle: Cambridge Scholars Publishing.

Kang, M. J., Hsu, M., Krajbich, I. M., Loewenstein, G., McClure, S. M., Wang, J. T., & Camerer, C. F. (2009). The Wick in the Candle of Learning: Epistemic Curiosity Activates Reward Circuitry and Enhances Memory. *Psychological Science, 20*(8), 963–973. https://doi.org/10.1111/j.1467-9280.2009.02402.x

Kim, R. S., Seitz, A. R., & Shams, L. (2008). Benefits of Stimulus Congruency for Multisensory Facilitation of Visual Learning. *PLoS ONE, 3*(1). https://doi.org/10.1371/journal.pone.0001532

Lee, S. J. (2017). A review of audio guides in the era of smart tourism. *Information Systems Frontiers, 19*(4), 705–715. https://doi.org/10.1007/s10796-016-9666-6

Levent, N., & Pascual-Leone, A. (2014). *The Multisensory Museum: Cross-Disciplinary Perspectives on Touch, Sound, Smell, Memory, and Space*. Lanham, Maryland□: Rowman & Littlefield.

McGillivray, S., Murayama, K., & Castel, A. D. (2015). Thirst for knowledge: The effects of curiosity and interest on memory in younger and older adults. *Psychology and Aging, 30*(4), 835–841. https://doi.org/10.1037/a0039801

McMillen, R., & Alter, F. (2017). Social media, social inclusion, and museum disability access. *Museums and Social Issues, 12*(2), 115–125. https://doi.org/10.1080/15596893.2017.1361689

Medved, M. I., Cupchik, G. C., & Oatley, K. (2004). Interpretative memories of artworks. *Memory, 12*(1), 119–128. https://doi.org/10.1080/09658210244000441

Medved, M. I., & Oatley, K. (2000). Memories and scientific literacy: remembering exhibits from a science centre. *International Journal of Science Education, 22*(10), 1117–1132. https://doi.org/10.1080/095006900429475

Nielsen, J. K. (2017). Museum communication and storytelling: articulating understandings within the museum structure. *Museum Management and Curatorship, 32*(5), 440–455. https://doi.org/10.1080/09647775.2017.1284019

Proctor, N., & Tellis, C. (2003). *The State Of The Art In Museum Handhelds In 2003*. Museums and the Web 2003, (March 2004), 1–12. Retrieved from http://www.archimuse.com/mw2003/papers/proctor/proctor.html/.www.archimuse.com

Renel, W. (2019). Sonic Accessibility: Increasing Social Equity Through the Inclusive Design of Sound in Museums and Heritage Sites. *Curator: The Museum Journal, 62*(3), 377–402. https://doi.org/10.1111/cura.12311

Renninger, K. A., & Bachrach, J. E. (2015). Studying Triggers for Interest and Engagement Using Observational Methods. *Educational Psychologist, 50*(1), 58–69. https://doi.org/10.1080/00461520.2014.999920

Renninger, K. A., & Hidi, S. (2011). Revisiting the conceptualization, measurement, and generation of interest. *Educational Psychologist, 46*(3), 168–184. https://doi.org/10.1080/00461520.2011.587723

Renninger, K. A., & Hidi, S. (2015). *The Power of Interest for Motivation and Engagement* New York: Routledge. https://doi.org/doi:10.4324/9781315771045

Roberson, D. N. (2011). Free time in an art museum: Pausing, gazing and interacting. *Leisure Sciences, 33*(1), 70–80. https://doi.org/10.1080/01490400.2011.533112

Rosenbloom, S. (2014). *The art of slowing down in a museum*. Retrieved from https://www.nytimes.com/2014/10/12/travel/the-art-of-slowing-down-in-a-museum.html

Ryan, R. M. (1982). Control and information in the intrapersonal sphere: An extension of cognitive evaluation theory. *Journal of Personality and Social Psychology, 43*(3), 450–461. https://doi.org/10.1037/0022-3514.43.3.450

Sandell, R. (2003). Social Inclusion, the Museum and the Dynamics of Sectoral Change. *Museum and Society, 1*(1), 45–62.

Serota, N. (1996). *Experience or Interpretation. The Dilemma of Museums of Modern Art. Walter Neurath Memorial Lectures*. New York: Thames and Hudson

Smith, J., & Smith, L. (2001). Spending Time on Art. *Empirical Studies of the Arts, 19*(2), 229–236. https://doi.org/10.2190/5MQM-59JH-X21R-JN5J

Smith, L., Smith, J., & Tinio, P. (2017). Time spent viewing art and reading labels. *Psychology of Aesthetics, Creativity, and the Arts, 11*(1), 77–85. https://doi.org/10.1037/aca0000049

Sung, Yeo-Ting; Chang, Kuo-En; Lee, Yi-Hsuan; Yu, W.-C. (2008). Effects of a Mobile Electronic Guidebook on Visitors' Attention and Visiting Behaviors. *Educational Technology & Society, 11*(2), 67–80.

Tishman, S. (2017). *Slow Looking*: the art and practice of learning through observation (1st edn). New York: Routledge. https://doi.org/https://doi.org/10.4324/9781315283814

VocalEyes, (n.d.) Museums, Galleries and Heritage: what is Audio Description? *VocalEyes*. Retrieved January 26th, 2021 from https://vocaleyes.co.uk/services/museums-galleries-and-heritage/

Ward, J. (2014). Multisensory Memories: How Richer Experiences Facilitate Remembering. In A. Levent, Nina, Pascual-Leone (Ed.), *The Multisensory Museum: Cross-Disciplinary Perspectives on Touch, Sound, Smell, Memory, and Space* (pp. 273–284). Lanham, Maryland: Rowman & Littlefield.

Whitehead, C. (2011). *Interpreting Art in Museums and Galleries*. London: Routledge. https://doi.org/10.4324/9780203145616

Woodruff, A., Aoki, P. M., Hurst, A., & Szymanski, M. H. (2001). The guidebook, the friend, and the room. In *CHI '01 extended abstracts on Human factors in computing systems - CHI '01*. https://doi.org/10.1145/634067.634229