Measuring Experiences of Art in the Museum:

Exploring Methodology for Getting It Right

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Can we measure the experiences of physical and VR art installations? How could that be done? The present research attempts to answer these questions through the use of a multimethod approach to assess every dimension of the experience of art. Wristband and questionnaires have been used as research tools to understand how the experience of art installations in the museum takes place and to study it, through and across two different installations. To examine art experiences in an ecologically valid setting, a pop-up lab was used at the Frankfurter Kunstverein, creating an opportunity to reach the «golden path» for empirical investigation of art experiences and, in the present instance, specific experience of art installations. Two installations have been selected from the exhibition «*The Intelligence of Plants*» (16.10.2021 – 20.02.2022) as single-cases to explore a suitable methodology for the experience of art installations. Both installations were chosen by the

curator Franziska Nori for their shared goal of connecting the observers' bodies with the ones of the giant trees featured in both installations, in order to look for commonalities with other non-human fellow beings. Additionally, both these installations aim at evoking experiences of the sublime in the audience. Sensations, emotions, and thoughts, as well as physiological reactions and movements, partake in these experiences. Data collected with the presented methodology is potentially very rich thanks to the presence of original art installations (rather than their reproductions) over the space and time they are meant to be visited. Data from the questionnaires can be considered ecologically valid, as consisting of accurate subjective reportages of the visitors while actually experiencing the installations *in situ*. The proper measurement of physical and behavioral patterns is however harder to achieve as it relies on biometrics in a real-world setting. To overcome this issue and have more control over the multiple variables that can affect the measurements, a collaboration among disciplines and professionals from the art sector is at the heart of the matter.

Keywords: Virtual Reality, Art experiences, Ecological approach, Sublime.

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1.1 Art Installations: Physical and Virtual

Art installations are works that hold the power to engage the audience and to connect it with the surrounding space, by employing their senses, including sound, touch, sight, and smell. They aim to become part of the audience's body and mind through

multisensory interaction and perception[1]. Artists can use miscellaneous materials to create art installations: traditional media (e.g.: painting, sculpture, natural objects, or man-made ones), new media (e.g.: film, animation, sound, audio), or mixed media. However, regardless the material, what characterizes art installations is their enveloping nature. This type of art products is able to envelop the audience in their inclusive environment (space); to fully engage with an art installation, the audience is expected to have a unified experience of the designed environment with the content attributed to the work.

Art installations can emerge out of two different environments: physical and virtual. The first refers to gallery-based spaces which are often an entire room or hall of a museum. The latter refers to digital or web-based spaces such as the ones created by Virtual Reality (VR, 360° technology, or panorama technology)[2]. The high levels of engagement evoked by physical or virtual art installations can culminate – in extreme cases – with the pure feeling of 'presence', a full immersion state that affects sensory impressions and awareness of observers. This could represent a plausible reason why art installations, specifically those designed through VR, seem to become more and more popular around the globe[3]. These moments of presence are characterized by an immediate sensitivity and they take place below one's absolute threshold for conscious awareness[4]. The audience is affected by art even before being aware of it at a conscious or linguistic level. Presence has been found to be an important characteristic in transcendent encounters that incorporate a sense of awe and sublime[5]. By transcendent encounters, we refer to those that «may be triggered via mechanisms in the brain, but the response lies in areas both more visceral and subliminal than those governing language»[4]. The empirical study of art installations is, therefore, still surrounded by many design challenges.

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[1] S. Sadia. *Empirical Methodologies and the Value of Subjectivity in the Analysis of the Experience of Contemporary Experiential Art*. in "Art & Perception", Vol. 9, No. 1, 2021, pp. 1-20

[2] O. Grau, *Virtual Art: from illusion to immersion* (2001) transl. by G. Custance, MIT press, Cambridge-London, 2003, pp. 2-13

[3] Y. Kim, H. Lee, *Falling in Love with Virtual Reality Art: A New Perspective on 3D Immersive Virtual Reality for Future Sustaining Art Consumption,* in "International Journal of Human–Computer Interaction", Vol. 38, No. 4, 2022, pp. 371-382

[4] M. Tröndle *An integrative and comprehensive methodology for studying aesthetic experience in the field: Merging movement tracking, physiology, and psychological data*. in "Environment and Behavior" Vol. 46, No. 1, 2014, pp. 102-135.

[5] A. Chirico, R.R. Clewis, D.B. Yaden, & A. Gaggioli, A. *Nature versus art as elicitors of the sublime: A virtual reality study.* in "PloS one", Vol. 16, No. 3.

1.2 A multi-method approach for investigating experiences of art installations

The experience of art installations is a complex interplay of different factors. Art installations can evoke responses, ranging from a huge variety of subjective thoughts and feelings, combined with bodily changes and expressive behavior. We can therefore distinguish three dimensions of this experience: semiotic, physiological, and behavioral. When experiencing an emotional event as the aesthetic one, the body is entirely engaged in a kinesthetic experience[6] because «the world we experience comes up at all times with our body as center, center of vision, center of action, center of interest».[7] For this reason, bodily changes (physiological dimension), as well as expressive behaviors (behavioral dimension), have been used as measures of embodied reactions from the audience in museum studies[8]. They can provide information on the autonomic nervous and visuomotor systems of our body interacting with the environment. Once these reactions are above our threshold of awareness, we are able to report our signs or thoughts about the perceived experience, our subjective feelings of emotions, and sensations (semiotic dimension)[9].

The combination of measures for the semiotic, physiological, and behavioral dimensions of the experience of art – hereafter referred to as the multi-method approach – has until now been largely applied for the investigation of 2D visual art such as paintings[10]. Just recently, the interest in using the multi-method approach for studying art installations in an ecologically valid setting, such as museums, is growing. For instance, Tröndle, Kirchberg, and Tschacher[8] recorded body responses such as heart rate (HR) and standing patterns when beholding a physical installation in the museum and answered questions about whether the installation can be considered art or not.

[6] M. Pelowski, M. Forster, P.P. Tinio, M. Scholl, & H. Leder *Beyond the lab: an examination of key factors influencing interaction with 'real' and museum-based art.* in "Psychology of Aesthetics, Creativity, and the Arts", 2017, Vol. 11, No. 3, pp. 245–264.

[7] W. James, L'expérience de l'activité, in Ed., Essais d'empirisme radical. Marseille, Agone (2005). Quoted by Richard Shusterman, Body and the Arts: The Need for Somaesthetics, Diogenes, 2011/1 (n° 233-234), p. 9-29.

[8] M. Burnett & S. Gallagher *4E cognition and the spectrum of aesthetic experience* in "JOLMA", 2020.

[9] B. V., van Heusden *Dealing with Difference: From cognition to semiotic cognition*. In "Cognitive semiotics", 2009, Vol. 4 (Supplement), 116-132.

[10] W. Tschacher, S. Greenwood, V. Kirchberg, S. Wintzerith, K. van den Berg, & M. Tröndle *Physiological correlates of aesthetic perception of artworks in a museum.* in "Psychology of Aesthetics, Creativity, and the Arts", 2012, Vol. 6, No. 1, pp. 96-103.

Later on, Pelowski et al.[11] considered the in-depth exploration of the semiotic dimension in conjunction with behavioral measures via mobile eye-tracking to answer research questions about installation art's emotional, evaluative, perceptual, and meaning responses. In 2021, Gulhan, Durant, and Zanker[12] brought the investigation of gaze patterns of art installations in the museum to a new level. In their study, participants experience both a physical and a VR installation of Piet Mondrian's Neoplasticism room design. After the experiences, they were asked to answer questions about their interest toward the installations and opinions about art. Although the experiment lacked the exploration of the emotional side of the experience that goes beyond the feeling of interest, it examined the potentiality of VR art installation. Lastly, in Kühnapfel et al.'s study participants' movements were recorded by two infrared depth cameras, their eye movements were recorded by eye-tracking glasses, while the assessment of participants' general appreciation of the artwork, emotional and cognitive experience, their art knowledge, and awareness of movement was detected by a questionnaire. [13]

Overall, the studies that favored ecologically valid settings and focused on art installations have been found to have the following shortcomings. First, there has not been a study that achieves a full combination of all three dimensions of experience. Physiological and behavioral data alone cannot provide insight into the semiotic states of the audience; thus, it is necessary to include self-report tools to tap into them. At the time of writing, studies by Pelowski et al. and Kühnapfel et al. were the only ones that took into account the complex emotional and cognitive aspects of the experience of art installations, although overlooking the meaning attributed (semiosis) to them. However, for a fuller understanding of the encounters with art installations, a broader range of physiological and behavioral measurements beyond eye tracking techniques could be included in their studies to determine how and why the experience of art installations develops across different areas of the body. It is essential to combine it with other

[11] M. Pelowski, et al. *Capturing aesthetic experiences with installation art: an empirical assessment of emotion, evaluations, and mobile eye tracking in Olafur Eliasson's "Baroque, Baroque!"*. in "Frontiers in Psychology", 2018.

[12] D. Gulhan, S., Durant, & J.M. Zanker *Similarity of gaze patterns across physical and virtual versions of an installation artwork*. In "Scientific reports", 2021, Vol. 11, No. 1, pp. 1-16.

[13] C. Kühnapfel, J. Fingerhut, H. Brinkmann, V. Ganster, T. Tanaka, E. Specker, … M. Pelowski (2022, April 29). *How do we move in front of art? How does this relate to art experience? Linking movement, eye tracking, emotion, and evaluations in an ecologically-valid gallery setting*. Pre-print available online on PsyArXiv.

quantitative and qualitative research techniques[14] to balance out the limitations of each method. For instance, eye tracking can show that a visitor spent more fixating time on a specific element of the installation, but it will not indicate the reason why this happened. On one hand, the visitor may have been fixating a specific element because they needed time to understand what exactly they were perceiving. On the other hand, they could have been focusing on that point out of amusement rather than mere confusion. It is important to combine mixed techniques to understand correctly the results. A combination of eye tracking with a HR monitor could allow, for example, for measuring the arousal of the emotion behind the experience as a plausible and physiological cause of the eye fixation. This would contribute to providing numerical evidence to the idea that the eye fixation occurred because of emotional processing. To discern whether that specific point of fixation evoked a positive or negative meaning, or a memorable reflection to the visitor, the research design should include tools for descriptive information such as self-reports and interviews. Hence, a more complete picture of the experience can emerge by adopting a multi-method approach.

Furthermore, as noted by the artist-researcher Sadia Sadia[4], none of these studies included art installations with moving images and sound, soundscapes, or darkened environments. These elements, typical of contemporary experiential art installations, would presumably enhance the semiotic and bodily responses of the audience. Additionally, the only study including the investigation of a virtual environment is the one by Gulhan, Durant, and Zanker[15]. However, it compares a physical art installation designed by an artist with a VR reconstruction which, although based on the same room design, was developed by the research team without artistic interpretation or intentions. The study compared the experience of an art installation and its virtual reproduction in VR but it does not necessarily provide deductions about the experience of a VR art installation, therefore leaving the analysis of the features characterizing this type of exploration an open challenge.

1.3 Scientific and theoretical background: the sublime

VR can distort or extend the human perception, which is bounded by space and time, and, thanks to it, the audience can be thrown into spectacular sceneries. This allows the

[14] N. K. Denzin, & Y.S. Lincoln, *The SAGE handbook of qualitative research* (3rd ed.), 2005, Thousand Oaks: Sage Publications.

audience to experience, for instance, the magnitude of trees or the limitlessness of galaxies even in confined spaces such as a lab or the hall of a museum.[9] For this reason, VR has often been used for the scientific investigation of feelings of awe and sublime, elicited by nature.

Sublime experiences are indeed been largely associated with natural environments[15]. Sublimity can then be described by paradigm cases of natural objects or phenomena, possessing aspects at the limit of human imagination such as enormous size, great height, vastness, or tremendous power. These characteristics may result in the experience of an intense semiotic response (i.e.: subjective feelings and bodily sensations underlying emotional states). The emotions inspired by sublimity are often a mix of feeling overwhelmed, anxious, and physically small as well as exciting pleasure and admiration.[16] Moreover, the admiration felt during sublime experiences evoked by nature can induce the audience into a perspectival shift of self into other beings, leading them to potentially increase their respect for nature because of its new perceived qualities[17]. This theoretical standpoint moves away from Kant's human-centered sublime[18], towards a more contemporary position of the environmental sublime. Therefore, the feeling of the sublime is – among all the reactions that art can evoke – the one that seems to deliver the strongest responses due to the formlessness of its experience. These reactions expose a connection to something physically and metaphysically grander than us, as nature can be. This aligns nicely with the vision at the heart of the exhibition and art installations selected for the present study in particular.

Sublime is intrinsically tied to emotions, imagination, and the sense of physical vulnerability of the audience[19]. Stamatopoulou, Lang, and Cupchik suggest that the sublime emerges as a «compact dynamic interaction» of a semiotic embodied experience towards evocative, yet not necessarily beautiful nor positive-valenced,

[15] E. Brady *The sublime in modern philosophy: Aesthetics, ethics, and nature*. Cambridge University Press, 2013

[16] L.C. Bethelmy, J.A. Corraliza. *Transcendence and Sublime Experience in Nature: Awe and Inspiring Energy*. In "Frontiers in psychology". 2020, Vol. 13; pp. 1-5.

[17] C. L. Oravec, *John Muir, Yosemite, and the sublime response: A study in the rhetoric of preservationism* in "Quarterly Journal of Speech", 1981, Vol. 67, No. 3 pp. 245-258.

[18] Kant, I. (1790). *Kritik der Urteilskraft*, Lagarde & Friedrich.

[19] J. I. Porter, *Is the Sublime an Aesthetic Value?* In "Aesthetic Value in Classical Antiquity", 2012, Leiden, The Netherlands: Brill.

stimuli.[20] The semiotic dimension of the experience of the sublime is characterized by a reflective engagement that might be given form and expression through a work of art, explaining why the sublime calls for art. That is, a subjective empathy reception process, where the individual feels increased self-reflection and self-awareness, as well as strong connectedness and closeness to the stimulus itself. According to Konečni, sublime-related experiences deeply move from within[21]. The physiological and behavioral dimensions of these experiences stand out for the responses of the audience of being physically moved, accompanied by (physiological) thrills and chills. Thus, movements and motion accompany sensations and emotions, and they are all at the core of transcendent experiences.

Although states of awe have been found to be frequently associated to the contemplation of artworks[22], Brady argues that art is not fully capable of eliciting sublimity.[23] According to her view, paintings cannot easily deliver a real sense of sublimity as their form is physically constrained by frames and canvases. They cannot capture the mathematical (i.e.: no definite size and scale) or threatening qualities (i.e.: disorder, wildness, physical vulnerability) of the experience of the sublime and, in turn, they can only partially convey it to the audience. Nonetheless, Brady points out few exceptions, such as land art and architecture, hinting the relevance of the type of medium used to express feelings of sublime through art. The reasons why sublime art experiences can constitute an interesting case of investigation are threefold: (1) emotions related to the sublime (awe or wonder) are associated with strong physical and psychological reactions[24]; (2) they are often reported in relation to art encounters, which means their inclusion is crucial; (3) the media used seem to be relevant in the experience of such transcendent encounters.

[20] D. Stamatopoulou, J. Lang & G.C. Cupchik (2019) *Empathy, awe and the sublime: Where aesthetics and ethics meet in experience.* in "Empathy: Past, present and future perspectives", pp. 197-266.

[21] V.J. Konečni *The aesthetic trinity: Awe, being moved, thrills.* in "*Bulletin of Psychology and the Arts*", Vol. 5, No. 2, pp. 27-44.

[22] M. N. Shiota, D. Keltner, A. Mossman, *The nature of awe: Elicitors, appraisals, and effects on self-concept* in "Cognition and emotion", 2007, Vol. 21 No. 5, pp. 944-963.

[23] M. Pelowski, et al. *Capturing aesthetic experiences with installation art: an empirical assessment of emotion, evaluations, and mobile eye tracking in Olafur Eliasson's "Baroque, Baroque!"*. in "Frontiers in Psychology", 2018

[24] A. Chirico, D.B. Yaden *Awe: A Self-Transcendent and Sometimes Transformative Emotion*. in "The Function of Emotions", 2018, Springer, pp. 221-233

2. Methods

Empirical studies focusing on VR often have been using *ad-hoc* designed stimuli and experiences in the lab for control over the experimental setting[25]. This may have led to the study of a different kind of art experience, at least, quite different from the one of real artworks[13] in a real museum[26].

To investigate the latter type of experience, this study used a pop-up lab in the Frankfurter Kunstverein, which is an interdisciplinary exhibition space for contemporary art and culture located in Frankfurt (Germany) to have a natural and ecologically valid setting for an art experience. Moreover, two art installations have been chosen from the exhibition «*The Intelligence of Plants*» at the Frankfurter Kunstverein (16.10.2021 – 20.02.2022) (see paragraph 2.2 for further details).

Participants' experience has been measured via (1) a wearable device enabling us to capture physiological and behavioral data[27], and (2) questionnaires to assess the subjective characteristics of the experience – namely, emotional state, bodily sensations, and feelings. The main purpose of this study was to explore a methodology to measure the experience of physical and VR art installations and how they differ or resemble each other in the semiotic, physiological, and behavioral dimensions. The proposed design will be described first, and subsequently analyzed and discussed. The discussion will unfold on three points: (1) exploration of its advantages and disadvantages; (2) its implications for future empirical aesthetics and museum studies; and (3) its relevance for answering questions of interests of art curators and fulfillment of the goals of artists.

The methodology outlined in the following pages, from the stimuli selection to the measurements taken, represents an effort of setting valid experimental conditions to investigate whether and how the media used for the creation of art installations constitute an influential factor in evoking transcendent art experiences involving sublime. This paper wants to introduce a more realistic approach that allows veracity of investigation of art experiences combining physiological measurements, behavioral ones, and questionnaires to detect objective and subjective information related to the way visitors interacted with the installations. Each of the methods employed is

[25] A. Chirico, D. B. Yaden, G. Riva, A. Gaggioli *The potential of virtual reality for the investigation of awe* in "Frontiers in psychology", 2016, Vol. 7

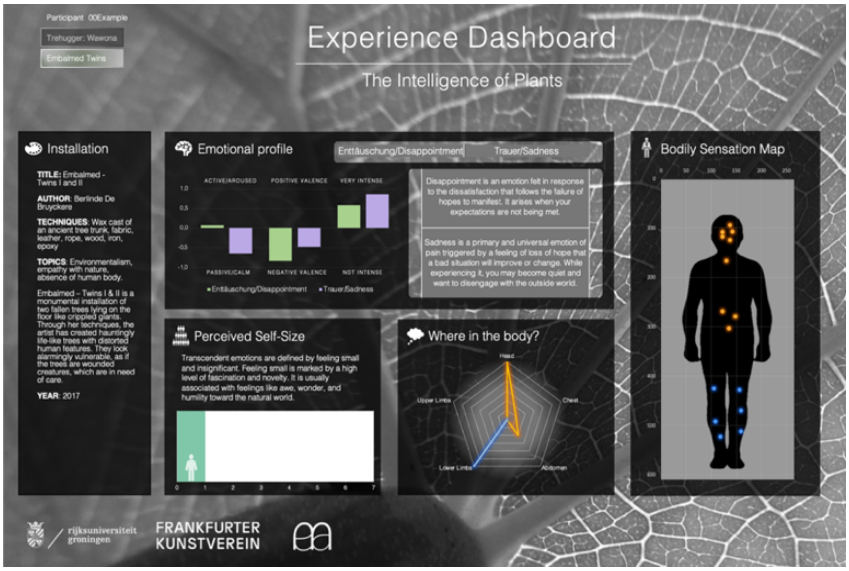
[26] S. Brown & E. Dissanayake, E. (2009). *Neuroaesthetics,* pp. 43-57.

[27] M. Mazzocut-Mis, A. Visconti, H. Tahayori, M. Ceria *Sublime Experience: New Strategies for Measuring the Aesthetic Impact of the Sublime*. in "Imagine Math", 2020, pp. 167-187

complementary to the other, thereby offering a unique in-depth understanding about visitors' overall experience with authentic installations and setting of experience.

Figure 1

Example of Experience Dashboard provided to the visitors who answered the questionnaire.



2.1 Participants

Visitors of the museum could voluntarily decide to participate in the data collection. The recruitment has been advertised on the museum's website beforehand. All participants had normal or corrected to normal vision. Exclusion criteria were balance or vestibular disorders; severe heart diseases; severe cognitive deficits. The experiment was approved by the Ethics Committee Psychology of the University of Groningen (research code: PSY-2122-S-0250) and it was conducted according to the Dutch ethical standards for scientific research. Informed consent has been obtained from each participant. Sixty-five visitors to the Frankfurter Kunstverein participated in the experiment. The investigators explained the benefits which would exist for visitors by participating in the study. This included education about emotions in art encounters and the evaluation of their own experience in the museum through visualization of the

questionnaires by means of an «Experience Dashboard» (see Figure 1). All this would lead them to get additional awareness about their visit to the Frankfurter Kunstverein.

2.2 Art installations

The proposed study used two art installations present within the exhibition «*The Intelligence of Plants*» (16.10.2021 – 20.02.2022) at the Frankfurter Kunstverein, to allow an ecologically valid exploration of art experiences. One of the co-authors of the present paper, Franziska Nori, the director of the Frankfurter Kunstverein and curator of the exhibition, selected the two installations based on their shared focus on awakening empathy with the life of non-human beings and their potential of inspiring connectedness to them as well as feelings of sublime. More specifically, *Embalmed Twins I and II* (2017), a two-sculpture installation made of wax, fabric, leather, rope, wood, iron, epoxy by Berlinde De Bruyckere[3], and *Treehugger: Wawona* (2017), a VR installation by Marshmallow Laser Feast[4]. Both installations then aimed at a transfer of experience from our human self to another being, namely the trees. According to the curators, the art experience of the selected installations leads the visitors to a form of empathy with the trees. The artists addressed this goal using different materials for creating their installations, both of which will be described in more detail below.

2.2.1 Embalmed Twins I and II

Berlinde De Bruyckere's monumental double sculptures were born out of a discovery of two two-centuries-old oak trees that fell due to hurricane Cyrill in France in 2016. Using wax, metal, epoxy, and textiles, the artist created two copies of the fallen trees and translated the emotion of seeing the power of natural forces into sculptural work (see Figure 2).[28] These sculptures make the fallen trees look like universal bodies that could belong either to plants as well as to animals or humans. Bandaged wounds and veins under the bark hint at the different and fragile materiality of the trees. Every detail as well as the material used can plausibly help the audience in empathizing with these fallen creatures.

Figure 2

[28] F. Nori, *Berlinde De Bruyckere*, in "The Intelligence of Plants", 2021, Frankfurter Kunstverein, Frankfurt am Main, p. 57.

Installation view of Embalmed Twins I and II.[29]

2.2.2 Treehugger: Wawona

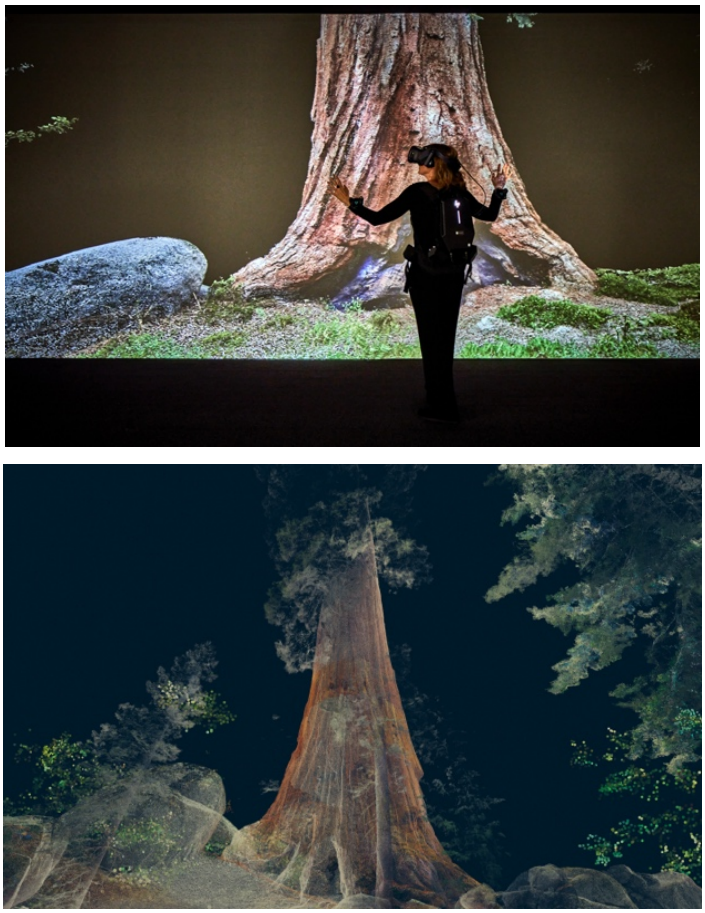
Marshmallow Laser Feast (MLF) produced this multimedia virtual reality installation focusing on one of the oldest trees on the planet, a giant sequoia in the Sequoia National Park in California, USA. The size and age of these trees challenge the limits of human imagination and they could not be fully captured by two- or three-dimensional static artifacts. MLF opted for creating a VR exploration of the giant sequoia. Visitors put on the data glasses and change the human perspective to follow the metabolic cycle of a drop of water on its way into the ground and from there into the roots to the tree crown [30] (see Figure 3). The immersive technology was used to create the impression of the scale of the giant sequoia and facilitate empathic transference.

[29] Berlinde De Bruyckere Embalmed Twins I and II, 2017 installation view Frankfurter Kunstverein 2021 Photo: Norbert Miguletz © Frankfurter Kunstverein Courtesy of the artist and Hauser & Wirth.

[30] F. Nori, *Marshmallow Laser Feast*, in "The Intelligence of Plants", 2021, Frankfurter Kunstverein, Frankfurt am Main.

Figure 3

Installation view[31] *and film still*[32] *of Treehugger: Wawona.*



2.3 Procedure and measurements of experience

The present study was announced online and via mail, so visitors could sign up in advance to participate in the study. Besides, visitors were approached at the museum entrances. There were two options to participate in this study that participants could choose for their own:

A. Participants could choose to fill in questionnaires about their subjective experience of the two installations. They could choose between answering a short version or a longer version of the questionnaires.

[31] Marshmallow Laser Feast Treehugger: Wawona, installation view Frankfurter Kunstverein 2021 Photo: Norbert Miguletz © Frankfurter Kunstverein Courtesy of Marshmallow Laser Feast.

[32] Marshmallow Laser Feast Treehugger: Wawona, 2017 Film still © Marshmallow Laser Feast Courtesy of the collective.

1. Basic (short) questionnaire, including Bodily Sensation Maps[33] (BSMs); Geneva Emotion Wheel[34] (GEW); and Perceived Self-Size scale[35] (PSS).
2. Extended (long) questionnaire, including, in addition to the short questionnaire: two open questions about the content and the meaning of the installations; and two adapted versions of the Inclusion of Community in the Self scale[36] (ICSS).

B. Participants could also choose to wear Empatica E4 Wristband during the experience of the selected installations. This device objectively measures electro-dermal activity (EDA), heart rate (HR), blood volume pulse (BVP), interbeat interval (IBI), and motion-based activity[37]. Afterward, they were asked to answer the questionnaires (part A) about their experience. The participant may, at their own discretion, fill out the basic or the extended questionnaire.

Thus, the collected data concerned three dimensions of the experience of the installations: (1) semiotic, (2) physiological, and (3) behavioral dimension. This partition reflects the transformative power of transcendent experiences inspired by the sublime, which leads to changes at the psychological and physical levels.[38]

2.3.1 Semiotic dimension

The questionnaires could be called up via QR codes with the participant's smartphone. The questionnaires were assessed in either German or English, depending on the participant's choice. They ask directly about the qualitative nature of the subjectively experienced affective state and thoughts regarding the two art installations. Although

[33] L. Nummenmaa, E. Glerean, R. Hari, J. K. Hietanen, *Bodily maps of emotions* in "Proceedings of the National Academy of Sciences", 2014, Vol. 111, No. 2, pp. 646-651.

[34] K. R. Scherer, V. Shuman, J. Fontaine, C. Soriano *The GRID meets the Wheel: Assessing emotional feeling via self-report* in "Components of emotional meaning: A sourcebook", 2013.

[35] Y, Bai, L. A., Maruskin, S. Chen, A. M. Gordon, J. E. Stellar, G. D. McNeil, K. Peng, K, D. Keltner, *Perceived Self-Size Scale* in "Journal of Personality and Social Psychology", 2017.

[36] D. Mashek, K. W. Cannaday, J. P. Tangney *Inclusion of community in self scale: A single-item pictorial measure of community connectedness* in "Journal of Community Psychology", 2007, Vol. 35, No. 2, pp. 257-275.

[37] A. A. Schuurmans, P. de Looff, K. S. Nijhof, C. Rosada, R. H. Scholte, A. Popma, R. Otten, *Validity of the Empatica E4 wristband to measure heart rate variability (HRV) parameters: A comparison to electrocardiography (ECG)* in "Journal of medical systems", 2020, Vol. 44, No. 11, pp. 1-11.

[38] K. J., Schneider, *Awakening to Awe: Personal Stories of Profound Transformation*. Rowman & Littlefield, 2009

self-report tools may result in being intrusive to the user's experience since respondents must stop what they are doing (i.e.: the art experience) to perform the task, they enable respondents to a quick, intuitive, and accurate subjective reportage.

The basic questionnaire includes the following self-report tools (see a, b, and c in Figure 4):

1. BSMs. This tool can provide topographical depictions of bodily sensations of emotions. It has previously been proved as a valuable asset to gain insights about one's bodily changes underlying the experience of art encounters with digital paintings[39]. In the proposed methodology, their aim is to investigate whether the experience of the two art installations directly affects one's sense of the internal state of their body (interoception).[40]
2. GEW, created by the Swiss Centre for Affective Sciences, proved itself useful to identify the type and strength of the experienced emotions of encounters with artworks in museum studies[41]. In the present study, the GEW will also represent a way to assess whether there is a correspondence between the media used to create the installations and the emotions that the viewers reported.
3. PSS is a pictorial self-report that people can use to rank how small or great they felt. Visitors were presented with seven circles and asked to select the one that best fits their perception of self-size. This tool is aimed at measuring the feeling of diminishing of the self, or small self, usually associated with feelings of transcendent emotions.[42]

In addition to the tools presented in the basic questionnaire, participants could decide to answer questions from the extended questionnaire regarding their own thoughts about the installation and the connectedness felt with it (see d, and e in Figure 4).

1. Two open questions were asked by giving the following instructions ahead: «As you saw, we are interested in what you think about your experience with

[39] G. Schino, L.M. van Klaveren, H.G. Gallegos González, R.F.A. Cox, *Applying bodily sensation maps to art-elicited emotions: An explorative study.* In "Psychology of Aesthetics, Creativity, and the Arts", 2021 Advance online publication.

[40] H. D. Critchley, & S. N. Garfinkel, *Interoception and emotion*. In "Current opinion in psychology", 2017, Vol. 17, pp. 7-14.

[41] P. P.L. Tinio, A. Gartus *Characterizing the emotional response to art beyond pleasure: correspondence between the emotional characteristics of artworks and viewers' emotional responses.* In "Progress in brain research", 2018, Vol. 237, pp. 319-342

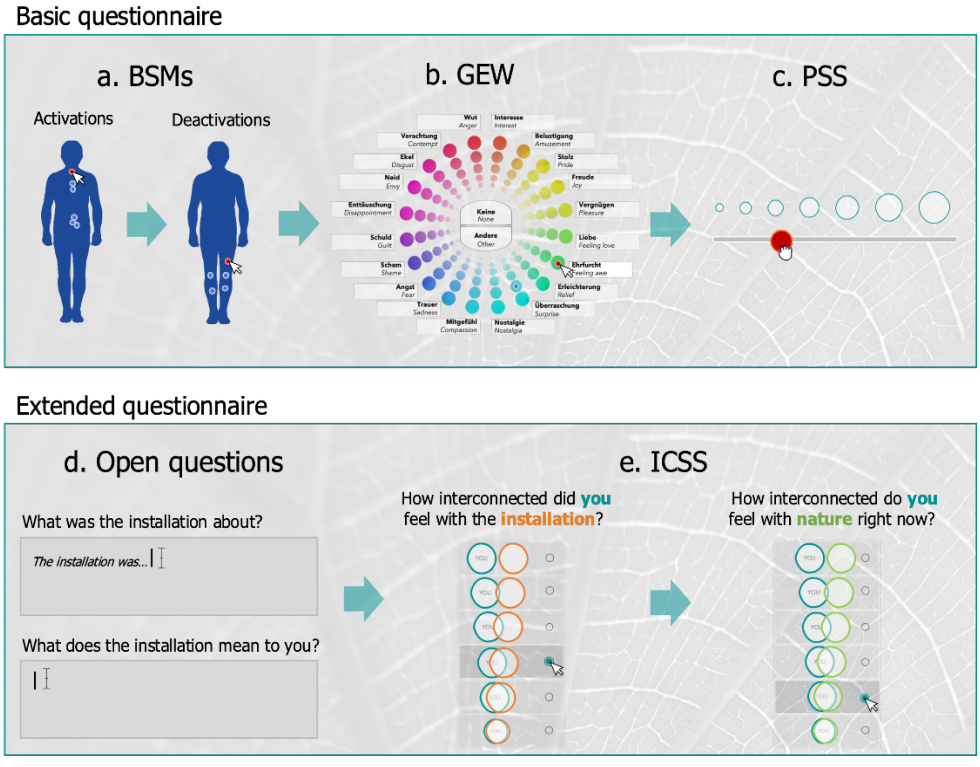
[42] L.C. Bethelmy, J. Corraliza, J. *Transcendence and Sublime Experience in Nature*. in "Frontiers in psychology.", 2019

the installation and nature. In order to do this, we invite you to reflect on it by answering two open questions. Below each question, there is a text box. You can click it and type your response if you feel like it. I would like you to write right away, without planning out what you write. Just write as if you were speaking to yourself». The open questions aimed at gathering information regarding the installation from the visitors' point of view. The questions asked: (1) What was the installation about? and (2) What does the installation mean to you? The response was required to be at least 30 characters.

2. Lastly, participants could answer two adapted versions of the ICSS. ICSS is a single-item pictorial tool to measure how people feel interconnected with something. In this study, the first ICSS was used to measure the relationship between the participant and the installation, and the second ICSS measured the relationship between the participant and nature after having experienced the installation.

Figure 4

Self-report tools used in the questionnaires.



2.3.2 Physiological dimension

Physiological activities and expressive behaviors have few advantages such as (1) continuous measurement in real-time; (2) no intrusiveness for the user, and (3) no bias from cognitive or social desirability constraints[43]. To access the visitors' changes, at a physical and behavioral level, while experiencing the art installations, the current methodology relied on the use of Empatica E4 Wristband. Visitors could voluntarily wear the Empatica E4 Wristband for real-time physiological data acquisition. Participants that wanted to wear the Empatica E4 received them at the entrance of the installation areas upon administration of informed consent. After the experience of the installation, they could return the device to the researchers. Empatica E4 is a wrist-worn research wearable that has Electrodermal activity (EDA, also known as galvanic skin response, or GSR) electrodes, a temperature sensor, and a photoplethysmography (PPG) to record autonomic nervous systems (ANS) parameters such as heart rate (HR), blood volume pulse (BVP) and interbeat interval (IBI). These parameters have been associated with emotional responses and Empatica E4 has previously been validated as a reliable emotion recognition tool outside laboratory[44]. The collection of physiological data via Empatica E4 aims at answering the research question regarding the comparison of bodily changes across the different types of art installations (i.e.: physical and VR). The methodology adopted in the present study aims at integrating more physiological measurements than previous literature to give more granular results of the understanding of art experiences.

2.3.3 Behavioral dimension

While the physiological dimension could be measured by EDA, HR, and temperature recorded by the Empatica E4 Wristband, the behavioral dimension was assessed through the actigraphy detected by the same device. Empatica E4 contains a Micro-electromechanical systems (MEMS) type 3-axis accelerometer that captures motion-based activity. The accelerometer captures the continuous gravitational force applied to

[43] A. Dzedzickis, A. Kaklauskas, V. Bucinskas *Human emotion recognition: Review of sensors and methods* in "Sensors", Vol. 20, No. 3:592.

[44] M. Ragot, N. Martin, S. Em, N. Pallamin, J.M. Diverrez, *Emotion recognition using physiological signals: laboratory vs. wearable sensors* in "International Conference on Applied Human Factors and Ergonomics", 2017, pp. 15-22.

the XYZ dimensions. It represents the direction and position of the wristband at which acceleration occurred.

The idea of the body as a measure of the world has its roots in the pragmatist intuitions of William James and John Dewey[45] as well as theories of phenomenology supported by Husserl[46], Merleau-Ponty[47], and Gallagher[48]. Le Roy describes that, when experiencing architecture, for instance, people have the possibility to explore beyond visual limitations.[49] Similarly, visitors experiencing art installation can choose how to approach the different elements of the work. Therefore, the possibilities of interaction with each one of the elements and with the environment in which they are placed, are dictated by the body that experiences them. The collection of behavioral data can shed light on the way visitors move in the two different environments of the art installations (i.e.: physical and VR) and interact with their elements. By collecting the moving average of each visitor during the experience of the art installations, the present design wants to explore a comparison of body interaction through movement behaviors across the types of installations. The scope of this manuscript is discussing the adopted methodology and its theoretical implications and, ultimately, suggesting a tentative protocol of ideal biomarkers and methods of investigation for the experience of art installations *in situ*.

3. Discussion

3.1 Exploration of advantages and disadvantages

Art installations can trigger transformative changes at the semiotic, physiological and behavioral dimensions. However, drawing empirical evidence from these three experiential dimensions is a complicated matter. First of all, multidisciplinary conversations of the research team led to the conclusion that, to tap into the experience

[45] K. Chandler *Dewey's phenomenology of knowledge.* in "Philosophy Today", 1977. Vol. 21, No. 1, pp. 43-55.

[46] C. Rozzoni. *A Husserlian Approach to Aesthetic Experience: Existential Disinterest and Axiological Interest*, 2019, in "PHAINOMENON", 29 pp.121-127

[47] M. Merleau-Ponty & B. Smyth (2020). T*he Sensible World and the World of Expression: Course Notes from the Collège de France*, 1953. Northwestern University Press.

[48] S. Gallagher (2012) *What Is Phenomenology?* In: Phenomenology. Palgrave Philosophy Today. Palgrave Macmillan, London. Pp. 7-18

[49] M. D. P. Ferreira *Embodied Emotions: Observations and Experiments in Architecture and Corporeality* (2015) Publisher: Faculdade de Arquitectura da Universidade de Lisboa, Lisbon, 2015, pp. 119-132

of art installations, empirical evidence cannot be collected by measuring how participants respond to a reproduction of an artwork in the laboratory. We wanted to take into account the complex nature of art installations and that participants' reactions to it are also tied with the time and space in which the experience of art installation takes place. The encompassing environment in which art installations are framed is thought to impact the audience's reactions.[7] For this reason, it is important to conduct field observations to investigate the experience of art installations, that is to carry out empirical research in an ecologically valid setting such as museums, as presented in the proposed methodology. Studies in the laboratory «will never achieve scientific certainty. They will be based on observation rather than on experiment; and they will remain, for that reason, conjectural and suggestive».[50] The use of a real-world setting enables the visitors' most insightful behaviors that would be otherwise subdue in laboratory settings.[51] However, it is hard to bring research tools such as MRI tables, into a museum and, even, if possible, their implementation can result to be invasive of the visitor's experience at the museum, ending in affecting it.

The presented research also attempted to design a methodology that would alter the experience of visitors with the installation as little as possible. For this reason, the wrist-worn Empatica E4 was considered a suitable choice. Firstly, it is the only wearable on the market granting access to raw data of the combined sensors that simultaneously measure sympathetic nervous system activity, movements, and heart rate. These measures can capture the process that dynamically changes over time while experiencing the art installation. Secondly, among all the wearable devices, wrist-worn ones are commonly used by laypeople. Suffice to think about how smartwatches are frequently worn as physical fitness monitors, pedometers, monitors for quality of sleep, and so on. In addition, wrist-worn devices are not very noticeable, nor heavy and they are not particularly visible to others. All of these features contributed to not disturbing the visitor's experience of the installations but rather revealing spontaneous behavior[52] – contrary to the one under the influence of cameras rolling, or while wearing

[50] V. Lee *Beauty and Ugliness and other studies in psychological aesthetics* (1912) in Lee and Anstruther-Thomson, p. viii

[51] C. C. Carbon *Art perception in the museum: How we spend time and space in art exhibitions.* In. "i-Perception", 2017, Vol. 8, No. 1

[52] C.C. Carbon *Empirical approaches to studying art experience*, in "Journal of Perceptual Imaging" Vol. 2, No. 1, 2019, pp: 1-7.

experimental unusual equipment. Moreover, both installations ensured a certain level of privacy. *Embalmed Twins I & II* were placed in a darkened environment where spotlights aimed at recreating beams of moonlight. *Treehugger: Wawona* made use of VR equipment, including headsets that intended to isolate the visitor wearing them. These characteristics, plausibly expected in modern and contemporary art installations, should evoke in the audience greater responses in terms of valence and arousal. The level of privacy granted by the installations in combination with the use of a device similar to the smartwatches with which people are very familiar with, could have reduced the visitors' feeling of being under scrutiny and observed by other visitors (feedback effect on participants). Therefore, we consider this design choice an improvement compared to previous studies that used experimental equipment like mobile eye-tracker or gloves for measuring physiological patterns, which could not be hidden from other visitors.

An obvious limitation of using biometric techniques in the museum is that there is a wide spectrum of factors (individual, social, and environmental) that may influence the measured patterns. On one hand, testing biometrics in the museum may be challenging as variables cannot be carefully controlled. On the other hand, the semiotic dimension assessed by questionnaires can only benefit from such complexity. The results from the questionnaires could reflect the true semiotic experience of each visitor toward the two physical and virtual art installations. This is because the experience was not merely reproduced in the laboratory, but fully present.

To sum up, the data detected by the presented methodology are potentially very rich as we ensured the presence of original artworks in the space and time they are meant to be visited. This rendered the data from the questionnaires ecologically valid and representative of the true experience. However, the proper measurement of physical and behavioral patterns is harder to achieve as it relies on biometrics in a real-world setting.

3.2 Implications for future empirical aesthetics and museum studies

From our standpoint, the only way to research about accurate art experiences while happening in authentic art spaces (such as museums, ateliers, galleries) is to collaborate with art curators and artists on creating artworks and ways to enjoy them that can be

useful for the detection and collection of data without affecting their nature and the artists' intents. Therefore, multidisciplinary communication could be the solution to the problems reported in the present paper. Conducting empirical experiments with an open mindset and a group of researchers with diverse expertise is essential, and we encourage future research to pursue the same path. In our experience, it allowed the data collection to be authentic in terms of setting and conditions, thus preserving the aura of the artwork and the curatorial staging.

The biggest limitation outlined, which is the lack of control over environmental variables and distractors, could be overcome by setting up special conditions together with the museum staff. For instance, *Treehugger: Wawona* managed the presence of other visitors while experiencing the art installation since one visitor at a time was allowed to use the VR equipment. The Frankfurter Kunstverein did not restrict the public access to their halls for the experiment, and the ecological validity of the testing paradigm was conserved. This represents a small example of how the methodology proposed can be beneficial for research purposes.

Furthermore, the feedback received from English-speaking visitors that participated in the study was positive. The questions asked regarding the art installation allowed visitors to express their feeling toward the installations. Visitors were psychological observers, as Vernon Lee in her 'gallery diaries'. Besides representing a benefit for the research team, participation in the experiment stimulates the participating visitors' introspection.[53] According to Lee, this reflection allows a heightened experience where people can perceive their affective responses, mental notes, and bodily accompaniments without interrupting the process of perception but rather leading them towards an epiphanizing experience of art.

By detecting the body's passive responses, active movements, affective feelings, and thoughts of the audience in the museum, the methodology explored can help researchers in their systematic study of arts and aesthetics in the light of theories of embodied cognition, motor and kinesthetic psychology, and *Einfühlung* (empathy)[54].

[53] S. Lanzoni *Practicing psychology in the art gallery: Vernon Lee's aesthetics of empathy*. In "Journal of the History of the Behavioral Sciences", 2009, Vol. 45, No. 4, pp. 330-354.

[54] R. Vischer (1873) *Über das optische Formgefühl. Ein Beitrag zur Ästhetik. Leipzig: Herman Credner,* English edition: On the optical sense of form: a contribution to aesthetics. In: Mallgrave, HF, Ikonomou E (eds) (1994). Empathy, form, and space: problems in german aesthetics, 1873–1893 p. 7

3.3 Relevance for answering questions of interests of art curators and fulfillment of the goals of artists.

Inspired by Wiseman and colleagues[55], the present study established a collaboration between researchers with backgrounds in humanities, psychology, and art curation. This helped in designing the experiment in a way that could answer multidisciplinary questions. While the empirical results will be presented in multiple-cases analysis to assess the methodology's validity in a separate instance, we will hereby provide examples of the usefulness of the methodology in terms of the potential discovery of the experience of art installations in the museum, and the difference in terms of experiential dimensions among physical and Virtual Reality (VR) environments for art installations.

As Hume states, one's perceptions of their internal and external senses are «clear and evident».[56] The use of BSMs can then be a reliable method to further explore the dialogue between the body of the audience and the material used for the art installations. That is, how do the emotions elicited by the physical and the VR installations relate to one's self-awareness of bodily changes? In previous works, Blakeslee and Blakeslee claimed that body maps can extend the mind's capacity of experiencing digitality as real.[57] The Bodily Sensation Maps (BSMs) captured how the audience experienced their bodies in relation to the different environments for the two art installations. They can be compared as self-measurements of the embodiment of the physical and virtual environment. BSMs could also unravel how the transcendent emotions evoked by the two installations reflect on the audience's bodies and interoception.

The use of the Geneva Emotion Wheel (GEW) can be used to detect the way emotions were felt during the experience of the installations, their valence (positive or negative), intensity, and to what extent they activate physiological activity (low or high arousal). Such information can be compared across the types of installation, providing insights into the following questions: is the strength of the emotions different for the two installations? Did VR increase emotional responses in terms of arousal? What

[55]B. Wiseman, A. Carusi, E. Briggs, S. Poyntz, M. Pelowski, L. Alcock, & C. Mazzà *Embodied viewing and Degas's Little Dancer Aged Fourteen: A multi-disciplinary experiment in eye-tracking and motion capture.* in "The Senses and Society", 2019, Vol. 14, No. 3, pp. 284-296.

[56] D. Hume *A Treatise of Human Nature*, Vol. 1: The Text. Ed. by David Fate Norton and Mary J. Norton (Oxford: Clarendon Press, 2007). Book 1, Part 2, Section 3, Paragraph 1, pp. 33.

[57] S. Blakeslee & M. Blakeslee, M. *Where mind and body meet.* In "Scientific American Mind", 2007 Vol. 18, No. 4, pp. 44-51.

installation stimulated more attractiveness (positive valence) or aversiveness in the audience?

Besides the intuitive self-report tools drawn from psychological aesthetics, two open questions were included in our design for qualitative information about the semiotic dimensions. Participants were asked 'What was the installation about?' to shed light on participants' focus of attention for their evaluation of the installations' contents. They were also asked 'What does the installation mean to you?' to open a window on their cognitive processes for sense-making as well as enhancing emotional responses as proved by Pelowski.[58]

Keeping in mind that art experiences cannot be reduced to their physiological embodiment, we cannot either rely exclusively on questionnaires and qualitative measures such as open questions to present a full picture of transcendent art encounters. Sublime experiences are intimate and hard to be precisely defined by exact words, and art experiences, in general, are not exclusively mental. Therefore, in conjunction with emotional and evaluative aspects of the semiotic dimension described by subjective reportage, we should capture and consider the way the body reacts in the environment. Vischer conceptualizes the centrality of the body and its relationship to experience by stating that «the whole body is involved; the entire physical being is moved».[59] Similarly, Vernon Lee defines the importance of one's physical corporeal responses and motor actions during experiences of art as it is impossible to clearly distinguish mind and body in such experiences.[60] Therefore, to capture the process of the experience as it happens, we should also detect how it is perceived by our bodies. In the present instance, our multimethod approach can potentially analyze the differences in physiological and behavioral responses between different instances of art (e.g., the physical and the virtual) and attempt to describe the relationship between sublimity and movement.

Research outcomes concerning the relationship between the three dimensions of art experience can provide support to the decision-making process for the curatorial work.

[58]M. Pelowski *Tears and transformation: feeling like crying as an indicator of insightful or 'aesthetic' experience in empirical study of art*. In "Frontiers in Psychology" Vol. 6

[59]R. Vischer (1873) *Über das optische Formgefühl. Ein Beitrag zur Ästhetik. Leipzig: Herman Credner,* English edition: On the optical sense of form: a contribution to aesthetics. In: Mallgrave, HF, Ikonomou E (eds) (1994). Empathy, form, and space: problems in german aesthetics, 1873–1893 p. 99.

[60] V. Lee, *Beauty and Ugliness and other studies in psychological aesthetics* (1912) in Lee and Anstruther-Thomson, p. 153-54.

That is, art curators can use the findings to make evidence-based choices and strategies about the use of exhibition space to achieve a specific, desired effect. Further, the multimethod approach can also attempt to answer questions based on the artist's intentions, such as, in this specific case, whether an empathic transference of the self to another non-human being does take place through the appreciation of the art installations. The emotional experience (constituted by bodily changes, sensations and semiotic modes) triggered by the art installations may establish cognitive insight that can favor a sense of community with the natural elements subject of the installations. The results from the Inclusion of Community in Self Scale (ICSS) can be used to assess which type of installation generated stronger feelings of communion with nature. That is, based on the hypothesis that art installations, both physical or virtual ones, can help the user overcome the limitations of their own human body to empathize with those trees. However, in order to put the present methodology to the service of artists and reach practice-based evidence, it would be advisable to involve the use of expertise from the artists themselves. Researchers should take into account the artists' statement about their work and the way these may affect the audience. The outcomes resulting from the presented methodology can support the art-making process for an optimal impact and delivery of the artists' intentions. That is, the study of art installations can be beneficial for artists. They can receive feedback from the target population to which their work is directed to, attest the impact and overall effect of their work on the audience, and verify whether it aligns with their intended message. Future research could improve by personally including the artists in the early stage of experimental designing.

The exploratory methodology used in the present study aims at constituting a starting point on which to build a corpus of reference. It is valid in the exploration of *in situ* experience of art installations and can be replicated in future studies to address its usability in different contexts (such as the experience of paintings, music, performance art, and various art spaces).

4. Conclusion

The present paper wants to encourage future research in using a multi-method approach as it can help gain a full understanding of the data on multiple dimensions. The explored methodology has the potential of providing highly informative findings that can be relevant to different disciplines and professionals – from researchers in empirical aesthetics to experts in the curating process. For this reason, it is important to stimulate the dialogue between researchers, institutions, and artists for them to benefit from the research outcomes.

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