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Titel | Title

"Balance of aesthetic appeal and self-relevance: The effect of aesthetic appeal and self-relevance in art on human well-being"

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Zusammenfassung

Ästhetische Interventionen sind Teil unseres Alltags. Die Entscheidung, welche Kunstwerke installiert werden, wird hauptsächlich intuitiv oder durch Komitees getroffen, und nicht wissenschaftlich begründet. Mit wissenschaftlicher Begleitung kann eine informierte Auswahl getroffen werden. Um zu verstehen, wie sich die Eigenschaften der Kunstwerke auf das menschliche Wohlbefinden auswirken, wurden zwei Studien durchgeführt. Das Ausmaß des ästhetischen Anreizes und der Selbstrelevanz von Kunstwerken wurde systematisch variiert und das subjektive und physiologische Wohlbefinden der Betrachter gemessen. In Studie 1 wurden den 52 TeilnehmerInnen ästhetische ansprechende und selbstrelevante sowie wenig ästhetisch ansprechende und wenig selbstrelevante Reize präsentiert. In Studie 2 wurde den 127 TeilnehmerInnen nur ein Set von Kunstwerken präsentiert (ästhetisch ansprechende und selbstrelevante, ästhetisch ansprechende und wenig selbstrelevante, wenig ästhetisch ansprechende und selbstrelevante oder wenig ästhetisch ansprechende und wenig selbstrelevante Kunst). Fragebögen erfassten das subjektive Wohlbefinden, kontinuierliche physiologische Messungen lieferten Erregungsdaten. In Studie 1 steigerten Kunstwerke mit hohem ästhetischem Anreiz und hoher Selbstrelevanz das subjektive Wohlbefinden stärker als ästhetisch weniger ansprechende und weniger selbstrelevante Kunst. Kunstwerke von geringem ästhetischem Anreiz und geringer Selbstrelevanz führte sogar zu einer wahrgenommenen Steigerung von Stress. Studie 2 zeigte, dass die Kunstbewertungen hinsichtlich der Selbstrelevanz eine viel stärkere individuelle Variabilität aufwiesen als die Bewertungen hinsichtlich der Ästhetik. Allerdings zeigten weder die physiologischen noch die subjektiven Messungen einen signifikanten Effekt zwischen den verschiedenen Bedingungen. Die Gesamtergebnisse deuten darauf hin, dass Kunst eine wichtige Rolle bei der Steigerung des Wohlbefindens der BetrachterInnen spielt, ästhetischer Anreiz und Selbstrelevanz scheinen jedoch nur im direkten Vergleich eine Rolle zu spielen.

Schlagwörter: Kunst, Ästhetischer Anreiz, Selbstrelevanz, Wohlbefinden

Abstract

Aesthetic interventions in our everyday lives happen frequently, the decision which artworks, is mainly decided intuitively or by committees but is not scientifically justified. Thus, it is important to ensure that better decisions can be made with scientific support. To understand how different artworks impact human well-being, art therapies and art integrations in urban areas can be useful tools. Two studies examined the effects of the aesthetic appeal and self-relevance of artworks on viewers' subjective and physiological well-being. In Study 1, the 52 participants were presented with high aesthetic appealing and self-relevant as well as low aesthetic appealing and self-relevant stimuli. In Study 2, the 127 participants were presented with only one set of artworks (high aesthetically appealing and high self-relevant, high aesthetically appealing and low self-relevant, low aesthetically appealing and high self-relevant, or low aesthetically appealing and low self-relevant art). Questionnaires recorded subjective well-being, and continuous physiological measurements provided arousal data. In study 1, artworks with high aesthetic appeal and high self-relevance increased subjective well-being more than less aesthetically pleasing less self-relevant art. Artworks with low aesthetic appeal and low self-relevance even led to a perceived increase in stress. Our results showed that self-relevance art ratings had much stronger individual variability than aesthetic appeal ratings. However, neither the physiological nor the subjective measurements showed a significant effect between the different conditions. The overall results suggest that art plays an important role in increasing viewers' well-being, but aesthetic appeal and self-relevance only appear to play a role in direct comparison.

Keywords: Art, aesthetic appeal, self-relevance, well-being

1. Introduction

1.1 Stress in human beings

In today's society stressful encounters are everyday components of human existence, making stress a many-sided phenomenon among several biological levels (Del Giudice et al., 2018). However, defining stress is a challenging task. Selye (1973), who introduced the term 'stress' in biology, defined it as a specific physiological response which a body has to nonspecific demands, such as positive challenges and negative challenges. Stress can also be defined as a state in which homeostasis can be disrupted (Elenkov & Chrousos, 2006). This disruption is caused by internal or external influences known as stressors (Chrousos, 1992). Later in research, the term "stressors" gained prominence, which are perceived threats to homeostasis. These stressors are activated by perceptions of unpredictability and/or uncontrollability (McEwen and Wingfield 2003; Romero et al. 2009).

Commonly, stress has an association with negative events and outcomes because it can have a negative impact on the physical and the mental health of individuals (Korte et al., 2005). Nonetheless, assuming that stress always harms an individual's health would be inaccurate. The research of Sandi (2013) suggests that the outcome, how stress affects thinking, depends on the intensity of stress. For instance, mild stress tends to improve cognitive function, especially in simpler tasks or if the cognitive demands are reasonable. However, acute stress or long-term stress decreases performance in tasks that require complex thinking.

Nevertheless, stress can have long-term consequences that can be related to poor individual health (McEwen, 1998; McEwen, 2008). In general, stress can be defined as a physiological and emotional response when individuals face challenges in pursuit of their goals (Carver & Connor-Smith, 2010). The "stress response" involves the activation of the sympathetic nervous system (SNS), a decrease in parasympathetic activity and an increased activity of the hypothalamic-pituitary-adrenal (HPA) axis, which is the body's reaction to external demands (Kunz-Ebrecht et al., 2003; Selye, 1975). Due to a stressful environment, it is important to understand how stress can be measured and how to lower it for a better quality of life. Consequently, there is a need for establishing stress management approaches and being able to use approaches in an everyday situation to alleviate stress, which would be beneficial.

To measure well-being and stress responses in humans can be a challenging task. Several measuring approaches can be used to measure these scores. To measure subjective well-being, questionnaires completed by the participants themselves are a common approach. Questionnaires such as the State-Trait Anxiety Inventory (STAI-S) (Grimm, 2009, adapted from Spielberger et al., 1999), the Positive and Negative Affect Schedule (Krohne et al., 1996), and the momentary perceived stress levels (VAS- Visual Analogue Scale) are tools that are often used in the field of psychology as well. However, it is important to note that questionnaire data is subjective, meaning the information is based on personal opinions or perceptions rather than objective data. While self-reported questionnaire data is a useful method and often used to measure well-being and stress responses, comparing the subjective self-reported questionnaires with objective data, such as physiological measurements, would be more informative. Physiological measurements can also be obtained by using wearable measuring devices with integrated sensors. For instance, an algorithm suggested by Kyriakou et al. (2019), obtains the Moments Of Stress (MOS) scores, based on Skin Temperature (ST), the Galvanic Skin Response (GSR) and the Heart Rate (HR). Using a combination of both subjective and objective measurements, while less common than relying on only one of those methods, would aid in creating a more comprehensive awareness of the relationship between subjective perceptions and objective realities.

1.2 Effects of art on human well-being

Art can have a significant impact on human well-being. For instance, in a free exploration task, individuals spent up to half of their overall fixation time in exploring artworks and aesthetic objects (Mitschke et al., 2017). Regarding stress levels in humans, it is shown that art therapy reduces the level of the stress indicator cortisol (Visnola et al., 2010). The stress indicator cortisol is frequently used as a biomarker of psychological stress. Most often used for measuring stress is the salivary cortisol (Hellhammer et al., 2009). Nevertheless, cortisol is not the only stress indicator used to measure stress levels, stress affects various physiological processes in the human body, like muscle tension in the neck or a change in the heart rate (HR) and the heart rate variability (HRV) (Taelman et al., 2009). Furthermore, another possibility to measure stress is the skin temperature (ST) and the skin conductance response (SCR) also known as galvanic skin response (GSR). It determines the electrical conductance of the skin. SCR occurs as a result of rapid fluctuations in eccrine sweat gland activity, which is an outcome of the acetylcholine release by the sympathetic nervous system. Besides, SCR has the advantage that it is completely regulated by the sympathetic branch of the nervous system (Khalfa et al., 2002). Using wearable physiological sensors (chest belt containing a BioHarness 3 Sensor; Empatica E4 wrist band) the Skin Temperature (ST), the Galvanic Skin Response (GSR) and the Heart Rate (HR) can be detected. Based on these physiological measurements the algorithm Kyriakou et al. (2019) suggests that it is possible to obtain Moments Of Stress (MOS) scores which are physiological responses permitting stress detection.

As mentioned before, artworks have a great impact on human well-being regarding stress levels. Interacting with art can affect us emotionally (Welke et al., 2020). It is known that there is a reduction in salivary cortisol due to the production of art (Kaimal et al., 2016). Creating visual artworks can improve the general mood, more precisely reduce stress and anxiety plus improves the general health (Stuckey & Nobel, 2010). Visual art does not only have a positive impact on humans in a real-life setting, but it has also been shown that short art exposures in an online setting can improve negative mood, state anxiety and wellbeing (Trupp et al., 2022).

Additionally, Vessel et al. (2013) investigated how aesthetic appreciation of art is connected to individual differences and activates brain regions, such as default mode network, which is associated with the self. Self-relevance is a key determinant of aesthetic appeal in artworks (Vessel et al., 2023). Something becomes self-relevant when it resonates with or relates to one's personal identity, past experiences, and/or self-perception (Wagner et al., 2012). It seems there is a correlation between the judgments of aesthetic appeal of visual art and judgments of self-relevance. Hence it appears that self-relevance in artworks is perceived as having a higher level of aesthetic appeal (Vessel et al., 2023).

In the past there have been studies that demonstrate that art has a positive impact on human well-being (Trupp et al., 2022; Welke et al., 2020), more precisely the impact of creating artworks and human well-being have been studied more (Kaimal et al., 2016; Stuckey & Nobel) compared to showing artworks and analysing the impact on human well-being. Therefore, further research shows promise for investigating the impact of artworks on human well-being. Furthermore, other studies (Vessel et al., 2013; Vessel et al., 2023) found that aesthetic appeal and self-relevance play important roles in human beings regarding art, emotional responses, and stress reduction. The correlation of stress reduction with aesthetic appeal and self-relevance seems to be complex and diverse. For that reason, the main aim of this laboratory study is to investigate how aesthetic appeal and self-relevance in artworks affects human perception. To analyse this complex interaction, aesthetic appeal and self-relevance are considered individually.

1.3 Aims and hypothesis

The main aim of this laboratory study is to investigate how aesthetic appeal[1] and self-relevance[1] and their counterparts in artwork, influence the subjective well-being and physiological well-being in humans. For the first study, we hypothesize that the exposure to artwork reduces stress in human beings. More precisely, we hypothesize that the exposure of artworks with high aesthetic appeal and high self-relevance will impact the general human well-being and will reduce stress. Additionally, while some individuals respond more positively to aesthetically appealing art, others lean to prioritizing the self-relevance in artworks, creating a notable difference in perceived self-relevance. Hence, for the second study, we hypothesize, that the artworks perceived as self-relevant will vary significantly more than what is perceived as aesthetically appealing. Furthermore, we hypothesize, that observers exposed to a stimulus containing high self-relevance, regardless of their aesthetic appeal, will reduce stress and experience a more significant physiological and psychological well-being benefit.

[1] In the following scrip, we speak off aesthetic appeal and self-relevance. The four conditions used in this study contain a combination of high or low aesthetic appeal and high or low self-relevance. In some figures and text sections abbreviations were used for the four conditions. The abbreviations were the following: 1. high relevance & high aesthetic appeal = HH or HRHA, 2. high relevance & low aesthetic appeal = HRLA, 3. low relevance & high aesthetic appeal = LRHA, and 4. low relevance & low aesthetic appeal = LL or LRLA. For Study 1 we speak of HH and LL, and for Study 2 we speak of HRHA, HRLA, LRHA, and LRLA. HH and HRHA, and LL and LRLA refer to the same conditions used in both studies. However, for Study 1 and Study 2 different abbreviations were used, since both studies had different sets of artworks. For Study 1 the “extreme cases” of artworks were used and for Study 2 the more average artworks were used (see Figure 2).

2. General Methods

2.1 Artwork generation

The first step served the identification of self-relevant topics. Individuals (*n*=26) were asked to write down significant topics relevant in their personal lives as well as irrelevant topics. These topics were subjected to a rating study in which (*n*=85) different persons rated these topics for personal relevance. For identification of artwork styles of high and low aesthetic appeal, we used information derived from VAPS®, where individuals (*n*=120) assessed artworks on their aesthetic appeal. For instance, while impressionism is commonly perceived as aesthetically appealing, cubism is frequently perceived as less attractive by lay people. We used the artificial intelligence (AI), called DALLE-E2® for the creation of the artworks: High aesthetically appealing artworks were created in the impressionism style and low aesthetically appealing artworks were created in the cubism style. The prompts to generate artworks were based on the ratings of self-relevance and combined with style prompts. This resulted in roughly 10000 artworks, 90 of which were subjected to a rating study. An independent student population (n = 37) M_{age} = 21.82 (SD = 2.46) 29 female, 7 male, 1 other evaluated the presented artworks regarding its aesthetic appeal and self-relevance. Based on these results, artworks of 4 categories were chosen: high self-relevance & high aesthetic appeal, high self-relevance & low aesthetic appeal, low self-relevance & high aesthetic appeal, and low self-relevance & low aesthetic appeal. The resulting 4 stimulus groups were used in the laboratory studies.

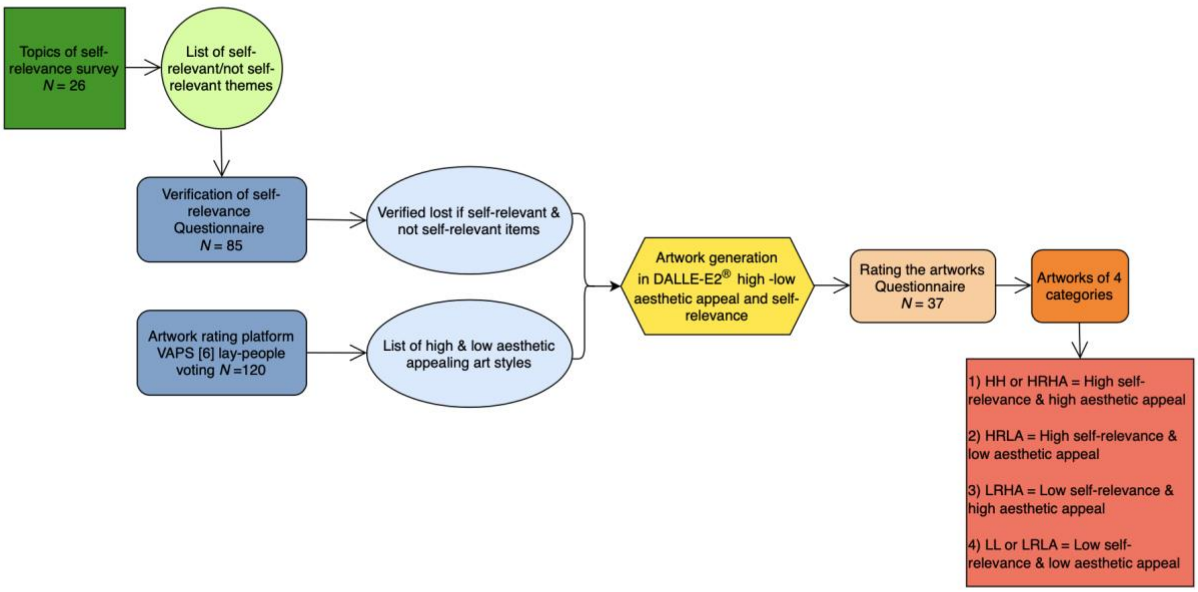

Figure 1. *Flow chart of the artwork generation.*

Each stimulus set consisted of five artworks, for study 1 we had a total of 10 different artworks and for study 2 a total of 20 (see Figure 2). Furthermore, for study 1 and study 2, different artworks were chosen. For study 1 we used the extremes, meaning the artworks rated most aesthetically appealing and self-relevant and least aesthetically appealing and least self-relevant were used. Study 1 artworks were labeled HH (high aesthetic appeal and high self-relevance) and LL (low aesthetic appeal and low self-relevance). For study 2, we chose artworks with matching values of self-relevance and aesthetic appeal. Study 2 artworks were labeled HRHA (high self-relevance & high aesthetic appeal), HRLA (high self-relevance & low aesthetic appeal), LRHA (, low self-relevance & high aesthetic appeal), and LRLA (low self-relevance & low aesthetic appeal).

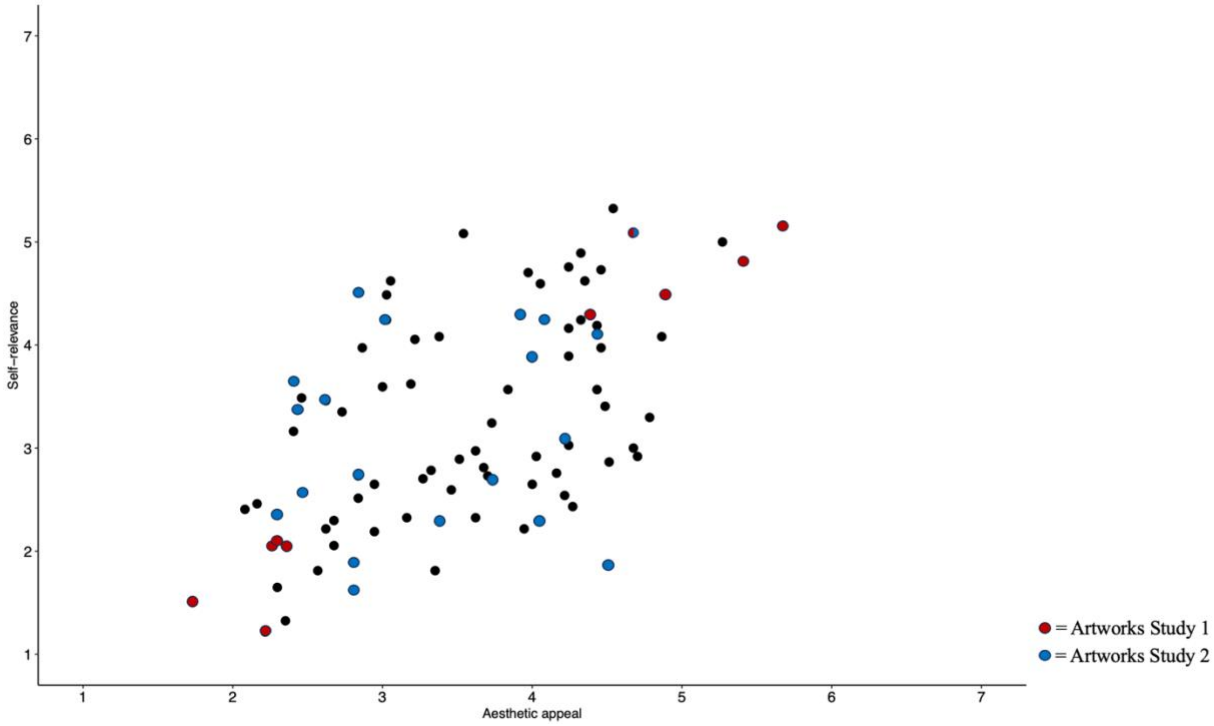

Figure 2. *Scatterplot visualizing the rating of the generated artworks.*

2.2 Measurements - Statistical analysis

2.2.1 Physiological well-being – Physiological measurements

The physiological measurements were taken via a wristband "Empatica E4" and a chest belt the "Zyphir Bio Harness". Physiological measurements such as Skin Temperature (ST), the Galvanic Skin Response (GSR) and the Heart Rate (HR) were measured. Based on these physiological measurements we used the algorithm Kyriakou et al. (2019) suggests, to obtain the Moments Of Stress (MOS) scores, for the evaluation of stress levels of the participants. The physiological data was exported from the application eDiary® and rearranged, so that all the corresponding files (pre-measurements, condition-measurements, mid-measurements, and post-measurements) were combined and put in a folder per participant. All these folders were then sorted to the condition/stimulus they were assigned to. The physiology and questionnaire data were combined using the unique participant IDs.

2.2.2 Subjective well-being – Questionnaire measurements

Subjective well-being measurements, were taken by questionnaires, using the State-Trait Anxiety Inventory (STAI-S) (Grimm, 2009, adapted from Spielberger et al., 1999), the Positive and Negative Affect Schedule (Krohne et al., 1996), resulting in two variables, positive/negative state mood and the momentary perceived stress levels (VAS). In total four dependent variables were obtained for subjective well-being. STAI-S measures the perceived anxiety levels, PANAS measures the affective mood states, for positive and negative mood states and VAS (Visual Analogue Scale) measures the momentary perceived stress levels on a scale from 0-100. For assessing the (STAI-S) a four-point Likert scale from 1 (not at all) to 4 (very much) was used. For assessing the PANAS, which was grouped in half positive and half negative items, a five-point Likert-type scale from 1 (not at all) to 5 (extremely) was used. The momentary perceived stress levels were measured using a slider-type scale.

The collected data was analyzed with the program R Studio®. Furthermore, the physiological data (MOS) was pre-processed by the Geo-social Analytics Lab at the University of Salzburg. The physiological data (MOS) were analyzed by using a two-way ANOVA. The questionnaire data were analyzed by applying a MANOVA and a two-way mixed ANOVA.

3. Study 1

3.1 Study design

In total 52 participants participated in the laboratory study, in a room at the University of Vienna which allowed no sunlight to create a dark environment, from the 8th to the 19th of May 2023. Three individuals were excluded because the artificial lights automatically turned on and this could be perceived as a stressor, the total sample size consisted of 49 individuals (n = 49) (M_{age} = 25.8755; Male = 26.53%; Female= 73.47%). A pretest-posttest experimental design, which was structured as a within-subject design was used. Each participant individually was asked to complete three questionnaires in total and to look twice at five artworks from the two given conditions, high self-relevance and aesthetic appeal (HH) and low self-relevance and aesthetic appeal (LL). The duration of the art exposure was four minutes each.

Prior to the initiation of the experiment each participant was equipped with a chest belt containing a BioHarness 3 Sensor (see Figure 3) and a Empatica E4 wrist band (see Figure 4) to measure the Skin Temperature (ST), the Galvanic Skin Response (GSR) and the Heart Rate (HR). The chest belt with the sensor was put on the skin under the left breast, near the heart. The wrist band was applied on the skin, with the sensor on the transition region between the forearm and the hand (Regio carpalis anterior) of the left arm. Both devices measured the same variables, and the averages of the collected data were used.

Figure 3. *BioHarness 3 Sensor chest belt (Biopac Systems Inc., 2015).*

Figure 4. *Empatica E4 wrist band (Empatica, 2020).*

After the participants had all the devices installed and connected to the eDiary® application, (presented by Petutschnig et al., 2022) and were sitting on the chair in front of the computer, they were asked to start with the first questionnaire. Furthermore, the participants were instructed to sit throughout the entire duration of the experiment.

The experimental set up contained of two beamers, through which the art was projected on two walls in the corner of the room (see Figure 5), and one computer where the participants had to answer three questionnaires (1st pre-questionnaire; 2nd mid-questionnaire; 3rd post-questionnaire). The artworks were presented in the same size between 73cm and 75 cm. The projected artworks and chair distance was kept constant. The order the artworks were shown was randomly assigned, resulting in half of the participants starting with HH and the other half starting with LL.

Figure 5. *Experimental set up.*

The art exposure occurred between the first (pre) and second (mid), and the second (mid) and third (post) questionnaire (seen Figure 6). Before beginning with the first questionnaire participants were asked about their age and their sex. The first questionnaire (pre) contained questions about their general mood, how they felt on a scale from 1-5 (1: not at all; 5: extremely) (PANAS-pre). They also had to answer how stressed they felt on a scale from 0-100 (0: not stressed; 100: very stressed) (VAS-pre) and a general description of feelings in the moment on a scale from 1-4 (1: not at all; 4: very) (STAI-pre). The first questionnaire served to assess the baseline mood.

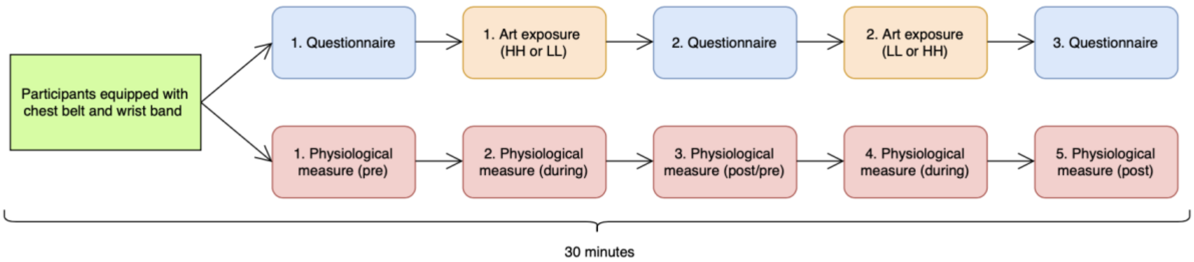

Figure 6. *Flow chart design of Study 1.*

After the participants finished the first questionnaire, they could turn the chair around and view the first artworks that were presented to them on the walls. After the first art exposure (4 minutes), the second questionnaire was filled out (PANAS, VAS, STAI plus rating of the art pieces on a scale from 1-7 on (1: not very; 7 very) aesthetic appeal and self-relevance), followed by the second art exposure, and a third questionnaire (PANAS, VAS, STAI plus rating of the art pieces on a scale from 1-7 on (1: not very; 7 very) aesthetic appeal and self-relevance).

One session of artwork exposure contained 5 different art pieces, once with the condition high aesthetic appeal and high self-relevance (HH) and once with low aesthetic appeal and low self-relevance (LL) (see Figure 7). Each art exposure had a duration of four minutes. Throughout the entire observation five physiological measurements were taken, three whilst the participants answered the questionnaires and two during the art exposure (pre_condition1_mid_condition2_post). The total duration of one experiment was approximately 30 minutes.

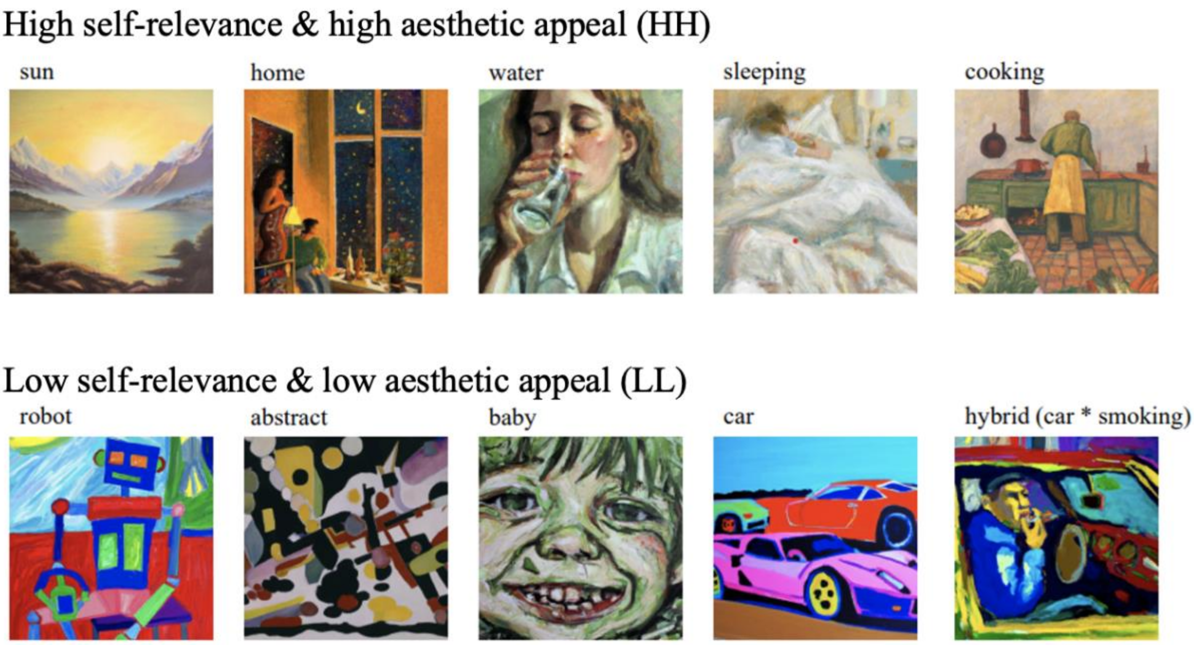

Figure 7. *Study 1 Artworks.*

3.2 Results

3.2.1 Physiological well-being

For the physiological measurements the Skin Temperature (ST), the Galvanic Skin Response (GSR) and the Heart Rate (HR) were documented. Amidst a novel algorithm from Kyriakou et al. (2019), moments of stress (MOS) could be detected. The MOS were analysed by an two-way ANOVA, once with the factor time (pre_viewing_post), once which condition occurred (cond) as well as the interaction of both factors (pre_post:cond). The analysis showed no effect regarding the factor time ($F(3,255) = 0.10$, $p = 0.40$). Neither did the condition show a significant effect ($F(1,255) = 0.01$, $p = 0.93$). The interaction of both, time and condition, also demonstrated no effect ($F(1,255) = 1.60$, $p = 0.21$). Overall, the analysis of the physiological measurements showed no differences, which indicated that looking at the presented artworks of either condition (HH/LL) did not result in a significantly measurable change regarding physiological stress response among participants. To visualize the physiological findings, the two graphs (see Figure 8) show the mean ± standard deviation (SD) of the moments of stress (MOS) for the two conditions during the experiment, high aesthetic appeal and high self-relevant art (HH) and low aesthetic appeal and low self-relevant art (LL).

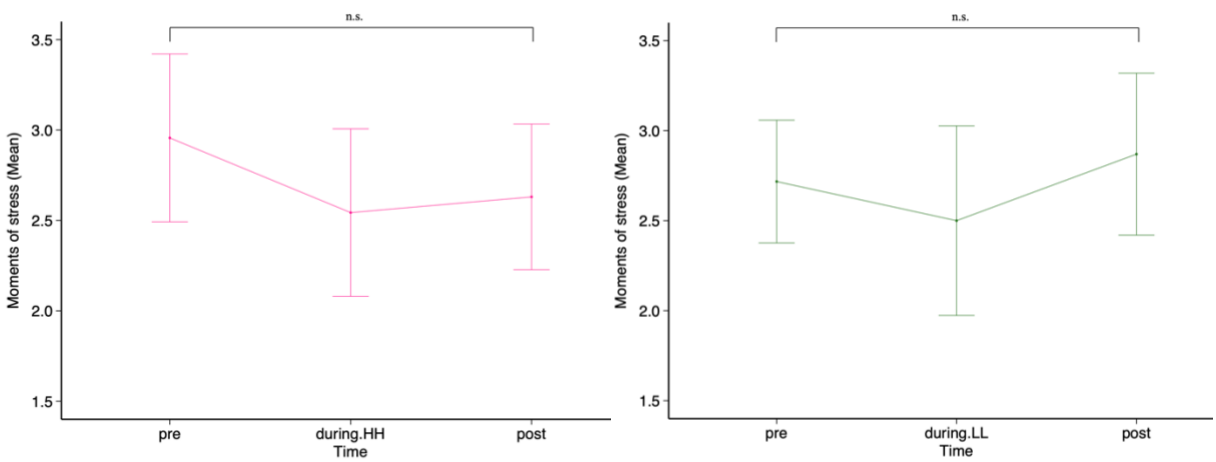

Figure 8. *Visualization of the mean ± SD of the moments of stress for HH (pink) and LL (green).*

3.2.2 Subjective well-being

For the questionnaire data, several measurements of subjective well-being were collected, including the state of anxiety (STAI), the perceived stress level (VAS) as well as the positive and negative affect schedule (PANAS.pos. & PANAS.neg.). This was possible to analyze by applying a MANOVA. The main results of the MANOVA, including the Pillai´s trace values are reported in Table 1. The closer the Pillai's Trace value is to 1, the stronger the evidence for a statistically significant effect.

Table 1. *MANOVA results of the subjective well-being.*

Factor	**Df**	**Pillai's trace value**	***F* value**	***p* value**
Pre_post	1	0.176238	7.5415	1.556e-05 ***
Cond	1	0.047213	1.7467	0.1431
Pre_post:cond	1	0.248622	11.6638	3.280e-08 ***
Residuals	144			

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

The MANOVA results displayed a main effect of the Time factor (pre_post) regarding the combination of the dependent variables, indicating a significant change in subjective well-being before and after the art exposure ($F(1,144) = 7.5415$, $p = 1.556e-05$). However, for the Condition no significant effect regarding the combination of dependent variables, could be detected ($F(1,144) = 1.7467$, $p = 0.1431$). For the interaction between Time and Condition (Pre_post:Condition) a significant effect on the combination of the variables was detected ($F(1,144) = 11.6638$, $p = 3.280e-08$). For interpretation's sake the partial eta square, the effect size, has been used, these values and the 90 % confidence interval are reported in Table 2.

Table 2. *Effect size of the MANOVA for subjective well-being.*

Factor	**Effect size**	**90% CI (Confidence Interval)**	**Interpretation**
Pre_post	0.18	0.07 - 0.25	Large effect
Condition	0.04	0.00 - 0.09	Small effect
Pre_post:Condition	0.25	0.14 - 0.32	Large effect

Reference for the interpretation of patrial eta square: small = .01, medium = 0.06, large = 0.14

The partial eta square of the MANOVA did find a small effect during the Condition (0.04), a large effect during the Time (0.18) and a large effect in the interaction between Time and Condition (0.25).

To further evaluate the effect of Time and Condition on subjective well-being measurements, a two-way mixed ANOVA was conducted for each dependent variable, including the state of anxiety (STAI), the perceived stress level (VAS) as well as the positive and negative affect schedule (PANAS.pos. & PANAS.neg.). The ANOVA was structured around two independent variables, Time and Condition. Descriptive statistics (mean (M) and standard deviation (SD) for all subjective well-being measurements across Time and Condition are reported in Table 3 and Table 4. To visualize the results of these four measurements, four different raincloud plots for each variable are shown (see Figure 9-12). Each figure includes the two conditions, high aesthetic appeal and high self-relevance (HH) and low aesthetic appeal and low self-relevance (LL), showing the comparison of pre and post art exposure. The condition high aesthetic appeal and high self-relevance (HH) is visible in pink and the condition low aesthetic appeal and low self-relevance (LL) is visible in green. For both conditions the lighter color shows the results of pre art exposure, and the darker color shows post art exposure.

For Anxiety (STAI) there has been a significant effect regarding the Condition ($F(1,144) = 5.14$, $p = 0.025$) and the interaction of Time with Condition ($F(1,144) = 46.23$, $p = 2.60E-10$). The condition high aesthetic appeal and high self-relevance (HH) show a decrease in anxiety, whereas the condition low aesthetic appeal and low self-relevance (LL) increased anxiety (see Figure 9). Table 3 demonstrates the mean values and the standard deviation for anxiety pre and post exposure for the two conditions. There was no statistically significant effect for the factor Time ($F(1,48) = 0.211$, $p = 0.647$). The state of anxiety decreased during high aesthetic appeal and high self-relevant (HH) artwork exposure, whereas during low aesthetic appeal and low self-relevant (LL) artwork exposure the level of anxiety increased.

For perceived stress levels (VAS) there has been a significant effect regarding Time $F(1,48) =13.20$, $p = 0.00039$) and the interaction of Time with Condition ($F(1,144) = 23.28$, $p = 3.52E-06$). For the condition high aesthetic appeal and high self-relevance (HH) there has been a decrease in stress reported, for low aesthetic appeal and low self-relevance (LL) the stress level increased (see Figure 10). Table 3 demonstrates the mean values and the standard deviation for stress pre and post art exposure for the two conditions. There was no statistically significant effect regarding the Condition ($F(1,144) = 1.480$, $p = 0.226$) could be shown. The perceived stress level decreased during high aesthetic appeal and high self-relevant (HH) artwork exposure and increased during the low aesthetic appeal and low self-relevant (LL) artwork exposure.

Table 3. *Descriptive statistic for Anxiety and Stress.*

	Anxiety				Stress			
	pre		post		pre		post	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Condition								
LL	34.2	7.57	39.0	8.41	31.7	24.0	33.2	22.2
HH	37.2	7.83	33.0	8.36	36.2	23.8	25.5	22.2

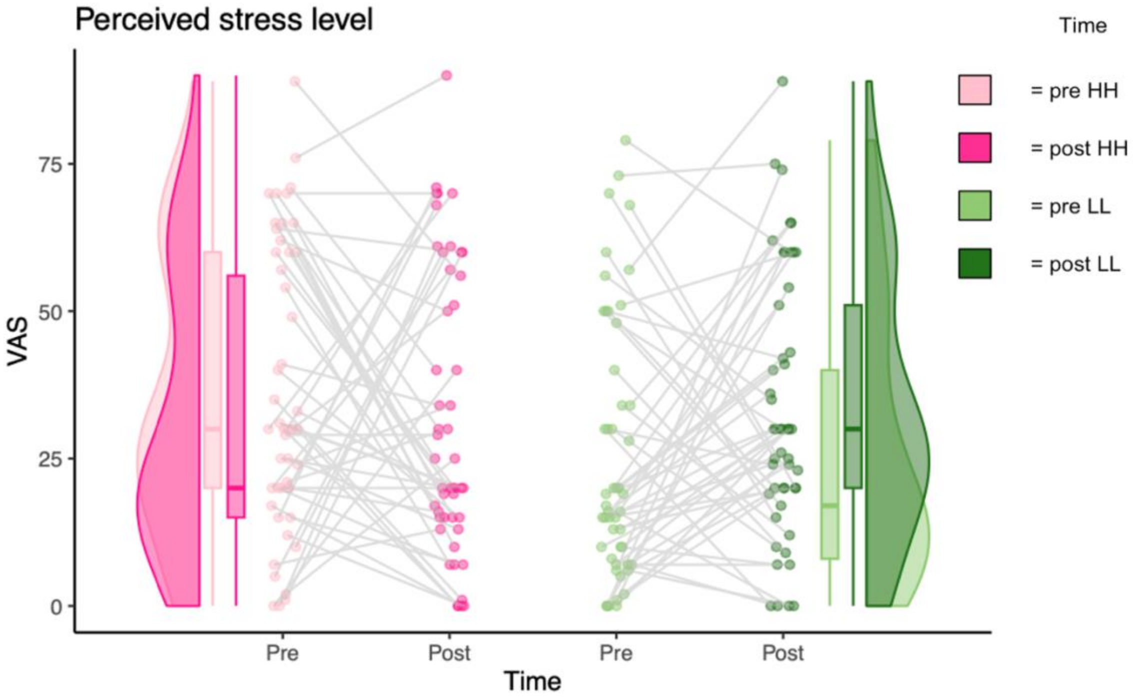

Figure 9. *Raincloud plots of anxiety pre- and post- art exposure.*

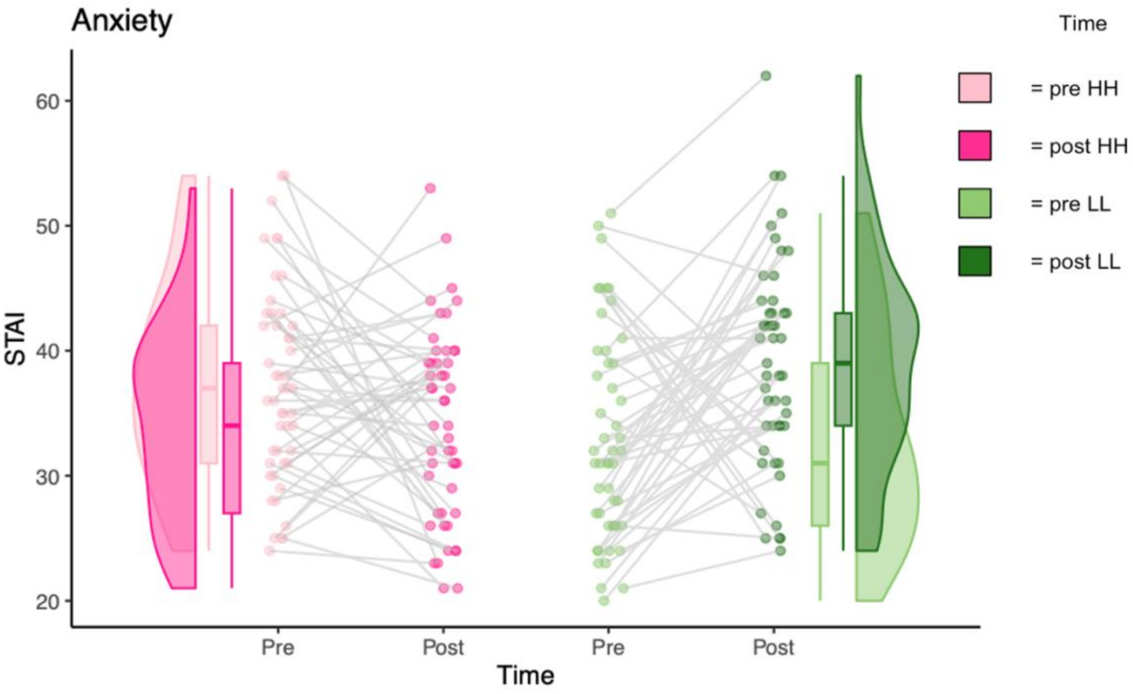

Figure 10. *Raincloud plots of perceived stress level pre- and post- art exposure.*

For positive mood (PANAS.pos) there has been a significant effect regarding Time $F(1,48) = 7.042$, $p = 0.0089$) and the interaction of Time with Condition ($F(1,144) = 7.88$, $p = 0.0057$). No difference could be shown for the high aesthetic appeal and high self-relevance (HH) condition, but in the condition low aesthetic appeal and low self-relevance (LL) a reduction (see Figure 11) in positive mood could be measured, regarding pre to post the art exposure. Table 4 demonstrates the mean values and the standard deviation for anxiety pre and post exposure for the two conditions. There was no statistically significant effect regarding the Condition $F(1,144) = 3.429$, $p = 0.0661$) could be shown. For the positive mood (PANAS.pos) the artwork exposure of high aesthetic appeal and high self-relevant (HH) had no effect on the positive mood, but during the low aesthetic appeal and low self-relevant (LL) art exposure the positive mood decreased.

For negative mood (PANAS.neg) there has been a significant effect regarding the Condition ($F(1,144) = 5.048$, $p = 0.026$) and the interaction of Time with Condition ($F(1,144) = 20.19$, $p = 1.43E-05$). The condition high aesthetic appeal and high self-relevance (HH) shows a decrease in negative mood, whereas the condition low aesthetic appeal and low self-relevance (LL) shows an increase in negative mood (see Figure 12). Table 4 demonstrates the mean values and the standard deviation for anxiety pre and post exposure for the two conditions. There was no statistically significant effect for the factor Time ($F(1,48) = 0.600$, $p = 0.440$). The negative mood (PANAS.neg) among participants decreased during the high aesthetic appeal and high self-relevant (HH) artwork exposure, in contrast it increased during the low aesthetic appeal and low self-relevant (LL) artwork exposure.

Table 3. *Descriptive statistic for Positive and Negative mood.*

	Positive mood				Negative mood			
	pre		post		pre		post	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Condition								
LL	31.4	7.22	28.4	7.28	12.7	2.81	13.7	3.26
HH	30.9	7.07	30.9	7.34	13.3	2.60	11.9	2.61

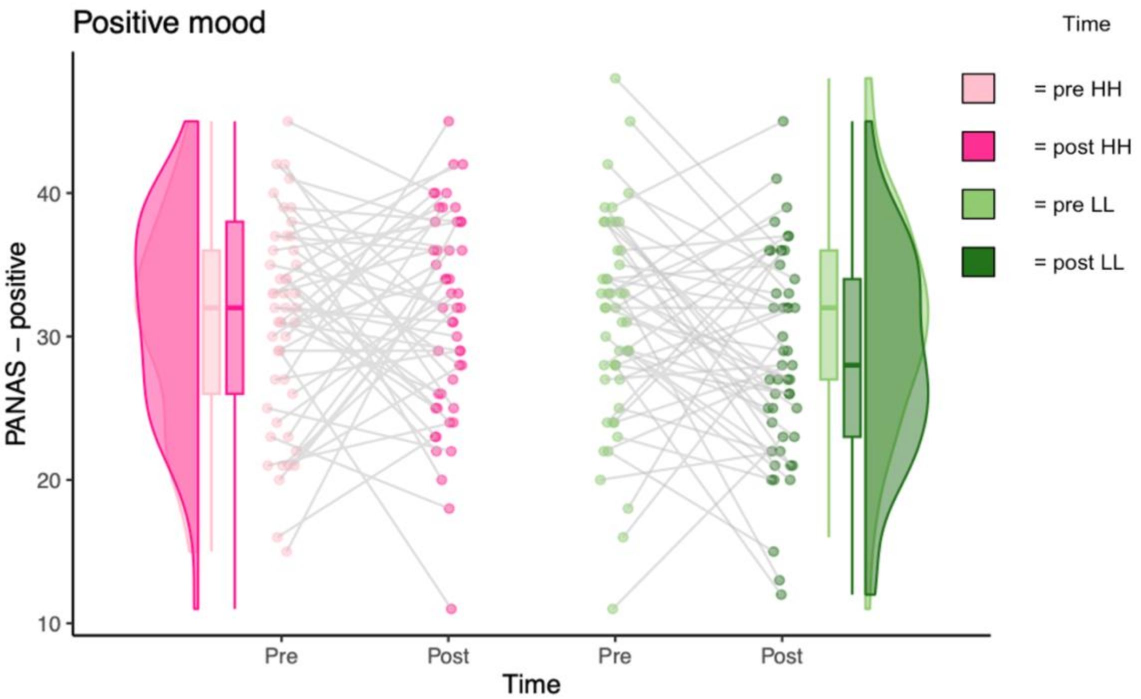

Figure 11. *Raincloud plots of positive mood pre- and post- art exposure.*

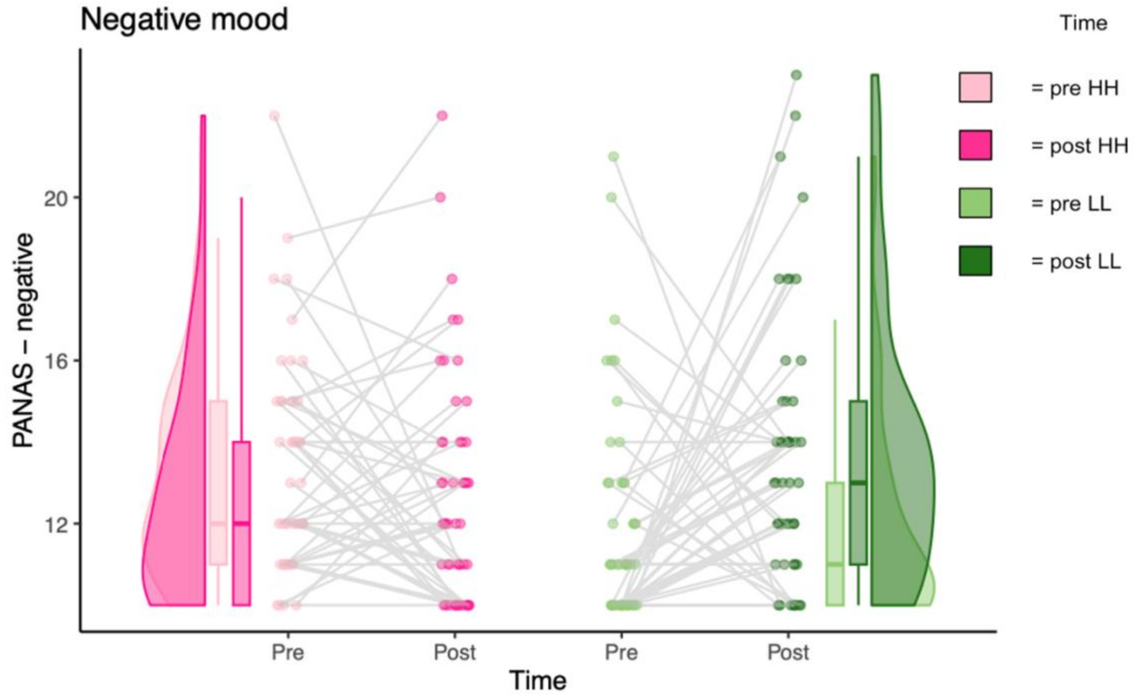

Figure 12. *Raincloud plots of negative mood pre- and post- art exposure.*

4. Study 1 Reflection and Study 2 Planning

4.1 Reflection on Study 1

Study 1 examined the effects of artworks with either high aesthetic appeal & high self-relevance (HH) or low aesthetic appeal & low self-relevance (LL) on the physiology and on the subjective well-being in humans. Each participant was exposed to both artwork conditions, meaning it was a within study design lasting four minutes. The results showed that artworks with high aesthetic appeal & high self-relevance (HH) enhanced subjective well-being. Interestingly, after the exposure of low aesthetic appeal & low self-relevance (LL) the well-being measurements declined. Despite the lack of physiological evidence, these findings were interesting and led to the planning of Study 2. The fact that art with low aesthetic appeal & low self-relevance (LL) had a diminishing effect on subjective well-being indicated that not all artworks have positive effects on human well-being. After obtaining these results the need to further explore the complex interaction of aesthetic appeal and self-relevance in artworks and the impact they have on physiological and subjective well-being persists.

4.2 Planning for Study 2

Having established that relevant and aesthetically appealing artworks affect human wellbeing more positively, the question of which characteristic is the main driver of this effect emerges: Aesthetic appeal or self-relevance. We systematically varied the dimensions aesthetic appeal and self-relevance, resulting in the following four conditions: 1. high relevance & high aesthetic appeal (HRHA), 2. high relevance & low aesthetic appeal (HRLA), 3. low relevance & high aesthetic appeal (LRHA) and 4. low relevance & low aesthetic appeal (LRLA). Note that the stimuli differ from Study 1, were we chose the artworks with the highest and lowest ratings in both dimensions. Due to the skewed distribution of the ratings of the artworks (Fig. 2), we had to work with medium high and medium low ratings. Duplicating the number of conditions made a within-subject design impossible for the following reasons: Firstly, the participants would have to answer the same questionnaire 5 times in a very short time span, resulting in a rapid decline in data validity. Secondly, the aim of the study could become transparent, biasing the subjects filling out the subjective well-being questionnaires. For these reasons, we opted for a between subject design, meaning each participant was exposed to one condition. Arti exposure was extended toa duration of 5 minutes, as we did not find effects in the physiological measurements in Study 1 and this longer exposure might lead to more salient effects.

5. Study 2

5.1 Study design

In total 127 participants participated in the laboratory study, in a room at the University of Vienna which allowed no sunlight to create a dark environment, from 6th of November to the 5th of December 2023. Of these 127 participants 25 were excluded due to technical issues for the physiological measurements, the total sample size consisted of 102 individuals (*n*=102) (M_{age} = 22.08; Male= 33.35%; Female= 64.71%; Other:1.97%; Don't want to say: 0.98%). In contrast to our previous study, this was a between-subject design, which means each participant was only exposed to one condition of our four conditions, but also structured as a pretest-posttest design. Each participant was asked to complete two questionnaires in total and to view at five artworks at the same time (see Figure 5), from one of the four conditions, which was randomly chosen. The four conditions were 1. high relevance & high aesthetic appeal (HRHA), 2. high relevance & low aesthetic appeal (HRLA), 3. low relevance & high aesthetic appeal (LRHA) and 4. low relevance & low aesthetic appeal (LRLA) (see Figure 14). The duration of the art exposure was 5 minutes.

Prior to the initiation of the experiment each participant was equipped with a chest belt containing a BioHarness 3 Sensor (see Figure 3) and a Empatica E4 wrist band (see Figure 4) to measure the Skin Temperature (ST), the Galvanic Skin Response (GSR) and the Heart Rate (HR). The chest belt with the sensor was put on the skin under the left breast, near the heart. The wrist band was applied on the skin, with the sensor on the transition region between the forearm and the hand (Regio carpalis anterior) of the left arm. Both devices measured the same variables, and the averages of the collected data was used.

After the participants had all the devices installed and connected to the eDiary® application, (presented by Petutschnig et al., 2022) and were sitting on the chair in front of the computer, they were asked to start with the first questionnaire. Furthermore, the participants were instructed to sit throughout the entire duration of the experiment.

The experimental setup contained of two beamers, through which the art was projected on two walls in the corner of the room (figure 5), and one computer where the participants could answer the questionnaires (1st pre-questionnaire & 2nd post-questionnaire). The artworks were presented in the same size between 73cm and 75 cm. The projected artworks and chair distance was kept constant.

The art exposure occurred between the first (pre) and second (post) questionnaire (see Figure 13). Before beginning with the first questionnaire participants were asked about their age and their sex. The first questionnaire (pre) contained questions about their general mood, how they felt on a scale from 1-5 (1: not at all; 5: extremely) (PANAS-pre). They also had to indicate how stressed they felt on a scale from 0-100 (0: not stressed; 100: very stressed) (VAS-pre) and provide a general description of feelings in the moment on a scale from 1-4 (1: not at all; 4: very) (STAI-pre). After the participants finished the first questionnaire, they could turn the chair around and view the artworks that were presented to them on the walls.

After the art exposure the participants answered a second questionnaire (post) which contained the same questions as the first one (pre). Additionally, the second questionnaire included a rating scheme for the different art pieces they just saw regarding their self-relevance, their aesthetic appeal, and how much attention they attributed to each artwork on a scale from 1-7 (1: not very; 7 very).

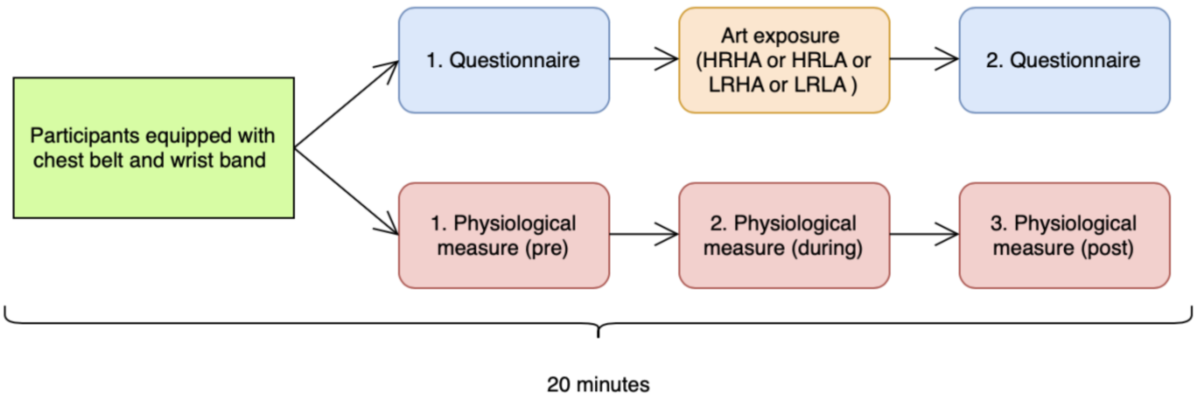

Figure 13. *Flow chart design of Study 2.*

One session of artwork exposure contained 5 different art pieces per condition (see Figure 14). Throughout the entire observation three physiological measurements were taken, two while the participants answered the questionnaires and one during the art exposure session (pre_condition_post). The total duration of one experiment per participant was approximately 20 minutes.

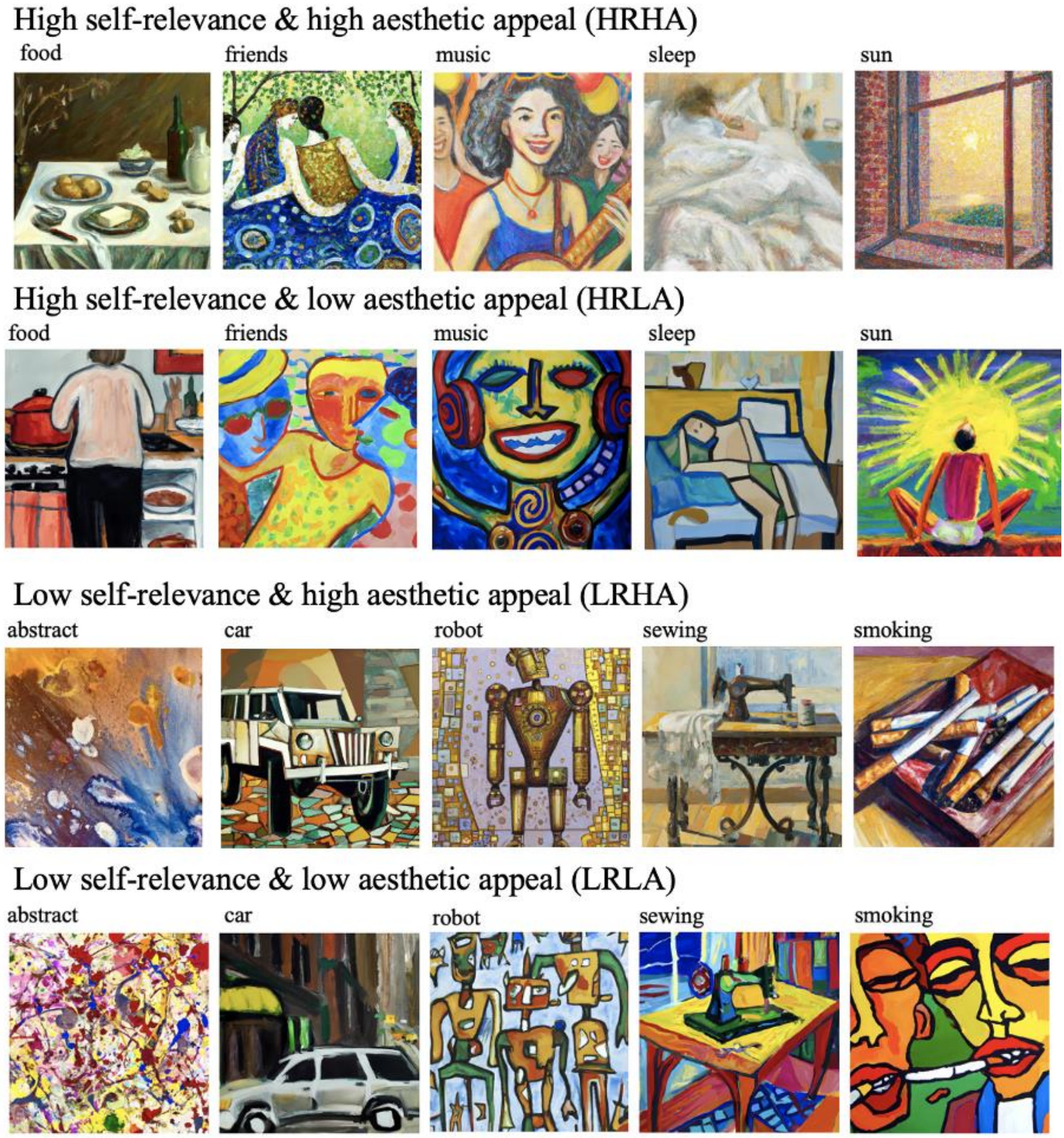

Figure 14. *Study 2 Artworks.*

5.2 Results

5.2.1 Physiological well-being

For the physiological measurements the Skin Temperature (ST), the Galvanic Skin Response (GSR) and the Heart Rate (HR) were documented. Amidst a novel algorithm from Kyriakou et al. (2019), Moments Of Stress (MOS) could be detected.

The Moments Of Stress (MOS) were analysed by an two-way ANOVA, once with the factor Time (pre_viewing_post) as well as the interaction of Time with the Condition (pre_post:cond). The analysis shows an effect in the factor Time (F (2, 1) = 7.03, p = .0011, η_p^2 = .07). However, for the interaction of Time (pre vs. post) * Condition (LRLA, LRHA, HRLA, HRHA) no effect could be shown (F (6, 3) = 0.38, p = .89, η_p^2 = .01).

Additionally, to identify which specific categories regarding Time, pre vs. viewing vs. post, differ from each other, post-hoc tests, such as the Tukey method, were conducted, to identify were the differences among those categories lie. The results of the multiple comparison for Time with Tukey indicate that the post value is significantly higher than the pre value (*ß = 8.67 (SE = 2.3), p = .0006)*. Not significant results were obtained regarding the pre vs. viewing (*ß = -5.12 (SE = 2.3), p = .07*) and the post vs. viewing (*ß = 3.55 (SE = 2.3), p = .27*) categories. This shows that there is no significant difference between pre and viewing values and no significant difference between post and viewing values.

To visualize the physiological findings a box plot (see Figure 15) which displays the sum of Moments Of Stress (MOS) among the four different conditions (LRLA, LRHA, HRLA, HRHA) at the three measuring time points (post = after art exposure; pre = before art exposure and viewing = during art exposure). Overall, the physiological Moments Of Stress (MOS) show that the art exposure did have a significant effect, however there is no significant difference between the conditions. Illustrated in the boxplot (see Figure 10) across all conditions, the Moments Of Stress after (post) art exposure (blue) are significantly higher than before (pre) art exposure (red).

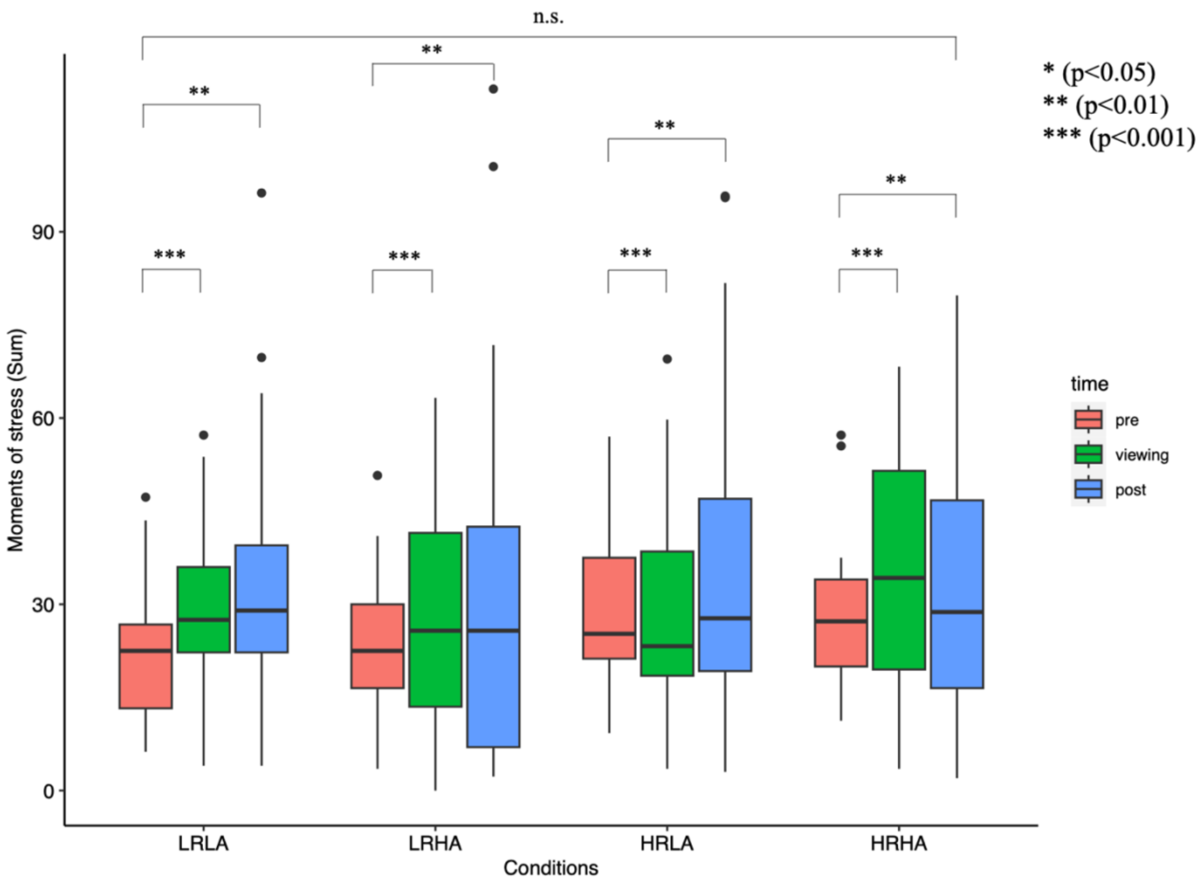

Figure 15. *Visualization of the sum of the Moments Of Stress (MOS) for the four conditions.*

5.2.2 Subjective well-being

For the questionnaire data, several measurements of subjective well-being were collected, including the state of anxiety (STAI), the perceived stress level (VAS) as well as the positive and negative affect schedule (PANAS.pos. & PANAS.neg.). This was possible to analyze by applying a MANOVA. The main results of the MANOVA (see Table 5) indicated a main effect of the Time factor (pre vs. post) regarding the combination of the dependent variables. This indicates a statistically significant change in subjective well-being before (pre) and after (post) the art exposure (F (3, 1) = 18.64, p < .0001). However, for the interaction between Time and Condition (Time (pre vs. post) * Condition (LRLA, LRHA, HRLA, HRHA)) no significant effect regarding the combination of dependent variables, could be detected (F (3, 3) = 0.77, p = .68).

Table 4. *MANOVA results of the subjective well-being.*

Factor	**Df**	***F* value**	***p* value**
Time (pre vs. Post)	1	18.64	< .0001
Time * Condition	3	0.77	0.68

To further evaluate the effect of Time on subjective well-being measurements, a two-way mixed ANOVA was conducted for each dependent variable, including the state of anxiety (STAI), the perceived stress level (VAS) as well as the positive and negative affect schedule (PANAS.pos. & PANAS.neg.). The ANOVA was structured around two independent variables, Time, and Condition (see Table 6 and 7). Descriptive statistics (mean (M) and standard deviation (SD) for all subjective well-being measurements across Time and Condition are reported in Table 8 and Table 9. To visualize the results of the four measurements of subjective well-being four different boxplots for each dependent variable (Anxiety (STAI); perceived stress level (VAS); positive mood (PANAS.pos) and negative mood (PANAS.neg)) are shown (see Figure 16-19). Each including the four Conditions, LRLA, LRHA, HRLA, HRHA. In these figures (see Figure 16-19) the pre-measurements are represented in red, and the post-measurements are represented in blue.

Table 6. *Two-way-mixed ANOVA with fixed effect Time on subjective well-being.*

Fixed effects	*F*(3,1)	*p* value	η_p^2
STAI			
Time (pre vs. post)	8.88	0.0036	0.08
VAS – Stress			
Time (pre vs. post)	59.23	< .0001	0.38
PANAS – Positive mood			
Time (pre vs. post)	4.06	0.047	0.04
PANAS – Negative mood			
Time (pre vs. post)	21.28	< .0001	0.18

Reference for the interpretation of patrial eta square: small = .01, medium = 0.06, large = 0.14

Table 7. *Two-way-mixed ANOVA with fixed effect Time * Condition on subjective well-being.*

Fixed effects	*F*(3,3)	*p* value	η_p^2
STAI			
Time * Condition	1.42	0.24	0.04
VAS – Stress			
Time * Condition	0.73	0.53	0.02
PANAS – Positive mood			
Time * Condition	0.81	0.49	0.02
PANAS – Negative mood			
Time * Condition	1.76	0.16	0.05

Reference for the interpretation of patrial eta square: small = .01, medium = 0.06, large = 0.14

For Anxiety (STAI) there has been a significant effect regarding Time (F (3, 1) =8.88, p = .0036, η_p^2 = .08). There was no statistically significant effect regarding the interaction of Time and Condition (F (3, 3) = 1.42, p = .24, η_p^2 = .04). The art exposure, regardless which Condition, did have a significant effect and showed a decrease in anxiety (see Figure 16). Table 8 demonstrates the mean values and the standard deviation for anxiety pre and post exposure for the four conditions. For Anxiety (STAI) the boxplots visualize that across all Conditions (LRLA, LRHA, HRLA, HRHA) the median scores are comparatively stable for pre and post throughout the four conditions. The post exposure median scores indicate a slight decrease in the conditions. The interquartile ranges (IQRs) between the pre- and post- measurement exposure scores overlap, indicating variability among individuals. The presence of outliers in both pre- and post-exposure could be evidence for individual differences in the responses to art exposure.

For perceived stress levels (VAS) there has been a significant effect regarding Time (F (3, 1) = 59.23, p < .0001, η_p^2 = .38). There was no statistically significant effect regarding the interaction of Time and Condition (F (3, 3) =0.73, p = .53, η_p^2 = .02). The art exposure, regardless which Condition, did have a significant effect and showed a decrease in stress (see Figure 17). Table 8 demonstrates the mean values and the standard deviation for perceived stress levels pre and post exposure for the four conditions. For perceived stress level (VAS) the boxplots visualize that across all Conditions (LRLA, LRHA, HRLA, HRHA) the post-measurement median scores decreased in comparison to the pre-measurement. The interquartile ranges (IQRs) for pre- and post-exposure demonstrate a rather consistent distribution of perceived stress levels among the individuals.

Table 8. *Descriptive statistic for Anxiety and Stress.*

	Anxiety				Stress			
	pre		post		pre		post	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Condition								
LRLA	40.1	7.64	37.8	6.27	52.5	7.64	43.2	6.27
LRHA	39.2	7.10	39.3	8.97	42.2	7.10	35.3	8.97
HRLA	41.0	12.0	37.1	11.1	48.2	12.0	36.2	11.1
HRHA	39.2	11.3	36.7	10.2	37.6	11.3	27.7	10.2

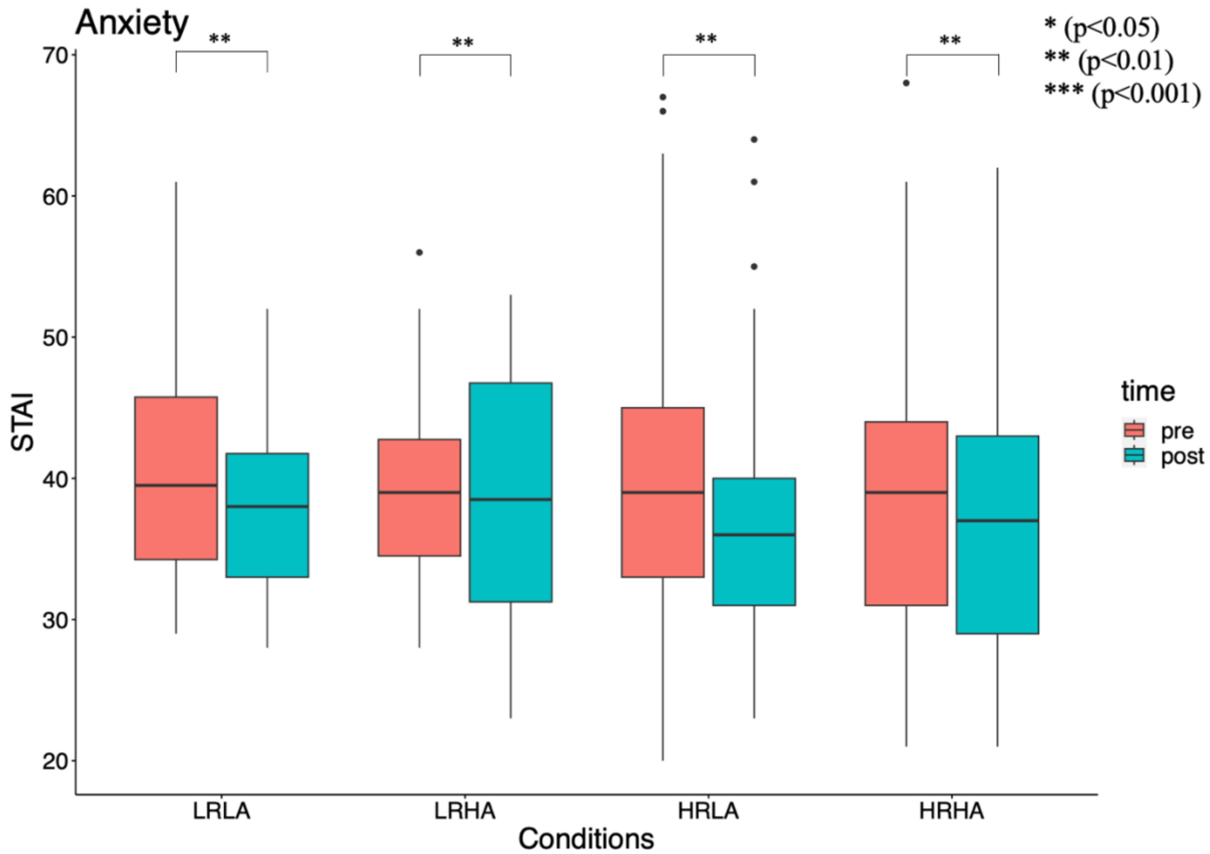

Figure 16. *Anxiety pre- and post- art exposure for the four conditions.*

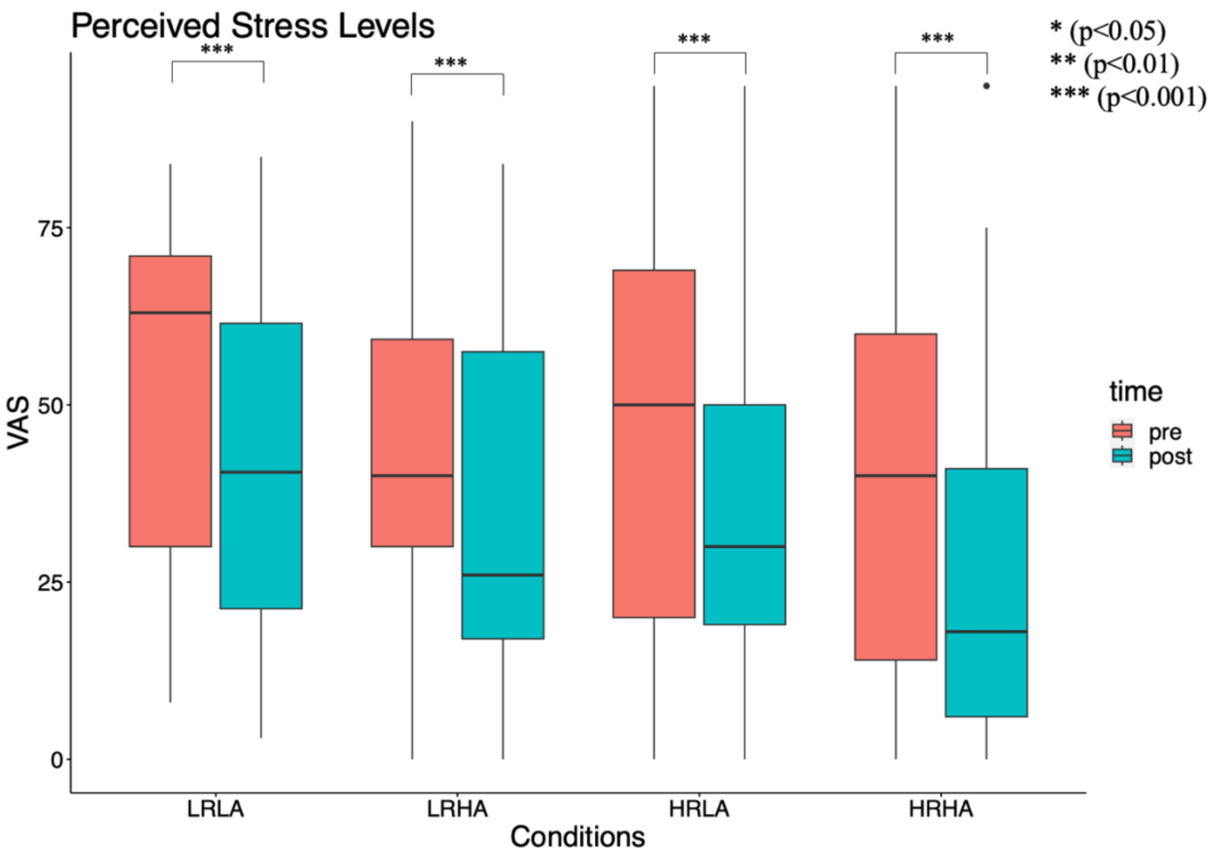

Figure 17. *Perceived stress levels pre- and post- art exposure for the four conditions.*

For positive mood (PANAS.pos) there has been a significant effect regarding Time (F (3, 1) = 4.06, p = .047, η_p^2 = .04). There was no statistically significant effect regarding the interaction of Time and Condition (F (3, 3) =.81, p = .49, η_p^2 = .02). This showed that there is a small but significant change in positive mood after the art exposure (see Figure 18). The art exposure, regardless which Condition, did show a small decrease in positive mood. For positive mood the scores (*M* and *SD*) are slightly higher pre art exposure than post art exposure, for all four conditions (see Table 9). For positive mood (PANAS.pos) the boxplots visualize that across all Conditions (LRLA, LRHA, HRLA, HRHA) the post-measurement median scores show no essential shift in comparison to the pre-measurements. The interquartile ranges (IQRs) overlap, which demonstrate that the art exposure did not extremely improve positive mood in participants. Although a significant change could be measured (F (3, 1) = 4.06, p = .047, η_p^2 = .04) the small effect size can be seen in the boxplots.

The negative mood (PANAS.neg) there has been a significant effect regarding Time (F (3, 1) = 21.28, p < .0001, η_p^2 = .18). There was no statistically significant effect regarding the interaction of Time and Condition (F (3, 3) =1.76, p = .16, η_p^2 = .05). The art exposure, regardless which Condition, did have a significant effect and showed a decrease in negative mood (see Figure 19). Table 9 demonstrates the mean values and the standard deviation for perceived stress levels pre and post exposure for the four conditions. For negative mood (PANAS.neg) the boxplots visualize that across all Conditions (LRLA, LRHA, HRLA, HRHA) the post-measurement median scores show a noticeable decrease in comparison to the pre-measurements, which indicates that individuals experienced a reduction in negative mood after the art exposure. The interquartile ranges (IQRs) show a slight decrease from pre- to post-art exposure, particularly in the HRHA condition, a compacter IQR in the post-art exposure is shown. The presence of outliers, again in both, pre- and post-exposure could be evidence for individual differences in the responses to art exposure.

Table 9. *Descriptive statistic for Positive and Negative mood.*

	Positive mood				Negative mood			
	pre		post		pre		post	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Condition								
LRLA	30.6	6.96	28.9	6.89	14.9	3.79	13.2	3.18
LRHA	29.6	4.77	28.3	6.92	14.0	6.10	13.7	4.71
HRLA	30.3	6.14	29.9	6.46	15.8	5.27	13.7	5.64
HRHA	29.5	5.37	29.4	6.78	13.9	3.88	12.8	3.54

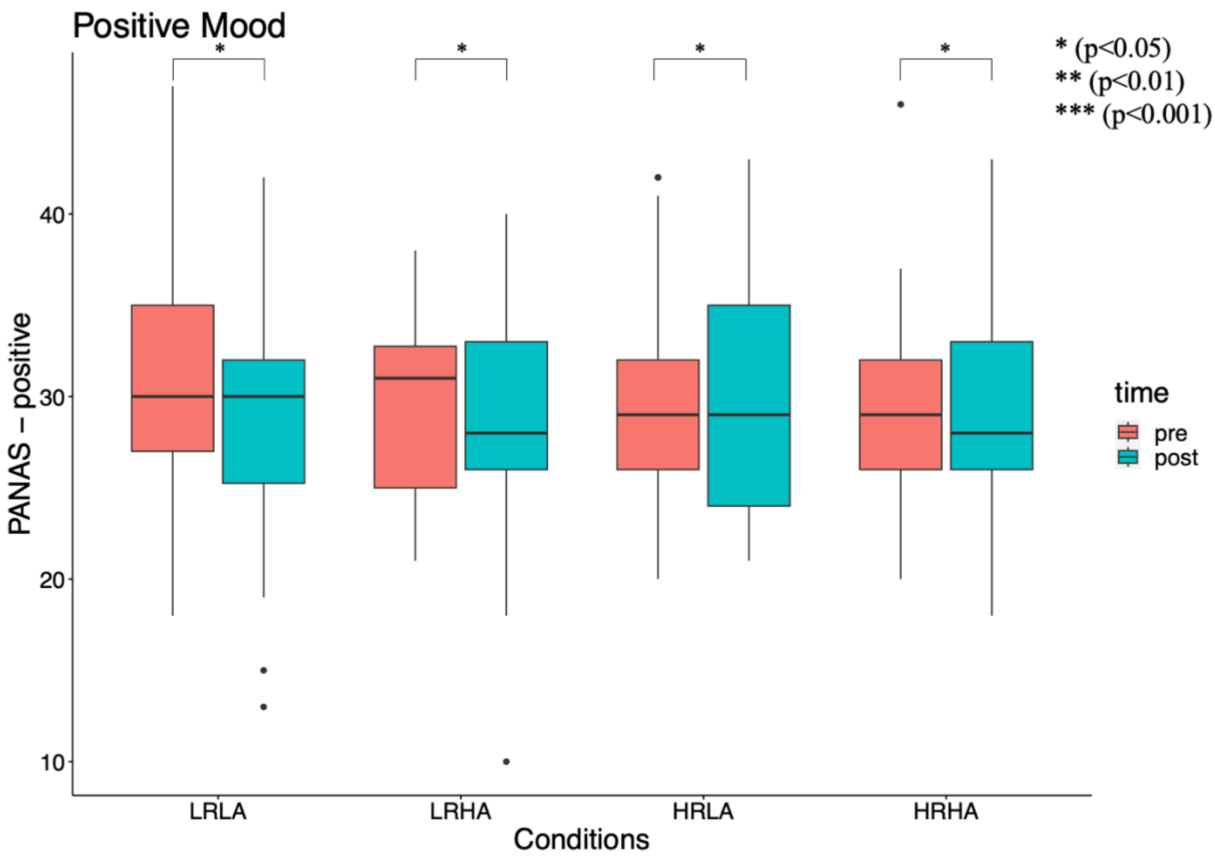

Figure 18. *Positive mood pre- and post- art exposure for the four conditions.*

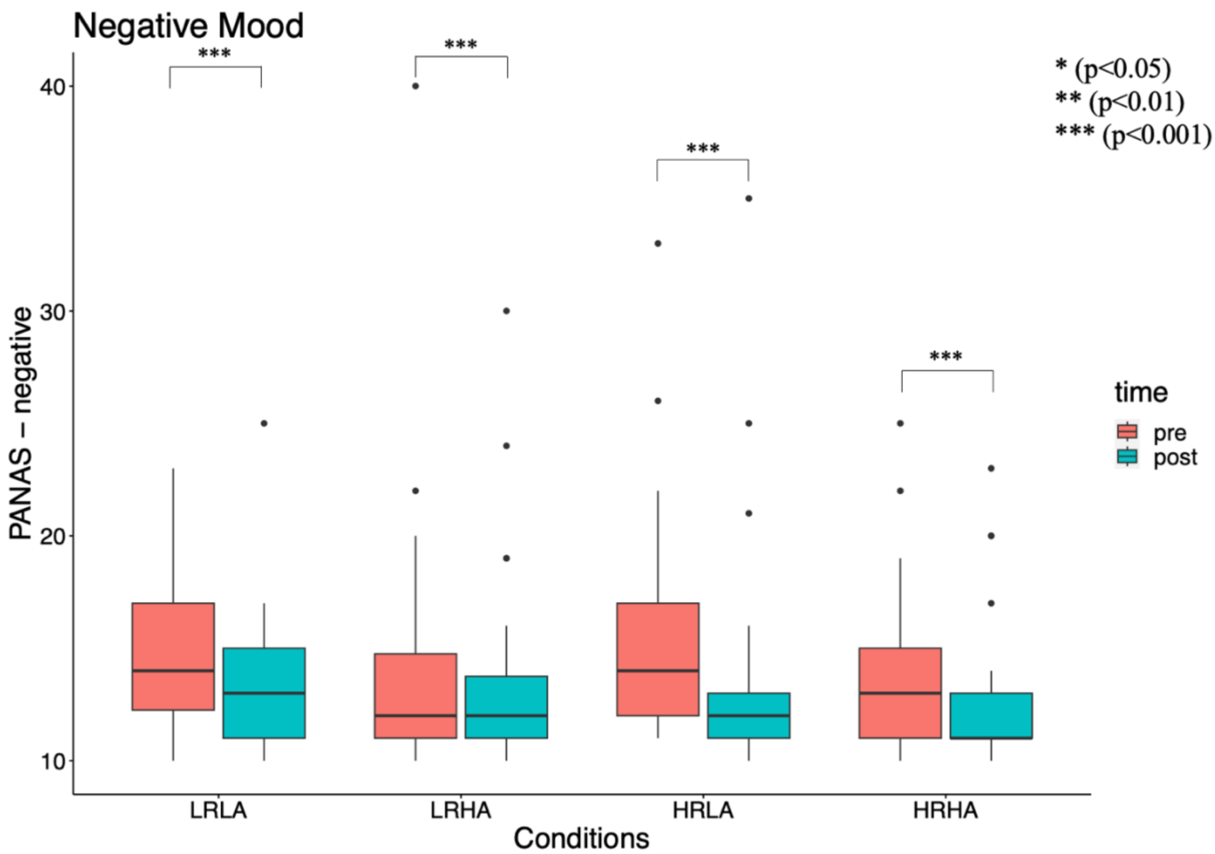

Figure 19. *Negative mood pre- and post- art exposure for the four conditions.*

5.2.3 Artwork ratings from the participants

To analyse the artwork ratings regarding aesthetic appeal and self-relevance, a one-way ANOVA was conducted. To visualize these findings, single-sided violin plots were created, to visualize how the data is distributed, the median and the IQRs, but also showing the density of the data values (see Figure 20).

Aesthetic appeal

The results of the ANOVA indicated that there are differences regarding aesthetic appeal between the conditions ($F_{condition}$ (3, 3) = 5.92, p = .0005, η_p^2 = .03). Aesthetic appeal ratings in the Condition HRHA were significantly higher than in LRLA and HRLA (HRHA-LRLA: $p_{adjusted}$ = 0.0062; HRHA-HRLA $p_{adjusted}$ = 0.00056). These results are plotted in Figure 20 on the left side and show that all medians are approximately 4 around the neutral point, except for the Condition HRHA, which is higher. Furthermore, the distribution in HRHA is more compact, which indicates that the presented artworks were generally perceived as aesthetically appealing with little variation. LRLA and HRLA have a wider distribution, which indicates a more varied perception on aesthetic appeal in the presented artworks. LRHA shows a bit more consistent range of perception of aesthetic appeal, with a more compact region.

Self-relevance

The results of the ANOVA indicated that there are differences regarding self-relevance between the conditions ($F_{condition}$ (3, 3) = 9.85, p < .0001, η_p^2 = .06). Self-relevance ratings in HRHA were higher than in LRLA and LRHA (HRHA-LRLA: $p_{adjusted}$ = 0.0023; HRHA-LRHA: $p_{adjusted}$ = 0.0002). Self-relevance ratings in HRLA were also higher than in LRLA and LRHA (HRLA-LRLA: $p_{adjusted}$ = 0.0038; HRLA-LRHA: $p_{adjusted}$ = 0.0003). These results are plotted in Figure 20 on the right side and show that the medians for LRLA and LRHA are generally lower than for HRLA and HRHA. Furthermore, the distribution in HRHA is more compact, which indicates that the presented artworks were generally perceived as self-relevant with little variation. LRLA has a broad distribution with two wider distributions, which indicates two different perceptions regarding the perception of self-relevance. LRHA shows a higher density towards lower self-relevance. HRLA shows a wider distribution in the perception of self-relevance, however comparatively to LRHA the distribution tends towards higher self-relevance.

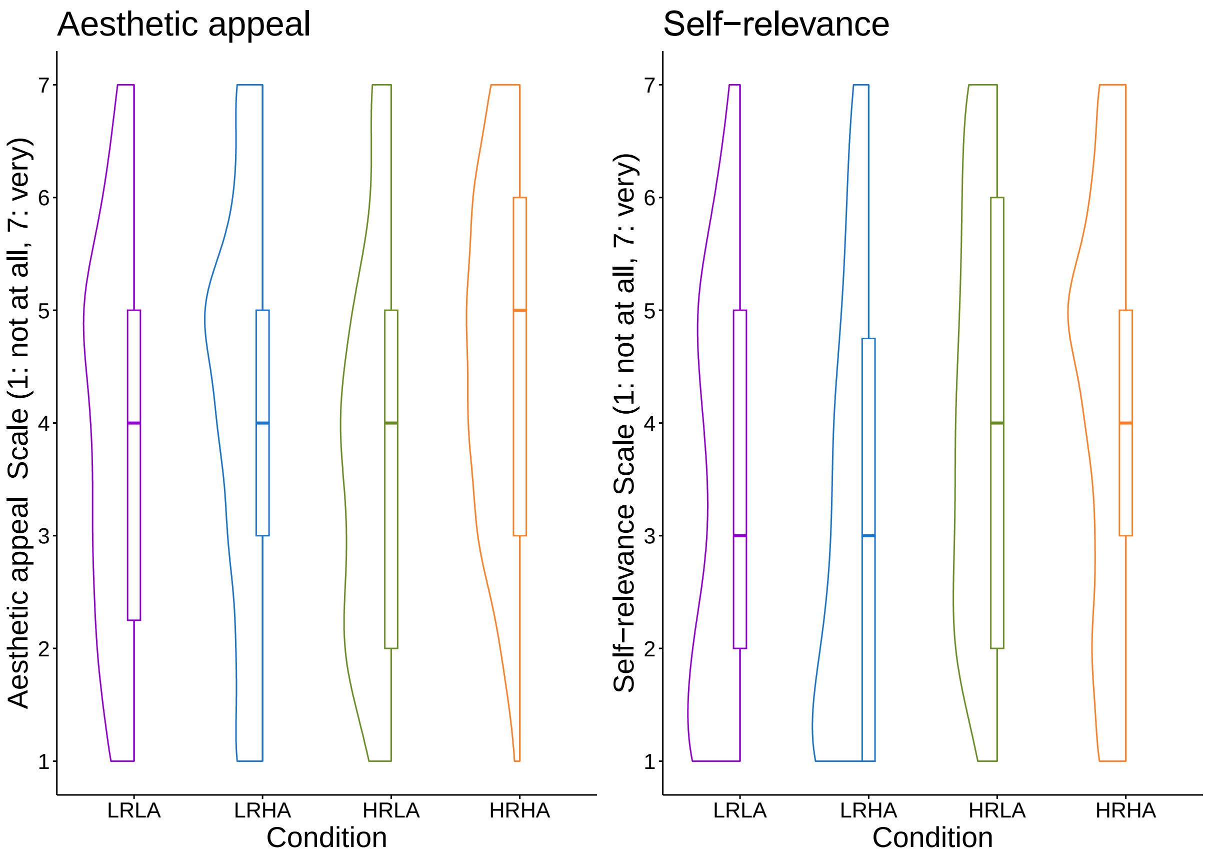

Figure 20. *Artwork rating from the participants regarding aesthetic appeal and self-relevance for the four conditions.*

6. Comparison of participants' artwork ratings

The following two boxplots (see Figure 21 and Figure 22) represent the artwork ratings of the actual participants regarding aesthetic appeal and self-relevance of the two separate studies, each with the corresponding conditions. The following conditions were rated: for study 1 HH (High aesthetic appeal and high self-relevance) and LL (Low aesthetic appeal and low self-relevance) and for study 2 LRLA (Low aesthetic appeal and low self-relevance), LRHA (High aesthetic appeal and low self-relevance), HRLA (Low aesthetic appeal and high self-relevance), and HRHA (High aesthetic appeal and high self-relevance).

6.1 Study 1

In HH, aesthetic appeal ratings show a higher median than self-relevance ratings, however both ratings are above the mid-point scale. The interquartile range (IQR) is narrower in HH than in LL regarding aesthetic appeal, which indicated less variance and more agreement among individuals regarding aesthetic appeal. In the LL Condition both aesthetic appeal and self-relevance ratings show a lower median. The IQR in LL regarding aesthetic appeal is relatively broad, which indicates a high variability among participants in their ratings.

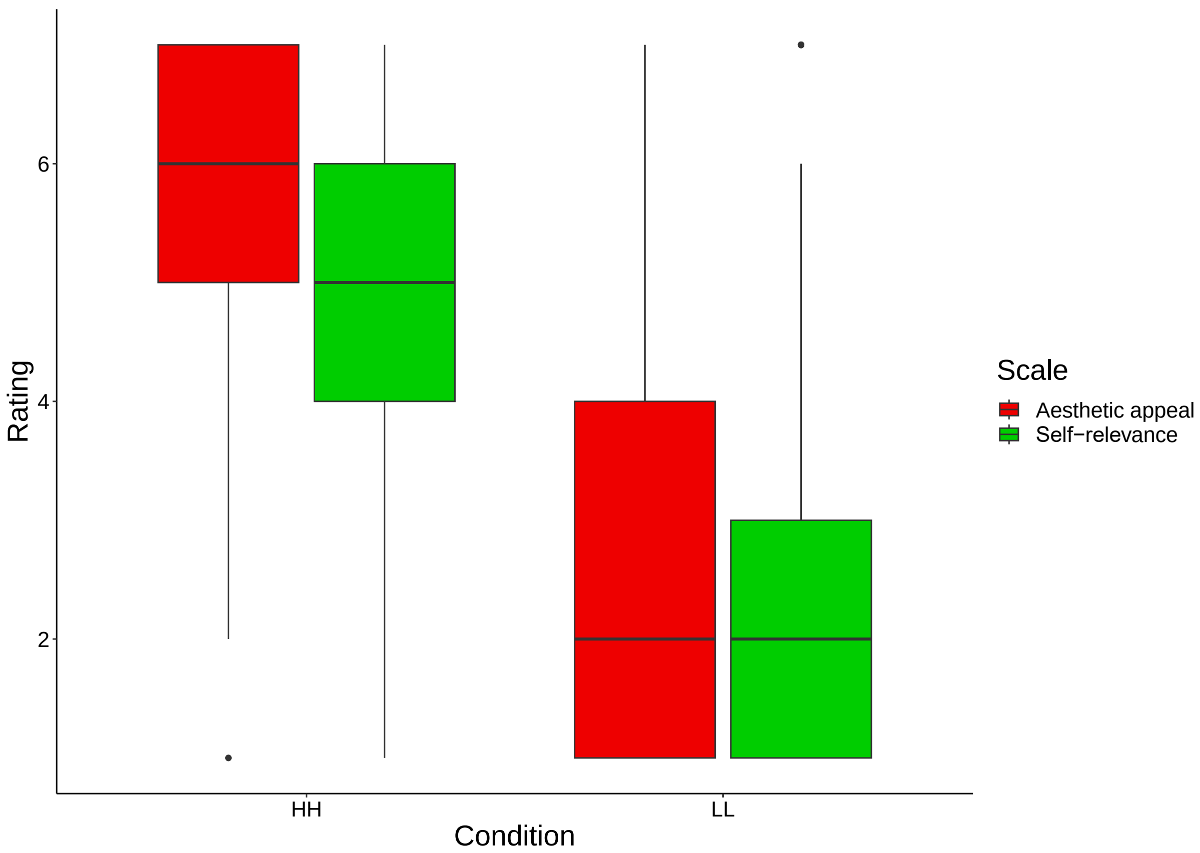

Figure 21. *Artwork ratings Study 1.*

6.2 Study 2

In the LRLA, aesthetic appeal and self-relevance show lower median ratings. For LRHA, the rating regarding aesthetic appeal is higher than for self-relevance, which reflects the idea of the condition. HRLA shows higher self-relevance ratings than aesthetic appeal, which again aligns with the idea of the condition. In the HRHA condition ratings for aesthetic appeal and self-relevance were higher, with aesthetic appeal being higher. Overall, the IQRs are broad, which suggests a high variability in perceptions of aesthetic appeal and self-relevance among the participants.

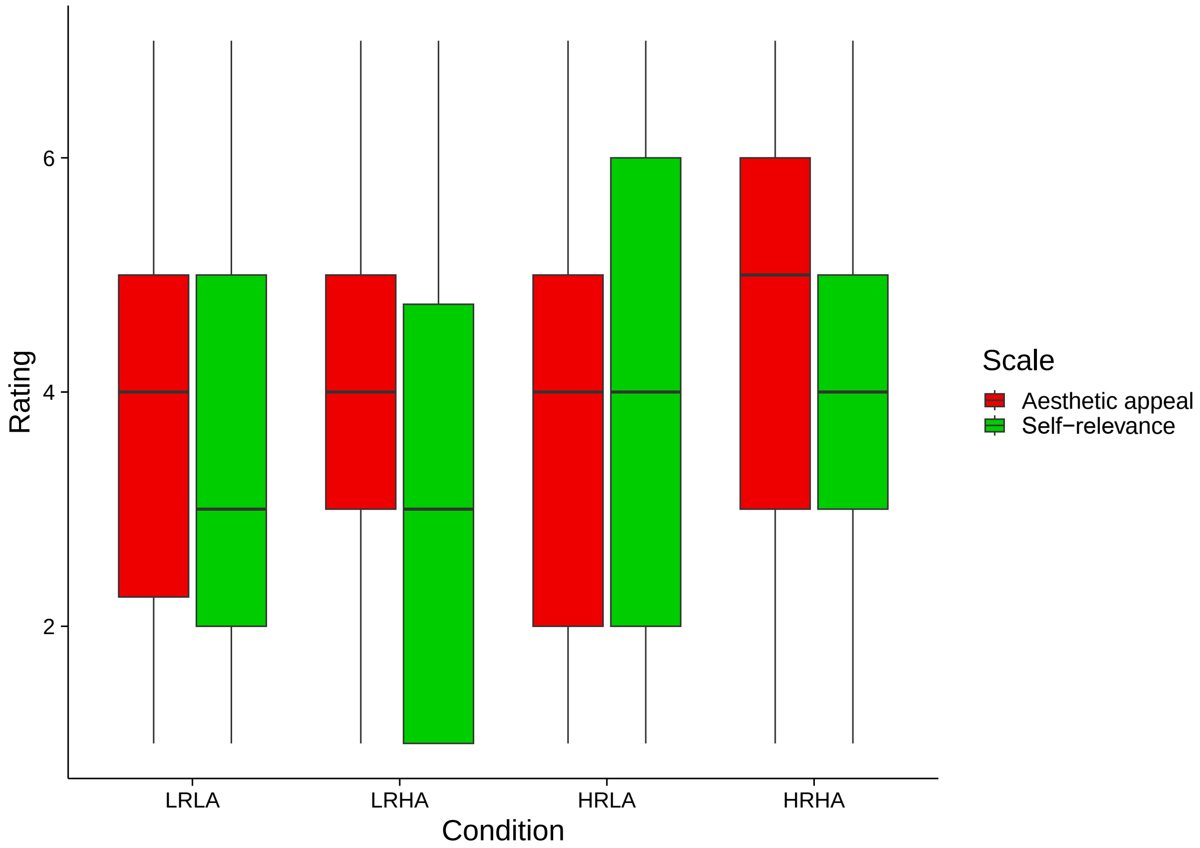

Figure 22. *Artwork rating Study 2.*

6.3 Comparison of Study 1 & Study 2

Comparing both studies, Study 1 shows a smaller variance among participants regarding their perception for aesthetic appeal and self-relevance compared to study 2. Furthermore, the rating regarding aesthetic appeal and self-relevance for study 1 have a higher concentration of ratings in the upper spectrum in HH and in the lower spectrum in LL, comparing to study 2, where the ratings predominantly display a scattering around the median of the scale.

7. General Discussion

Using two similar, yet non-identical studies, we aimed to investigate the impact of different artworks, regarding their aesthetic appeal and self-relevance, on human well-being, considering the subjective and physiological well-being. Hence, for study 1, we tested the following hypothesis (A) The exposure to artworks will impact the general human well-being and reduce stress in human beings, (B) The exposure of artworks with high aesthetic appeal and high self-relevance will impact the general human well-being and will reduce stress. For study 2, we tested the following hypothesis: (C) The artworks perceived as self-relevant will vary significantly more than what is perceived as aesthetically appealing. (D) The exposure of artworks containing high self-relevance, regardless about their aesthetic appeal, will reduce stress and experience a more significant physiological and psychological well-being benefit.

Our results for study 1, regarding the subjective well-being measures, supported our second hypothesis (B), the results provided evidence, that artworks with high aesthetic appeal and high self-relevance (HH) did reduce stress. The first hypothesis (A) could not be confirmed, since the condition low aesthetic appeal and low self-relevance (LL) did not show a stress reduction, but even led to a perceived increase of stress. Furthermore, the low aesthetic appeal and low self-relevance (LL), also increased anxiety levels, negative mood and decreased positive mood. We note that our second hypothesis (B) could only be partly supported, since physiological stress measures did not significantly change.

For study 2 our first hypothesis (C) could be supported, the results from the ANOVA regarding the self-relevance ratings did significantly vary more than what is perceived as aesthetically appealing. Self-relevance ratings in HRHA were significantly higher than in LRLA and LRHA. Additionally self-relevance ratings in HRLA were also significantly higher than in LRLA and LRHA. However, for aesthetic appeal only the conditions HRHA were rated significantly higher than in LRLA and HRLA. The second hypothesis (D) could not be supported by our results, since neither the physiological measurements nor the subjective measurements showed a significant effect between the different conditions. Despite that there was a significant change regarding the physiological measurement before and after the art exposure, along with an overall improvement in subjective well-being, this change was not specific to the containing self-relevance in the artworks since no significant effect in the interaction between Time and Condition could be measured.

The Findings of Vessel et al. (2023) indicated that artworks perceived as more self-relevant were also perceived as more aesthetically appealing, suggesting that, self-relevance is a deciding factor when determining the aesthetic appeal of an artwork, independent of the involved artistic skill. With our manipulation of the four conditions (LRLA, LRHA, HRLA, HRHA), the intention was to try and separate self-relevance and aesthetic appeal. It proved effective for self-relevance, where one could see a distinction between self-relevance and aesthetic appeal. However, it only proved partly effective regarding aesthetic appeal, where the participants could not always separate aesthetic appeal and self-relevance. This suggests a complex correlation between self-relevance and aesthetic appeal regarding the perception in art, which could possibly hint to an inseparable relationship between those two factors in cognitive processing. It is possible, that self-relevance and aesthetic appeal influence each other in the mind of the observers and make a separation of those factors difficult.

In examining the methodology of both studies, it became evident that the second study, the between-subject design, might have neglected the fact that the participants could compare both artwork exposures in the first study, which gave them a frame of reference. This difference between the approaches of the two studies is visible in the comparison of both artwork ratings the participants gave. The variance of the art ratings in the second study is substantially smaller than in the first study. One could argue that participants in the first study, who were exposed to all the conditions, namely all the artworks, might have compared the conditions and rated them comparatively. In the second study this was not the case. Participants were only exposed to one condition, namely one set of artworks, which gave them no frame of reference. As the findings of Schmit et al., (1995) already examined, the frame of reference is an important factor that can influence responses in participants. Therefore, it is important to note that a frame of reference could have influenced the participants of study 1 when comparing the different artwork exposures. Hence, with what participants compare the artwork exposures to, affect where their baseline lies. If nothing is shown to the participants beforehand, any art exposure might appear aesthetically appealing and self-relevant. However, the possibility of a direct comparison, could facilitate the participants' detection of differences between the conditions. Furthermore, it is important to note that for the first study the "extreme cases" of artworks were used and for the second study the more average artworks were used (see Figure 2). Hence, the difference in the variance of the art ratings could also be partly due to the chosen artworks, but also due to the different study design.

Regarding the physiological responses of the participants, we used the methodology (algorithm) that introduced the concept of the Moments Of Stress (MOS) scores (Kyriakou, K et al., 2019; Moser, M et al., 2023), which serve as the indicator for physiological stress responses. These MOS scores were obtained from physiological responses, such as the Skin Temperature (ST), the Galvanic Skin Response (GSR) and the Heart Rate (HR). However, these physiological responses could also be sensitive to react for excitement or arousal levels. In spite the fact, that the authors claim that these indicators represent physiological stress responses, one could also argue that the same indicators could be representative for excitement or arousal levels. This could be an important argument regarding our physiological findings in view of individuals' responses to art exposure. Considering that our findings in study 2 did prove a significant change in physiological responses, after art exposure the physiological responses were higher than before. Accordingly, to this argument, if claiming that these physiological responses are representative for arousal levels instead of Moments Of Stress (MOS), one could interpret this as an excitement or interest in viewing art. We thereby note that our physiological measurements could be an equivalent for arousal levels, experienced by individuals during art exposure.

This section examines the limitation encountered in our study, firstly it is important to note that while we did observe an effect in well-being measures, the participants had different well-being measures at the beginning of the experiment. Since, we live in a stressful society we did not think it were necessary to induce an additional stressor prior the experiment, apart from the possible stressor the laboratory setting would create. Deciding against an additional stressor might have hindered our discovery of an effect, since participants initially experiencing no stress, if the laboratory setting failed to induce a stressor, would demonstrate no change. Inducing a stressor to create a stressed baseline to measure against it would be recommended for further investigation. Secondly, due to technical issues with the "Empatica 4", for further studies it would be recommended to use devices that are constantly in use, to ensure functionality of the devices. Thirdly, one could argue that the durations of the art exposure, which lasts 4 minutes for study 1, and 5 minutes for study 2, were too long and participants might have drifted off. As Trupp et al., (2022) demonstrated, a short art exposure in an online setting, with only 1-2 minutes did improve similar measurements of well-being as used in our study. Hence, a shorter art exposure might also be sufficient and could ensure that participants would not get the chance to lose focus.

Despite these limitations, our results indicate that art exposure can enhance well-being on subjective as well as on physiological levels if claiming that these physiological responses are representative for arousal levels. These findings could offer insights for public health strategies, such as including online art platforms for therapeutic use, to provide a cost-effective method for improving public health.

7.1. Conclusion

In this research, the impact of art exposure on well-being was explored, with the finding that art exposure, even if it is for a short period, can have an important effect in improving human well-being. Furthermore, this research demonstrated that aesthetic appeal and self-relevance may have a strong correlation and is thus difficult to separate. Our findings indicate that the integration of art in everyday life can have positive effects on mental health. Future investigations could focus on finding or optimizing art exposure interventions fostering exposure on a regular basis and including art platforms for therapeutic use to create an environment that is more artistic and more beneficial to improving individuals' health.

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9. Appendices

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10. References

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