Mobile Eye Tracking in (Cultural Heritage) Education – Ideas and Research Agenda[1]

Tsvi Kuflik

The University of Haifa, Israel
`tsvikak@is.haifa.ac.il`

Abstract. Mobile Eye trackers are becoming a commodity. Their price is dropping and more and more vendors produce them. They are not quite a commodity, but they are getting there. Given the price drop and availability, it is time to explore potential uses for these devices. One of the areas where mobile eye trackers were been experimented with is art appreciation. In this position paper, the idea of integrating a mobile eye tracker as an offline as well as online educational aid in art appreciation is presented and a research agenda is laid out.

Keywords. Mobile Eye Tracker, Art Appreciation

1 Introduction

As the cost of mobile eye-trackers is lowering they are becoming widely available, but at the moment, for specific research purposes. Still, it is reasonable to assume that once proved to be of practical value they are going to become commodity and integrated into everyday devices. Some examples for relatively low cost mobile eye trackers are the Pupil-Lab[2] eye-tracker, the iMotions[3] eye-tracker and more, while the Tobii[4] devices mark the high end of both quality and cost of mobile eye-trackers.

For years, eye-trackers were used for studies that tried to use gaze patterns for reasoning about various aspects of users in different scenarios, as surveyed in by Yousefi et al. (2015). The applications that may involve the use of eye-trackers included aviation, marketing, learning, medicine, and other fields, and predicted that such applications would continue to appear. As noted, most existing mobile eye trackers are intended for specific applications and tasks.

Given the availability of relatively low cost mobile eye-trackers and the interest in studying aspects of art appreciation with eye-trackers, we plan to explore the potential contribution of integrating mobile eye trackers into art appreciation education.

---

[2] http://pupil-labs.com/pupil
[3] https://imotions.com/mobile-eye-tracking-lp/
[4] https://www.tobiipro.com/product-listing/tobii-pro-glasses-2/

2 Background and Related Work

Mobile Eye Trackers are becoming a valuable tool in the understanding of users' behavior and differences between processes of visual art appreciation. Eye trackers are not new to the area of art appreciation. Traditionally, high accuracy and expensive stationary eye trackers were used. Massaro et all (2011) used an eye tracker to compare two processes for art appreciation in different conditions.

Quian and pedriera (2011), used a stationary eye tracker and a set of reproductions and modified art works, tried to quantify how subjects look at different art pieces. They found that the fixations of subjects in a controlled experiment followed some general common principles (e.g., being attracted to saliency regions) but with a large variability for the figurative paintings, according to the subject's personal appreciation and knowledge. In particular, they found different gazing patterns depending on whether the subjects saw the original or the modified version of the painting first.

3 Research Agenda

Given the lowering costs and ease of use of nowadays mobile eye-trackers and our previous experience acquired during studies that explored the potential of using mobile eye trackers as a natural interaction device in cultural heritage setting (for details see Kuflik et al. 2018), we decided to embark on a new line of research of exploring the potential use of mobile eye-trackers in art appreciation education. Previous research (Kuflik et al. 2018), conducted at the Hecht museum in Haifa, Israel[5] found out that the conditions of the art gallery wing of the museum are ideal for the use of a mobile eye tracing, given the device's field of view both in elevation and left to right angles, given the visitors' height and their standing distance.

Following the above, the following three-stages study is planned: First, before taking the art appreciation course, students will explore the museum, possibly instructed to visit a few specific artworks while freely moving around. Their gaze patterns when looking at the artworks will be logged as they walk around. Then, during the course, after the students gained some knowledge, the process will be repeated, aiming at discovering changes of behavior of the students, as depicted by changes in their gaze patterns. We hope to be able to find significant differences showing the knowledge they gained as for how to observe a painting. Finally, assuming the second step proves to be successful, we will explore the potential of tracking students' behavior online and providing hints about aspects that are missed while observing paintings.

The study is planned for a two- years duration – exploratory study, data collection and offline analysis in the first year and an online support experimentation during the following enactment of the course during the following year.

Following the suggestions of Jacob and Karn (2003) that presented a list of promising eye tracking metrics for data analysis, we will try to consider:

---

[5] http://pupil-labs.com/pupil

- Gaze duration—cumulative duration and average spatial location of a series of consecutive fixations within an area of interest.
- Gaze rate—number of gazes per minute on each area of interest.
- Number of fixations on each area of interest.
- Number of fixations overall.
- Scan path—sequence of fixations.
- Number of involuntary and number of voluntary fixations (short fixations and long fixations should be well defined in terms of millisecond units).

We will try to consider all the above in order to characterize visitors' gazing behavior at an art gallery as part of the above-described study.

For experimentation we plan to use the Pupil-Lab mobile eye tracker, as we already used it in the past and gained some experience in using it in an indoor CH setting.

4   References

1. Gartus, A., Klemer, N., & Leder, H. (2015). The effects of visual context and individual differences on perception and evaluation of modern art and graffiti art. Acta psychologica, 156, 64-76.
2. R.J.K. Jacob, K.S. Karn, (2003) Eye Tracking in Human–Computer Interaction and Usability Research: Ready To Deliver the Promises, Elsevier Science BV.
3. Kuchinke, L., Trapp, S., Jacobs, A. M., & Leder, H. (2009). Pupillary responses in art appreciation: Effects of aesthetic emotions. Psychology of Aesthetics, Creativity, and the Arts, 3(3), 156.
4. T. Kuflik, M. Mokatren and I. Shimshoni, (2018). Exploring the potential of mobile eye tracker as an indoor intuitive pointing device: A case study in cultural heritage. Future Generation Computer Systems, 81:528-541.
5. Kuchinke L, Trapp S, Jacobs AM, Leder H. Pupillary responses in art appreciation: effects of aesthetic emotions. Psychol Aesthet Creat Arts 2009;3(3):156.
6. Locher P, Krupinski EA, Mello-Thoms C, Nodine CF. Visual interest in pictorial art during an aesthetic experience. Spat Vis 2007;21:55–77.
7. Locher, P., Krupinski, E., & Schaefer, A. (2015). Art and authenticity: Behavioral and eye-movement analyses. Psychology of Aesthetics, Creativity, and the Arts, 9(4), 356.
8. Massaro, D., Savazzi, F., Di Dio, C., Freedberg, D., Gallese, V., Gilli, G., & Marchetti, A. (2012). When art moves the eyes: a behavioral and eye-tracking study. PloS one, 7(5), e37285.
9. M. Pelowski, P.S.Markey, M. Forster, G. Gerger, H. Leder. (2017) Move me, astonish me...delight my eyes and brain: The Vienna Integrated Model of top-down and bottom-up processes in Art Perception (VIMAP) and corresponding affective, evaluative, and neurophysiological correlates. Physics of Life Reviews 21:80–125
10. Quian Quiroga, R., & Pedreira, C. (2011). How do we see art: an eye-tracker study. Frontiers in human neuroscience, 5:98.
11. Villani, D., Morganti, F., Cipresso, P., Ruggi, S., Riva, G., & Gilli, G. (2015). Visual exploration patterns of human figures in action: an eye tracker study with art paintings. Frontiers in psychology, 6, 1636.
12. M.V. Yousefi, E.P. Karan, A. Mohammadpour, S. Asadi, (2015) Implementing eye tracking technology in the construction process, in: 51st ASC Annual International Conference Proceedings, 2015.