RESTORED PAINTINGS AND VISUAL PERCEPTION: A PROPOSED PROTOCOL TO STUDY EMOTIONAL AND COGNITIVE INVOLVEMENT IN ART

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Abstract – In this ongoing study we are interesting in investigating visual skills, cognitive understanding of an artworks and the observers' brain response to the aestetic perception of the artwork. The study will involve a wide number of participants to the experiment, making our investigation a unique occasion to confirm data and outcomes from previous works described in literature.

INTRODUCTION: AIMS AND MOTIVATION

For some year neurosciences have begun to take an interest in art to try to understand the neurobiological bases of artistic production and to know which neurophysiological networks allow us to grasp how "beautiful" and/or "pleasant" or "unpleasant" and/or "ugly" a painting, a sculpture or an architectural work is.

Every time an aesthetic judgment is formulated, different areas of our brain are activated. The techniques of recording cerebral electrical activity (EEG, Electroencephalography) and the modern neuroimaging techniques (as Functional Cerebral Magnetic Resonance) allow to investigate what happens in the brain of people who observe an artistic work. If a "pleasing" work enters our field of vision, for which we formulate a positive aesthetic judgment, the medial orbital-frontal area is activated, together with the occipital cerebral areas designated for vision [10, 9]. If, on the other hand, our aesthetic judgment is negative, the left motor cortex is activated [8]. Finally, if we remain indifferent, the lower part of the cingulum and the parietal cortex enter into action [16]. Different areas are also affected when the subject of the artistic work changes: landscapes, portraits and faces, still lives or objects activate different areas, as if each type of representation corresponded to a different cerebral "micro-conscience"[15].

In this field, the neurology of art or neuroaesthetic, as named by Semir Zeki [20, 12], represents an approach that considers the artistic-aesthetic analysis as a function of the neurological impact and the neurophysiological study of the work of art. Many information has now been acquired in this area, but often these studies investigate only some functional and neurophysiological parameters and are conducted on a limited number of people.

In this context, our study, developed by CESPEB (Centro studi sulla Storia del Pensiero Biomedico) of the Università di Milano-Bicocca with the involvement of his Neuroaestetic Laboratory, born from interdisciplinary collaboration between Department of Phylosophy of the Università degli Studi di Milano and Department of Medicine and Surgery of the Università degli Studi di Milano-Bicocca, has a double aim: as first, to confirm the outcomes from previous researches through a significantly wider data sample; then, we also aim to add a series of investigations usually not used in research. Indeed, the project includes a first phase during which the already known data reported in the literature as related to the vision of pictorial works using non-invasive easy-to-use tools will be taken back to obtain more reliable quali-quantitative indicators.

Sometimes visitors cannot look at and understand a restored artistic exhibit displayed in a museum. Looking is a learned skill [17, 18, 19, 2, 21] that is neither innate nor spontaneous. In this paper, as previously mentioned, we introduce a promising approach consisting of analysing subjects' brain signals collected by an EEG-based device. The approach is currently in use in our *in fieri* project concerning museums and art exhibition in Lombardy Region.

In next paragraphs we will introduce the protocol in use and a discussion about our choices, in the light of the outcomes we expect from the study.

BACKGROUND

In our study we are interesting in investigationg visual skills, cognitive understanding of an artworks and the observers' brain response to the aestetic perception of the artwork.

To collect data useful to analyse these aspects we chose to use some devices and methods, better described in next paragraph about the adopted experimental protocol. Specifically, we chose to use Brain Computer Interfaces (BCIs) and an eye tracker to analyze brain data and visual skills related to the emotional and aestetic impact of an artwork on observers and the priming methodology to investigate their cognitive response. We also aim at using data coming from the measurement of the skin conductance, collected while individuals are looking at an artwork.

As visual literacy experts state [3, 4, 13, 14], visual skills are not to be confused with vision, colour vision, disease, and various anomalies. *Visual perceptual motor skills* and *ocular motor skills* are the main visual skills categories. These skills are developed after birth. Visual perceptual motor skills process visual information and affect eye/ body movements. They encompass abilities such as visual memory, visual-spatial skills (e.g., mapping locations), visual analysis (e.g., discrimination), visual-motor coordination, visual-auditory integration (e.g., matching sound and image), and visualization. Ocular motor skills involve eye movement control and focus control.

A work of art is composed of different layers of meanings including also the restored version of the object. How can we understand these meanings?

According to Angela Lawler and Susan Wood [11] there are five steps which teach people how to look at art. We have adapted this methodology to the observation of restored artworks.

The first step is to *observe* artworks in silence, secondly time it is taken to *describe* the artwork objectively. The third step *analyses* contents, such as colour, balance, space, line, value, and technique. The fourth step tries to *interpret* the works of art exploiting what museum-goers know and have seen. Finally, museum-goers try to make a critical judgement of the artwork. Judging art requires fair and logical consideration. Angela Lawler and Susan Wood recommend taking time, because *reading* art is a slow, thoughtful, and exciting process of discovery.

There is a final step we would like to add in order to foster visual skills: comparing the artwork before and after the restoration, asking the visitors to list the diversities between both pictures (the restored one and a picture of the artwork before the restoration).

THE PROTOCOL

The ability to analyse the formal qualities of a restored artwork is an important step of the art-making process understanding, depending on several factors and involving visual skills, the brain response to stimuli [5, 6, 7] and the body related reaction to such perceptions. Here is a streamlined example of a tentative method of collecting artwork-related visual skills data through the collection of different brain and body response.

The approach

We decided to adopt an ecological approach, that is we decided not to isolated the individuals from the environment. Specifically, we chose to collect data while individuals submitted to the experiment are visiting a Art exhibition so that we could collect real response to stimuli from artworks in a real environment, also influenced by distracting factors, noises, fatigue due to the tour. Indeed, we intend to analyze a real scenario, that is the condition in which individuals usually look at artworks.

The data will be collected on a selected number of paintings, specifically ten, and in conditions of spontaneous and "guided" vision, allowing us to elaborate fundamental information to understand the neurobiological mechanisms involved in the neuroaesthetic perception.

Participants to the experiments

A population of several hundred people will be studied, namely, a large number of visitors to temporary exhibitions and permanent art museums in Lombardy Region. The sample will be composed by individuals of different nationality, sex, age and education level, so that we could have a large set of data to perform our analysis and comparisons.

Materials

During the vision of the paintings the skin resistance will be recorded to know the neurovegetative involvement of the subject, the eye movements with an eye-tracker, which highlights the parts of the work most observed by the visitor, and the brain electric activity with an EEG-based Brain Computer Interface (BCI) headset [1] to observe the changes of the electric activity in brain areas solicited and activated by the vision of the masterpiece.

Because of the ecological approach we chose to use easy-to-wear devices, such as:

- the Pupil headset for the eyetracking (https://pupil-labs.com/store/);
- the Mindplay (http://mindplay.com/) EEG-based BCI;
- tools developed using the bitalino (https://bitalino.com/en/) to measure the skin conductance and possible other biofeedbacks.

All these devices are used during the performed experiment to assess and collect data on the museum-goers' visual skills and emotional/cognitive reactions to the artworks. The listed devices have been chosen because they are low-cost and portable. Also, they can be connected via bluethoot or WI-FI to a computer, so the visitors will be free in movement and not under the effect of anxiety often induces by more complex devices. Moreover, they are perfectly comparable to the performance of medical devices. Indeed, for this latter reaons, they are widely used in research.

Thanks to devices listed above, the participants will visit the museum without any restrictions.

Individuals will be informed about the experiment and provided by a written consent to take part in the experiment.

Also, a questionnaire will be prepared, with the aim to verify what they experienced and what they remember after the visit.

Procedure

At the onset, participants wear the BCI devices and read the instructions which they will then paraphrase back to the experimenter. Participants are asked whether they have any doubts as to what they have to do.

The museum-goers freely observe the restored artwork for 1 minute. Subsequently the experimenter asks each participant separately to describe the artwork without any specific instruction. After that he guides the analyses of the visual features of the restored artwork following a preset list of visual contents such as colour, balance, space, line, value, and technique.

The next step is very delicate since it requires an interpretation of the artwork made by the participant. After collecting the participant's interpretation, the experimenter explains the discoveries made during the restoration in order to give a correct point of view on the basis of scientific results. The museum-goer is invited to try to express a critical judgement of the artwork.

To facilitate the complete understanding of the artwork, the participant is encouraged to look at a copy of the artwork before the restoration and to list the differences between the two pictures (the restored one and a high-resolution picture of the artwork before the restoration).

After the museum exhibition tour, participants, still wearing *Mindwave* in order to collect more EEG signals, complete a questionnaire about the visual features of the corresponding restored artworks. Indeed, at the end of their tour, the participants will be asked to answer some questions about the masterpieces chosen for the experiment in order to check what they remember. This latter step will allow us to analyse also the effect of the priming approach on the visitors' cognitive process.

DISCUSSION AND CONCLUSION

The novelty of the study consists in many points. First of all, a population of several hundred people will be studied, making the project one of the larger experiment ever performed in the field. Also, the ecological approach is very interesting, allowing us to collect data on a selected number of paintings in conditions of spontaneous and "guided" vision, to elaborate fundamental information to understand the neurobiological mechanisms involved in neuroaesthetic perception in a real enviroment. This approach will allow us to obtain important information giving us practical and useful guidelines for exhibitions and museums. Another aspect is related to the new cognitive technologies adopted (EEG-Based BCI headset) and Artificial Intelligence approaches (eye tracking, facial expression recognition) combined with physiological measurements (skin conductance, possible ECG, EMG) allowing freedom of movement to the individuals participating to the experimental sessions.

References

[1] B. Z. Allison, E. W. Wolpaw, J. R. Wolpaw. "Brain-computer interface systems: progress and prospects", *Exper.t Rev. Med. Devices*, 4(4): 463-74, 2007.

[2] M. Baxandall, "Patterns of intention: on the historical explanation of picture", *New Haven: Yale University Press*, 1986.

[3] J. Debes, "The Loom of Visual Literacy", in *Audiovisual Instruction*, 14 (8), pp. 25-27, 1969.

[4] M. R. DeLong, "The way we look: A framework for visual analysis of dress", *Ames: Iowa State University Press, 1987.*

[5] R. Folgieri, L. Dei Cas, F. Soave, C. Lucchiari, "Art in the neuroscience ERA: how the brain understands and creates art", *Proceedings and report,* 111, 90-95, 2016.

[6] R. Folgieri, C. Lucchiari, B. Cameli, "A Blue Mind: A Brain Computer Interface Study on the Cognitive Effects of Text Colors", *Br. J. Appl. Sci. Technol.* 9, 1–11. doi:10.9734/BJAST/2015/17821, 2015.

[7] R. Folgieri, C. Lucchiari, D. Marini, "Analysis of brain activity and response to colour stimuli during learning tasks: an EEG study", *Proc. SPIE* 8652, 86520I–86520I–12. doi:10.1117/12.2007616, 2013.

[8] T. Ishuzu, S. Zeki, " The brain's specialized system for aestethic and percerptual judgment", *Eur. J. Neurosci.,*37, 1413-1420. doi:10. 1111/ejn.12135, 2013

[9] T. Ishuzu, S. Zeki, "A neurobiological enquiry into the origin of our experience of the sublime and beautiful", *Front. Hum. Neurosci.*, 8, 819. doi: 10.3389/fnhum. 2014.00891, 2014

[10] H. Kabata, S. Zeki, "Neural correlates of beauty", *J. Neurophysiol.*, 91, 1966-1705. doi: 10.1152/jn.00696. 2003, 2004

[11] A. Lawler, S. Wood, "Learning to Look. Interdisciplinary Tour*", K-12. Educator's Guide*, 2011. Retrieved 12 April, 2011, from http://museum.research.missouri.edu/pdfs/ LearningToLookGuide.pdf.

[12] L. Lumer, S. Zeki, *La bella e la bestia: arte e neuroscienze*, Laterza, Roma-Bari 2011

[13] L. Nuel, "Art & visual literacy", in *Journal of Visual Verbal Languaging*, fall, pp. 77-79, 1984.

[14] J. Rountree, W. Wong, R. Hannah, "Learning to Look: Real and Virtual Artefacts", 2002. Retrieved 13 May 2011 from http://www.ifets.info/journals/5_1/rountree.html

[15] V. S. Ramachandran, W. Hirstein, "The science of art. A neurological theory of haestetic experience", *J. Conscious. St.*, 6-7, 15-51, 1999.

[16] I. Rentschler, B. Herzbeger, D. Epstein, "Beauty and the Brain", Birkhauser, Basel 1988.

[17] P. H. Rueschhoff, M. E. Swartz, "Teaching art in the elementary school: enhancing visual perception". New York: *The Ronald Press Compan,* 1969.

[18] R. Sinatra, "Visual literacy connections to thinking, reading and writing". Charles C. Thomas, Springfield, 1986.

[19] J. Taylor, "Learning to Look: A Handbook for the Visual Arts". *Chicago: University of Chicago Press,* 1981.

[20] S. Zeki, "La visione dall'interno: arte e cervello", *Bollati Boringhieri,* Torino 2003.

[21] R.E. Wileman, " Visual communicating". *Educational Technology Publications.* N.J: Englewood Cliffs, 1993.