Spontaneous Memory of Art Exhibitions: Explanations from Eye-Tracking

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Abstract. The experiment here presented differentiated between two spatial strategies of displaying art in order to assess how eye movement (recorded with a mobile eye-tracking device) contributes to the formation of human memories of an art exhibition. Results showed that space allowing its visitors to simultaneously engage with large amount of artworks prevented some participants from forming accurate spatial memories. Lower number of long oculomotor dwells on individual objects was correlated with this phenomena.

1 Introduction

At least two types of memories contribute to our experience of an art gallery visit: memories of the individual objects, and memories of their spatial locations. Multiple studies investigated the impact of the artworks' spatial arrangement on the formation of these memories. Most recent works have emphasised the importance of the area of 'comfortable viewing' defined as the visibility cone restricted to $\sim 60°$ in front of the picture. It has been suggested that these areas naturally 'guide' visitor movement by attracting it to specific parts of the gallery [1] and that deeper cognitive processing of artworks is more likely to occur within these spaces [2]. Other works emphasised the role which co-visibility of multiple pictures plays in human understanding of the exhibition [3] and spatial memory of it [2]. The main aim of the work here presented is to untangle the relations between these two spatial factors.

2 Procedure and Hypotheses

Forty one participants, split into two conditions, explored a non-public art gallery containing 12 pictures hung on pre-defined locations in a sequence randomised for each participant. The visitors were asked to wear a mobile eye-tracking device during their visit and performed two unanticipated memory tests afterwards. *Recognition Test* measured their reaction times for each object seen inside the gallery (presented individually on a computer screen among distracting, novel stimuli). In the subsequent *Miniature Task*, visitors were presented the floor plan of the gallery containing empty artwork locations and asked to arrange all miniaturised versions of the pictures in their recalled spatial order.

Experimental conditions differed by the presence of wall partitions separating the pictures in the gallery. This created two situations in which the variability of possible viewing angles and distances for each visitor-artwork interaction was either broad and flexible, or highly restricted. It also resulted in a different number of pictures potentially co-visible to the visitor at any given time (Fig. 1).

Based on the previous work [2] it was hypothesised, that despite so different spatial environments, *recognition memory* (indicative of the level of processing) will remain similar across the conditions, as the 'areas of comfortable viewing' in front of the pictures were unvaried. It was also expected that Condition 2 will have negative impact on spatial memory due to its higher co-visibility characteristic.

3 Results

Different wall arrangements across the conditions carried the risk of impacting the time visitors spend looking at pictures, thus compromising any claims about its influence on memory. Indeed, participants in Condition 1—which consisted of larger total area of wall surfaces—did spend significantly more time looking at empty walls (Cond. 1: $M = 93.05$ sec., $SD = 30.83$; Cond. 2: $M = 47.48$ sec., $SD = 30.87$; $t(27) = 3.78$, $p < .001$). However, cumulative time spent on viewing each picture on average was similar across the conditions (Cond. 1: $M = 33.92$ sec., $SD = 19.16$; Cond. 2: $M = 34.10$ sec., $SD = 25.78$). This suggests that the visitors in both conditions spontaneously took, on average, almost equal amounts of time to investigate the paintings, despite this being somewhat a 'less efficient' process under Condition 1.

Despite exploring the gallery under very different spatio-visual conditions, the Recognition Test results across the groups did not differ significantly (Cond. 1: $M = 1383$ ms, $SD = 424$; Cond. 2: $M = 1496$ ms, $SD = 489$). This result is in accordance with the hypothesis that deeper processing of artworks during the unrestricted art gallery exploration occurs primarily in the area in front of the pictures. The availability of larger spectrum of viewing possibilities does not seem to contribute to this aspect of the experience.

Participants' performance in the Miniature Task was similar across the groups (Cond. 1: $M = 1.34$, $SD = .70$; Cond. 2: $M = 1.30$, $SD = 0.99$). However, further analysis of scatterplots revealed that—similarly to the previous study [2]—a subset of participants in Condition 2 which involved higher picture co-visibility, performed exceptionally poorly. Thus, despite similar mean scores, this spatio-visual aspect of Condition 2 seems to consistently, negatively impact spatial memory of a noticeable proportion of visitors. Eye-tracking recordings shed more light on this effect.

Observational visitor studies have previously suggested that museum visitors tend to visually scan a picture for up to 10 seconds before deciding whether to spend more time in front of it, or to proceed forward [4]. Based on this assump-

tion, eye-tracking recordings from the current study were classified for dwells[1] shorter and longer than 10 seconds. In result, low number of long dwells would indicate that the visitor tended to prefer a more dynamic viewing behaviour, favouring multiple, but shorter dwells.

As correlation analysis demonstrated, lower performance on *Miniature Task* seems to be linked to this type of oculomotor behaviour. However the effect was only significant in the high co-visibility condition (Spearman's ρ calculated for Cond. 2 = -.59, p = .008; Fig. 2).

4   Discussion

It might seem counter-intuitive that keeping one's eye gaze within the boundaries of a single picture is linked to the viewer's understanding of spatial relation between this, and other pictures in space. In fact, such prolonged viewing means that all other pictures remain at this time out of sight. A speculative explanation of this phenomena can be linked to the fact that a longer visual dwell on a single object in unfamiliar space is highly correlated with suspending (or significantly slowing down) one's whole-body locomotion. Perhaps, in a visually monotonous environment of an art gallery filled with relatively similar stimuli, slowing down and stopping provides an opportunity for more efficient spatial updating. Concurrently, the lack of similar correlations with Recognition Test results and the general similarity of Recognition Test scores across the conditions confirms, that the memory of the object itself is dependent on separate factors from the memory of its spatial location [5].

References

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[1] A single dwell is defined as a series of saccades and fixations subsequently occurring within the boundaries of a single picture. It is a period of uninterrupted visual investigation of a separate artwork.
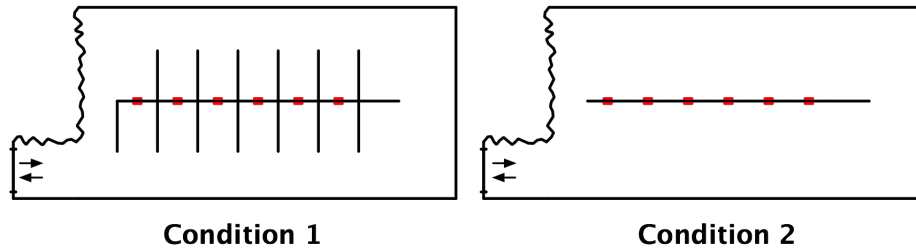
Fig. 1. Spatial conditions arranged in the experiment. Rugged line symbolises a black curtain covering one of the walls in the experimental space; red lines symbolise picture locations. In Condition 1 no single spatial location allowed the visitor to see more than 2 pictures at the same time.
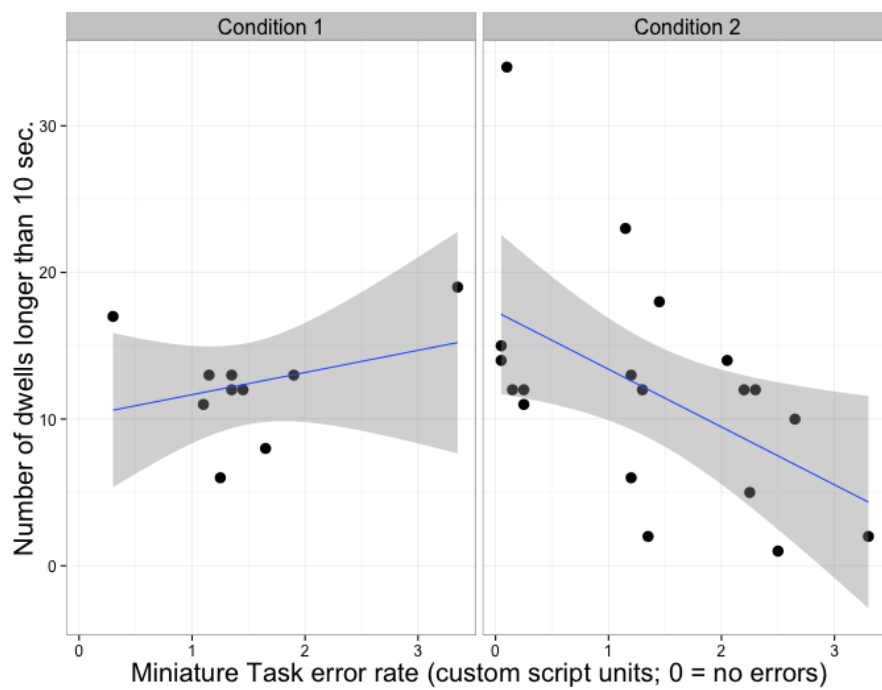

Fig. 2. Relationship between Miniature Task performance and the number of dwells longer than 10 seconds.