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"Aesthetic experience and transformative potential of performance art in comparative juxtaposition of "art vs. non-art" using fNIRS"

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Abstract

The present paper aims to generate insight into the cognitive processing of an artwork, to better understand how art-viewing can result in transformative experiences and intense emotions. To do this, an experiment comparing the perception of a stimulus in an art setting vs. in a non-art setting was conducted. While previous research has done such a comparative juxtaposition mainly in regards to the aesthetic appraisal of pictures, the present study takes a broader look at emotional, social and metacognitive factors. The concept of the performance "The Artist Is Present" by Marina Abramović was used to create a performance art piece consisting of two people, looking into each other's eyes, one person being a performance artist. The situation was introduced as an art performance in one condition, and simply as an experimental task to test fNIRS devices in another condition to create a non-art setting. Participants were instructed to subsequently rate their experience on a variety of scales. Further, fNIRS measurements were conducted on both artist and participants to measure both single-brain activation in selected regions of interest, as well as cross-brain coherence. Participants of both conditions reported emotional experiences and changes of mind. While no significant differences were found regarding brain activation, participants of the art condition reported significantly higher levels of anxiety, tension, confusion, sadness and other "negative" emotions, and showed different intercorrelation patterns. Results further suggest the possibility of a role of negative felt emotions for transformation and change of mind through art perception.

Keywords: performance art, empirical aesthetics, fNIRS, hyperscanning, transformative experience, art perception

Note: a German version of the abstract is provided at the end of the paper

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"The technique of art is to make objects "unfamiliar", to make forms difficult, to increase the difficulty and length of perception because the process of perception is an aesthetic end in itself and must be prolonged. Art is a way of experiencing the artfulness of an object; […]"
Viktor Shklovsky (1965)

Introduction

In the world of art, the constructs and concepts that make up our perceived reality can suddenly be valenced in a completely different way than how we would perceive and process them in our daily life. Art can romanticize pain, find beauty in suffering and make the mundane seem sublime. Art appears to present a category of stimuli that follow different rules for perception and meaning-making.

Pelowski and Akiba (2011) describe in their model of art perception how art can result in transformative experiences trough meta-cognitive processing and a revaluation and remodeling of pre-existing schemata. Indeed, people often report experiencing insight and change after being confronted with an artwork. This was the case, for example, during Marina Abramović's "*The Artist Is Present*" (2010). During the over 700-hour-long performance, visitors of the MoMA were able to simply sit in front of the artist, without any interaction other than looking into the artists eyes. The performance soon attracted great interest and people were waiting hours to be able to experience the performance first-hand and sit in front of the artist, one person at a time. Many people reported intense emotions and an overwhelming feeling of transformation. Experiences were described as "almost religious". (Samuels, 2016, paragraph 3). In an interview right after the end of her performance Abramović said:

"[…] very soon while you're having this gaze and looking at me, you start having this invert and you start looking at yourself. So I am just a trigger, I am just a mirror and actually they become aware of their own life, of their own vulnerability, of their own pain, of everything […]" (Stigh, 2010)

This piece is particularly interesting in the context of art research because there seems to be no medium, in the classical sense, neither communication like speech or mimic, nor movement, like for example in dance performances. The medium is in this case, the artist herself and the exchange of artist and viewer seems to be happening solely through presence and eye contact. This makes this piece an interesting subject to study the transformative potential of art and underlying mechanisms as the aesthetic experience is not tied to actual visuals features but

rather to the cognitive perception of a performative situation that takes place in the context of art.

1. THE PRESENT THESIS

The aim of this study is to investigate the role an “art” context plays for meaning-making, social cognition and other cognitive processes and experiential factors, as well as to explore if an intense emotional experience and/or transformative experience trough an art performance is possible in a controlled setting.

A useful tool in gaining better understanding of the cognitive processing of an artwork, and how it may result in intense emotional experiences and transformation, is to compare it with the processing of a similar stimulus outside the art context. Cognitive models of art perception describe how outcomes are modulated by innate properties of both artwork and viewer (*for an overview see Pelowski et al. (2016),* Pelowski et al., 2017), but also mention the classification of a stimulus as an artwork as a possible prerequisite of an aesthetic experience (Leder et al., 2004; Leder, 2013; Locher et al., 2010; Pelowski et al., 2017; Pelowski & Akiba, 2011).

Comparative analyses of the perception of an object in an “art” vs. “non-art” condition have been conducted in previous studies (Arai & Kawabata, 2016; Kirk et al., 2009; Van Dongen et al., 2016). However, these studies focus mainly on the aesthetic appraisal of the presented stimuli. There seems to be little to no research that explores higher level cognitions of the aesthetic experience, such as meaning-making, meta-cognitive processing and transformative potential, in a comparative juxtaposition of “art” vs. “non-art”. Further, the presented stimuli were almost exclusively pictures, while no similar research has been conducted using performance art as a stimulus.

This thesis aims to fill this gap by creating an interpersonal experience in two different conditions. The interaction follows the procedural the structure of Marina Abramović’s “The Artist Is Present” (2010). In both conditions two strangers were seated in front of each other and were asked to look into each other’s eyes. In the first condition, this interaction was be introduced to the participants as an art performance in which they part-take. In the second condition, the interaction was be introduced as a test trial for calibrating new fNIRS devices, without any mention of

art. Participants were simply be asked to complete the task of maintaining eye-contact. Subsequently the participants were be given a questionnaire with questions regarding their experience and perceived self-transformation, meta-cognitive judgements and emotions.

Additionally, fNIRS measurements were conducted on both participants and artist during their mutual gaze. Cross-brain coherence, as well as single-brain activation in selected regions of interest, were analyzed. At the end of the experiment participants were given the option to keep or donate a lottery ticket as a means to compare prosocial behavior. Further, participants were given online-questionnaires regarding personal characteristics such as loneliness, prosocialness, etc., one week prior to testing, and then again after testing.

This research project is part of ARTIS (Art and Research on Transformations of Individuals and Societies), which is a EU Horizon 2020-funded project with the aim to generate insight on “Societal Transformations and the Arts”. Through the conduction of this experiment we aimed to generate a broad set of data that can be used to investigate questions regarding prosocial behavior, art perception and transformation.

In this paper specifically, the experiential questionnaires, fNIRS data, prosocial behavior, as well as differences in pre- and post-eye-contact questionnaires serve as dependent variables to explore the following questions:

1) Does an art context result in different emotional experiences and/or a somehow altered or different processing of a stimulus?
2) Is the art context relevant to the transformative potential of the aesthetic experience?

2. THEORETICAL BACKGROUND AND PREVIOUS RESEARCH

2.1. Art perception and transformative aspects

2.1.1. The transformative of the performative and art as a liminal “space” – an anthropological perspective

The belief in the transformative power of the performative is at the core of a majority of human cultures. In an anthropological analysis of performativity, Fischer-Lichte (2013) refers to the transformative power of performative acts like celebrations or rituals like baptisms, initiations and weddings. These performative acts are in many cultures intuitively believed to be of a transformative nature, as they permanently change an aspect of the social reality, for example, social relations. Turner (1969) explores rituals and symbols’ cultural and social significance as *cultural performances*. According to Turner the transformative act exists in a liminal space, between a clear before and after, where subsequently a definite change has occurred. For example, during an initiation ritual, an individual would first be an outsider. Then, during the initiation ritual they enter a liminal space and upon its conclusion, they emerge as a fully integrated member of the group. Turner highlights how rituals and symbols are essential in continuously reproducing the dynamic process of social reality (Erhard, 2019). Rituals are also seen as a reaction to crisis or conflict. They provide a designated space where people can interact with others or themselves, in ways different than what social norms and constructs usually allow. Turner (1969) also references jogglers in the Middle Ages, or theatre performances, where social norms don´t apply in the same way because the viewers and performers are in a liminal space outside of usual social conventions.

Similar to the way rituals were described in the previous section, art enables individuals to perceive and experience reality in a manner unrestricted by societal norms. Due to the nature of modern art, which seems to want to break every rule as soon as you declaratively try to apply it, nothing nomothetic can really be said about art and art performance in general. However, similarly to the way rituals have been characterized, we could assume, that most performances have a beginning and an end, leaving a, what could be considered liminal space in between, in which transformation can take place.

Looking at an art performance through the lens of psychological art processing models, the “beginning and end” here, does not need to be the beginning and end of the performance but rather of the aesthetic experience. In line with Pelowski’s model of transformative aesthetic experiences (Pelowski & Akiba, 2011) pre-existing schemata could be disrupted by the performance and then, during meta-cognitive reassessment and cognitive mastery a change occurs, which subsequently results in new schemata *(see also 1.1.3.)*.

2.1.2. The context of art – what makes art art?

Research on art perception has increasingly integrated the idea that the context in which an art piece is perceived affects the resulting aesthetic experience (Leder & Nadal, 2014). In some art-processing theories, the context in which an art piece is viewed is taken into account as a first step or a pre-step of an aesthetic experience (Leder, 2013; Leder et al., 2004; Locher et al., 2010; Pelowski, Markey, et al., 2017; Pelowski & Akiba, 2011). According to Leder (2013), an aesthetic episode can begin when the viewer is in a situational context, that allows for it to happen. He thereby takes Duchamp´s ready-mades into account since the setting and context in which these objects are presented characterizes them as an artwork. He further suggests that “*top-down classification before the actual episode can also be expected to affect the aesthetic experience by engaging an aesthetic mode or not, leading to an aesthetic episode in one setting but not in another*” (Leder, 2013, p.29).

Several studies show that the same stimulus is rated as more aesthetically pleasing when presented as “art” than when it is not introduced as an artwork (Arai & Kawabata, 2016; Kirk et al., 2009; Van Dongen et al., 2016).

The classification of something as art can be done by the artist, a gallery or even the conductors of an experiment on neuroaesthetics. However, from a viewer’s perspective, these are ultimately just suggestions and in order to experience something as an artwork, they themselves need to perceive and declare it as such. When asked to rate stimuli on a scale as to how much the participant considers the stimuli an art piece, answers vary greatly between participants. This means that certain images are rated as art by one person, but not so much by another (Pelowski, Greger, et al., 2017), which needs to be taken into account when researching art perception.

2.1.3. Art perception as stages of information processing – the Vienna Integrated Model of Art Perception (VIMAP)

Currently, multiple different cognitive models aim to describe the act of art perception as a sequence of different processing stages with inputs and different possible outcomes (*for an overview see Pelowski et al. (2016)*). Depending on the model, considered inputs might be properties of the viewer, such as personality, previous knowledge, etc.; properties of the artwork, such as style, display, etc.; and settings, such as cultural and social context. Possible outputs range from basic bodily reactions and affect to higher-level processes such as self-adjustment, and perception of transcendence. The stages of information processing through which these outputs are generated differ greatly between the models. One of the most comprehensive models is the Vienna Integrated Model of Art Perception (VIMAP) (Pelowski et al., 2017). The VIMAP regards both top-down and bottom-up processes and consists of seven processing stages which occur roughly in a linear order, but may be re-looped. The first stage, *Pre-classification*, is followed by three bottom-up processing-oriented stages: *Perceptual Analysis, Implicit Memory Integration*, and *Explicit Classification*. This is followed by the stage *of Cognitive Mastery*. During the stage of *Cognitive Mastery*, the results of the bottom-up processing stages are met by top-down executive cognitions in an attempt to form a coherent experience. The perceptual process might already end at this stage or re-loop, for example, due to low self-relevancy or because no further processing is needed.

In this case, the viewer might simply enjoying the artwork without experiencing incongruence with previously existing schemata, as the artwork is not challenging the viewer's expectations or views. The viewer then leaves, or re-loops and experiences harmony, flow, and emotional resonance. One might even already experience low-level schema change if self-relevance is low and pre-existing schemata are not too drastically challenged. However further processing might be necessary, to process incongruency in schemata with high self-relevance. In the next processing stage - *Secondary Control* - the viewer assesses coping necessity and potential. Here, the viewer might experience a negative reaction and abort, for example, by deciding to re-classify the stimuli and classify it as "not art". The viewer might also continue and reach the next and final processing stage: Self-awareness / Meta-cognitive Assessment. Pre-existing schemata are re-examined and readjusted,

resulting in transformation. The experience of epiphany can be accompanied by a re-looping of the processing stages and a subsequent experience of harmony and flow.

It should be noted here that in the case of high self-relevance and low schema congruence both in the negative outcome of devaluing the artwork, as well as in a transformative outcome, negative emotions are being felt, as the incongruency in schemata is often accompanied by feelings of anxiety, anger, or confusion.

2.1.5. Neurocognitive processes during art perception

The affective and cognitive processing of art is a complex process and thus includes a lot of different brain areas that are assumed to be active during different stages of the aesthetic experience. The Vienna Integrated Model of Art Perception / VIMAP (Pelowski et al., 2017) suggests a possible involvement of the medial prefrontal cortex (mPFC), the dorsolateral prefrontal cortex (dlPFC), the orbitofrontal cortex (OFC), anterior cingulate cortex (ACC), posterior cingulate cortex (PCC), as well as the amygdala, insula, and hypothalamus. They suggest an expected activation in the MPFC during the VIMAP stage “self-reflection and transformative outcome” (amongst other stages), as MPFC activation has been suggested to be tied to metacognitive reflection, re-appraisal, and insight. Kirk et al. (2009) have shown higher activation of the medial OFC, as well as the ventral MPFC when a stimulus was introduced as an artwork, compared to when it was not. The left DLPFC is also said to be connected to an “aesthetic processing mode” (Cupchik et al., 2009). (Pelowski, et al., 2017) describe an expected involvement of the DLPFC during various stages of the VIMAP as it might allow for a self-detached aesthetic processing mode. Additionally the DLPFC plays a role in searching for novel interpretations and creative thinking (Colombo et al., 2015).

Naturally the selection of regions of interest (ROIs) for this thesis is restricted by the characteristics of fNIRS which, only allows access to brain areas relatively close to the skull. For this reason areas like the ACC, PCC, OFC or the amygdala, which could arguably be relevant, have not been considered. The MPFC, as well as the dlPFC have been included as ROIs.

2.2. Social cognition, hyperscanning and brain synchronicity

For the present thesis it is important to not only consider art-processing, but also social cognition, to take into account the social component of the eye-contact. Hyperscanning studies involve the simultaneous measuring of brain activity in two or more participants. This research approach of cognitive neuroscience aims to generate a better understanding of the dynamic nature of social interactions by looking at interpersonal interaction in terms of examining interactive interbrain processing rather than just analyzing data from one single brain in a social situation (Liu & Pelowski, 2014). The Interactive Brain Hypothesis by Di Paolo and De Jaeger (2012) states that interactive processing, involving causal relationships between the brain and the social environment, plays a crucial role in social cognition, which highlights the importance of using dual- or multi-brain approaches, rather than, or in addition to, just analyzing a social reality created in one single brain (De Jaeger et al., 2016; Di Paolo & De Jaeger, 2012).

One of the phenomena that can be observed in simultaneous brain scanning is the occurrence of brain synchronicity. Brain synchronicity refers to the oscillatory coupling of signals between brains, which indicates cross-brain coherence, and encompasses a wide range of functions and effects (Hirsch et al., 2017; Liu & Pelowski, 2014). It has already been researched in the context of musical art production, for example during cooperated humming (Osaka et al., 2014) or playing guitar in duets (Sänger et al., 2012). It is has also been shown to increase when playing a game that requires cooperation (Cui et al., 2012; Funane et al., 2011), as well as during direct eye-to-eye contact (Dikker et al., 2020; Dravida et al., 2020; Hirsch et al., 2017; Koike et al., 2019; Noah et al., 2020). Brain-to-brain synchrony has been linked to subsequent prosocial behavior (Hu et al., 2017). Interbrain synchrony has also been assumed to support affiliative bonding (Zheng et al., 2020) and is generally suggested to be correlated to successful social interaction (*review*: Mende & Schmidt (2021)).

2.2.1. Eye-to-eye contact and neural correlates of social cognition

Neurocognitive processes during eye-to-eye contact, and generally during social situations are complex and broad. The following section is supposed to provide a very short overview of aspects relevant to this study.

On an affective level reactions to eye-to-eye contact are very context-dependent. However, it can generally be said, that direct eye contact increases affective arousal and evokes a generally positively valenced affective response (Hietanen, 2018). Pönkänen, Peltola & Hietanen (2011) showed that direct gaze, compared to averted gaze, elicited relatively greater left-sided frontal EEG asymmetry, which has been linked to activation of approach oriented motivation (Harmon-Jones & Gable, 2018).

Furthermore, as already mentioned, increased cross-brain coherence of signals can be observed during direct eye-to-eye contact (Dikker et al., 2020; Dravida et al., 2020; Hirsch et al., 2017; Koike et al., 2019; Noah et al., 2020). Brain regions that have been linked to increased inter-brain synchronicity in previous studies are, amongst others, the angular gyrus (AG), which is located in the Temporal-parietal Junction (TPJ) (Noah et al., 2020), the occipital temporal cortex (Dravida et al., 2020), the superior temporal and middle temporal gyri (Dravida et al., 2020; Hirsch et al., 2017), the supramarginal gyrus and the motor cortex (Hirsch et al., 2017) as well as the anterior cingulate cortex (ACC) and the anterior insular cortex (AIC) (Koike et al., 2019).

Koike et al. (2019) also report increased connectivity between the ACC and the AIC during live direct eye contact, compared to “eye contact” with a delayed screen recording. The conjoint activity of the ACC and the AIC is part of emotion processing and is assumed to form a central role in self-awareness (Medford & Critchley, 2010). Conty, George & Hietanen (2016) argue, that direct eye-contact triggers self-referential processing, which means that stimuli are more likely to be processed in relation to the self. They suggest, that this phenomenon might arise due to the direct gaze heightening our awareness, of being the focus of another person’s attention. This is supported by findings indicating that people are able to rate and classify their bodily reactions to viewing emotional pictures more accurately when they are directly looked at by another person (Maltazar et al., 2014). In a study examining the dynamics of speed-dating, it has been found that in a condition with direct eye contact, participants were more likely to disclose intimate information about themselves, while simultaneously asking fewer intimate questions (Croes et al., 2020). These findings could also be interpreted, as eye contact facilitating self-disclosure and comfort in confronting oneself.

Further, social cognition in general, includes a wide variety of brain regions, including the mPFC, which is also related to social cognitive processes, emotional experience and self-awareness (Krämer et al., 2010; Lieberman et al., 2019). The mPFC plays a crucial role in metacognitive functions and is also connected to the identifying and processing of self-relevant information (Schmitz & Johnson, 2007). The TPJ is also believed to be related to the perception and evaluation of social stimuli and plays an important part in a variety of social functions, such as detection of social agents, and mentalizing. Especially the AG region, which is a subpart of the TPJ, is highly involved in intention, and theory of mind (reviewed in: Carter & Huettel, 2013). The right TPJ shows increased activation during real-life eye-to-eye contact (Noah et al., 2020) and the left TPJ has been shown to play a crucial role in inferring other people's beliefs and perspective-taking (Samson et al., 2004). However, the literature regarding lateralization of TPJ function is rather inconsistent (Santiesteban et al., 2015). Tusche et al. (2016) showed, that TPJ activity, through its role in perspective-taking, can even predict prosocial behavior in some individuals.

Because of this, both left and right TPJ have been included, in addition to MPFC and dlPFC, as ROIs for fNIRS measurements in this thesis.

3. METHODS

3.1. Participants

Participants were recruited via LABS (*https://labs-univie.sona-systems.com)* and other online recruiting tools. Participants who registered over LABS received 4 credits (one credit amounts for 15 minutes) for their participation. There were no pre-set exclusion criteria. The final sample comprised 44 participants. Descriptive statistics of characteristics of the sample are provided at section *4.1.1.*.

3.2. Setting

3.2.1. Location and setup

The experiment was conducted at *Akademie der Bildenden Künste* (academy of fine arts) in Vienna. The setting of an art university had been chosen to provide a space that is plausible for both an art performance, as well as a laboratory setting for the non-art condition. The experiment was conducted in a spacious room, that was empty except for the experiment setup. Two chairs were placed in front of each other with a distance of 1,5 m. The distance was determined in test-runs in which both the performer and study-assistants as well as random students that were walking by the

Figure 1 | *photos of experimental setup with participant (left) and artist (right)*

testing room, were asked which distance feels the most comfortable while maintaining a felt “closeness” to the other person. Analogue to “The Artist Is Present”, no table or other object was placed in between the two participants. Initially, during the early stages of “The Artist is Present”, Marina Abramović included a table separating her from the visitor, however Abramović eventually decided to remove the table as she felt it was an unnecessary buffer between her and the visitor (Abramović, 2016). The present study followed this decision, however at the beginning of the measurements there was a curtain separating performer and participant. The purpose of this arrangement was to prevent any initial eye contact between performer and participant prior to the beginning of the trial and to record baseline measures of brain activity without eye-to-eye contact. Just before the actual trial (performance/testing) the curtain was pulled back.

3.2.2. Actress

The performance was executed by the performance artist and actress Mathea Magdalena. The actress performed both the role of the artist as well as the role of the participant *(The terms actress and artist are used interchangeably in this paper and always refer to the same person).* The artist received a briefing about the whole experiment and took part in test runs to practice the performance before actual participants took part.

3.3. Data acquisition

3.3.1. fNIRS measurements

There are multiple different approaches for conducting hyperscanning studies. In this study we will conduct measurements using fNIRS (functional near-infrared spectroscopy) as it is suited for research on interpersonal interactions in natural situations and is also used in a number of other hyperscanning studies that focus on eye-to-eye contact (Dravida et al., 2020; Hirsch et al., 2017; Noah et al., 2020). fNIRS is a non-invasive neuroimaging method during which changes in light absorbance in the near-infrared spectrum, are observed (Scholkmann et al., 2014). This shows changes in the oxygenated and deoxygenated haemoglobin

concentration, from which neural activity in the observed brain regions can be inferred.

While NIRS does have a relatively lower spatial resolution and the monitoring of deep brain tissues is not possible, as it would be for example with fMRI, cortex areas and brain tissues closer to the skull are still accessible (Liu & Pelowski, 2014). Moreover, compared to other measurement techniques such as MRI, fNIRS offers fewer physical restraints and does not involve any visual blockages like being inside an MRI tube. As a result, fNIRS allows for natural face-to-face contact during scanning, making it a suitable brain imaging method for the present study.

3.3.1.1. Regions of interest (ROIs); Optode Placements and conduction of measurements

The selection of ROIs is based on theories and studies on art perception, social cognition and eye-to-eye contact (see section *1.1.5* and *1.2.1).* The final set of regions of interest were: mPF, left dlPFC, left TPJ and right TPJ, due to their presumed functions and involvements, described in the literature review.

Recordings of hemodynamic activity were made with a NIRSport 8x8 (NIRx Medical Technologies LLC, Berlin, Germany, https://nirx.net/nirsport/). Eight emitters (laser diode emitters, γ1/2 = 760|850 nm, with average Power of 5 mW) and eight detectors were placed on each person, resulting in sixteen physiological channels per person. The sampling rate was approximately 7.81 Hz.

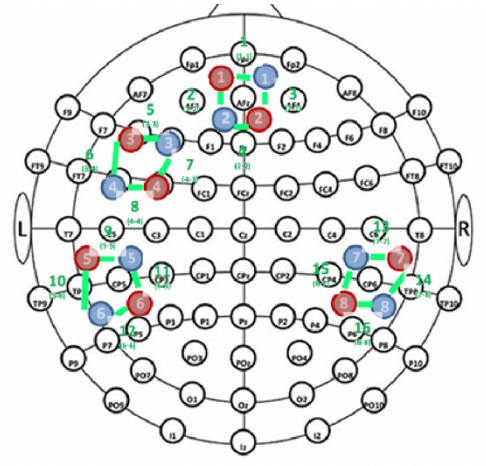

Figure 2 | *montage of optodes on fNIRS cap*

Following general practice, four channels were placed around AFz to record activity in the mPFC. Four more channels were placed around FFC5h for the left dlPFC (*following (Vassena et al., 2019)*), as well as four channels each for lTPJ and rTPJ on each side around CP5/CP6 accordingly *(following (Barreto et al., 2021))*. A cap made of opaque fabric was placed over each head to shield optodes from distracting light coming from outside sources.

3.3.2. Behavioral questionnaires

In addition to fNIRS measurements the participants were given questionnaires regarding personal information and questions about their experience. These consisted of one one short questionnaire before the experiment and another one after the trial. Additionally, an online questionnaire was sent to participants prior to the experiment, which they were asked to fill out about a week (min. 2 days) before testing.

3.3.2.1. Online questionnaire

The online questionnaire contained essential questions that needed to be asked before the experiment [rather than after]. However, administering the questionnaire immediately before the testing could have potentially served as a strong priming effect, distorting the perception of the subsequent performance/testing. For this reason, participants were sent a link to the questionnaire in an e-mail, with the request to complete it about one week (at least two days) prior to their participation in the experiment. To ensure anonymity, participants were required to generate a unique participant ID when filling out the questionnaire.

One part of the online questionnaire consisted of questions regarding factors that could distort the participant's experience in the experiment. Behavioral patterns during eye contact as well as cognitive and affective reactions to direct eye contact differ between neurotypical individuals and individuals with autism spectrum conditions (Dubey et al., 2015; Senju & Johnson, 2009), as well as for people with certain psychiatric conditions such as for example social anxiety disorder (Schneider et al., 2009). However, instead of asking for psychiatric history, participants were asked how comfortable they generally feel with direct eye contact.

Additionally, participants were asked about their general predisposition to feel stressed in social situations. (Krämer et al. (2010) show a negative correlation between MPFC activation and participants' predisposition to feel stressed in social situations, in a task that involves the perception of social situations. To test for this, the Interaction Anxiousness Scale (IAS) (Leary, 1983) was applied. The IAS consists of 15 statements which are to be rated on a 5-point Likert scale regarding the degree to which the statements apply to oneself. The responses can be summarized to a

total score, with a higher score indicating a greater tendency to experience subjective anxiety when in a social situation. Reported Cronbach's *alpha* coefficients range from .87 to .89 (Leary & Kowalski, 1993).

Participants were also asked questions regarding their relationship to art. For this they are given the Aesthetic Responsiveness Assessment (AReA) (Schlotz et al., 2021). The AReA measures differences in how people respond to artworks and also asks about their own creative behavior. The scale consists of 14 items, which are to be answered on a 5-point Likert scale. The items load onto 3 subscales (Aesthetic Appreciation, Intense Aesthetic Experience, and Creative Behavior), which add up to Aesthetic Responsiveness as a second-order factor. The Composite reliability coefficient for the total score (Aesthetic Responsiveness) is .89. (Schlotz et al., 2021). The items consist of statements such as "I am deeply moved when I see art" or "I visit museums or go to musical/dance performances". Following the AReA we added three extra items regarding transformative experiences with art and knowledge about art ("I often have transformative experiences when looking at art"; "I am interested in art"; "I consider myself knowledgeable about art"). The extra items are not added to the total score.

Next, participants were asked about their art education ("Have you ever studied fine art or art history"), for which they had to select one of the following options: "No never", "I have taken some art classes in high school", "I took some art classes at university", "I have a bachelors/ undergraduate in art or art history" or "I have a Masters/PhD in art or art history". After this, participants were asked to rate how much they like certain art forms on a 5-point Likert scale. Out of these only "performance art" was used for analysis, but other art forms were added as distractors.

Further, the participants were given various scales regarding social perception, empathy, etc.. The QCAE (Questionnaire of Cognitive and Affective Empathy) (Reniers et al., 2011) consists of 31 items, which are to be rated on a 4-point scale. The QCAE consists of 5 subfactors: "Perspective Taking" and "Online Simulation" which load onto the second-order factor Cognitive Empathy (CE); and "Emotion Contagion", "Proximal Responsivity" and "Peripheral Responsivity" which load onto the second-order factor Affective Empathy (AE). Cognitive Empathy and Affective Empathy are moderately correlated with each other ($r = .31$, $p<.01$) (Reniers

et al., 2011). Reported Cronbach's *alpha* coefficients for the Cognitive and Affective Empathy subscales range from >.77 to >.81 (Girolamo et al., 2019).

The Social Connectedness Scale – Revised (SCS-R) (Lee et al., 2001) measures how much a person feels connected to others. It consists of 20 Items that load onto one total score and has a Cronbach's *alpha* coefficient of .92 (Lee et al., 2001). The items are originally answered on a 6-point scale however for this study it has been used as a 4-point scale. Since many scales were given to participants, all Likert scales with an even number of options were applied with four options and all scales with an uneven number of options were applied as a 5-point scale. This is to avoid giving participants too many different rating scales, which might be perceived as frustrating and confusing. However even scales were never changed to an even number as the absence of a middle option can be relevant to the outcome (Reniers et al., 2011).

Another scale used was the Self-Reflection and Insight Scale (SRIS) (Grant et al., 2002). However a shortened and more efficient version by Silvia (2021) was used. The SRIS measures individual differences in private self-consciousness. It consists of 12 items which load onto two subscales: the Self-reflection Scale (SRS) and the Insight Scale (IS). Cronbach's *alpha* coefficients are .87 for the SRS and .83 for the IS (Silvia, 2021). The original scale uses a 7-point Likert scale, which for this study has been adapted to a 5-point scale for the reasons mentioned above.

To check for self-reported prosocialness we used the Prosocialness Scale by Caparara et al., (2005). It consists of 16 items, which are to be rated on a 5-point Likert scale, and together form one total score, a higher sore indicating a higher level of prosocialness. The reported Cronbach's *alpha* coefficient is .91 (Caparara et al., 2005).

To operationalize loneliness we applied the short scales for emotional and social loneliness by De Jong Gierveld and Van Tilburg (2006). The two subscales, emotional and social loneliness, each consist of 3 items. Originally they are to be answered on a 3-point Likert scale, which for this study has been changed to a 5-point scale. Reported Cronbach's alpha coefficients for the emotional loneliness subscale are between .68 and .74, and between .69 and .73 for the social loneliness subscale (De Jong Gierveld & Van Tilburg, 2006).

Additionally, basic demographic factors such as age, gender, sexuality and handedness were also collected in the online questionnaire.

3.3.2.2. Pre-eyecontact questionnaire

In addition to the written consent form, which also includes the rule of the performance/experiment, the participant was asked again to give their unique participant-ID (same as in the online questionnaire). Together with this, participants were given the Positive and Negative Affect Schedule - PANAS (Watson et al., 1988) in paper-and-pencil form. The PANAS consists of 20 items, each being an adjective describing an affective state, for example, “enthusiastic” or “ashamed”. The items are to be rated in regards to how well they describe ones state in the current moment on a 7-point scale. The items can be analyzed separately, or added up to two subscores, Negative Affect, and Positive Affect, consisting of 10 items each. The Negative Affect scale has a reported Cronbach’s *alpha* of .82, and the Positive Affect scale an *alpha* of .85 (Thompson, 2007).

3.3.2.3. Post-eye-contact questionnaire

Firstly, participants were again given the PANAS (Watson et al., 1988). After this, participants were instructed to rate the experience they had just had. For this, participants were first provided with a list of 14 constructs, which were to be rated on a 7-point scale (1 = “no such feeling; 7 = “ the most intense such feeling in my life”). The items were adapted from Pelowski (2015) and included for example “feeling like crying”, “tension”, “happiness”, “sadness”, etc.. Items such as “felt the paintings watching me” were removed, as they did not make sense in the given context. Two extra items “chills/goosebumps” and “boredom” were added. The factor “feeling chills and/or goosebumps” as people can experience “aesthetic chills” when engaging with an artwork (Silvia & Nusbaum, 2011) which coincides with a sudden peak in intensity of being emotionally moved.

Next, adjective pairs, such as “good:bad” or “deep:shallow”, were provided, which again were to be rated on a 7-point bipolar scale in the form of e.g. 1 = “good” and 7 = “bad”. The adjective pairs were again adapted from Pelowski (2015), however, only a selection of items was used, which for this study, then consisted of 10 pairs.

To analyze perceived personal connection with the other person, participants were given 6 items, which were mostly derived from speed dating studies (Lewandowski & Aron, 2004; Luo & Zhang, 2009; Pepping et al., 2017). Questions include for example “How similar do you perceive yourself to this person?” or “How much could you feel a connection with the other person?”. Questions regarding sexual attraction have been left out. The questions in the studies use different amounts of increments in their scales (5 to 9 points). However, they all are presented in the form of questions to which the participants can agree on a scale from “not at all” to “very much”. In this study, a 7-point scale was used for all of these items. The full rating scales, as well as all used questions regarding personal connection are added to this paper as a supplement (*Supplement B*).

Following this, participants were asked, analogue to Pelowski et al. (2017), to rate on a scale how much they themselves considered the performance to be art, and how much they liked it. Participants will also be asked if, and how well they knew their eye contact partner (the performer) prior to the experiment, as social closeness can increase brain synchronization (Dikker et al., 2020), and also otherwise distort the experience.

Participants then had the possibility to further describe their experience in their own words if they wished to add anything. For this, two questions were asked in an open question format: “What did this experience mean?” and “Is there anything else you would like to let us know in regards to the experience you just had?”

Subsequently, participants answered a short form of the Spielberger State-Trait Anxiety Inventory (STAI) (Mateau & Bekker, 1992). In consists of 6 items in the form of adjectives such as “calm”, “tense” or “worried”, which are to be rated on a 4-point scale. Mateau and Bekker (1992) report a reliability coefficient of *alpha* = .82 for the six-item version.

Lastly, some of the questionnaires that were already asked in the online questionnaire, were repeated to check for effects of time and group. The repeated questionnaires were the QCAE (Reniers et al., 2011), the SCS-R (Silvia, 2021), the SRIS (Grant et al., 2002), as well as the Prosocialness Scale by Caparara et al. (2005) and the Loneliness Scale by De Jong Gierveld and Van Tilburg (2006).

3.3.3. Other behavioral variables

Another variable that was recorded was the time of eye contact. Participants were instructed to hold eye contact for a minimum of 5 minutes. After this they were free to continue for as long as they chose, with a maximum of 10 minutes.

Figure 3 | *photos of donation box*

Participants were also given the possibility to donate a “lottery ticket”. They were informed that the research team will draw one ticket from the pool of all participants and the person corresponding to this ticket will receive 100€. Alternatively, the participant could donate their ticket, and if a donated ticket is drawn, the 100€ will be donated to a non-profit organization (the organization was “Rosa-Lila Villa Vienna”; an organization benefiting LGBTQ+ youth). To donate, the participant could throw their ticket into a box located by a window on the way out of the building, where they are not directly seen by the researching team. The choice of donating or keeping the ticket, was later anonymously collected through the unique participant ID.

3.4. Procedure

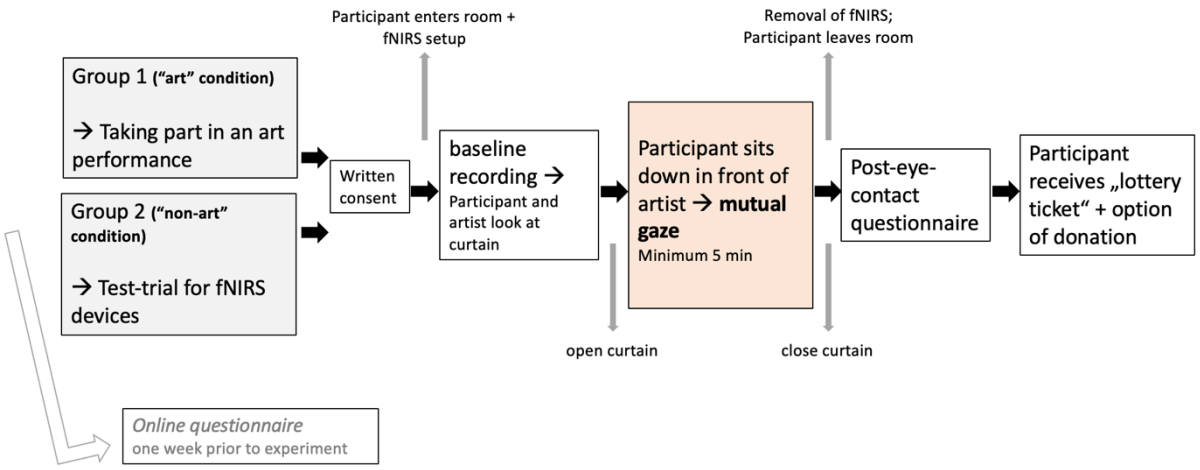

Figure 4 | *experimental procedure*

“Art” and “non-art” conditions were continuously switched around to firstly, ensure randomization and secondly, ensure, that no “learning effects” of the artist would create group differences. Through this we also hoped to equal out possible differences in the artists’ daily condition, mood, etc. as measurements for both conditions were conducted each day.

After arrival, participants were seated outside of the performance room. In the art condition, participants were then told that they are about to take part in an art performance, during which fNIRS recordings will be conducted, and during which they will simply sit and look into the artists’ eyes. In the non-art condition participants were told that they should look into the eyes of another participant, that is already in the room to test new fNIRS devices. The eye contact partner is the artist in all conditions, which is however not disclosed.

Participants of both conditions are given a written consent form, the PANAS in paper & pencil form, as well as a sheet of paper with the “rules” of the experiment. In this the participants were instructed to hold eye-contact, remain seated, and not to talk to the other person, however, these “rules” were introduced as part of an art performance in one condition and as instructions for the testing in the non-art condition (both instruction papers are attached as a supplement at the end of this paper). In addition to this, participants were verbally informed that they are about to take part in an art performance with a performance artist; or that they are about to look into the eyes of another participant, while we conduct measurements of brain activity.

After this, the participant enters the performance room. The participant is seated in front of the curtain behind which the artist/”other participant” is already seated. The fNIRS device is then put onto the participant. After calibration of the channels, instructions are given to stare at the curtain for one minute and then look down. The curtain is then pulled back and at the signal “go”, actress and participant look up to look into each other’s eyes for a minimum of 5 minutes. After 5 minutes they are given a signal and are then free to stop the experiment at any moment by simply looking down. This is analogue to “The Artist is Present” where visitors could look in the artist’s eyes for as long as they wanted. The performance was however ended after 10 minutes to not keep the next participant waiting for too long. The curtain is then closed, the fNIRS device is removed and the participant is led outside

to a table where they are instructed to fill out the last questionnaire. Lastly, participants are given a “lottery ticket” with the possibility to donate.

4. RESULTS

Statistical analyses were conducted using RStudio Version 2022.02.1 (*RStudio*, 2022) and IBM SPSS 27.0 (IBM Corp., 2020).

4.1. Behavioral data

4.1.1. Descriptive statistics of the sample

The final sample consisted of 44 participants (12 men, 31 women, 1 non-binary person). The average age was 23.3 (SD = 6.4) in a range from 18 to 49. In regards to art education, 24 participants reported having never taken art classes, 19 participants reported having taken art classes in high school, and one participant reported to have taken art classes at university. None of the participants reported having a Bachelor, Master, PhD, or any other degree in art or art history. Responses

x-axis shows possible values to choose from in regards to how much the statements apply to oneself (1 = not at all; 5 = very much);
y-axis shows the frequency with which a value was selected (the exact number is also displayed in each bar); total N = 44

Figure 5 | *distribution of responses to questions regarding attitudes and experiences with art*

to questions about art interest, art knowledge and transformative experiences with art are shown in Figure 5.

4.1.4. Baseline group differences prior to testing

To check for any group differences prior to testing, *t*-tests, or Mann-Whitney-Tests, if criteria for *t*-tests were not met, were applied. There were no significant group differences in gender, age, sexuality, art education, liking of art forms, loneliness, prosocialness, IAS, QCAE, SRIS, SCS-R or AReA – scores prior to the experiment. Additionally, no participant reported to have known the performer prior to the experiment.

4.1.3. Group differences in experience

Experiential ratings and ratings of personal connection

Replies to Likert-type scales provide ordinal variables. However, in scales with 5 or more points, variables can be treated as ordinal approximations of continuous variables without detriment to the analysis, and in that way generally provide more robust results than by using non-parametric tests (Norman, 2010; Sullivan & Artino, 2013). Bonferroni corrected independent sample *t*-tests were applied, for the comparison of experiential ratings and personal connection between groups. Rothman (1990) suggests, that in exploratory research, adjustments for multiple assessments are not necessarily needed, and might even cause loss in valuable information. Due to the very large number of variables as well as the rather explorative nature of this study, significance levels both before and after Bonferroni correction are reported here. Bonferroni correction was applied over the entire item pool of experiential factors, emotional ratings and ratings of personal connection.

Results are shown in *Table 2* and illustrated in *Figure 6 & 7*. Significant group differences were found for “need to leave”, “anxiety”, “confusion” and “tension”; on the scales “good:bad” and “happy:sad” and item 1 and 6 from questions regarding personal connection (see *Figure 7*). While ratings for “Did you consider this to be art?” did not differ significantly between groups, more extreme cases on either side were found in the art group, as shown in *Figure 9*. A similar observation can be made for “How much did you like it?” (distribution shown in *Figure 9*)

STAI scores

An independent sample *t*-test was conducted to compare STAI (State-Trait Anxiety Inventory) scores of the art- (M = 6.78 , SD = 3.46) and non-art-group (M = 4.48 , SD = 2.46). This sample has a N = 40, as the STAI was added subsequently, and was thus not filled out by the first four participants. The independent sample *t*-test showed that STAI scores were significantly higher for participants of the art-group $t(42) = -2.52$, $p = 0.015$, compared to the non-art group, meaning that participants of the art-group reported higher levels of anxiety.

PANAS scales

For the analysis of PANAS scales, one participants had to be excluded from the analysis due to being a very extreme outlier (over 3 SDs). There were significant results only for the post eye-contact PANAS Negative Affect scale, with the art group having significantly higher values ($t(42) = -2.44$, $p = .019$). All results with descriptive statistics are shown in *Table 1*. A graph illustrating differences in pre- and post-scales as well as group differences is provided as Supplement C.

Table 1
descriptive data and results of t -tests (art vs. non-art) of PANAS subscales; (N=43)

PANAS subscale	Cohen´s *d* [95%CI]	p	art		non-art	
			M	SD	M	SD
pre eye-contact						
Positive Affect Scale	.44 [-.26 : 1.12]	.234	33.38	5.62	27.5	5.80
Negative Affect Scale	.55 [-.15 : 1.25]	.134	2.65	1.613	30.25	5.66
post eye-contact						
Positive Affect Scale	.49 [-.12 : 1.10]	.122	30.91	5.85	28.29	5.01
Negative Affect Scale	**.76** [.14 : -1.38]	**.019 ***	32.82	6.64	28.48	4.82

** p<.05 ; ** p<.01*

Table 2
descriptive data and results of t -tests (art vs. non-art) of experiential / emotional factors; (N=44)

item	Cohen´s *d* [95%CI]	p	p adj.	art M	art SD	non-art M	non-art SD
experiential factors							
feeling like crying	-.38 [-.98 : .22]	.200	.400	1.74	1.484	1.29	.717
need to leave	**-.76** [-.96 : -.15]	**.014 ***	.073	2.65	1.613	1.67	.796
anxiety	**-.79** [-1.40 : -.17]	**.012 ***	.073	3.17	2.081	1.86	1.062
confusion	**-1.41** [-2.06 : -.74]	**< .001 ****	**.001 ****	4.00	1.595	1.95	1.284
tension	**-1.00** [-1.63 : -.31]	**.002 ****	**.020 ***	4.43	1.619	2.86	1.526
surprise	-.12 [-.71 : .48]	.703	.803	3.78	1.536	3.62	1.284
self-awareness	.51 [-.09 : 1.11]	.092	.294	4.13	1.817	4.95	1.322
felt being watched	.06 [-.54 : .65]	.852	.879	4.26	2.416	4.38	1.802
changed my mind	.18 [-.42 : .77]	.561	.690	2.52	1.974	2.86	1.824
epiphany	-.28 [-.87 : .32]	.362	.552	2.65	1.496	2.24	1.480
sadness	-.48 [-1.08 : .12]	.111	.296	1.83	1.230	1.33	.730
happiness	.40 [-.21 : .99]	.197	.400	3.74	1.544	4.33	1.461
chills/goosebumps	-.41 [-1.00 : .20]	.184	.400	3.09	1.730	2.43	1.502
boredom	.14 [-.45 : .73]	.652	.773	1.96	1.147	2.14	1.526
bipolar scales							
good:bad	**-.66** [-1.26 : -.04]	**.032 ***	.149	2.74	1.573	1.90	.831
beautiful:ugly	-.31 [-.91 : .29]	.301	.507	3.00	1.537	2.57	1.165
intimate:remote	-.47 [-1.07 : .13]	.122	.300	3.13	2.007	2.29	1.521
happy:sad	**-.79** [-1.37 : -.17]	**.011 ***	.073	3.39	1.406	2.48	.814
meaningful:meaningless	-.04 [-.63 : .56]	.907	.907	2.96	1.461	2.90	1.446
sincere:insencere	-.23 [-.83 : .37]	.444	.617	2.91	1.474	2.62	1.024
deep:shallow	.20 [-.39 : .79]	.509	.652	2.61	1.234	2.86	1.236
strong:weak	-.09 [-.68 : .51]	.775	.827	2.87	1.456	2.76	.995
serious:humorous	.60 [-.01 : 1.20]	.051	.183	3.43	1.950	4.43	1.287
superficial:profound	.30 [-.30 : .89]	.322	.515	4.43	1.727	4.90	1.375
personal connection							
PC 1	**.63** [.02 : 1.23]	**.041 ***	.165	4.39	2.105	5.48	1.209
PC 2	-.21 [-.80 : .34]	.485	.647	5.00	1.679	4.67	1.461
PC 3	.34 [-.26 : 93]	.272	.484	2.61	1.373	3.10	1.513
PC 4	.36 [-.24 : .95]	.241	.454	4.53	1.442	5.00	1.225
PC 5	.50 [-.11 : 1.10]	.104	.296	4.00	1.784	4.81	1.436
PC 6	**1.02** [.39 : 1.65]	**.001 ****	**.020 ***	2.87	1.325	4.14	1.153
other							
like no/yes	-.09 [-.68 : .50]	.763	.827	4.26	2.158	3.76	1.670
art no/yes	-.26 [-.85 : .34]	.394	.573	5.17	1.586	5.05	1.161

All ratings made on 7-point scales. Significance was calculated via independent *t*-tests with Bonferroni correction over the entire item pool; *** p <.01, *p <.05* | (full questions for PC items are listed in Figure 7)

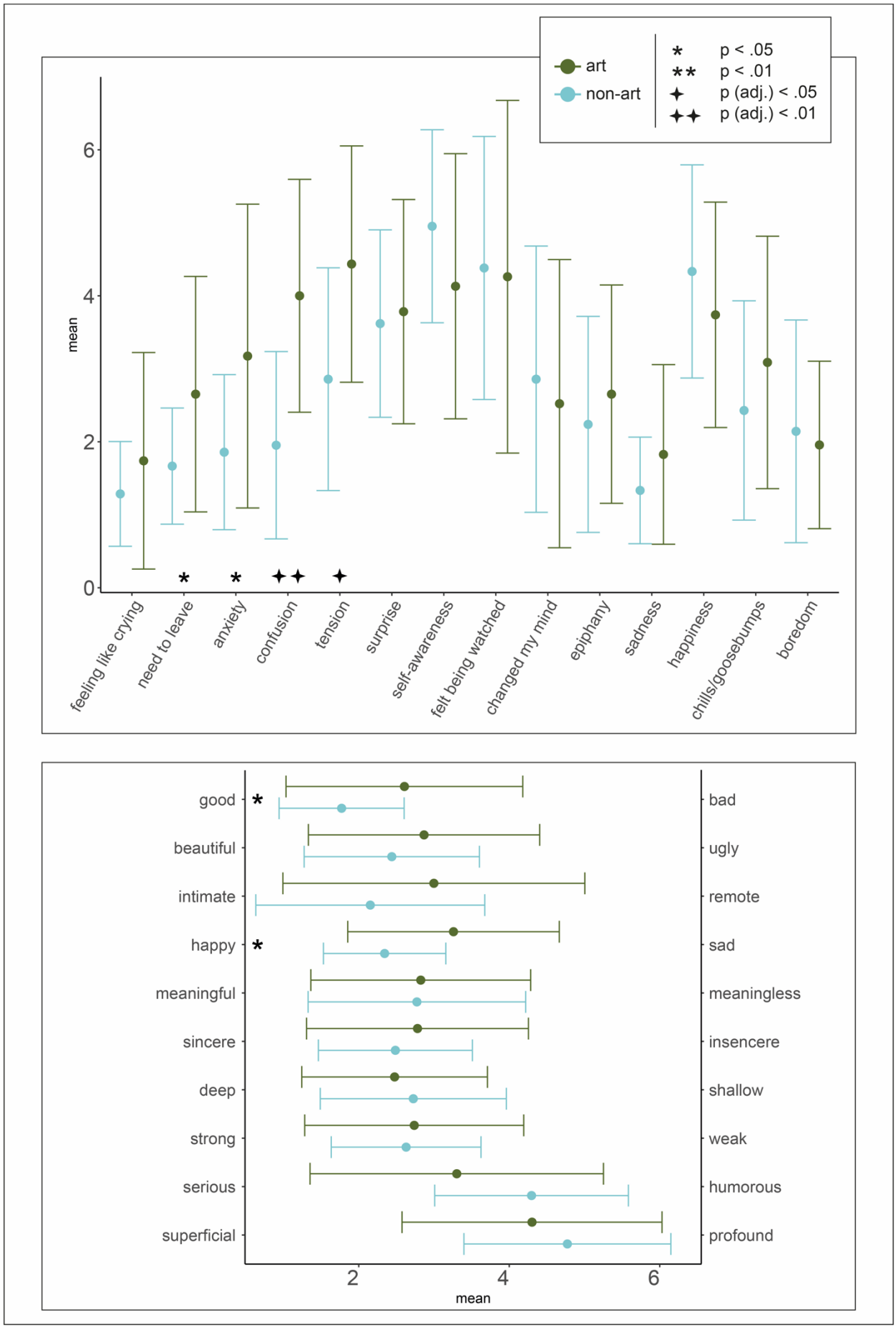

Figure 6 | *Mean and SD group comparison of reported experiential and emotional factors (up) and ratings of the experience on bipolar scales (down) in art vs. non-art; with sig. level of t-tests (before and after Bonferroni correction over the entire item pool)*

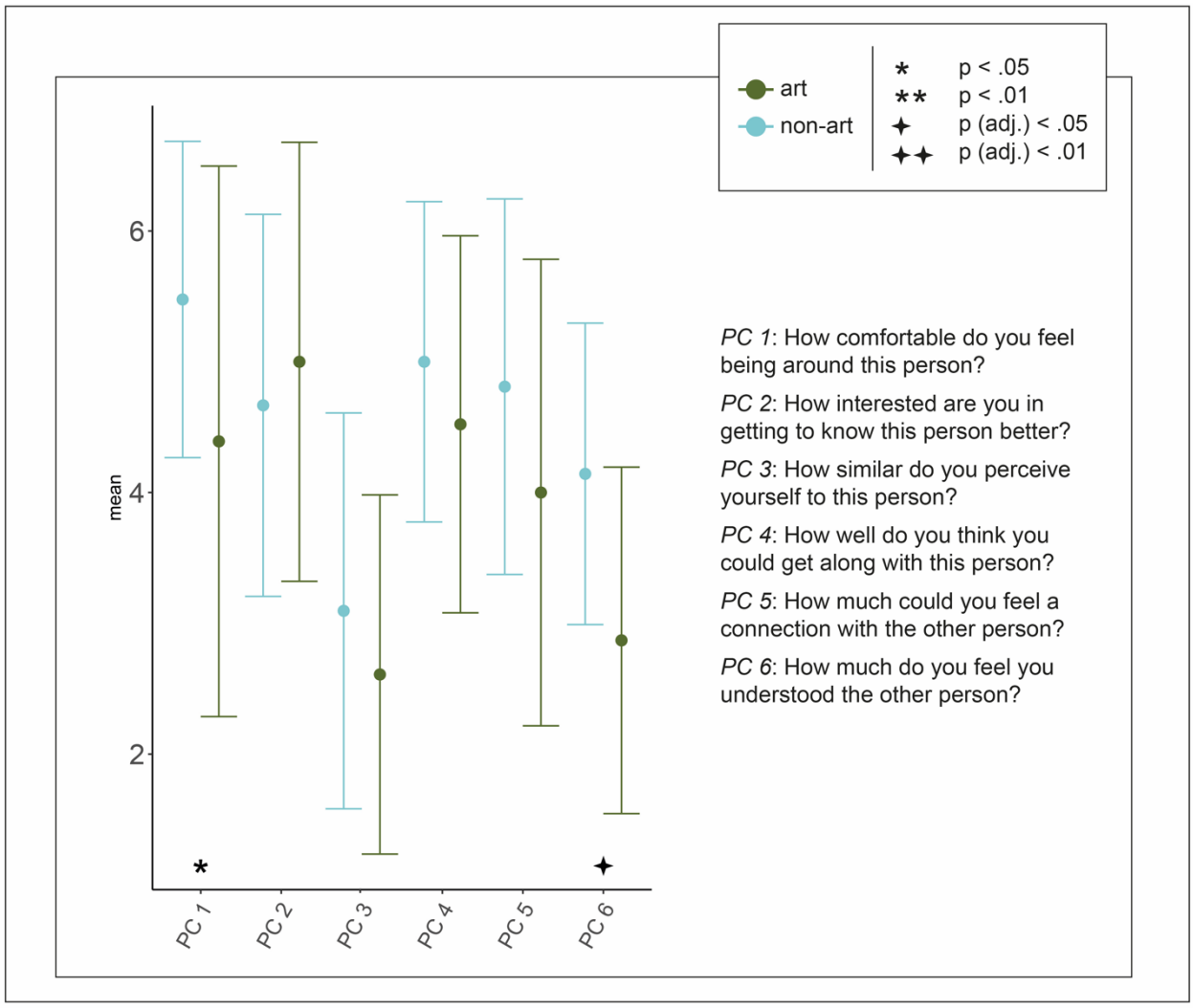

Figure 7 | *Mean and SD group comparison of reported experienced personal connection in art vs. non-art; with sig. level of t-tests (before and after Bonferroni correction over the entire item pool)*

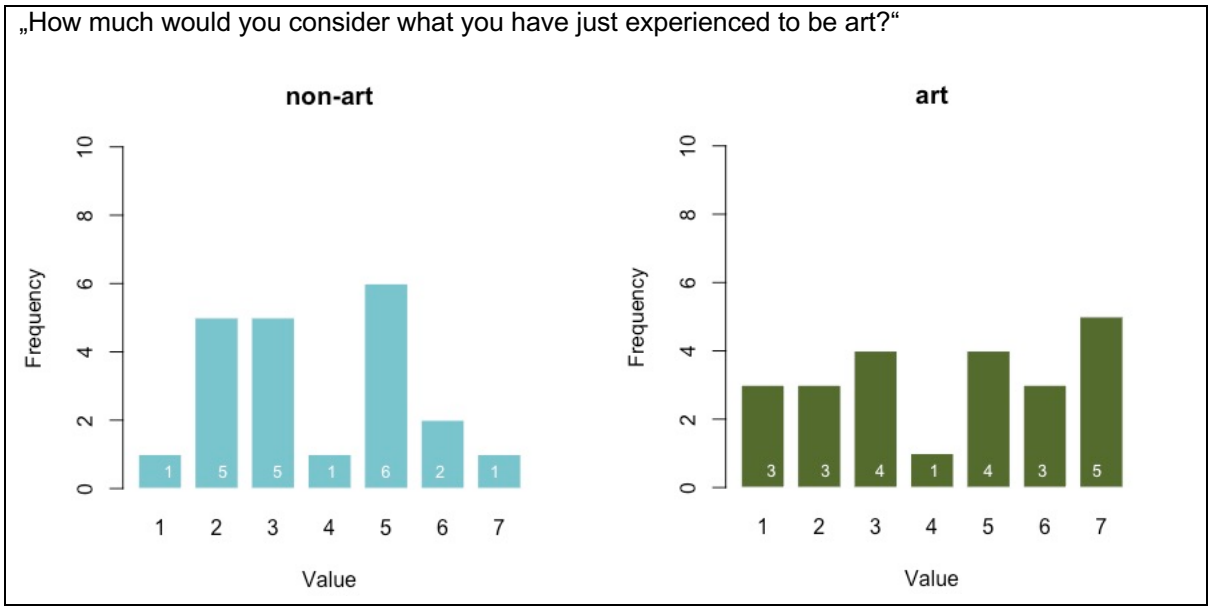

Figure 8 | *Distribution of responses to* “Did you consider this to be art?”*; separated by group*

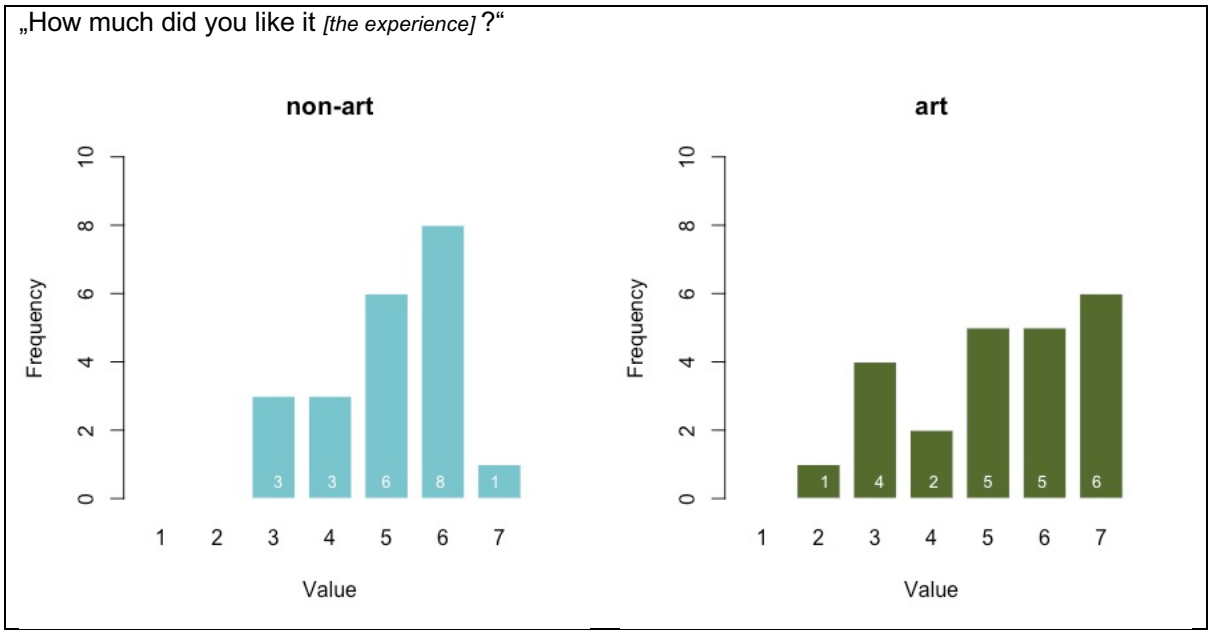

Figure 9 | *Distribution of responses to* “How much did you like it?”*; separated by group*

4.1.3.1. Intercorrelations

Additionally, intercorrelations of experiential and emotional ratings were calculated separately for both conditions. Scale ratings were again treated as ordinal appropriations of continuous data. Correlations were calculated as Pearson correlation coefficients. Due to the explorative nature of this paper and the small sample size of these correlations, p-values were not adjusted for multiple measures, following (Rothman, 1990). Results are illustrated in *Figure 10*. A complete table with all numerical coefficients and significance levels is provided as a supplement (Supplement D).

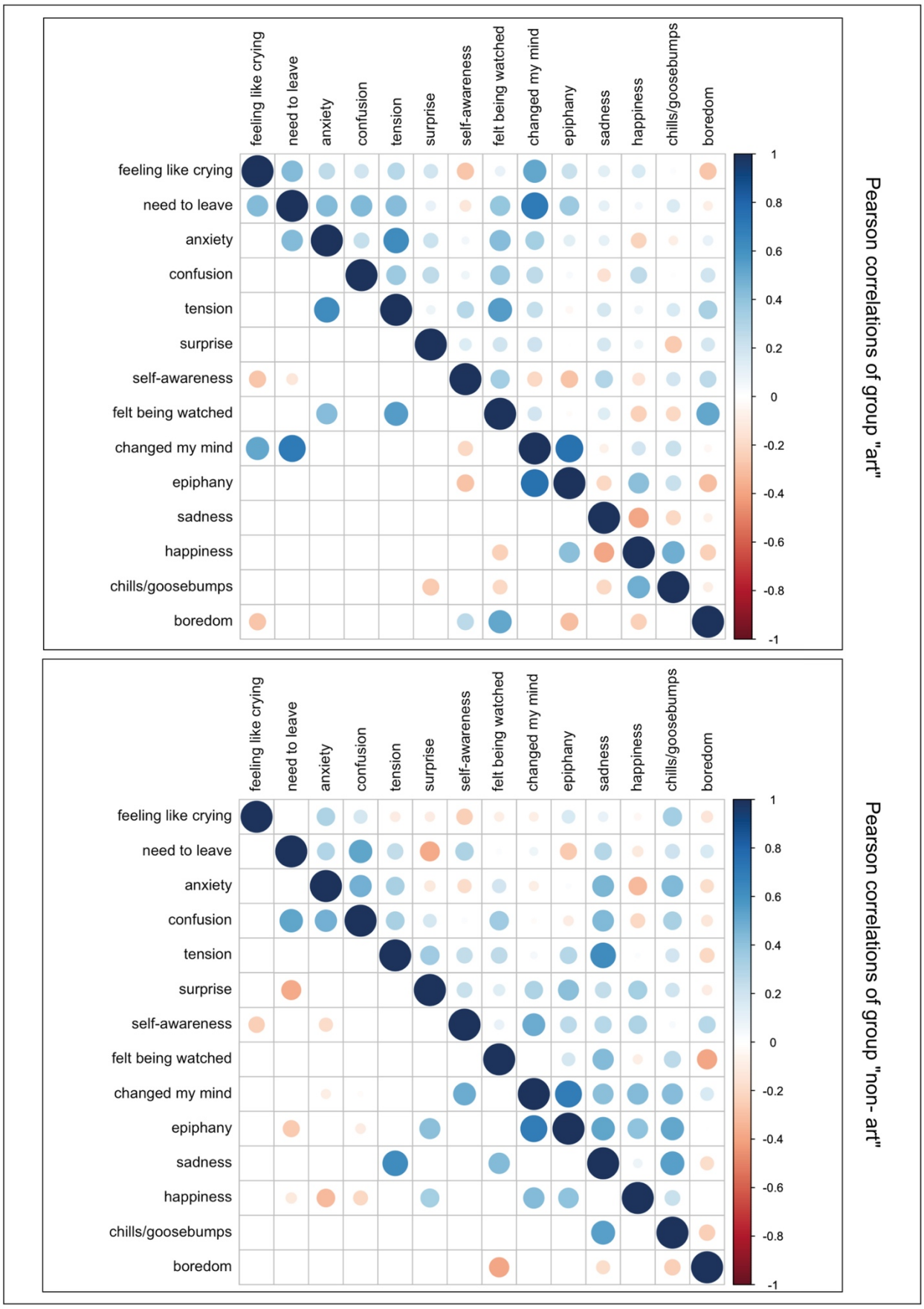

Figure 10 | *Plot of correlation matrices of experiential and emotional factors, separated by group*
Circle size determined by Pearson correlation coefficients;
Upper triangular shows all correlations; lower triangular only shows significant correlations (p<.05)

4.1.4. Group differences in donations

In the art condition, 13 participants donated their ticket while seven did not. In the non-art condition, ten participants donated their ticket, while the remaining 10 did not. Four participant were excluded from the analysis, as the possibility to donate was not available at the time of their participation. A chi-square test of independence showed that, despite more people donating in the art condition, differences between art and non-art in the decision to donate were not significant X^2 (1, N = 40) = 0.41, p = *.52* . Overall, 57,5% of participants decided to donate their ticket.

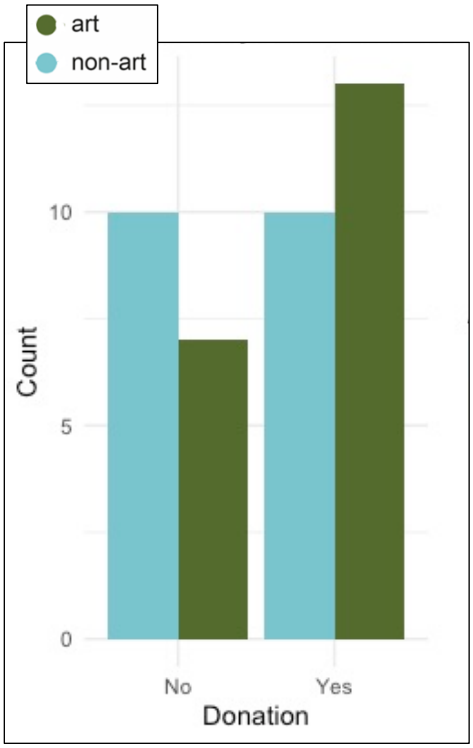

Figure 11 | *frequency of donation separated by group*

4.1.5. Group differences in eye-contact time

Group differences in eye-contact time were analyzed by applying a Mann-Whitney-Test, as the data was not normally distributed and requirements for a *t*-test were not met. Five participants were excluded from the analysis, as in four cases the eye-contact time was stopped after five minutes by the research team, and in one other case the instruction was misunderstood by the participant. Results show no significant group differences in eye-contact time for art (Mdn = 5.83 minutes) (N1) and non-art (Mdn = 5.62 minutes) (N2), U(N1 = 19, N2 = 20) = 167, p = .525.

4.1.6. Differences in questionnaire scores before and after the experiment; including interactions with group

To compare questionnaire scores before and after the eye-contact, and analyze interactions with the experimental group, 2x2 mixed ANOVAS were conducted. *Table 3* shows the results for interactions. Results for the analysis of main factor is discussed below. One participant had to be removed for the analysis of QCAE/CE scores due to a missing data point. *Figure 12* shows line graphs for mean scores before and after the eye-contact with different lines for each group to visualize

interactions. Note, that since all scales have different scalings the graphs also show results in different scalings and increments.

Table 3

results 2x2 mixed ANOVAs questionnaire scores pre/post | art/non-art

	interaction (group/time)				
scale	F	p	partial η^2		
Interaction p < .05					
Loneliness / emotional	F(1,42) = 7.741	**.008****	.156	main effects for significant interactions are discussed below	
SRIS / IS	F(1,42) = 4.154	**.048***	.090		
				main effects (p)	
Interaction p > .05				time	group
Loneliness / social	F(1,42) = 1.206	.278	.028	.029*	.503
SRIS / SRS	F(1,42) = .302	.585	.007	.164	.128
Prosocialness	F(1,42) = .558	.460	.013	<.001**	.044*
SCS-R	F(1,42) = .469	.497	.011	.036*	.511
QCAE / CE	F(1,41) = .000	.985	.000	.091	.309
QCAE / AE	F(1,42) = 2.737	.105	.061	.042*	.838

** p<.05 ; ** p<.01*

Emotional loneliness showed a statistically significant interaction with p = .008 (F(1,42) = 7.741, partial η^2 = .156). Simple main Effects analysis shows, that the main effect of group is not significant at either timepoint, neither pre (M = .850, SE = .67, p = .211) nor post (M = -1.017; SE = .77, p = .196). The simple main effect of time was significant in the non-art group (F(1,20) = 25.5, p < .001, partial η^2 = .560), and not significant in the art group (F(1,22) = 1.47, p = .238, partial η^2 = .063).

For SRIS / IS interaction is also statistically significant with p = .048 (F(1,42) = 4.154, partial η^2 =.090). Simple main Effects analysis shows that the main effect of group is not significant at either timepoint, neither pre (M = -1.308, SE = .1.25, p = .301) nor post (M = .700, SE = 1.25, p = .580). The simple main effect of time was significant in the non-art group (F(1,20) = 16.20, p = .001, partial η^2 = .448), however not significant in the art group (F(1,22) = .011, p = .916, partial η^2 = .001).

Interactions of group and time were not significant for Prosocialness, Loneliness/social, SCS-R, SRIS/SRS, QCAE/CA and QCAE/AE. For the social subscale of the Loneliness Scale the main effect of time, was significant with $p = .029$ ($F(1,42) = 5.107$, partial $\eta^2 = .108$) with no significant main effect for group ($F(1,42) = .457$, $p = .503$, partial $\eta^2 = .011$). For SRIS/SRS neither the main effect of time ($F(1,42) = .164$, $p = .688$, partial $\eta^2 = .004$) nor the main effect for group were significant ($F(1,42) = .128$, $p = .723$, partial $\eta^2 = .003$). For Prosocialness the main effect of time was significant with $p < .001$ ($F(1,42) = 20.668$, partial $\eta^2 = .330$). The main effect for group was also significant with $p = .044$ ($F(1,42) = 4.327$, partial $\eta^2 = .093$). For SCS-R the main effect of time was significant with $p = .036$ ($F(1,42) = 4.669$, partial $\eta^2 = .100$), while the main effect of group was not significant ($F(1,42) = .511$, $p = .429$, partial $\eta^2 = .012$). For QCAE / CE neither the main effect of time ($F(1,42) = 2.995$, $p = .091$, partial $\eta^2 = .068$) nor group were significant ($F(1,42) = 1.509$, $p = .309$, partial $\eta^2 = .025$). Lastly for QCAE / AE there was a significant main effect for time with $p = .042$ ($F(1,42) = 4.386$, partial $\eta^2 = .095$), and no significant main effect for group ($F(1,42) = .042$, $p = .838$, partial $\eta^2 = .001$).

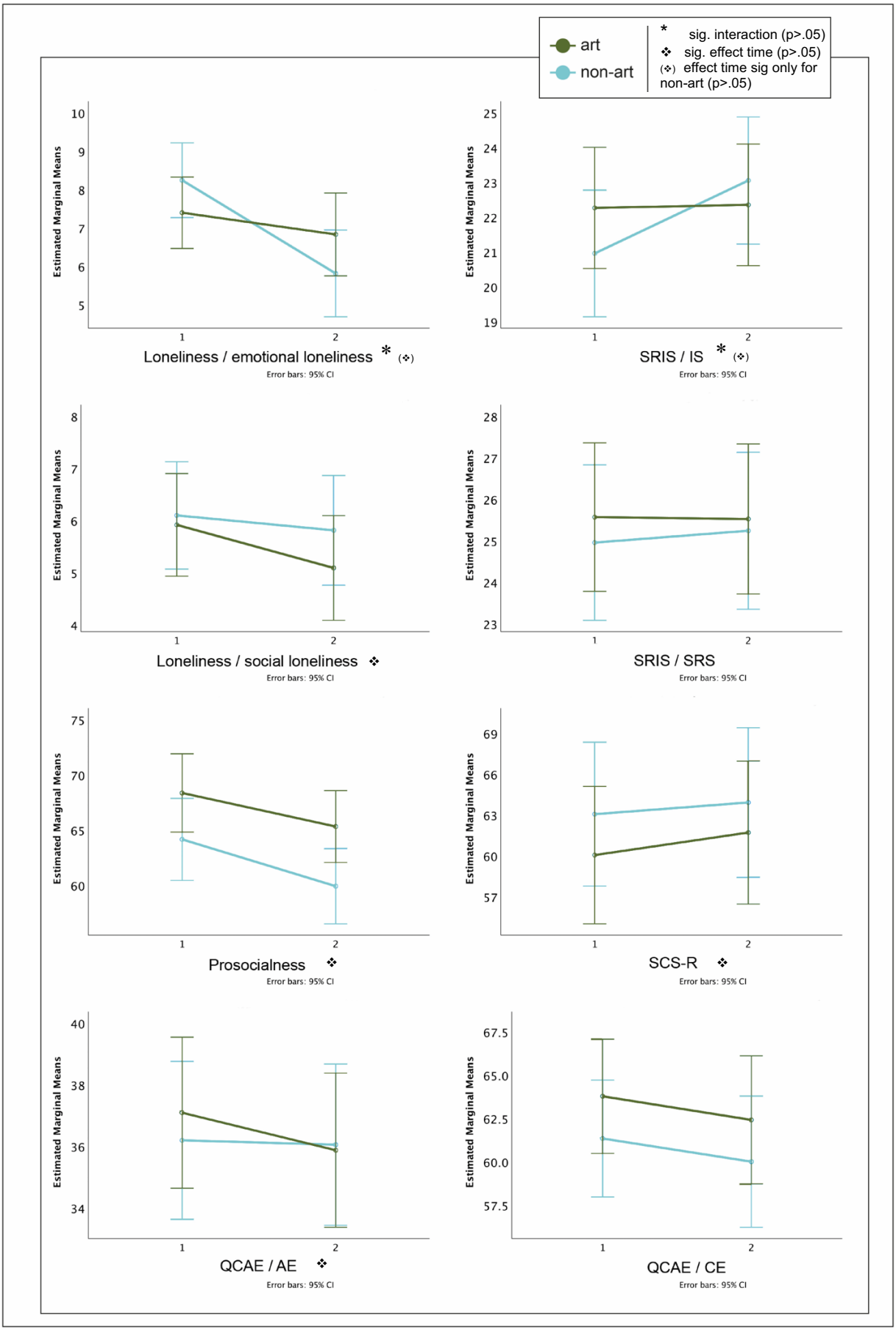

Figure 12 | *Mean scores in mixed ANOVAS for all pre/post scales (note: all graphs have different scalings as the questionnaires they are based on, each follow different scales)*

4.1.7. Responses to open questions

84% of participants answered at least one of the two open questions “What did this experience mean?” and “Is there anything else you would like to let us know regarding the experience you just had?”. Participants from both groups reported having had intense and/or emotional experiences. Some examples include:

> *„It was a special experience for me, which I didn't understand at all. So right now I am a little bit confused.“ (art)*
>
> *„It was to me a profound experience to be connected to one another in this way, to feel close on a fundamental human level.” (art)*
>
> *„This experience was extremely interesting and to me also moving. Something was happening inside of me, as I felt feelings such as shame, interest and happiness.” (art)*
>
> *„It was a very new experience, a bit uncomfortable, but very intimate.” (art)*
>
> *„felt very intense, at some point i felt dizzy, but probably because it is too much for me having an eye contact with another person especially unknown one, but overall it was very interesting“ (non-art)*
>
> *„It was nice to get to look someone in the eyes for quite a time without it being awkward. It was relaxing to some extent.“ (non-art)*

A full list of all responses, separated by group, is provided as Supplement E.

4.2. fNIRS data

3.2.1. Data pre-processing

Following standard procedure steps of fNIRS data preprocessing in current scientific practice, the raw fNIRS data of both artist and participants were pre-processed to exclude channels with bad signals, minimize noise and motion artefacts, and finally convert changes in optical density to changes in levels of blood

oxygenation. This was done using Matlab and Statistics Toolbox Release R2022b (*MATLAB*, 2022) with the Homer3 Toolbox (Huppert et al., 2009).

Channels were firstly pruned manually, by checking each channels signal using line plots and CWT-plots. Channels with signals that were too distorted or too weak were excluded from further processing and analysis. A complete list of all excluded channels with reason for exclusion for each brain recording is provided as a supplement (*Supplement C*). From a total of 88 single-brain recordings (44 actress, 44 participants), 9 recordings had to be completely excluded, leaving 39 single-brain recordings of participants and 40 single -brain recordings of the artist, resulting in 38 possible paired brain dyads. Note that for some participants, only certain ROIs had to be excluded which is why there are different N values for each ROI in the fNIRS data analysis.

The remaining data was then band-pass filtered [0.2 – 0.01 Hz] to account for physiological oscillations (removing very low as well as very high frequency oscillations; e.g. cardiac rhythms). Further, motion artifacts were corrected by using spline interpolation. The resulting data was then used to calculate relative changes in blood oxygenation, providing values for concentrations of HbO^2 (oxygenated hemoglobin), HbR (deoxygenated hemoglobin), as well as HbT (total hemoglobin).

3.2.2. Analysis of inter-brain synchrony

Wavelet coherence was calculated for each ROI of each pair to analyze differences in brain synchrony. Coherence scores were created for each ROI by calculating the mean of all channels making up the ROI. Mean cross-brain coherence during baseline recordings was subtracted from mean cross-brain coherence during eye contact for each ROI of each dyad. This is done to account for cross-brain coherence due to simply sitting and staring, without any “interaction” with each other. Group differences between art and non-art in cross-brain coherence were compared using simple t-tests. Descriptive statistics and results of these t-tests with Cohen’s d are provided in *Table 4*. There were no significant group differences in cross-brain coherence between art and non-art in any of the ROIs.

Table 4

group comparisons of cross-brain coherence per ROI (mean baseline coherence is subtracted from mean eye-contact coherence) ; descriptive data and results of t-tests

ROI	group	N	M	SD	Cohen's *d* [95%CI]	df	p
mPFC	non-art	17	.34	.04	-.21 [-.053 : .95]	29	.557
	art	14	.33	.03			
dlPFC	non-art	12	.35	.04	-.25 [-.56 : 1.05]	25	.532
	art	15	.34	.03			
rTPJ	non-art	9	.34	.02	-.22 [-.77 : 1.23]	16	.640
	art	9	.34	.03			
lTPJ	non-art	8	.34	.03	-.23 [-.73 : 1.19]	18	.621
	art	12	.33	.03			

4.2.3. Analysis of single-brain activity in participants

3.2.3.1. Analysis of baseline recordings

Table 5

group comparisons of mean activity during baseline (15s to 60s); descriptive data and results of t-tests

ROI	group	N	M	SD	Cohen's *d* [95%CI]	df	p
mPFC	non-art	18	-.0000011	.0000013	.17 [-.52 : .85]	31	.644
	art	15	-.0000007	.0000025			
dlPFC	non-art	16	-.0000016	.0000019	.49 [-.20 : 1.17]	32	.174
	art	18	-.0000004	.0000027			
rTPJ	non-art	14	-.0000031	.0000023	.03 [-.68 : .74]	29	.939
	art	17	-.0000025	.0000023			
lTPJ	non-art	12	-.0000008	.0000023	-.40 [-1.17 : .37]	25	.325
	art	15	-.0000001	.0000022			

Baseline recordings were conducted before the actual eye-contact with participants and artist simply staring at the curtain in front of them over a duration of one minute. The first 15 seconds have been cut off as participants are often still adjusting themselves and thus creating unwanted noise in the signals. If recordings were longer than 60s recordings were also cut off at the 60s mark. *Table 5* shows group comparisons of baseline recordings using independent sample t-tests. While

no difference is statistically significant, dlPFC and lTPJ comparisons both show effect sizes of at least d = .4. It should however be noted that baseline recordings naturally cannot be z-scored (*see 2.2.3.2.)* and should therefore be interpreted with a lot of caution.

Graphs illustrating differences in baseline recordings and mean activations over time are provided as Supplement G.

3.2.3.2. Difference in single-brain activity for art vs. non-art

Before comparing the data, each participant's data has been z-scored. For z-scoring, the baseline mean of each channel is subtracted from the values of each timepoint and then divided by the standard deviation. This process normalizes the signal across participants and makes it easier to make comparisons, as inter-subject differences can be reduced. From the one minute of baseline recordings the first 15 seconds were cut off to calculate the mean and SD for the z-scoring, as people are often still adjusting themselves in the first few seconds, and thereby creating unwanted noise, which would distort the baseline mean.

Z-scored mean activations for each ROI were then compared applying independent sample t-tests. Results as well as effect size estimates using Cohen's d are shown in *Table 6.*

Table 6

group comparisons of mean activation over five minutes of eye-contact; descriptive data and results of t-tests

ROI	group	N	M	SD	Cohen's *d* [95%CI]	df	p
mPFC	non-art	18	.25	.32	-.43 [-1.12 : .27]	31	.246
	art	15	.07	.52			
dlPFC	non-art	16	.26	.37	-.54 [-1.22 : .15]	32	.137
	art	18	-.01	.63			
rTPJ	non-art	14	.09	.53	-.19 [-.90 : .52]	29	.615
	art	17	-.02	.59			
lTPJ	non-art	12	-.07	.48	-.03 [-.79 : .73]	25	.946
	art	15	-.09	.64			

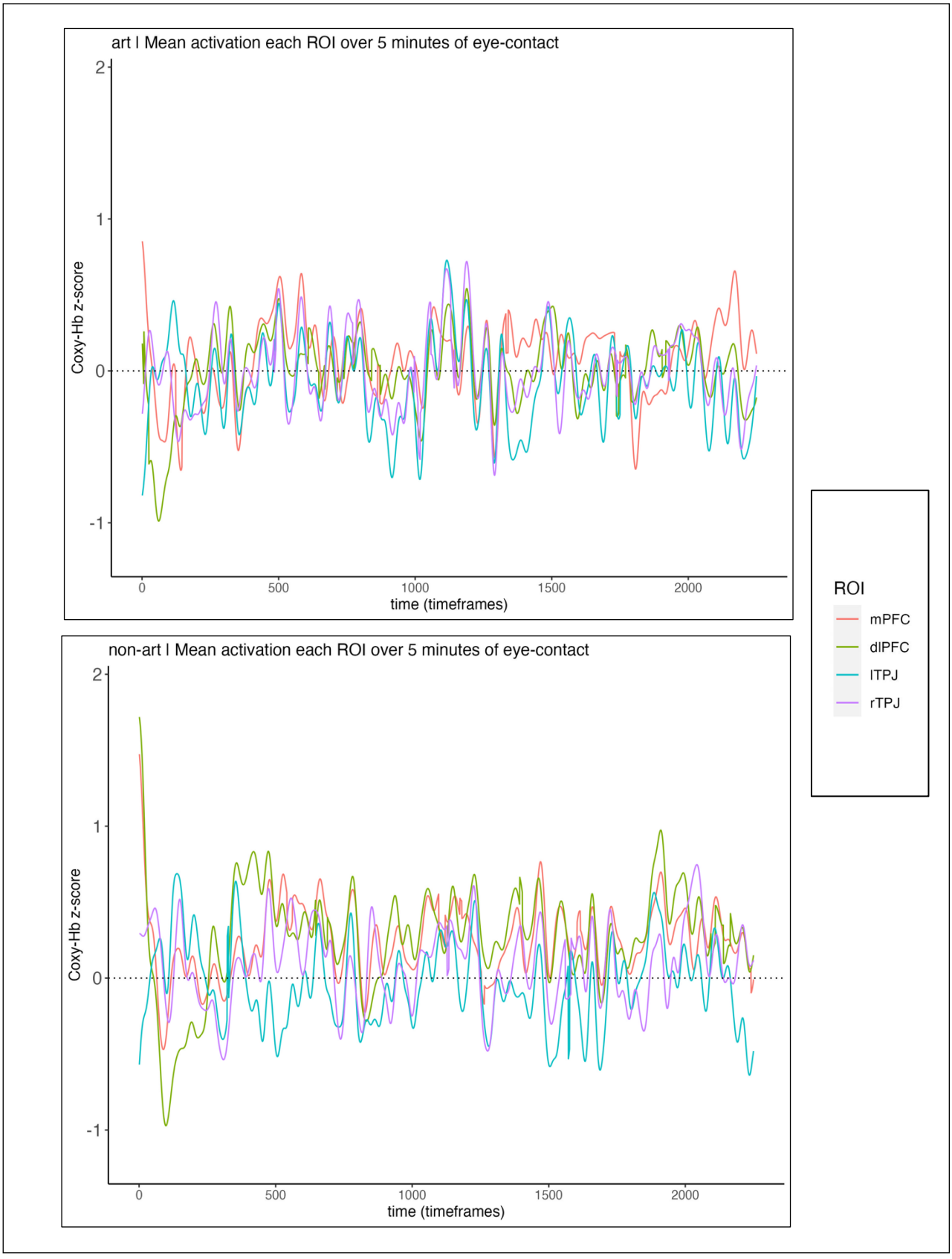

Figure 13 | *Z-scored mean activation of each ROI per timepoint over all participants separated by group*
(sampling rate: 1 s = 7.81; 5 min = 2346.75)

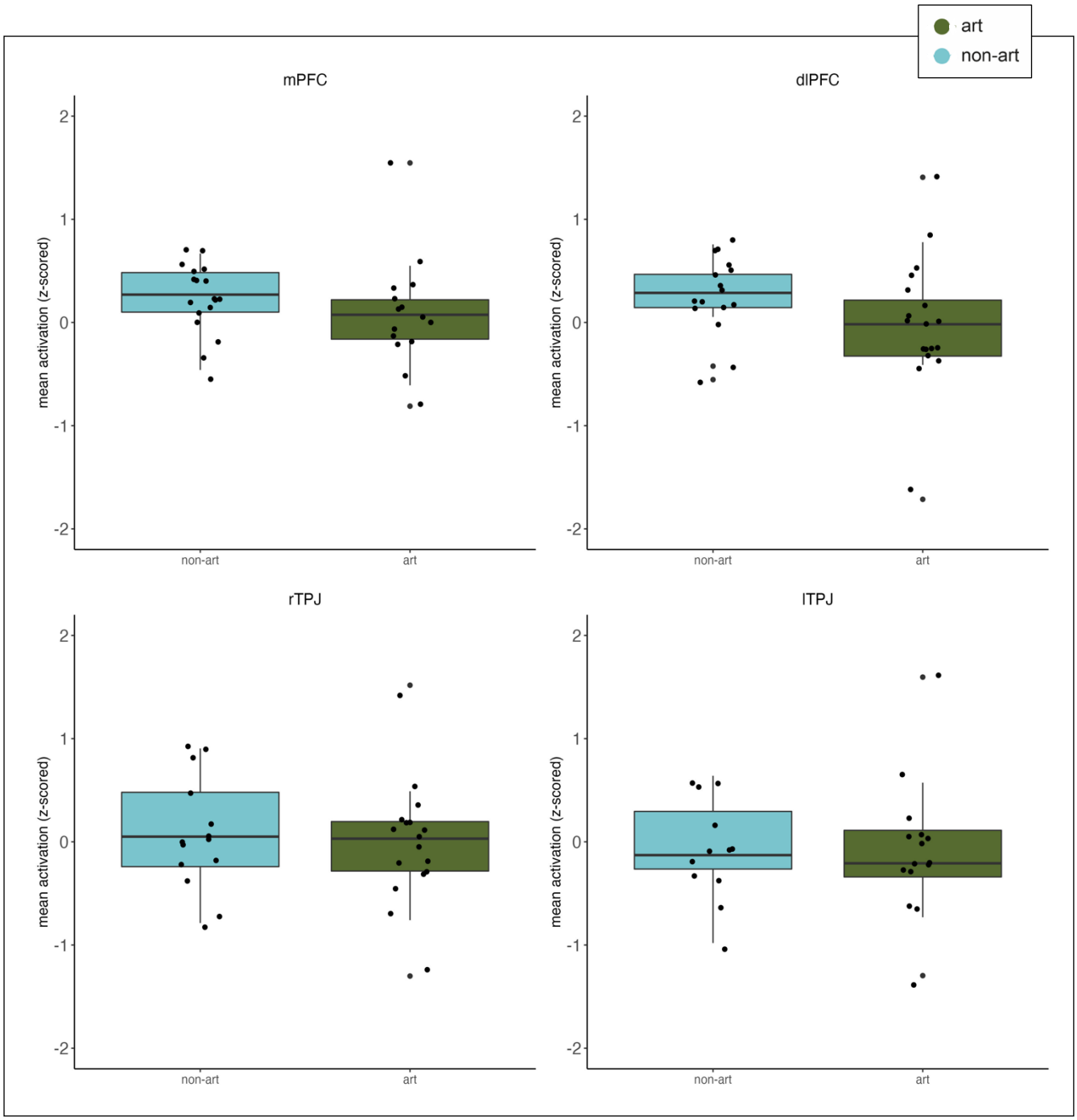

Figure 14 | *Z-scored mean activation of each ROI over all timepoints, showing median, quartiles and distribution; separated by group*

5. DISCUSSION

The current study employed behavioral as well as physiological methods to explore differences in perception and emotional, social, and metacognitive processing of a stimulus in an art context compared to outside of it. However both social interactions and the perception of an artwork are complex and nuanced experiences, that differ greatly between people. The results highlight this complexity and involvement of a large variety of factors that contribute to the way in which an artwork is processed and further, to the possibility of an artwork facilitating transformation. Significant differences in experiential factors such as emotions and metacognition were found.

The results should be interpreted with caution as multiple interpretations might be possible. The following section provides a possibly non-exhaustive overview of possible interpretations and implications and highlights the limits of the current study, while providing implications for further research.

5.1. Group differences in behavioral data and possible implications and limitations

Participants in the art condition reported significantly higher levels of *confusion*, *tension*, *anxiety* and *need to leave* as well as significantly higher STAI scores, signifying higher self-reported levels of anxiety, as well as higher scores on the PANAS Negative Affect Scale. When describing their experience, participants in the art group also described it significantly higher as “bad” and “sad”. Participants also stated to have felt significantly less comfortable with the other person and to have understood her significantly less in the art condition.

This initially goes against a common perception of art as a safe space or art-viewing as a recreational activity with the goal of finding comfort and beauty. Studies like the ones by Van Dongen et al. (2016) or Arai and Kawabata (2016), where pictures were rated as more aesthetically pleasing when perceived in an art context might suggest a stimulus to become more pleasing when put into an art context. The results of the present study on the other hand, appear to stand in a contrast to this. It is important to note that the just mentioned studies compare aesthetic ratings of pictures, while the present study compares experiential and emotional factors of an

art performance. While Van Dongen et al. (2016) shows a negative stimuli to be rated more positively in an art context, Gerger et al. (2014) showed, that the art context modulated positive appraisal, it did however not have such an effect on negative emotions meaning that, while it increased positive appraisal it did not make negative emotions disappear. The current study however shows more negative felt emotions in the art context. While it is unclear why that was the case, a few explanations of what might have happened can be considered possible.

Taking into account Turner's (1968) concept or metaphor of cultural performances in a "liminal space" *(see 1.2.1.)* it could be suggested, that by placing the same stimulus in an art context, the social and perceptual norms of everyday life are changed or altered, which might cause higher levels of confusion and tension. A common, familiar stimulus might suddenly become novel, as the meaning that is attached in a normal social context is removed or changed and needs to be re-understood, revalued and recategorized. Unlike in the non-art condition, where the purpose of the eye contact was said to be simply for testing the fNIRS devices, the purpose and "social rules" of eye contact as an art performance are not necessarily clear and had to be established by the participants themselves. The stimulus of eyecontact would have then become a novel stimulus, requiring recategorization and understanding which possibly could result in discomfort and confusion.

People also generally have very different approaches to modern art. In a study, Pelowski et al. (2017) showed that under 50% of participants actually classified ready-made sculptures as art. The classification of eye-contact as performance art might thus also lead to irritation in some people.

Sample characteristics should also be considered with over 77% of participants in the current sample responding to the questions "I often have transformative experiences when looking at an artwork." and "I consider myself knowledgeable about art." with scores below 3 (on a scale of 1 to 5). When the art context presents a context, that one is not all too familiar with, there might also be discomfort and confusion in being confronted with a novel artwork, especially with the participatory element of not only observing, but also being observed in a "space" with, as previously described, unclear social "rules".

Another possibility of explanation, or maybe rather an additional one, presents itself when considering the discomfort, as simply a part of the aesthetic experience, and/or further, a component of transformation and schema change.

Menninghaus et al. (2017) state in their model of art processing, that negative emotions are generally a crucial element of art and art perception and may even contribute to the enjoyment of art through processes of distancing and embracing, which allows for a more enjoyable experience of negative emotions.

Pelowski et al. (2016) note that many previous art processing models have often put less focus on negative factors. However, “negative” felt emotions play a crucial role in higher level schema change and transformation. The VIMAP (Pelowski, Markey, et al., 2017) notes, that in the case of high self-relevance and low schema congruence, negative emotions are being felt regardless of the subsequent outcome. If the schema discrepancy is resolved by reclassifying the artwork as “not art” or “bad”, this might be accompanied by anger, anxiety or shame, as well as the need to stop and leave. If a discrepancy in schemata is resolved by a transformation of previously held schemata (transformative outcome), this is initially also accompanied by negative emotions such as confusion or anxiety, but then followed by feelings of epiphany or harmony.

While self-reported levels of “changed my mind” do not differ significantly between groups, it should be noted, that, while in the non-art condition correlations between “changed my mind” and the factors that do significantly differ between groups: *anxiety*, *confusion*, *tension*, as well as *need to leave*, are all relatively small ($r<.1$), with some even being slightly negative, in the art condition however, all four show correlation coefficients with “changed my mind” between .2 and .7 (see Fig. 10), suggesting a possible difference in the qualitative properties of change of mind in the art group compared to the non-art group, and possibly pointing at an importance of negative emotions in a change of mind in the art context. Additionally, “feeling like crying”, which could be considered an indicator of schema-change (Pelowski, 2015), is significantly correlated with changed my mind in the art group, while having no notable correlation in the non-art group.

Future studies are needed to clarify, if and how negative emotions are relevant to schema change, or rather if they indicate a qualitatively different form of schema change, such as higher-level or lower-level, or if they could lead to a longer-lasting transformation. This could be done by including follow-up questionnaires days or

weeks after the experiment to take a look at longer-term effects and distant retrospective ratings of the experience.

Further, while simply categorizing a stimulus as an artwork might not result in a significant mean difference in an experiential factor/variable (e.g. "*Did you like the experience?*"), it might still make the experience more "polarizing" in terms of producing more "extreme" experiences, on both ends of a spectrum. This can be observed for example in Figures 8 & 9, depicting the distribution of responses to "*Did you like the experience*?" and "*Did you consider this to be art*?". While group means do not significantly differ, there are more "extreme" values on both sides when the stimulus is introduced as an artwork. Further, the majority of variables show higher SDs in the art condition, possibly suggesting a higher tendency for "extremer" values. It could be hypothesized that the art-context might possibly heighten the intensity of an experience, which then might heighten the potential for transformation or an intense emotional experience, either positive or negative or mixed.

It should also be considered, that a transformative and intense experience with an artwork is usually not the norm, but rather very dependent on many internal and external factors of observer and artwork. In the current sample, only five participants responded to the statement "*I often have transformative experiences when looking at an artwork*" with a value above three on a 5-point Likert scale in terms of agreement. This should be considered when trying to generate a transformative experience with an artwork in a "laboratory setting".

Another factor often described as a part of the aesthetic experience and the processing of an artwork is the experience of aesthetic chills (Bannister & Fischer, 2019; Jain et al., 2023; Pelowski, Markey, et al., 2017; Silvia & Nusbaum, 2011). Aesthetic chills describe the occurrence of piloerection or shivers during an intense emotional sensation and peaks of pleasure. Aesthetic chills are connected to a higher positive rating of the experience as well as to greater arousal (Jain et al., 2023). While differences in intercorrelations of experiential factors between groups (*Figure 10*) should be interpreted with caution, it can be noted, that while in the non-art group chills/goosebumps were significantly positively correlated with sadness, in the art group they were significantly negatively correlated with sadness and

significantly positively correlated with happiness. This supports the idea that aesthetic chills are potentially inherent to the aesthetic experience. Moreover, this could be suggesting that participants had aesthetic experiences more frequently when the stimulus was presented in an art compare to non-art context.

5.2. Changes and differences in pre & post questionnaires

It should be noted that all scales used for pre/post comparisons provide self-described data, meaning they do not necessarily represent the actual prevalent "value" of a construct in a person but rather the degree to which the person described the construct as applicable to themselves. It cannot be said, for example, that participants were generally less prosocial after the eye-contact compared to the pre-test, it can only be said, that participants generally described themselves as less prosocial. It is important to keep this in mind when interpreting the results.

While the interpretation of the eye-contact actually significantly changing the level of a characteristic in a person is of course possible, it is also possible, that the experience simply changed the way the person views themselves or put themselves into a different context that led to a different self-rating. As mentioned in *1.2.1.* Croes et al. (2020) showed, that participants in a speed dating study were more likely to disclose intimate information about themselves during direct eye-to-eye contact, while simultaneously asking fewer questions about the other person. Considering, that eye-contact can be hypothesized to facilitate self-disclosure, it is possible that the post ratings might simply signify a more honest rating. Since the post-rating was done directly after the eye-contact their self-rating might also be affected by how they felt during the experience.

The intercept of time and group was significant in two cases: Emotional Loneliness (Loneliness subscale emotional loneliness) and Insight (SRIS/IS). While participants of the non-art group described themselves as less emotionally lonely and more insightful after the eye-contact, this was not the case for participants of the art-group. It could be argued, that participants rated themselves as less lonely because they have just encountered an intimate social interaction in the non-art group, while in the art group the interaction was, as previously described, removed from a "normal" social context and placed in an art context where the eye-contact is not

simply a social interaction, but rather an interactive performance that was being observed. In the art condition, participants experienced significantly higher levels of confusion, and they further reported to have understood their eye-contact partner significantly less. This might possibly result in participants in the art group experiencing no increase in their self-described level of insight, that occurred in the non-art group.

5.3. Differences in fNIRS data and possible implications and limitations

Due to the small sample size, which was further decreased by the eliminating certain channels due to poor data quality, fNIRS data comparisons should be interpreted with caution. The current study shows no significant group differences, neither in brain synchrony levels nor in single brain activations. Nonetheless small trends will be discussed here while also considering notable limitations.

5.3.1. Inter-brain synchrony

The comparative analysis of inter-brain synchrony was, in this present paper, rather explorative. In regards to levels of cross-brain coherence, group differences in both directions could have been plausible. Jiang et al. (2015) showed higher interpersonal neural synchrony for leader-follower pairs, compared to follower-follower pairs during a group discussion task. Considering this it could have been expected to observe higher levels of synchrony in the art condition as it could be hypothesized for there to be a leader-follower dynamic in the artist-viewer dyad. On the other hand, multiple studies show increased cross-brain coherence during cooperative tasks (Cui et al., 2012; Funane et al., 2011; Osaka et al., 2014; Sänger et al., 2012) and assume a connection to social bonding (Mende & Schmidt, 2021). While the non-art condition can be assumed to represent a somewhat social task, the art condition represents a situation in which the participant is simply observing a performance, that is to some degree removed from its normal social context. It could have been argued that this might result in lower cross-brain coherence in the art condition. In the current study there were no significant differences in cross-brain coherence, with only a small tendency towards less synchrony in the art condition in each of the ROIs.

5.3.2. Single-brain activity

Baseline recordings

An important limitation to firstly acknowledge pertains the baseline recordings. Baseline recordings were conducted to z-score recordings during the eye-contact (see *3.2.3.2.*). They were conducted directly before the eye-contact by having participant and artist stare at the curtain in front of them. However participants were, at this point already aware if they were about to see an artwork or simply look at another person to test the fNIRS devices. This might have already influenced brain activity and subsequently skewed eye contact recordings through the process of z-scoring, which would influence group comparisons. Future studies should eliminate this possibility by having an experimental design where baseline recordings are conducted before participants are separated into groups.

In the present study there were no significant group differences in mean activation during baseline recordings, however there were somewhat notable effect sizes for dlPFC (d = .49) and lTPJ (d = -.40). Mean dlPFC activation was higher in the art-group, while mean lTPJ activation was higher in the non-art group. Since baseline data can naturally not be z-scored, as it is the dataset that is used to z-score subsequent data, it cannot be said if this is due to preexisting signal differences caused by physiological factors unrelated to group differences, or if this possibly suggests different modes of preparation for processing a certain type of stimulus.

Results by Samson et al. (2004) suggested that the lTPJ playes an important role in inferring other people's believes and perspective taking. Furthermore, the TPJ is said to play an important role in social cognitions in general (Carter & Huettel, 2013). The dlPFC on the other hand is assumed to be involved in an "aesthetic processing mode" (Cupchik et al., 2009) and shows connection to creative thinking and searching for novel interpretations (Colombo et al., 2015). It would thus be plausible to argue, that the differences in baseline recordings might be connected to participants expecting different kinds of stimuli, since lTPJ activity was higher in the non-art group, a social situation, and dlPFC activity being higher in the art group which could indicate an aesthetic processing mode, even prior to perceiving the art performance. Kirk et al. (2009) showed differences in activation in the OFC and ventral mPFC when a stimulus was introduced as an artwork, compared to when it

was not, even prior to actually perceiving the stimulus, so different modes of preparation even before viewing the artwork could be plausible.

However, in the present study, such a statement cannot be made with any certainty due to the data not being z-scored and thus reducing comparability. Future studies are needed to clarify if the observed differences are connected to the brain preparing for viewing art or a social situation, or if they are simply random differences caused by a lack of z-scoring and a small sample size.

Brain activity during eye-contact

No significant group differences were found in any of the ROIs when comparing group mean activations over the first five minutes of eye contact. While not significant, mean activations where generally higher in the non-art group, especially in the mPFC and the dlPFC, with a medium effect size for differences in the dlPFC (d = -.54). However this should be interpreted with caution, especially taking into account the previously mentioned limitations in z-scoring, and the observed opposite effect in the dlPFC during baseline recording.

Another observation that can be made is the general tendency for larger SDs in the art group, which is in line with the behavioral data, which also shows higher SDs and more “extreme” values for the art group.

5.4. Further limitations and future research implications

Another possible limitation of the experimental design should be mentioned. While in the art condition the participant knows that they are the only person that can stop the eye-contact, in the non-art condition the participant believes that both they themselves, as well as the other “participant” have the option to stop the eye-contact. Because of this, participants in the non-art condition might have continued with the eye-contact simply because they are waiting for the other “participant” to stop. Future research could avoid this by framing the non-art situation, again, as a test-run for the fNIRS device, however with the difference, that the other person is introduced as part of the research team. This could generally improve comparability of the two conditions, as the other person is then in both cases part of the team, and not another participant, and the differentiation of art and non-art can still be maintained.

Further, as already mentioned, both experimental conditions present potentially emotionally intense and unnatural situations. Even though the non-art condition was intended to be as neutral as possible, holding eye-contact with another person for a prolonged amount of time is still an unnatural situation which by itself might trigger intense emotional reactions and even potential transformation. It might possibly be meaningful to present a more neutral stimuli as art/non-art when trying to better understand the process of transformation through art. A more neutral stimuli might be useful to better highlight differences in information processing and meaning making in art vs. non-art. Furthermore a stimulus/artwork, that does not directly involve the viewer might generate different results as the current study involves the participant in both the “art” and “non-art” condition, as the participant is not just observing but also being observed and thus involved in the art performance. A more passive role as a viewer, might possibly cause less discomfort in the participant, if some discomfort is related to being observed while having an aesthetic experience, and then allow for different experiences in perceiving an artwork. This could be probable, considering that “anxiety” and “tension” were significantly positively correlated with “felt being watched”, while this was not the case in the non-art condition. It should however also be noted that participants of experiments on aesthetics are usually aware that they are, at least in some way being observed, since they are taking part in an experiment. The direct gaze just possibly heightens this awareness.

Lastly, as already mentioned, the sample size was relatively small. A similar study design with a bigger sample size could solidify found effects and further, possibly find clustered cooccurrences in experiential factors that possibly mimic the outcomes of the VIMAP (Pelowski, Markey, et al., 2017), and then find neural correlates and characteristic timelines of patterns of brain activation for different outcomes (e.g. Harmony, Transformation, Negative/Abort, etc.). Further future studies should add more extensive measures for transformation and, as already mentioned, include follow-up questionnaires in longer time intervals to explore long-term effects.

6. CONCLUSION

This study shows different emotional reactions comparing the perception of a stimulus as art compared to in a non-art setting. It further suggests a role of "negative" felt emotions as a part of an aesthetic experience and a part they might play in personal transformation through art perception. Other interpretations might be possible and limitations and implications for future research were discussed.

There were significantly higher levels of negative emotions such as "need to leave", "anxiety", "confusion" and "tension" during the experience when the stimulus was introduced as an artwork. These factors were positively correlated with "changed my mind" in the art group. "Changed my mind" was also significantly positively correlated with "feeling like crying", in the art-group and not in the non-art-group. Feeling like crying has been considered to be an indicator of schema change during art perception (Pelowski, 2015). However there were no significant group differences in the mean reported level of "changed my mind". Participants of both groups reported to have experienced changes of mind and intense emotional experiences, as prolonged eye-contact with a stranger can be emotional and transformative even without the context of art.

Future studies are needed to clarify, if and how negative emotions in art are in fact relevant to schema change through art perception, or rather if they indicate a qualitatively different form of schema change, such as higher-level or lower-level, and/or if they could lead to a longer lasting transformation.

There were more donations in the art-group than in the non-art-group, however the difference was not significant. There were no significant group differences found in inter-brain coherence and mean activation of each ROI over the course of the eye-contact. Some observable trends were discussed.

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Table of Abbreviations

ACC	anterior cingulate cortex
AG	angular gyrus
AIC	anterior insular cortex
AReA	Aesthetic Responsiveness Assesment (Schlotz et. Al., 2021)
dlPFC	dorsolateral prefrontal cortex
fNIRS	functional Near-Infrared Spectroscopy
IAS	Interaction Anxiousness Scale (Leary, 1983)
lTPJ	left temporal-parietal junction
mPFC	medial prefrontal cortex
OFC	orbitofrontal cortex
PANAS	Positive and Negative Affect Schedule (Watson et al., 1988)
PCC	posterior cingulate cortex
QCAE	Questionnaire of Cognitive and Affective Empathy (Reniers et al., 2011)
QCAE/AE	QCAE subscale Affective Empathy
QCAE/CE	QCAE subscale Cognitive Empathy
ROI	region of interest
rTPJ	right temporal-parietal junction
SCS-R	Social Connectedness Scale - Revised (Lee et al., 2001)
SRIS	Self-Reflection and Insight Scale (Grant et al., 2002)
STAI	State-Trait Anxiety Inventory (Matteau & Bekker, 1992)
TPJ	temporal-parietal junction
VIMAP	Vienna Integarted Model of Art Perception (Pelowski et al., 2017)

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Abstract German

Die vorliegende Arbeit zielt darauf ab, Einblicke in die kognitive Verarbeitung eines Kunstwerks zu gewinnen, um besser zu verstehen, wie das Betrachten von Kunst zu transformativen Erfahrungen und intensiven emotionalen Erlebnissen führen kann. Dafür wurde ein Experiment durchgeführt, bei dem die Wahrnehmung eines Stimulus in einem Kunstkontext mit der außerhalb des Kunstkontextes verglichen wurde. Während frühere Studien eine solche vergleichende Gegenüberstellung vor allem im Hinblick auf die ästhetische Bewertung von Bildern vorgenommen haben, wird in der vorliegenden Studie ein breiterer Blick auf emotionale, soziale und metakognitive Faktoren geworfen. Dem Grundkonzept der Performance "The Artist Is Present" von Marina Abramović folgend, wurde eine Performance inszeniert bei der sich zwei Menschen in die Augen sehen, wobei eine Person die Performancekünstlerin ist. Die Situation wurde in der Experimentalgruppe als Kunstperformance und in der Kontrollgruppe einfach als experimentelle Aufgabe zum Testen von fNIRS-Geräten vorgestellt, um einen „art“ und einen „non-art“ Kontext zu schaffen. Die TeilnehmerInnen wurden angewiesen, ihre Erfahrungen anschließend auf verschiedenen Skalen zu bewerten. Darüber hinaus wurden sowohl bei der Künstlerin als auch bei den TeilnehmernInnen fNIRS-Messungen durchgeführt, um sowohl die Einzelhirnaktivierung in ausgewählten *regions of interest* als auch die interpersonelle Hirnsynchronizität zu messen. TeilnehmerInnen beider Gruppen berichteten von emotionalen Erlebnissen und *changes of mind*. Während hinsichtlich der fNIRS Daten keine signifikanten Unterschiede festgestellt wurden, wurde von TeilnehmerInnen im Kunstkontext ein signifikant höheres Maß an Angst, Anspannung, Verwirrung, Traurigkeit und anderen "negativen" Emotionen berichtet, sowie weiters unterschiedlichen Interkorrelationsmuster. Die Ergebnisse zeigen ein unterschiedliches Auftreten emotionaler und metakognitiver Faktoren, und deuten auf die Möglichkeit hin, dass negative Emotionen bei der Transformation durch Kunstwahrnehmung eine wichtige Rolle spielen.

Supplements

INDEX OF SUPPLEMENTS

Supplement A

Informed consent with "rules" for art (first) and non-art (second) condition

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Participant information and declaration of consent to participate in the study:

AllgBioPsych_22SS_EyeContact

You are about to take part in a performance art piece.

The following "rules" apply:

- When we tell you to look up, look into the artists eyes and hold eye contact
- Please hold eye contact for a minimum of 5 minutes. After that you can continue as long as you would like.
- Please remain seated during the performance
- No talking to the artist during the performance

Please state your unique participant ID
To create your participant ID please use:
- the day of the date you were born e.g. 31.01.1985: 31
- The first two letters of your first name e.g. Peter: Pe
- The first two letters of your mothers first name e.g. Susanne: Su
--> the full Code in this example would thus be 31PeSu

Participant ID: _____

Participant signature:

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Participant information and declaration of consent to participate in the study:

AllgBioPsych_22SS_EyeContact

For this study you will be asked to hold eye contact with another person

The following "rules" apply:

- When we tell you to look up, look into the other persons eyes and hold eye contact
- Please hold eye contact for a minimum of 5 minutes. After that you can continue as long as you would like.
- Please remain seated during eye-contact
- No talking to the other person

Please state your unique participant ID
To create your participant ID please use:
- the day of the date you were born e.g. 31.01.1985: 31
- The first two letters of your first name e.g. Peter: Pe
- The first two letters of your mothers first name e.g. Susanne: Su
--> the full Code in this example would thus be 31PeSu

Participant ID: _____

Participant signature:

Supplement B

Rating scales to describe the experience (given post eye-contact)

In regards to the experience just had, please rate the following feelings on how much you have just experienced them from 1 to 7.

1 = "no such feeling"

7 = "The most intense such feeling in my life"

	1	2	3	4	5	6	7
feeling like crying	○	○	○	○	○	○	○
Need to leave	○	○	○	○	○	○	○
Anxiety	○	○	○	○	○	○	○
Confusion	○	○	○	○	○	○	○
Tension	○	○	○	○	○	○	○
Surprise	○	○	○	○	○	○	○
Self-awareness	○	○	○	○	○	○	○
Felt being watched	○	○	○	○	○	○	○
Changed my mind	○	○	○	○	○	○	○
Epiphany	○	○	○	○	○	○	○
Sadness	○	○	○	○	○	○	○
Happiness	○	○	○	○	○	○	○
feeling chills / goosebumps	○	○	○	○	○	○	○
boredom	○	○	○	○	○	○	○

You will now be given opposing descriptions of the personal experience you just had. Please rate on the scale how you would better describe your personal experience.

good : bad

good ○ ○ ○ ○ ○ ○ ○ bad

beautiful : ugly

beautiful ○ ○ ○ ○ ○ ○ ○ ugly

intimate : remote

intimate ○ ○ ○ ○ ○ ○ ○ remote

happy : sad

happy ○ ○ ○ ○ ○ ○ ○ sad

meaningful : meaningless

meaningful ○ ○ ○ ○ ○ ○ ○ meaningless

sincere : insencere

deep : shallow

deep ○ ○ ○ ○ ○ ○ ○ shallow

strong : weak

strong ○ ○ ○ ○ ○ ○ ○ weak

serious : humorous

serious ○ ○ ○ ○ ○ ○ ○ humorous

superficial : profound

superficial ○ ○ ○ ○ ○ ○ ○ profound

How comfortable do you feel being around this person?

not at all ○ ○ ○ ○ ○ ○ ○ very much

How interessted are you in getting to know this person better?

not at all ○ ○ ○ ○ ○ ○ ○ very much

How similar do you perceive this person to yourself?

not at all ○ ○ ○ ○ ○ ○ ○ very much

How well do you think you could get along with this person?

not at all ○ ○ ○ ○ ○ ○ ○ very much

How much could you feel a connection with the other person?

not at all ○ ○ ○ ○ ○ ○ ○ very much

How much did you feel that you understood the other person?

not at all ○ ○ ○ ○ ○ ○ ○ very much

Would you consider what you have just experienced to be art?
1 = no
7 = yes

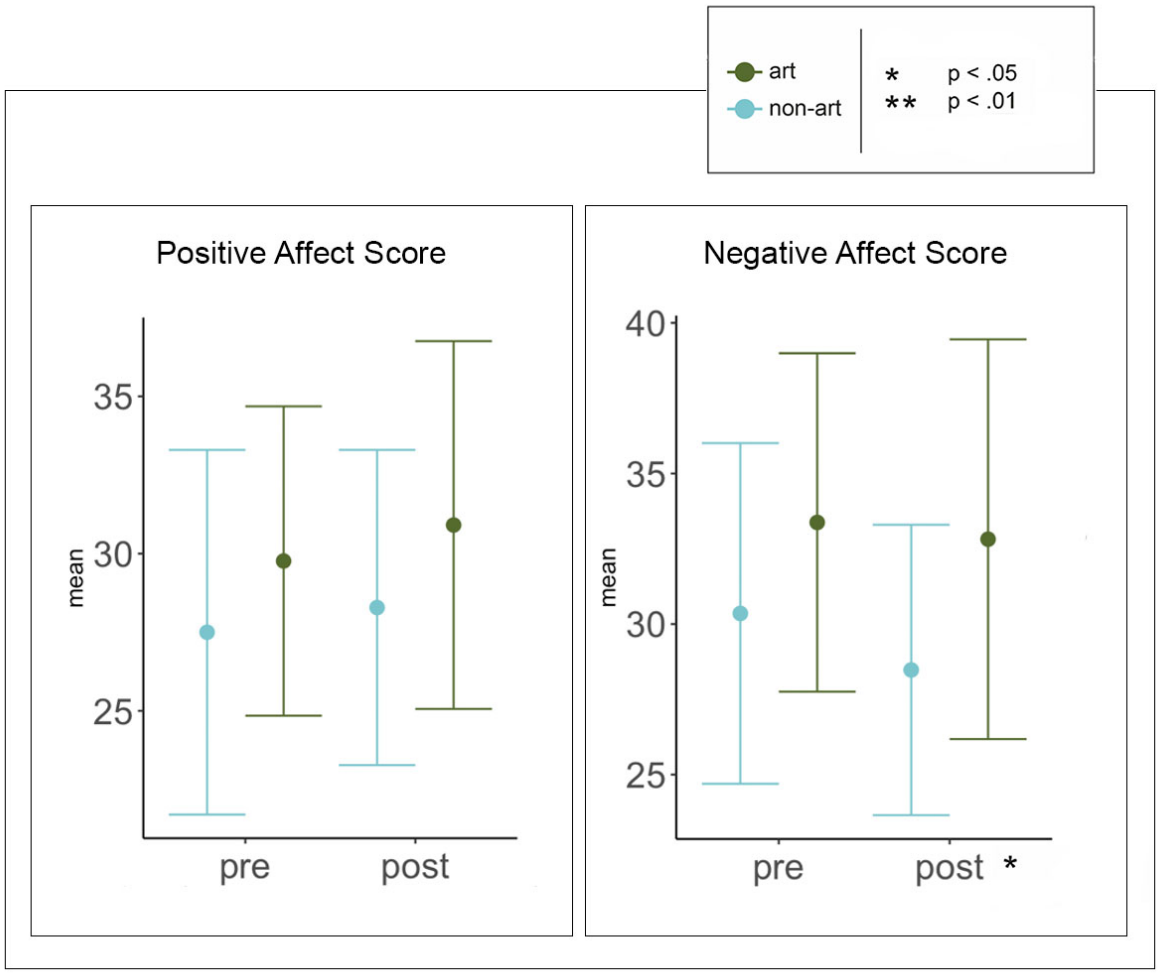
1	2	3	4	5	6	7

How much did you like it?
1 = not at all
7 = very much

1	2	3	4	5	6	7

Supplement C

Mean and SD of PANAS subscale before and after eye contact; separated by group; N = 43



Supplement D

Intercorrelation-matrices for experiential and emotional factors; separated by group

art
* < .05
** < .01

		feeling like crying	need to leave	anxiety	confusion	tension	surprise	self-awareness	felt being watched	changed my mind	epiphany	sadness	happiness	chills / goosebumps	boredom
feeling like crying	r	1	.435*	0,251	0,192	0,276	0,193	-0,273	0,096	.514*	0,224	0,123	0,167	0,027	-0,274
	p		0,038	0,248	0,380	0,202	0,377	0,207	0,663	0,012	0,305	0,575	0,445	0,903	0,206
need to leave	r	.435*	1	.439*	.442*	.426*	0,097	-0,123	0,386	.702**	0,362	0,106	0,053	0,158	-0,082
	p	0,038		0,036	0,035	0,043	0,661	0,575	0,069	0,000	0,089	0,632	0,810	0,472	0,709
anxiety	r	0,251	.439*	1	0,233	.624**	0,211	0,054	.424*	0,331	0,123	0,101	-0,226	-0,080	0,098
	p	0,248	0,036		0,285	0,001	0,333	0,807	0,044	0,123	0,578	0,646	0,300	0,716	0,655
confusion	r	0,192	.442*	0,233	1	0,370	0,260	0,063	0,366	0,260	0,038	-0,162	0,258	0,016	0,199
	p	0,380	0,035	0,285		0,083	0,232	0,776	0,086	0,231	0,863	0,460	0,234	0,941	0,363
tension	r	0,276	.426*	.624**	0,370	1	0,076	0,274	.551**	0,239	-0,047	0,177	0,066	0,164	0,329
	p	0,202	0,043	0,001	0,083		0,729	0,207	0,006	0,273	0,830	0,420	0,766	0,453	0,126
surprise	r	0,193	0,097	0,211	0,260	0,076	1	0,141	0,200	0,204	0,005	0,171	0,071	-0,266	0,175
	p	0,377	0,661	0,333	0,232	0,729		0,521	0,361	0,351	0,981	0,434	0,748	0,219	0,425
self-awareness	r	-0,273	-0,123	0,054	0,063	0,274	0,141	1	0,344	-0,210	-0,284	0,295	-0,149	0,184	0,265
	p	0,207	0,575	0,807	0,776	0,207	0,521		0,108	0,336	0,190	0,171	0,496	0,400	0,223
felt being watched	r	0,096	0,386	.424*	0,366	.551**	0,200	0,344	1	0,189	-0,024	0,138	-0,237	-0,201	.513*
	p	0,663	0,069	0,044	0,086	0,006	0,361	0,108		0,387	0,913	0,529	0,277	0,357	0,012
changed my mind	r	.514*	.702**	0,331	0,260	0,239	0,204	-0,210	0,189	1	.742**	-0,073	0,181	0,226	-0,050
	p	0,012	0,000	0,123	0,231	0,273	0,351	0,336	0,387		0,000	0,740	0,409	0,300	0,822
epiphany	r	0,224	0,362	0,123	0,038	-0,047	0,005	-0,284	-0,024	.742**	1	-0,207	0,412	0,223	-0,301
	p	0,305	0,089	0,578	0,863	0,830	0,981	0,190	0,913	0,000		0,343	0,051	0,306	0,163
sadness	r	0,123	0,106	0,101	-0,162	0,177	0,171	0,295	0,138	-0,073	-0,207	1	-0,384	-0,206	-0,070
	p	0,575	0,632	0,646	0,460	0,420	0,434	0,171	0,529	0,740	0,343		0,071	0,345	0,751
happiness	r	0,167	0,053	-0,226	0,258	0,066	0,071	-0,149	-0,237	0,181	0,412	-0,384	1	.485*	-0,238
	p	0,445	0,810	0,300	0,234	0,766	0,748	0,496	0,277	0,409	0,051	0,071		0,019	0,275
chills/goosebumps	r	0,027	0,158	-0,080	0,016	0,164	-0,266	0,184	-0,201	0,226	0,223	-0,206	.485*	1	-0,090
	p	0,903	0,472	0,716	0,941	0,453	0,219	0,400	0,357	0,300	0,306	0,345	0,019		0,684
boredom	r	-0,274	-0,082	0,098	0,199	0,329	0,175	0,265	.513*	-0,050	-0,301	-0,070	-0,238	-0,090	1
	p	0,206	0,709	0,655	0,363	0,126	0,425	0,223	0,012	0,822	0,163	0,751	0,275	0,684	

Non-art
* < .05
** < .01

		feeling like crying	need to leave	anxiety	confusion	tension	surprise	self-awareness	felt being watched	changed my mind	epiphany	sadness	happiness	chills / goosebumps	boredom
feeling like crying	r	1	0,000	0,319	0,178	-0,098	-0,093	-0,249	-0,088	-0,082	0,168	0,095	-0,048	0,345	-0,131
	p		1,000	0,159	0,439	0,673	0,688	0,277	0,703	0,724	0,466	0,681	0,837	0,126	0,573
need to leave	r	0,000	1	0,296	.522*	0,247	-0,375	0,317	0,023	0,069	-0,269	0,287	-0,115	0,209	0,165
	p	1,000		0,193	0,015	0,280	0,094	0,162	0,920	0,767	0,239	0,208	0,621	0,363	0,476
anxiety	r	0,319	0,296	1	.471*	0,326	-0,115	-0,183	0,187	-0,088	0,023	.451*	-0,322	.448*	-0,172
	p	0,159	0,193		0,031	0,149	0,619	0,427	0,418	0,703	0,922	0,040	0,154	0,042	0,456
confusion	r	0,178	.522*	.471*	1	0,328	0,171	0,028	0,354	-0,024	-0,099	.444*	-0,204	0,322	-0,124
	p	0,439	0,015	0,031		0,146	0,460	0,904	0,115	0,916	0,669	0,044	0,374	0,154	0,592
tension	r	-0,098	0,247	0,326	0,328	1	0,354	0,244	0,257	0,046	0,281	.628**	0,022	0,181	-0,206
	p	0,673	0,280	0,149	0,146		0,116	0,286	0,260	0,842	0,216	0,002	0,923	0,433	0,371
surprise	r	-0,093	-0,375	-0,115	0,171	0,354	1	0,225	0,131	0,317	0,419	0,249	0,338	0,193	-0,098
	p	0,688	0,094	0,619	0,460	0,116		0,328	0,572	0,161	0,059	0,277	0,134	0,403	0,671
self-awareness	r	-0,249	0,317	-0,183	0,028	0,244	0,225	1	0,092	.495*	0,262	0,276	0,319	0,036	0,276
	p	0,277	0,162	0,427	0,904	0,286	0,328		0,692	0,023	0,252	0,226	0,158	0,877	0,226
felt being watched	r	-0,088	0,023	0,187	0,354	0,257	0,131	0,092	1	0,002	0,171	0,431	-0,089	0,269	-0,384
	p	0,703	0,920	0,418	0,115	0,260	0,572	0,692		0,993	0,460	0,051	0,702	0,238	0,085
changed my mind	r	-0,082	0,069	-0,088	-0,024	0,046	0,317	.495*	0,002	1	.698**	0,413	0,432	0,425	0,169
	p	0,724	0,767	0,703	0,916	0,842	0,161	0,023	0,993		0,000	0,063	0,051	0,055	0,463
epiphany	r	0,168	-0,269	0,023	-0,099	0,281	0,419	0,262	0,171	.698**	1	.524*	0,401	.514*	0,006
	p	0,466	0,239	0,922	0,669	0,216	0,059	0,252	0,460	0,000		0,015	0,072	0,017	0,978
sadness	r	0,095	0,287	.451*	.444*	.628**	0,249	0,276	0,431	0,413	.524*	1	0,078	.547*	-0,179
	p	0,681	0,208	0,040	0,044	0,002	0,277	0,226	0,051	0,063	0,015		0,736	0,010	0,436
happiness	r	-0,048	-0,115	-0,322	-0,204	0,022	0,338	0,319	-0,089	0,432	0,401	0,078	1	0,228	0,000
	p	0,837	0,621	0,154	0,374	0,923	0,134	0,158	0,702	0,051	0,072	0,736		0,321	1,000
chills / goosebumps	r	0,345	0,209	.448*	0,322	0,181	0,193	0,036	0,269	0,425	.514*	.547*	0,228	1	-0,246
	p	0,126	0,363	0,042	0,154	0,433	0,403	0,877	0,238	0,055	0,017	0,010	0,321		0,282
boredom	r	-0,131	0,165	-0,172	-0,124	-0,206	-0,098	0,276	-0,384	0,169	0,006	-0,179	0,000	-0,246	1
	p	0,573	0,476	0,456	0,592	0,371	0,671	0,226	0,085	0,463	0,978	0,436	1,000	0,282	

Supplement E

All answers to open questions after the experiment; separated by group

note: response to the open questions was not mandatory so not all participants responded to the questions

Art

„What did this experience mean to You?"	"anything else"
power of eye contact, getting to "know" a person you don't know yet just with eye contact	
Es war eine sehr intensive Erfahrung, über die ich mir erst noch im Klaren werden muss.	Es war interessant zu erleben wie schnell die Zeit vergehen kann. Ich war mir nach dem 1. "Läuten" sicher, dass das noch nicht bedeuten konnte, dass die 5 Minuten bereits zu Ende sind.
This experience showed me how intimate eye contact actually is and how uncomfortable it feels to share such an intimate experience with a stranger.	No.
Being intimate with a stranger through eye contact	I was quite nervous in the beginning, because I thought it will be much more uncomfortable but I really loved the experience!
It was a very new experience, a bit uncomfortable, but very intimate	I had the very strong urge to laugh and had to pull myself together not to
Eye contact isn`t my strength in general, so for me it was a little challenging. Still it was a really exiting and somehow beautiful experience.	
To me it meant stepping out of my comfort zone and trying a new experience that I	It felt strangely deconstructing, if that makes sense in the given circumstances.

would usually not make. In a more general, art-focused sense, I have no idea.	
It was to me a profound experience to be connected to one another in this way, to feel close on a fundamental human level	Ein Erlebnisbericht in drei Akten: (1) I felt an immediate sense of nervous anxiousness and excitement when first meeting the other persons gaze. A nervousness of being connected through this gaze to a person I don't have a preexisting relationship with, someone entirely unknown. I felt the urge to look at the whole of them to study the face to get to know them this way which made it at first difficult not to break eye contact. (2) It took a while for me to become comfortable with the intimacy of the experience but at some point I found myself sinking into it. I realised that I now felt an intense need to maintain the connection with the other person, and holding on to the tie between us somehow felt very important. They have beautiful eyes, elegantly sloped and a kind, soft gaze, and i feel a sense of comfort. (3) I think of what I want to send to them through this tether, a wish to send affection in this strange way. Eventually I get a sense of having to say goodbye and I find it difficult to release the connection, to tear myself away. To me it was a beautiful experience to see them

It showed me how intimate prolonged eye contact can be, however I wouldn't like to share that level of intimacy with anyone.	The lighting of the room was a bit of a distraction.
For me it showed me that eye contact can be pretty tough to hold for a long time. But it also showed me that the more you hol eye contact with a person the more you feel comfortable with that person after some time.	
It was a special experience for me, which i didn't understand at all. So right now I am a little bit confused.	No, i just think my glasses were really dirty, which i realised just when i was looking at the artist.
it meant to follow the task, focussing eyecontact to person unknown, while censors read my neurofeedback.	
I don't know, but it gave me more confidence in myself	I had an intense urge to burst out laughing a lot of the time. Had to distract myself with songs an maths in my head.
I have no idea. I was so confused the entire time. The artist seemed to go through various emotions so more than eye contact it kind of felt like watching a play without text. It did not really mean anything to me, it was just interesting to observe.	The room was a bit dark so it was hard sometimes to concentrate on the eyes.
Never in my life have I looked in someone's eyes for so long. I had a strong urge to just look away. As I was 'forced' to continue looking i first tried to think of something different but then really concentrated on the person in front of me. This experience was extremely interesting and to me also moving. Something was happening inside of	I found it very interesting and do think it's a kind of performance art, as something unusual and interesting was happening inside of me

me, as I felt feelings such as shame, interest and happiness	
I have no idea - maybe figuring out if a connection could be established just by eye-contact?	considered it somehow fun
I usually avoid eye contact because I think it's awkward but it did not feel like it	
I don't really know. Mostly I am just confused right now, but maybe that is because I don't understand Art that much.	No
Wie nah man einer Person kommt, alleine durch Augenkontakt.	Normalerweise fällt es mir sehr schwer Augenkontakt mit einer Person für eine längere Zeit zu halten, da ich sehr hektisch bin, aber diese Erfahrung hat mir gezeigt wie interessant und intim es doch sein kann sich darauf einzulassen. Meine Wahrnehmung ist manchmal etwas verschwommen (nicht unbedingt unangenehm), da die Heizung im Hintergrund etwas gestört hat.

Non-art

„What did this experience mean to You?"	"anything else"
It was fun to just look at another person, without saying anything, without any distractions and just appreciating looking at them	
It was a very interesting experience I have never had before.	Might be good to reduce sources direct or indirect sunlight because it is harder to stay focused on the eyes when the light is blinding you a bit.

That eye contact can be very intense and show a lot about how you perceive a person and what you can already say about their emotions in the first 5 minutes without having ever talked to them	viel erfolg noch bei eurer forschung :)
For me it meant to be open to the person i was looking at and fully commit to the 5 minutes i had to look in their eyes.	
How people can connect through eyesight alone and how it affects your brain activity	Maybe giving the participant better directions as in how to get to the lab
I'm not sure. I don't think it meant anything in particular to me personally. My mind was just filled with thoughts regarding what this study is about and my plans for the rest of the day. At some point I forgot there was a person looking at me.	It was not as uncomfortable as I initially thought it to be.
It was nice to get to look someone in the eyes for quite a time without it being awkward. It was relaxing to some extend	I were not sure if I had to say when I want to stop after the 5 min
I realised that I hardly ever look anyone in the eye that long. It is a way to get in sync, but that would take longer.	I found the whole setting and set up interesting and therefore I already had a good experience. That has probably biased my answers in the questionaire.
To me, it means that you should always be open to new experiences, for example i thought i would have a way different feeling/experience during this than it actually was	
to see how comfortable you are with holding eye contact and interesting that you mirror the smiling of the other person	

I don't really know what the aim of this study was. Therefore I don't know what the experience should mean to me. But it was really interesting to take place in a study like that and I would be happy to know more about the backround.	It definitely was a fun and friendly experience! Although the room was very dark, so after a time it felt quite uncomfortable to look at the same spot the whole time.
It was a very new experience. It was very interesting and challenging at the same time	
felt very intense, at some point i felt dizzy, but probably because it is too much for me having an eye contact with another person especially unknown one, but overall it was very interesting	i would like to know the result (what did the data say) of it but dont know if it is allowed
see how u react to the situation, calm, relaxing	it felt like meditation i needed a lot of focus because the light was a bit dark
Not much	I was focused on the other persons face and also on my own thougths
Nothing in particular that comes to mind	It felt like the person sitting across from me was part of the research team conducting the experiment, which probably changed my look at it.
To examine the mindsets of different people regarding to transgender people	
It meant I don't have to fear 5 minutes of eye contact. I felt comfortable although I experienced exitement.	

Supplement F

Excluded channels per fNIRS recording

A_[...] : actress

P_[...] : participant

Participant ID	channels to exclude	Reason
A_18JoBe	4, 9, 10, 20, 25, 26	CWT - no heart line
A_22ChMa	all channels excluded	CWT - no heart line
A_06DaIr	none	
A_18JaKa	1, 2, 3, 4, 12, 13, 15, 17, 18, 19, 20, 28, 29, 31	CWT - no heart line
A_03LiMi	3 4 6 8 9 10 11 12 13 14 19 20 22 24 25 26 27 28 29 30	CWT - no heart line
A_12MaDo	4 8 9 10 11 12 13 14 20 24 25 26 27 28 29 30	CWT - no heart line
A_25KlBe	4 6 7 8 12 13 14 16 20 22 23 24 28 29 30 32	CWT - no heart line
A_26AnMa	4 6 7 8 10 12 13 14 16 20 22 23 24 26 28 29 30 32	CWT - no heart line
A_30HaMa	4 5 6 7 8 10 11 12 13 14 16 20 21 22 23 24 26 27 28 29 30 32	CWT - no heart line
A_28tosy	3 4 7 8 9 10 11 13 14 15 16 19 20 23 24 25 26 27 29 30 31 32	CWT - no heart line
A_29KaMi	4 6 8 9 10 11 12 13 14 16 20 22 24 25 26 27 28 29 30 32	CWT - no heart line
A_27FeSa	3 7 8 9 13 19 23 24 25 29	CWT - no heart line
A_10KiBi	all channels excluded	CWT - no heart line
A_16ClKa	all channels excluded	CWT - no heart line
A_15ClSa	4 5 7 8 9 10 11 12 13 14 15 16 20 21 23 24 25 26 27 28 29 30 31 32	CWT - no heart line
A_23VeRe	4 6 7 8 9 10 11 12 13 14 15 16 20 22 23 24 25 26 27 28 29 30 31 32	CWT - no heart line
A_29LaDo	3 5 6 7 8 10 12 13 14 15 16 19 21 22 23 24 26 28 29 30 31 32	CWT - no/weak heart line
A_31MeDo	3 4 6 7 8 9 10 11 12 13 14 15 16 19 20 22 23 24 25 26 27 28 29 30 31 32	CWT - no/weak heart line
A_24MEAR	6 7 8 9 10 11 12 13 14 15 16 22 23 24 25 26 27 28 29 30 31 32	CWT - no heart line
A_13RaMo	6 7 8 9 10 11 12 13 14 15 16 22 23 24 25 26 27 28 29 30 31 32	CWT - no heart line + high spikes
A_14MiMa	2 5 6 7 8 9 10 11 12 13 14 15 16 18 21 22 23 24 25 26 27 28 29 30 31 32	CWT - no heart line
A_02AnKa	5 6 7 8 9 10 11 13 14 15 16 21 22 23 24 25 26 27 29 30 31 32	CWT - no heart line
A_02ISJA	5 6 7 8 9 10 11 12 13 14 15 16 21 22 23 24 25 26 27 28 29 30 31 32	CWT - no heart line
A_05LuBa	3 5 6 7 8 9 10 11 12 13 14 15 16 19 21 22 23 24 25 26 27 28 29 30 31 32	CWT - no heart line
A_01SoIv	2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32	CWT - no heart line
A_26AlSa	5 6 7 8 9 10 11 12 13 14 15 16 21 22 23 24 25 26 27 28 29 30 31 32	CWT - no heart line
A_25BeCh	6 7 8 9 10 12 13 14 22 23 24 25 26 28 29 30	CWT - no heart line

A_29AlAg	3 4 6 7 8 9 10 11 12 13 14 15 16 19 20 22 23 24 25 26 27 28 29 30 31 32	CWT - no heart line
A_09LiAn	all channels excluded	CWT - no heart line
A_12HaHe	none	
A_22YeRo	none	
A_11KeDo	none	
A_15MaEl	none	
A_03RoEl	3 19	CWT - no heart line
A_11NaMa	none	
A_06EvCl	2 4 7 8 10 12 13 14 15 16 18 20 23 24 26 28 29 30 31 32	CWT - weak and inconsistent heartlines
A_22FlMa	2 8 9 10 11 18 24 25 26 27	CWT - no/weak heart line
A_20StEv	11 12 27 28	CWT -no heartline
A_28LiAn	none	
A_27MiGe	1 2 7 8 9 10 11 12 13 14 15 16 17 18 23 24 25 26 27 28 29 30 31 32	CWT - no heart line
A_07MaTh	none	
A_17SaMi	1 2 3 7 8 10 12 13 15 16 17 18 19 23 24 26 28 29 31 32	CWT - no/weak heart line
A_10HaCl	none	
A_19MoIs	none	
P_18JoBe	none	
P_22ChMa	all channels excluded	CWT - no heart line
P_06DaIr	8 9 10 24 25 26	CWT - no heart line
P_18JaKa	8 9 10 11 12 13 15 24 25 26 27 28 29 30	CWT - no heart line
P_03LiMi	1 3 4 5 7 10 11 12 13 16 17 19 20 21 23 26 27 28 29 32	CWT - no heart line
P_12MaDo	1 2 3 4 5 6 7 8 9 10 12 13 15 17 18 19 20 21 22 23 24 25 26 28 29 31	CWT - no heart line
P_25KlBe	2 4 5 6 7 8 9 10 11 12 13 18 20 21 22 23 24 25 26 27 28 29	CWT - no heart line
P_26AnMa	1 2 4 5 6 7 13 14 16 17 18 20 21 22 23 29 30 32	CWT - no heart line
P_30HaMa	2 3 4 7 8 9 10 11 12 13 15 18 19 20 23 24 25 26 27 28 29 31	CWT - no heart line
P_28tosy	none	
P_29KaMi	3 4 7 13 19 20 23 29	CWT - no heart line
P_27FeSa	all channels excluded	CWT - no heart line
P_10KiBi	2 3 4 6 7 8 9 11 12 13 14 15 16 18 19 20 22 23 24 25 27 28 29 30 31 32	CWT - no heart line
P_16ClKa	all channels excluded	CWT - no heart line
P_15ClSa	none	
P_23VeRe	8 24	CWT - no heart line
P_29LaDo	2 3 4 5 6 7 9 10 11 12 13 14 15 18 19 20 21 22 23 25 26 27 28 29 30 31	CWT - no heart line + high spikes
P_31MeDo	6 7 8 10 12 13 14 22 23 24 26 28 29 30	CWT - no heart line
P_24MEAR	2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32	too many NaN's (16,32); CWT - no heart line
P_13RaMo	1 2 3 4 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 22 23 24 25 26 27 28 29 30 31 32	CWT - no heart line

P_14MiMa	9 10 11 12 13 14 16 25 26 27 28 29 30 32	CWT - no heart line + high spikes
P_02AnKa	all channels excluded	CWT - no heart line
P_02ISJA	5 7 8 9 10 11 12 21 23 24 25 26 28	CWT - no heart line
P_05LuBa	none	
P_01SoIv	4 5 6 7 8 9 10 11 12 13 14 15 16 20 21 22 23 24 25 26 27 28 29 30 31 32	CWT - no heart line
P_26AlSa	5 7 9 10 11 12 14 16 21 23 25 26 27 28 30 32	CWT - no/weak heart line
P_25BeCh	2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32	CWT - no heart line
P_29AlAg	1 2 3 4 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 22 23 24 25 26 27 28 29 30 31 32	
P_09LiAn	all channels excluded	CWT - no heart line
P_12HaHe	6 14 16 22 30 32	CWT - no heart line
P_22YeRo	3 4 5 7 8 11 14 15 16 19 20 21 23 24 27 30 31 32	(8 /24; too many missing NaN's + no heart line); CWT - no heart line
P_11KeDo	1 2 3 4 7 11 12 13 14 15 17 18 19 20 23 27 28 29 30 31	CWT - no heart line
P_15MaEl	1 2 3 4 5 7 11 12 15 16 17 18 19 20 21 23 27 28 31 32	CWT - no heart line
P_03RoEl	none	
P_11NaMa	1 2 3 4 7 8 11 12 13 14 15 16 17 18 19 20 23 24 27 28 29 30 31 32	CWT - no heart line
P_06EvCl	4 6 20 22	CWT - no heart line
P_22FlMa	7 23	CWT - high spikes
P_20StEv	3 9 10 11 14 16 19 25 26 27 30 32	CWT - no heart line
P_28LiAn	2 3 4 7 18 19 20 23	CWT - no heart line
P_27MiGe	7 16 23 32	CWT - no heart line
P_07MaTh	2 18	CWT - no heart line
P_17SaMi	2 5 6 7 15 18 21 22 23 31	CWT - no/weak heart line
P_10HaCl	1 2 3 5 7 17 18 19 21 23	CWT - no/weak heart line
P_19MoIs	2 3 4 6 7 8 11 12 13 14 15 16 18 19 20 23 24 27 28 29 30 31 32	CWT - no heart line

Supplement G

Mean activation for each timepoint per ROI during baseline recordings (15s-60s); separated by group