- Dissertation -

Cultural engagement during the digital age - Prerequisites, processes and outcomes of digital cultural engagement

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Abstract

Due to the shift of cultural engagement opportunities into the digital space, it is essential to analyze prerequisites, processes and outcomes of this relative new form of cultural engagement. Two types of opportunities for (digital) cultural engagement were examined, first exploring the amount of participation in cultural activities during the COVID-19 pandemic. Subsequently, an opportunity to engage directly with digital culture via a virtual reality art-gallery was developed. In this VR-environment, the textual information accompanying the paintings was altered to study its role as a potential factor influencing this digital cultural engagement opportunity. Individual characteristics such as valuing of culture, openness to experience, positive affect and expertise were understood as prerequisites for utilization. Current motivational and emotional processes were understood as part of utilization and as mediating the relationship between prerequisites and possible positive outcomes of digital cultural engagement.

Article 1 focused on the beneficial effects of cultural engagement during the COVID-19 pandemic, exploring what was being used and by whom, by examining the amount of participation in self-initiated as well as digital cultural activities. It was analyzed to what extend motivational (basic need fulfillment) and emotional (aesthetic experiences) processes might mediate the relationship between (digital) cultural engagement and its impact on optimism.

Article 2 focused on the influence of expertise, openness to experience and positive affect prior to the VR-visit on positive affect after the VR-visit, expecting aesthetic experiences to mediate this relationship. Here, three types of aesthetic experiences were assessed, deepening the focus on emotional processes of paper one, and broadening the attention to include the psychophysiological measurements heart rate and heart rate variability. Moreover, the influence of these psychophysiological signals on self-assessed aesthetic experiences was investigated in a separate analysis.

Article 3 pinned down on the importance of the path between expertise and positive affect after the VR-experience. It was investigated whether positive affect might mediate the relationship between expertise and aesthetic judgement. Moreover, the type of textual information, either stylistic or affective, that accompanied the paintings was expected to moderate the relationship between expertise and positive affect after the VR-experience.

Results showed that during the COVID-19 pandemic, both cultural activities were able to increase aesthetic experience and perceived autonomy, but only digital cultural offerings were connected to an increase in perceived relatedness, which in turn was able to increase optimism. Visiting the VR-art-gallery resulted in a decrease in negative affect compared to before the visit. Individual prerequisites were able to impact positive affect after the VR experience. Especially openness to experience and high positive affect before the visit led to an increase in positive affect after the visit when self-assessed aesthetic experience during the visit were high. Women with high expertise reported high positive affect after the VR-visit when they experienced a higher heart rate during the visit, highlighting the potential

impact of gender on subjective interpretations of physiological responses in the VR environment. In the VR-gallery, textual information did not moderate the relationship between expertise and positive affect; Rather, the impact of the affective textual information indicate that the VR context might increase the valence of emotionally charged content, indicating that this type of content might enhance digital cultural engagement.

Taken together, digital cultural engagement opportunities can have an impact on positive outcomes, but predispositions and processes during utilization, as well as factors shaping the opportunities are vital to understanding the full scope of their impact.

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VR	Virtual Reality
HR	Heart Rate
HRV	Heart Rate Variability

1. Introduction

Culture, cultural education, and activities, hold immense importance in society for a variety of reasons. Before delving into some of those reasons, it is important to be clear about the terminology used. The different use of the terms “culture” or “cultural activity” in different contexts leads to numerous different definitions (Fuchs, 2013). In this thesis, cultural activities are specified according to the UNESCO definition, as activities that “embody or convey cultural expressions, irrespective of the commercial value they may have” (UNESCO, 2009, p. 23). In addition, a narrower term of culture, common in German, is used here, which limits “culture” to the arts (Fuchs, 2013). The final inclusion of what ultimately constitutes culture/the arts in this thesis was then again based on the 2009 UNESCO Framework for Cultural Statistics. Here, cultural domains and their corresponding cultural activities were outlined, including “performance and celebration” (music, dance, and theater), “books and press” (literature), “visual arts and crafts” (art), “cultural and natural heritage” (cultural educational events), “audio-visual and interactive media” (film), and “design and creative services” (creating something) (UNESCO, 2009, p. 24).

Cultural activities have been proven to be very beneficial for mental well-being. They have been shown to be related to better physical and mental health and overall life satisfaction (Cuypers et al., 2012), a buffer against depression in adults (Fancourt & Steptoe, 2019a) and behavioral or social maladjustment in children (Fancourt & Steptoe, 2019b), a buffer against moderate-severe postnatal depression (Fancourt & Perkins, 2018), and are even related to a decrease in mortality, remarkably also mortality due to external causes (Väänänen et al., 2009). Consequently, it is unsurprising that it is assumed that the responsibility of actors in cultural education also lies in supporting the individual in coping with their life and opening up the possibility of a happy life for them (Bockhorst, 2013). In light of this, there is a branch of cultural education concerning the “art of living” that advocates that people can use the arts to consciously and purposefully develop their subjective relationships with themselves and the world and live a self-determined life (Bockhorst, 2013).

With regard to the aspect of the "art of living" concept (Bockhorst, 2013) that deals with individuals' relationship to the world, it is apparent how crucial cultural activities and education are also to the social life of individuals. Exposure to culture and cultural education is known to be an important foundation for autonomous participation in society (Autorengruppe Bildungsberichterstattung, 2012, p. 157). Cultural projects for children and adolescents have shown that social interactions are particularly relevant for the participants and, at the same time, central to the well-being that can be prompted by these projects (Thole et al., 2017).

In addition, there is an ongoing debate about whether cultural education has a positive effect on performances in other domains, in other words the transfer effects of cultural education. This is often referred to as the “Mozart-effect” (Schumacher et al., 2007). Schumacher et al. (2007) state that, while there is no solid evidence for the “Mozart effect”, i.e. the positive effect of cultural education on

cognitive performance, there is evidence that cultural activities have a positive impact on social and emotional development, especially by strengthening social relatedness (Schumacher et al., 2007). Winner et al. (2013) came to a similar conclusion, stating that despite the lack of a Mozart-effect, art should be enjoyed for art's sake, concluding that "well-being and happiness of individuals will be higher in countries where the arts are given a prominent role in our schools, because of the inherent pleasure gained from the arts" (p. 265). The importance and positive qualities of cultural education become even more prominent when considering that cultural education, as the name suggests, is education and not upbringing, that is, it continues indefinitely (Reinwand-Weiss, 2013).

However, cultural engagement opportunities have shifted more and more into the digital space since the beginning of digitalization. During the COVID-19 pandemic, when (analog) cultural activities were heavily restricted, digital cultural activities were a silver lining. Many cultural actors shifted their cultural offerings to the digital world. In the beginning of the pandemic, 16% of museums increased online exhibitions (International Council of Museums, 2020), a number that further grew by 15% in a 3-year span (International Council of Museums, 2023). Therefore, one could argue that the pandemic gave digital culture even more momentum.

In the same time period, the Rat für Kulturelle Bildung (Council for Cultural Education) in Germany gave an overview of the most important fields of action for schools as a cultural space. It was emphatically pointed out that digitalization should be understood as a profoundly transformative cultural process that must be taken into account without fail. This includes new forms of aesthetic expression that have emerged through digital transformation and have now become a part of young people's everyday lives (Rat für kulturelle Bildung, 2020). When students take up new (artistic) activities after starting their studies, these are mostly in the field of new media and technology. These new fields thus play an important role in aesthetic activities and open up new fields of aesthetic engagement (Autorengruppe Bildungsberichterstattung, 2012). In addition, digitalization is significantly changing the landscape of informal learning, offering new opportunities for acquiring knowledge outside of traditional educational environments (Weyel & Lehmann-Wermser, 2020). Access to cultural activities or education is changing due to this transformation. Especially for rural areas, digital culture might be an unprecedented opportunity to participate in activities that would otherwise be unattainable (Rat für kulturelle Bildung, 2020).

It has long been known that the parental home strongly influences the child's cultural activity (Bourdieu & Passeron, 1990). In addition, it is also assumed that children can come into contact with culture through school (Nagel, 2010). There is much evidence that both influences (school and home) play an important role in the child's cultural activity (Grosz et al., 2022; Nagel, 2010). Digital culture could now be another possibility to introduce children to culture, regardless of school and parents, or could at least transform these existing influences. Most children today have more or less unrestricted access to the Internet (MPFS, 2023). Now, a young child is no longer dependent on their parents taking

them to a concert; it may also be able to stream it on a platform. A child does not have to wait for a school trip to see an artist's exhibition - it may be available to view digitally on the internet. As discussed above, this was already reflected in the findings of the Autorengruppe Bildungsberichterstattung (2012) twelve years ago. Even as early as 2006, Bamford noted that through the internet "students can obtain information from galleries, museums and the broader public educational sphere much more easily" (Bamford, 2010, p. 34) Another implication of this expanded access becomes clear when considering that cultural activities in "highbrow culture" can even improve social status (Nagel, 2010). Now, young people who would otherwise not have access to this sort of culture can also benefit from these social advantages. Even more so, in some cases, there is a sense of shame around the topic of cultural engagement, particularly if an individual feels out of place in the environments where such culture is prevalent, creating even more distance (Liebau, 2015) . Digital culture might be a first step to navigate around this shame: a first exposure within a safe space.

Hence, the message is clear: Do not sleep on digital culture. That being the case, amid the evolving landscape of digital culture, research on the topic of digital culture still remains scarce (Liebau, 2017). However, there is a need to assess the validity of established aesthetic theories and experiences in digital settings, since the reception of digital culture could be very different from that of analog culture. For instance, embodiment (as in the aesthetic construct "Leiblichkeit") plays a great role in aesthetic experience, both as the embodiment of the observer and the physicality (Körperlichkeit) of the aesthetic object (Unterberg, 2015). In a digital space, the physicality of the object, but in some cases also the embodiment of the viewer, can be distorted or at least very different. In addition, during the aesthetic experience, a special relationship to space is assumed, in the sense that a new "aesthetic" space can emerge that can be distinguished from the "factual" space (Brandstätter, 2013). However, in some digital spaces, as the name indicates, an entirely new space is created, as for example within the space of virtual reality (VR). Moreover, viewing art in the virtual world can lead to the adoption of a meta-perspective, e.g., more abstract thought processes and imaginative elaborations (Antonietti & Cantoia, 2000).

Given the potential benefits of digital culture, as well as its potential differences compared to analog cultural activities, it is thus critically important to investigate the prerequisites of using digital culture, the processes that might emerge, as well as the outcomes it may have. The research questions and analyses can be framed by the utilization-of-learning-opportunities model, which specifies how teaching and learning are related (Vieluf et al., 2020). In this model it is assumed that an (learning-) opportunity is provided, which is shaped by several factors, such as instructional quality. Whether students use this opportunity (usage/utilization) depends on various factors, such as individual predisposition, as well as more emotional or motivational processes that are more specific to the situation. Utilization can then lead to (positive) outcomes, such as enhanced knowledge or interest. Although the model was developed to analyze teaching and learning in school, it has already been applied to other (cultural) learning opportunities (e.g. Knoll & Stecher, 2018) and helps to systemize

and analyze the utilization of cultural learning opportunities, and the impact of cultural activities on outcomes such as well-being in the present dissertation.

The prerequisites, processes, and outcomes under investigation in the three articles can be found in Figure 1. The utilization of digital cultural engagement opportunities in dependence on the following prerequisites of the participants and under consideration of the following processes were analyzed by carrying out (moderated) mediation models. Initially, we analyzed opportunities for cultural engagement through amount of participation in cultural activities during the COVID-19 pandemic (article 1, Gotthardt et al., 2023a). Subsequently, we introduced an opportunity to engage directly with digital culture via a virtual reality gallery (article 2, Gotthardt et al., 2023b; article 3, Gotthardt et al., under review). As mentioned above, the (cultural) opportunities themselves can also be shaped by several factors; in the VR-gallery, we manipulated textual information accompanying the paintings to analyze its impact on the processing of artworks. It was differentiated between prerequisites and processes that arise during utilization. Based on Vieluf et al. (2020), we understood individual characteristics as prerequisites for utilization, and current motivational and emotional processes as part of utilization.

Concerning prerequisites, we focused on valuing of culture (article 1), as well as openness to experience, positive affect (article 2), and expertise (article 2 and 3). The influence of these factors on the outcome of digital culture engagement—namely, well-being (articles 1 and 2) and aesthetic judgement of artworks (article 3)—were explored. Regarding the mediating processes, in article 1 we analyzed the mediating role of motivational processes (basic needs fulfillment) and emotional processes (aesthetic experiences) for the impact of digital participation on well-being. No prerequisites of participants that could influence these processes were included in this mediation analysis. Instead, the amount of cultural participation acted as an influence on the processes of utilization. The influence of the prerequisite 'valuing of culture' on the amount of cultural participation was examined individually.

In the second and third articles, because all participants interacted with the same digital cultural engagement opportunity (a VR-gallery), the amount of participation in cultural engagement opportunities that were previously understood to influence motivational and emotional processes was omitted as a research focus. Instead, the influences of prerequisites were included in the mediation model. The mediating role of emotional processes, aka aesthetic experience (article 2) and positive affect (article 3) were then further investigated. Moreover, we included moderating effect, such as the moderation of gender on the relationship between aesthetic experiences and positive affect. The moderation of textual information on the relationship between expertise and positive affect also helped analyze cognitive processes that might be at play during art-processing. Specific moderation effects can be seen in the figures of the individual articles. It is important to note, however, that while article 3 focuses more on cognitive processes, they are considered in all three articles. Motivational and emotional experiences are difficult to separate from cognitive processes (Vieluf, 2020, p.70), and the influences of prerequisites on processes, and of processes on outcomes, can hardly be understood without referring to underlying cognitions and cognitive theories.

Focusing on mediated and/or moderated effects in all three articles aimed to provide a comprehensive overview of the complex processes at play in the utilization of digital cultural engagement opportunities. Figure 1 contains arrows indicating the relationships and their directions of the (moderated) mediation analyses. It is theoretically assumed that these relationships can be bidirectional; for instance, increased motivation could lead to increased participation in cultural engagement opportunities (Rakoczy et al., 2022), which in turn might increase expertise. Nevertheless, this figure only illustrates the directions that were statistically tested in the mediation analysis.

Uncovering these processes and identifying influencing factors that could improve the experience could provide ideas for cultural actors to improve their digital cultural engagement opportunities.

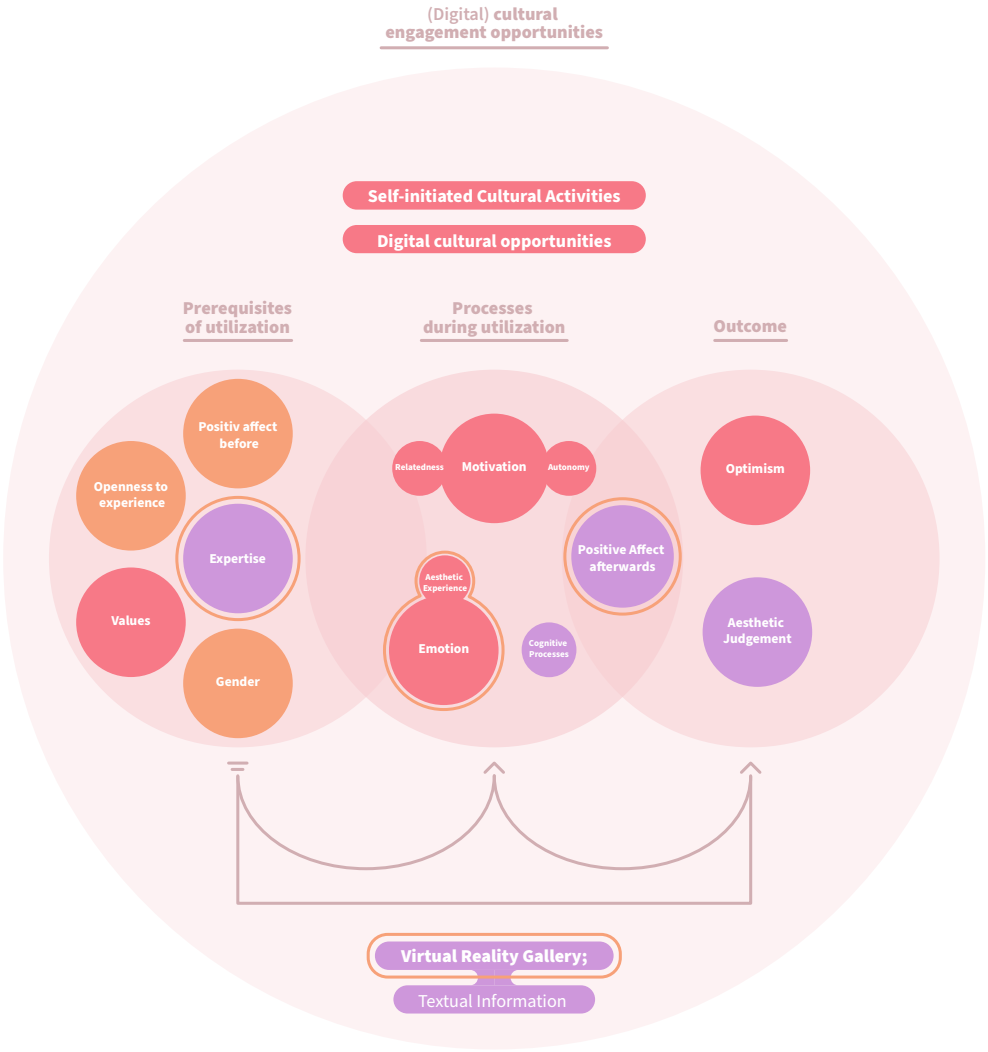

Figure 1. Integration of the constructs from all three articles according to the utilization-of-learning opportunities model (Vieluf et al., 2020).
Note: Red= Article 1; Orange= Article 2; Purple= Article 3. For variables that appear in multiple articles, the outlines are colored to match the additional article. As in all utilization-of-learning-opportunities models, moderations are not shown (Vieluf et al., 2020).

2. Theoretical Background

2.1 The opportunity of (digital) cultural engagement (during the COVID-19 pandemic)

The significance of digital cultural engagement has experienced a notable momentum due to the COVID-19 pandemic, as discussed in the introduction. Due to this momentum, the initial opportunity for cultural engagement that was analyzed was the amount of participation in cultural activities during the COVID-19 pandemic.

Apart from the negative consequences of the pandemic on mental health (Armbruster & Klotzbücher, 2020; Brodeur et al., 2020) much of (German) cultural life faced drastic changes as well. Due to pandemic related restrictions, almost all cultural institutions had to close, including 97% of European museums at the beginning of the pandemic (International Council of Museums, 2020). Artists and consumers alike had to cancel a drastic number of cultural events during these times (Frick et al., 2021). As discussed above, cultural activities have been proven to be very beneficial for mental well-being (Cuypers et al., 2012; Fancourt & Perkins, 2018; Fancourt & Steptoe, 2019a, 2019b; Väänänen et al., 2009). Thus, the severe restrictions in cultural engagement in these challenging times were very unfortunate. However, many cultural actors shifted their cultural offerings to the digital world (International Council of Museums, 2020, 2023), giving digital culture momentum.

Therefore, two distinct opportunities of cultural engagement were still possible at that time: Firstly, participation in digital cultural offerings, and secondly, self-initiated cultural activities. The difference between the use of digital cultural offerings and self-initiated cultural engagement is that the former requires a (digital) external offering (e.g., digital platform for streaming live concerts). Since such external offerings are required to participate in these activities, this engagement is referred to as participation in digital cultural offerings. In contrast, external (digital) offerings are not necessary for self-initiated cultural activities (e.g., simply playing the guitar alone). It does not require an external platform to make it possible; individuals can initiate the process of cultural activities themselves. Therefore, these activities are referred to as self-initiated cultural activities.

2.1.1 Motivational and emotional processes as mediators during utilization

Apart from determining what kind of cultural activities were used, the question remained how exactly this participation in culture (self-initiated as well as digital) might serve as a buffer against the detrimental effects of the pandemic. One central concept of this dissertation is that emotional processes are mediating factors that are part of utilization. The emotional process of aesthetic experiences was expected to mediate the relationship between the amount of utilization of cultural engagement opportunities during COVID-19 (instead of predispositions, explained below) and possible positive outcomes. Aesthetic experience can be defined as “as an exceptional state of mind in which a person is

focused on a particular object, transcending its everyday uses and meanings and losing the awareness of surroundings and even of himself/herself; in this state a person can have an exceptional emotional experience, that is a feeling of unity with the object" (Marković, 2010, p. 58). However, this "object" is not limited to aesthetic stimuli such as an artwork; these experiences can occur independently of aesthetic stimuli (Brandstätter, 2013). Since these emotions are almost always positive (Menninghaus et al., 2019) and frequently experiencing positive emotions encourages the development of resources such as resilience (Fredrickson, 2013), people who frequently participate in cultural activities might have experienced a protective effect on their mental well-being during the challenges of the pandemic. This also ties back to the notion of "art of living" (Bockhorst, 2013); "art of living"-projects were shown to increase participants' resources (Keupp, 2011).

Another concept that might mediate the relationship between usage of cultural engagement opportunities and outcomes, especially during a period such as the COVID-19 pandemic, is that of motivational processes, particularly through the satisfaction of basic needs (self-determination theory, Deci & Ryan, 2012) . Individuals should feel that they have choices regarding activities pursued to fulfill their need for autonomy, i.e., to act volitionally. The need for competence is met when individuals feel they can manage the activity they want to pursue, i.e., act effectively. Lastly, individuals should feel liked and valued by their surroundings to fulfill their need for relatedness, i.e., act in connectedness with others (Niemiec & Ryan, 2009). When activities can meet these needs, motivation becomes more intrinsic, and it positively impacts well-being; when the needs are neglected it thwarts well-being (Vansteenkiste & Ryan, 2013). The pandemic and its restrictions distinctly threatened perceived autonomy and relatedness. It was a time dominated by restraints, rules, and social distancing. Individuals were often unable to make decisions for themselves (threatening autonomy), and it was difficult to plan and conduct joint experiences (threatening relatedness). Therefore, the fulfillment of these two needs, resulting in more intrinsic motivation, was suspected to mediate the relationship between the amount of usage of cultural engagement opportunities and a possible positive outcome.

Numerous studies have shown that volitional activities (Behzadnia & FatahModares, 2020; Weinstein et al., 2016) and cultural activities (Koehler & Neubauer, 2020; Sherrick et al., 2021) might help to increase the satisfaction of thwarted needs. Exposure to culture and cultural education helps individuals to participate autonomously in society (Autorengruppe Bildungsberichterstattung, 2012). Cultural projects with young people have shown that social interaction, or relatedness, is particularly relevant for the participants and, at the same time, central to the well-being that can be prompted by these projects (Thole et al., 2017). "Well, I don't think it would be as much fun on my own," was one participant's central conclusion (Thole et al., 2017, p. 27). Similarly, Schumacher et al. (2007) state that, while there is no solid evidence for the "Mozart effect", i.e., the positive effect of cultural education on cognitive performance, there is evidence that cultural activities have a positive impact on social and emotional development, especially by strengthening social relatedness. The concept of "art of living" also assumes that cultural activities can increase self-determination in individuals (Bockhorst, 2013),

which, according to Deci and Ryan (2012), would include the fulfillment of the basic needs for autonomy and relatedness. Even Schiller already emphasized that art gives people back the freedom that brings them into contact with their most human needs (Schiller, 1795/2022). Therefore, using cultural activity opportunities (self-initiated and cultural) might have helped increase thwarted needs in individuals, which in turn may have increased their mental well-being. Self-initiated activities were not expected to increase relatedness as these activities were expected to be undertaken largely alone due to the restrictions; digital cultural offerings, on the other hand, made it possible to safely connect with others digitally, and was thus expected to increase relatedness.

2.1.2 Values as an important prerequisite for the utilization of digital cultural engagement opportunities

Due to the novelty of the situation, it was of great interest to find out who, despite the circumstances, tried to take advantage of the two different opportunities for cultural engagement. Situated expectancy-value theory (Eccles & Wigfield, 2020) suggests that choices depend on the expectancy of how well an activity will be managed, and on how much it is valued. As cultural activities are freely selectable behaviors, values are especially important here (Wigfield & Eccles, 2000). For instance, intrinsic values were shown to predict students' cultural activities (Kröner & Dickhäuser, 2009). Brandstätter (2013) also noted that the relationship we build with objects during aesthetic experiences does not have any purpose other than the experience in itself. Moreover, the importance (attainment values) and usefulness (utility values) of an activity are deemed to be important when it comes to cultural engagement (Eccles, 1983). Therefore, these types of values (attainment/utility and intrinsic) were chosen as important factors concerning the usage of cultural engagement opportunities during the pandemic. Furthermore, moving beyond a strictly theoretical approach, it was justifiably presumed that individuals who were actively engaged in cultural activities prior to the pandemic would persist in seeking out such experiences during the restrictions. This prior engagement is included when talking about the term "values" from here on.

2.2 Virtual reality art as an opportunity for digital cultural engagement

Shifting the discussion to the other opportunity for cultural engagement that was analyzed, this section delves into the prerequisites and processes associated with engaging in digital culture through a self-developed virtual reality (VR) art gallery, distinct from the context of COVID-19.

VR attempts to realistically recreate the analog world. This has the advantage over, for example, art on a computer monitor, since the art can be viewed in 3D and from all angles, leading to greater valuing of the artworks (Usui et al., 2018). Viewing art in the virtual world can lead to the adoption of a meta-perspective, e.g., more abstract thought processes and imaginative elaborations (Antonietti &

Cantoia, 2000). Therefore, art in VR does not act as a substitute for analog culture but can be seen as an opportunity to expand experiences. Furthermore, embodiment (as in the aesthetic construct “Leiblichkeit”) plays a great role in aesthetic experience, both as the embodiment of the observer and the physicality (Körperlichkeit) of the aesthetic object (Unterberg, 2015). In the virtual world, both forms of embodiment, but especially that of the observer, are greatly distorted, in the sense that the viewer usually no longer even has a body. In addition, during the aesthetic experience, a special relationship to space is assumed, in the sense that a new “aesthetic” space can emerge that can be distinguished from the "factual" space (Brandstätter, 2013). However, in the context of VR, there is a third space to consider: This encompasses the physical space in which the VR-glasses are located, the virtual space that reflects the "factual" space within the VR-environment (such as the VR-gallery), and the “aesthetic” space that emerges due to the aesthetic experiences. However, should the VR application itself be the artwork, the distinction between the "factual" and “aesthetic” spaces may blur, since the "factual" space within VR ceases to exist. Either way, the circumstances under which art in VR is experienced vary greatly. Consequently, it remains vital to investigate exactly how VR art-processing functions.

In addition to taking a closer look at the positive impact of digital culture on mental well-being, we focused on the impact of reception of VR-art on the outcome aesthetic judgement. The opportunity to engage with art in VR can be shaped by various factors, such as accompanying textual information about the artwork (e.g., Cupchik et al., 1994). By manipulating the type of textual information used to describe the paintings in the VR-gallery, it was possible to investigate the extent to which cognitive processes that are assumed to take place during the analog viewing of art can be transferred to the virtual world. If cognitive processes in the analog and virtual worlds are similar, it can be assumed that the positive outcomes of analog culture, such as the aforementioned impact on social and emotional development (Schumacher et al., 2006), as well as resources and capabilities (Bockhorst, 2013), also pertain to digital culture.

2.2.1 VR-Art and positive affect

Regarding the impact of VR-art, the goal was to move away from a COVID-19 focus and more towards a more general facet of psychological well-being: positive and negative affect (Diener et al., 1995, 1999; Thapa et al., 2023). Emotions associated with positive affect (e.g., excitement, enthusiasm; Breyer & Bluemke, 2016) can increase flourishing, which is linked to quality of life (Thapa et al., 2023). On the other hand, emotions such as distress that are associated with negative affect can decrease flourishing, which might then decrease well-being. Moreover, as mentioned above, frequently experiencing positive emotions encourages the development of resources such as resilience (Fredrickson, 2013), indicating that people who often experience positive emotions (e.g., through art) have greater resources and are therefore better equipped to deal with “ill-being.” Thus, affect can be

seen as a facet of well-being, as repeated engagement might increase well-being. Several studies indeed have shown that analog as well as digital art can enhance positive affect (Ho et al., 2015; Nisi et al., 2017; Paddon et al., 2014) and decrease negative affect (Trupp et al., 2022, 2023). Therefore, our aim was to investigate how the opportunity of art engagement in a VR-gallery impacts positive and negative affect. In an initial analysis it was explored whether virtual reality (VR) can enhance positive affect and diminish negative affect when compared to the affect experienced before the VR-visit. The impact on positive affect was then examined in detail through specific prerequisites and processes, as discussed in detail below.

2.2.1.1 Emotional processes as mediators during utilization. Regarding VR as a digital cultural engagement opportunity, the aim was to expand the research on emotional processes and focus on the analysis of psychophysiological measurements of aesthetic experiences, a highly effective tool to analyze the emotional impact in a museum-context (Keuchel & Reinwand-Weiss, 2016). Heart rate (HR) and heart rate variability (HRV) are psychophysiological responses that relate closely to self-assessed aesthetic experiences (Menninghaus et al., 2019; Tschacher et al., 2012). HR refers to the number of heart beats per minute, and is therefore synonymous with the notion of "Beats per Minute" (Gramann & Schandry, 2009). A higher HR is related to arousal and linked to emotions such as joy (Tschacher et al., 2012). HRV is the standard deviation of the time between two consecutive heartbeats, also called Inter-Beat-Interval (Gramann & Schandry, 2009). Higher HRV is associated with a more positive and receptive state (Stürmer & Schmidt, 2014) and is related to positive mood (Kop et al., 2011). It was assumed that heightened HR and HRV during viewing of the digital artworks would be closely linked to self-assessed (via questionnaire) aesthetic experiences (Menninghaus et al., 2019; Tschacher et al., 2012). Therefore, apart from analyzing increased HR and HRV as an emotional process that might act as a mediator, the influence of these psychophysiological signals on self-assessed aesthetic experiences were investigated in a separate analysis. Since gender has been shown to play a vital role in psychophysiological measurements (Benedek & Kaernbach, 2011; Quesnel & Riecke, 2018), it was also expected to influence this relationship.

2.2.1.2 Expertise, openness to experience and positive affect prior as individual predispositions influencing utilization. There are several prerequisites that might have an influence on emotional processes in the form of both self-assessed and psychophysiological aesthetic experiences. As discussed below, openness to experience, expertise, and positive affect have been shown to influence aesthetic experiences in analog settings. However, since cognitive processes in VR might differ (e.g., Antonietti & Cantoia, 2000), it is essential to investigate whether these influences would hold true in the virtual world.

Expertise in the arts is one of these influences and is considered "the knowledge base concerning art that facilitates aesthetic experience in individuals" (Smith & Smith, 2006, p. 50). People high in

expertise can process artworks more easily, which may lead to a more satisfying experience (Leder et al., 2004; Reber et al., 2004). Moreover, people high in expertise experience aesthetic chills more frequently, a category of aesthetic experience (Silvia & Nusbaum, 2011) that is of a more psychophysiological nature. Another influence on aesthetic experience is the personality trait "openness to experience." This has likewise been linked to more psychophysiological responses to art, such as aesthetic chills (Čukić & Bates, 2014; McCrae, 2007; Silvia & Nusbaum, 2011). Openness is linked to higher positive reactions to art such as interest and arousal (Fayn et al., 2015), the latter also hinting at the possibility that openness might increase HR during artwork viewing. This is especially the case for novel artworks (Fayn et al., 2015), indicating that the relationship might be even more pronounced in the novel virtual environment. Moreover, openness is linked to higher immersion, i.e., higher presence and focus, in virtual environments (Rodriguez-Boerwinkle & Silvia, 2022; Weibel et al., 2010). Lastly, positive affect before exposure to arts has been shown to positively influence aesthetic experience either directly (Weigand & Jacobsen, 2023) or by increasing appreciation of the artworks (Belke et al., 2006; Konečni & Sargent-Pollock, 1977). In their model of aesthetic appreciation, Leder et al. (2004), also included affective state as an important influence on aesthetic processing.

Existing literature suggests that the frequency and intensity of aesthetic experiences and participation in cultural activities is related to gender. For instance, women were shown to consume high-brow culture more often (Katz-Gerro, 2002) and to have a stronger influence on their husbands' cultural participation (Upright, 2004). They show heightened aesthetic experience (Silvia & Nusbaum, 2011), and stronger physiological reactions such as chills (Benedek & Kaernbach, 2011), also during VR experiences (Quesnel & Riecke, 2018). Hence, we assumed gender would moderate the relationship between aesthetic experiences and positive affect, with women expected to exhibit a stronger connection.

2.2.2 VR-art and aesthetic judgement

Aesthetic judgment mostly refers to "judgments like figural goodness, pleasantness, liking, and preference" (Reber et al., 2004, p. 365). It is one of the final outcomes of the aesthetic processing of a stimuli (Leder et al., 2004; Leder & Nadal, 2014). Therefore, it is an interesting outcome as it allows for the examination of the transferability of several theories regarding cognitive processes during art-processing into the virtual world.

2.2.2.1 Positive affect as mediating processes during utilization. When concentrating on the long-term impact of positive affect, it can be seen as an indicator of well-being that could lead to increased levels of well-being over time (e.g., Fredrickson, 2013). In contrast, positive affect can also be viewed for what it portrays at the moment the affect-scale is completed: a snapshot of the individual's current mental state. As this current mental state might influence further potential outcomes of the

engagement, i.e., by serving as an indicator about the experience (Schwarz & Clore, 1996), positive affect can also be seen as an emotional process of cultural engagement. In this regard, it can serve as a mediating factor between predispositions of utilization and other outcome, rather than being the outcome outright. Both approaches are warranted; affect can be understood as an emotional process (e.g., Leder et al., 2004; Leder & Nadal, 2014), nonetheless, should these processes occur frequently, the affect ultimately contributes to well-being (e.g., Fredrickson, 2013).

Several theories assume that positive affect can increase the judgement of an aesthetic stimuli. For example, in the model of aesthetic appreciation (Leder et al., 2004; Leder & Nadal, 2014), affective state directly influences aesthetic judgement. The concept of processing fluency (Reber et al., 2004) and effort-after-meaning theory (Russell, 2003) propose that successful interpretation and comprehension (i.e., processing) of an artwork results in increased positive affect, which can then be attributed to the painting (feeling-as-information model, Schwarz & Clore, 1996), leading to increased judgement (Reber et al., 2004). In this regard, the positive affect that arises after visiting an art gallery, for example, can lead to a better evaluation of the paintings seen. Amid the evolving landscape of digital culture, there is a need to assess the validity of established aesthetic theories and experiences in digital settings. Discovering that positive affect also has an impact on judgement in VR would suggest that previous "analog" models of art-processing (processing fluency, effort-after-meaning theory, feeling-as-information model, model of aesthetic appreciation) can be transferred to virtual reality.

2.2.2.2 Expertise as a prerequisite influencing utilization. Considering positive affect plays a crucial role in shaping aesthetic judgments, exploring prerequisites that influence this potential emotional process offers valuable insights into the development of aesthetic judgment within VR. Several findings and theories indicate that higher expertise might lead to increased affect during artwork viewing. As mentioned above, the idea of processing fluency, introduced by Reber et al. (2004), posits that the ease and fluency with which a painting is processed, more likely seen in people with expertise, increases the experienced affect. Consistent with this concept is, again, the effort-after-meaning theory (Russel, 2003), according to which successful interpretation (more likely seen in experts) partly explains satisfaction during artwork-viewing. Moreover, the model of aesthetic appreciation includes several stages of art-processing, two of which (explicit classification and cognitive mastering of an artwork) are profoundly impacted by expertise (Leder et al., 2004; Leder & Nadal, 2014). Completing these stages successfully results in heightened positive affect, and because expertise boosts the likelihood of successful completion, it is also linked to this uplift. Lastly, the connection between art expertise and positive affect could create a self-perpetuating cycle: Engaging with art is an activity driven by intrinsic motivation, meaning it is pursued for the sheer enjoyment it provides (Deci & Ryan, 2012). Recalling also the discussion of intrinsic values and cultural participation above, the relationship we build with objects during aesthetic experience does not have any other purpose other than the experience in itself

(Brandstätter, 2013) and is therefore deeply intrinsic. This intrinsic purpose, when pursued, leads in turn to further learning and the enhancement of expertise, intensifying positive affect once more.

Therefore, expertise might enhance positive affect, which would then enhance the outcome of the digital cultural engagement opportunity: aesthetic judgement. Due to these arguments for mediation, it is unlikely that expertise influences judgement directly. In addition, it would be too simplistic to say that expertise generally leads to a higher rating of artworks, as many other factors such as personal taste can come into play (Leder et al., 2004). As with the connection between positive affect and judgment, evidence for the connection between expertise and positive affect may suggest that the "analog" models of art-processing discussed here are transferable to virtual reality.

2.2.2.3 Impact of textual information on cognitive processing of artworks (in interaction with expertise). The inclusion of additional textual information about a painting can deepen the aesthetic appreciation of the piece (Millis, 2001). Millis (2001) suggests that this is due to the "elaboration effect," wherein textual information contributes to individual interpretations of artworks, provided that the added information is supplementary (Millis, 2001). Considering the established links among expertise, positive affect, and aesthetic judgement, it is therefore intriguing to explore the role of textual information within this context. For example, different kinds of text may activate distinct frames of reference, influencing how the painting is subsequently interpreted. A more stylistic description of a painting might provide a stylistic frame of reference, resulting in the painting being judged as more stylistically significant. On the other hand, a description with mood-based details might provide an emotional frame of reference, leading to the painting being judged as emotionally significant (Cupchik et al., 1994).

With regard to analog art-processing, it is assumed that experts process images more stylistically, while novices process works of art more (Cupchik & László, 1992). Stylistic texts are therefore unlikely to make a positive contribution to experts' art-processing, as this "frame of reference" is already in use and offers nothing new (elaboration effect, Millis, 2001). According to the same logic, affective texts are unlikely to enhance novices' art-processing, since this "frame of reference" is already in use and offers no novel insights. Following this reasoning, novices could benefit from stylistic texts, whereas experts may find greater value in affective texts. Belke et al. (2006) tested the assumption that the usefulness of stylistic texts depends on the level of expertise and found that stylistic information indeed enhanced appreciation in naïve viewers, but not in experts (Belke et al., 2006). This is consistent with the model of aesthetic appreciation (Leder et al., 2004), which contains several stages of artwork-processing, among them "explicit classification" and "cognitive mastering." In line with the assumptions of Cupchik & László (1992), novices concentrate on content classification during the explicit classification stage, and interpretations related to themselves in the cognitive mastering stage. Experts, on the other hand, tend to classify based on style, and engage in interpretations specific to the art in these stages (Leder et al., 2004).

Building on this logic, we aimed to replicate the finding that stylistic texts enhance appreciation in naïve viewers (Belke et al., 2006). Additionally, we sought to explore if affective or emotional textual information would enhance experts' appreciation of paintings, as this type of information would contribute to rather than conflict with their pre-existing knowledge. This possibility was explored by providing participants with either stylistic or affective textual information (Cupchik et al., 1994) (as detailed in 3.5 of the methods section), thereby manipulating a factor that might shape the digital cultural engagement opportunity. Theoretically, stylistics should prompt style classification and art-specific interpretations of the VR-artworks, whereas affective texts might elicit content classification and self-related interpretations.

2.3 Research questions, hypothesis, and integration of the concepts of the separate studies

Revisiting Figure 1, here, the concepts of the three articles are reconnected under the provided theoretical framework. Moreover, the corresponding research questions and hypothesis are presented.

2.3.1 Concepts and research questions of article 1

The primary focus of the first article of this dissertation (red circles, Figure 1) was to delve into the relatively new opportunities of cultural engagement that arose due to the COVID-19 restrictions. Due to digital culture's relative novelty, the aim was to get a glimpse of the overall usage of these opportunities. To do this, two distinct opportunities of cultural activity that were still possible were measured: participation in digital cultural offerings and engagement in self-initiated cultural activities. It was essential to get an overview of what was being used, but also by whom it was being used.

Although values were thought to be an important prerequisite for the utilization of digital cultural engagement opportunities during these times (Wigfield & Eccles, 2000), in contrast to the following works, the influence of this prerequisite on the mediating factors was not the focus here. Values were therefore not included in the mediation model. Rather, the extent to which values affected the amount of cultural engagement during the pandemic was examined here, to see who was taking advantage of the opportunities under these exceptional circumstances. Moreover, it was essential to analyze whether this cultural engagement might serve as a buffer against the negative effects of the pandemic. Thus, as the mental well-being focus was significantly centered around the COVID-19 pandemic, the construct measured was optimism regarding the pandemic (Lengning et al., 2020). As gender played a role regarding optimism and worries during the COVID-19 pandemic (Lengning et al., 2020), the influence of gender on optimism was controlled for. It was assumed that a positive impact on optimism would occur if the relationship between amount of usage of cultural engagement opportunities and optimism was mediated by motivational and emotional processes, i.e., aesthetic experience, and the basic needs for relatedness and autonomy.

Laying the groundwork for exploring digital cultural engagement opportunities within this thesis, the goal of the first article was thus to answer the following research questions. The conceptual mediation model can be found in Figure 2.

1. How frequently did individuals participate in digital cultural offerings and realize different kinds of self-initiated cultural activities during the COVID-19 pandemic?
2. Who was culturally active during the pandemic-related restrictions? It was expected that individuals who took part in many cultural activities prior to the pandemic-related restrictions and who place a high value on cultural activities attempted to substitute for lost cultural events by participating in digital cultural offerings or self-initiated cultural activities.
3. Did the participation in digital cultural offerings and self-initiated cultural activities have an impact on psychological well-being during the COVID-19 pandemic via perceived autonomy and relatedness, and via aesthetic experience?
    a) Individuals who participated in digital cultural offerings and increased their self-initiated cultural activities were expected to report more optimism regarding the pandemic (total effect).
    b) It was expected that participation in digital cultural offerings is connected to higher perceived autonomy and relatedness, and more aesthetic experiences. An increase in self-initiated cultural activities was expected to be connected to higher perceived autonomy and aesthetic experience.
    c) Higher perceived autonomy and relatedness and more aesthetic experiences were expected to increase optimism during the COVID-19 pandemic.
    d) Indirect effects of both forms of cultural activity on optimism were assumed. Specifically, individuals who participated in digital cultural offerings and self-initiated cultural activities were expected to experience more perceived autonomy and aesthetic experiences, as well as relatedness in the case of digital cultural offerings. In turn, they were expected to be more optimistic about the outcomes of the pandemic.

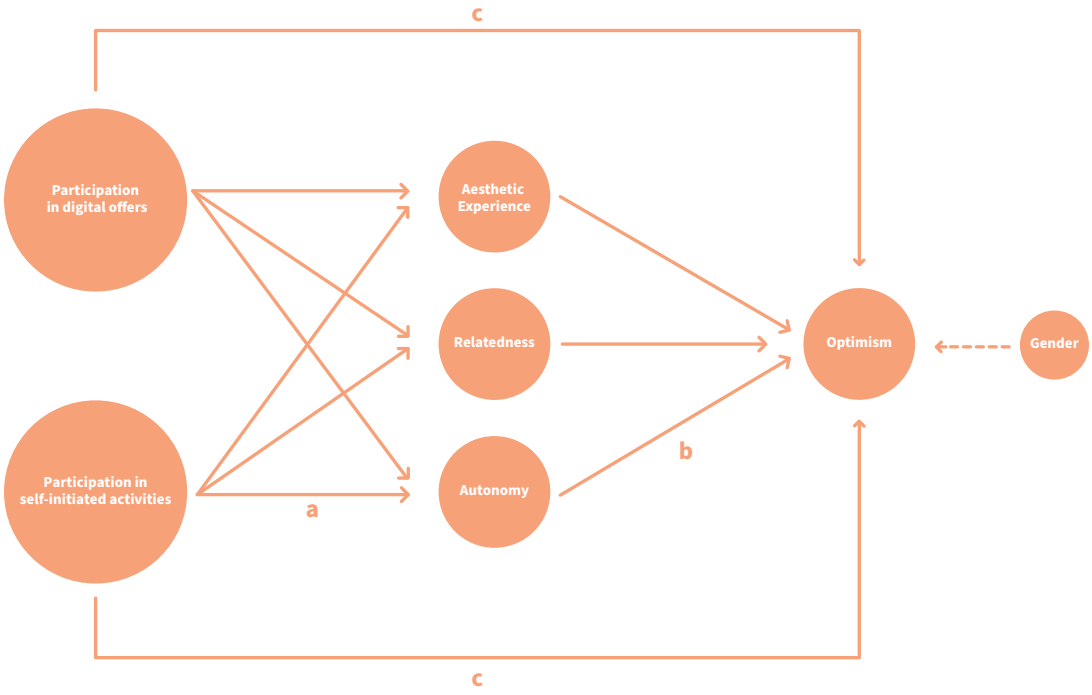

Figure 2. Mediation model of Gotthardt et al. (2023a)

2.3.2 Concepts and research questions of article 2

While article 1 illuminated the use of several types of opportunities for digital cultural engagement during the COVID-19 pandemic, comparing it with self-initiated, i.e., analog culture, the focus of articles 2 and 3 turned towards one specific opportunity of digital engagement in the arts in order to carry out further in-depth analyses of its influences and impact. Hence, while the first article contrasted analog (self-initiated) culture with digital culture, the other two articles concentrated solely on the latter. Rather than inquiring about the level of engagement in digital culture, in articles 2 and 3 participants were directly immersed in digital art through the use of a self-developed virtual reality art gallery, adding another layer to the examination of digital cultural engagement opportunities.

In the second article (orange circles and outlines, Figure 1), the aim was to expand the research on aesthetic experience as an emotional process influencing utilization and focus on the analysis of the impacts of the psychophysiological measurements of aesthetic experiences on well-being. In the first article, both emotional (aesthetic experiences) and motivational (basic needs for relatedness and autonomy) processes acted as a mediator between participation in culture and well-being (optimism during COVID-19). We refrained from exploring the basic needs in this setting since they were particularly relevant in the COVID-19 context which was no longer applicable during the time of sampling.

Since all participants were exposed to a digital offering, the variable measuring the amount of participation in digital cultural offerings – central to the first article – was omitted. This exclusion then opened the door to introducing prerequisites of utilization into the analysis, such that the focus was on the influence of individual characteristics on the three forms of aesthetic experiences. Regarding the impact of the VR-gallery, the attention was narrowed towards a more general facet of psychological well-being - positive and negative affect - as the goal was to move away from a COVID-19 focus. Moreover, due to the influence of gender on cultural participation (e.g., Katz-Gerro, 2002; also supported by the findings of article 1) and psychophysiological signals (Benedek & Kaernbach, 2011; Quesnel & Riecke, 2018), the influence of gender was thoroughly investigated here, rather than simply controlled for as in article 1.

Cultural participation such as exposure to artworks increases positive affect (Cuypers et al., 2012; Fancourt & Steptoe, 2019a; Väänänen et al., 2009). In article 2, again, it was assumed that this is due to the heightened emotional processes during art-work viewing, as outlined above. Here, aesthetic experience was again chosen as the emotional process, and extended to also include psychophysiological measurements, particularly HR and HRV. These aesthetic experiences were furthermore expected to be influenced by predispositions of utilization. This culminated in the formulation of the following research questions. A conceptual diagram illustrating these assumptions can be found in Figure 3.

1. Does digital culture in the form of a visit to a VR-gallery impact positive and negative affect?
   It was expected that visiting the VR-gallery leads to an increase in positive affect and a decrease in negative affect.
2. Are psychophysiological measurements of aesthetic experience related to self-assessed aesthetic experience in a VR-gallery setting?
   It was expected that a higher HR and HRV during viewing time of the artworks leads to higher self-assessed aesthetic experience after the visit to the virtual gallery. Moreover, it was expected that this relationship is stronger in women.
3. Do individual characteristics influence positive affect via more intense aesthetic experiences?
   a. It was expected that participants who scored higher on openness to experience and expertise, as well as positive affect prior to the study, report more intense aesthetic experiences (measured by questionnaire [model 1], HR [model 2], and HRV [model 3]; a-Path of the mediation models).
   b. It was expected that participants who show or report more intense aesthetic experiences (measured by questionnaire [model 1], HR [model 2], and HRV [model 3]) report higher positive affect after VR experience (b-path of the mediation models).
   c. It was expected that this relationship between aesthetic experiences and positive affect after the VR-experience is influenced by gender, assuming that the connection is stronger in women (moderation of b-path).

d. It was expected that an indirect positive effect of the individual characteristics (openness, expertise, and positive affect prior to VR) on positive affect after the VR-experience is mediated by aesthetic experiences (measured by questionnaire [model 1], HR [model 2] and HRV [model 3]). Participants with high openness to experience and expertise, as well as positive affect prior to the study, were expected to show more intense aesthetic experiences, resulting in higher affect after the VR-experience (indirect effects).

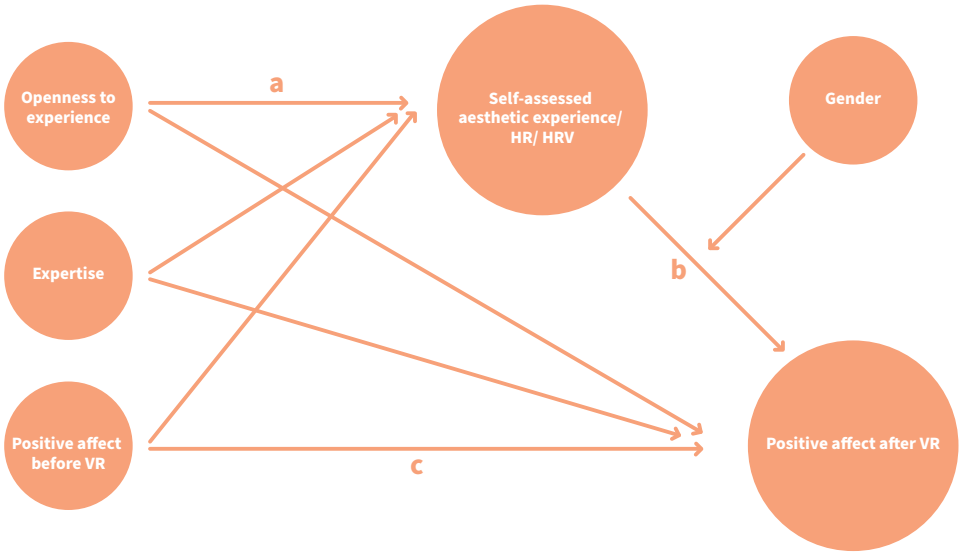

Figure 3. Conceptual model of the three moderated mediation analysis in Gotthardt et al. (2023b)

2.3.3 Concepts and research questions of article 3

After taking a closure look at the positive effects of digital culture in the first two articles, the goal of the third and final article (purple circles, Figure 1) was to focus more on the reception of art in the form of aesthetic judgement and to analyze the transferability of several theories regarding cognitive processes during art-processing into the virtual world.

Extensive literature suggests that positive affect can increase the judgement of an aesthetic stimuli (Leder et al., 2004; Leder & Nadal, 2014; Reber et al., 2004; Russell, 2003; Schwarz & Clore, 1996). Since there is a need to assess the validity of established aesthetic theories and experiences in digital settings as cognitive processes in VR might differ (Antonietti and Cantoia, 2000), this relationship was investigated in the VR-setting. Rather than concentrating on the long-term impact of positive affect, seeing it primarily as an indicator of well-being that could lead to increased levels of well-being over time (e.g., Fredrickson, 2013) as in article 2, article 3 views positive affect as a snapshot of the individual's current emotional state that might act as an indicator of the experience (Schwarz &

Clore, 1996) and therefore influence aesthetic judgement. Navigating through the findings of article 2, the importance of expertise as an influencing prerequisite of affect became apparent: The results showed that expertise directly influenced positive affect in the sample (see Section 4.2). Moreover, the idea of processing fluency, introduced by Reber et al. (2004), posits that the ease and fluency with which a painting is processed, more likely seen in people with expertise, increases the experienced affect. This, again, was indicated by the findings of article 2 (Section 4.2) which showed that participants with expertise experienced a rise in heart rate when observing artworks in the VR-gallery, which, in turn, led to an enhancement of affect among women. This heightened heart rate might indicate enjoyment during processing of the artwork, subsequently resulting in women reporting higher positive affect. This would support the different notions concerning processing fluency mentioned above. However, further investigations are needed to fully support this link between processing and heart rate.

Therefore, the influence of expertise on positive affect was further investigated in article 3. Moreover, by manipulating the VR-opportunity regarding the textual information used to describe the paintings in the VR-gallery, it was possible to investigate the extent to which cognitive art-processing which is assumed to influence aesthetic judgement in the analog world, e.g., through activation of different frames of references (Cupchik et al., 1994), can be transferred to the virtual world. Thus, textual information was included as a moderator on the relationship between expertise and positive affect, which was eventually assumed to impact aesthetic judgement. If these established links of artwork processing hold true in the virtual world, it can be assumed that (cognitive) processes in the analog and virtual worlds are similar, and that the positive impacts of analog culture discussed in the beginning might also be assumed for digital culture.

Hence, the following hypotheses were proposed. The corresponding paths of the model can be found in Figure 4:

1. Expertise leads to higher positive affect (a-path).
2. The relationship between expertise and affect is moderated by the type of textual information that is given (moderation of a-path). Participants low in expertise were expected to show higher affect when exposed to stylistic textual information. In contrast, participants with high art-expertise were expected to show heightened affect when exposed to affective textual information (moderation of a-path).
3. Higher affect leads to higher judgement (b-path).
4. Expertise does not directly lead to higher judgement (direct effect, c-path), but rather to higher judgement via heightened affect (indirect effect), considering the differential effects of the moderation.

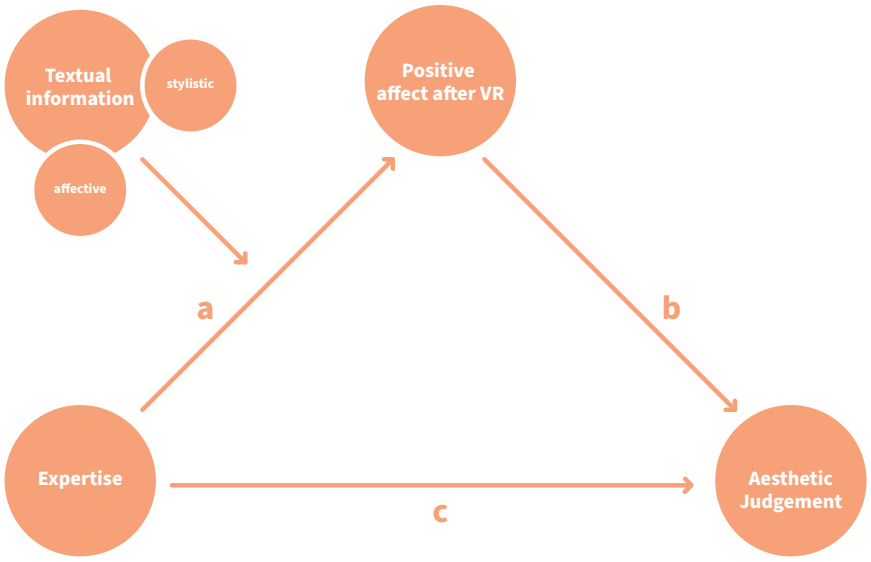

Figure 4. Conceptual model of the moderated mediation model of Gotthardt et al. (under review).

3. Implementation and use of instruments

Here, a short overview of the procedure of the studies, the different questionnaires used, as well as the psychophysiological measurements, is given. The information provided aims to aid understanding of the studies and is not exhaustive. For comprehensive details, please refer to the attached articles.

3.1 Procedure online study – Article 1

The research questions of study 1 were investigated on the basis of an online-survey. The survey was made available via "SoSci Survey" (Leiner, 2024) and was online from the 13th of May 2020 until 15th of July 2020. Participants answered demographic questions (gender, age, federal state of residence, if they are currently in education, living environment, if they were an essential worker, living conditions, feeling burdened by one's living conditions, and being at high-risk for COVID-19). A date-specific memory anchor was used to recall when participants first felt the impact of restrictions, adjusting for regional differences in Germany. They reported on canceled cultural events, attainment/utility and intrinsic values, and optimism. After the anchor was displayed a second time, participants' engagement in digital and self-initiated cultural activities during the pandemic was captured, including the fulfillment of basic needs and aesthetic experiences from these activities.

3.2 Procedure laboratory VR study – Articles 2 and 3

To analyze the research questions in articles 2 and 3, an experimental VR study was conducted. The study was conducted from February until April 2022. Upon arrival, participants received a brief introduction. After positioning the VR glasses on the participants, adjustments were made for visual clarity and height-adjustment using Steam VR (Valve Corporation, 2022). Participants then practiced in a VR-training space, utilizing a point-and-teleport technique for movement to minimize nausea (Buttussi & Chittaro, 2021), although they could also move backwards using the joystick for finer adjustments. Following the practice session, participants were connected to the psychophysiological measurements. Subsequently, they entered the virtual art gallery, starting with a video about the artist's life at the entrance, before exploring the gallery freely on their own. To wrap up the VR session, the researcher removed the VR glasses and disconnected the participant from the equipment. The experiment was concluded with participants completing a second questionnaire.

3.3 Overview of questionnaire items

The following table gives an overview of the questionnaires used to investigate each construct important to the three separate articles.

Table 1. Overview of questionnaires.

Article 1 - Can the arts cure pandemic hearts				
Construct	**Questionnaire name**	**Author(s)**	**Questionnaire Type**	**α**
Gender	-	Developed by the authors	Binary questionnaire with 0=women and 1= men	-
Cancelled cultural events	Cultural activities prior to the COVID-19 pandemic	Developed by the authors	Open format	-
Attainment/utility values regarding cultural activities	Value of cultural engagement – attainment/utility value	Developed by the authors	Preference ranking questionnaire	-
Intrinsic values regarding cultural activities	Value of cultural engagement – intrinsic value	Developed by the authors	Preference ranking questionnaire	-

Psychological well-being in the form of optimism	Concerns and optimism about COVID-19	Lengning et al. (2020)	5-point Likert scale	.75
Perceived autonomy	State Relative Autonomy	Brown and Ryan (2003)	5-point Likert scale	.81
Perceived relatedness	Basic Psychological Need Satisfaction and Frustration Scale (BPNSFS)	Heissel et al. (2018)	5-point Likert scale	.73
Aesthetic Experience	Aesthetic Experience Scale	Silvia and Nusbaum (2011)	5-point Likert scale	.91
Digital cultural activities during the COVID-19 pandemic	Digital cultural activities during the COVID-19 pandemic	Developed by the authors	4-point Likert scale	.65
Self-initiated cultural activities during the COVID-19 pandemic	Self-initiated cultural activities during the COVID-19 pandemic	Developed by the authors	4-point Likert scale	.57
Article 2 - Can virtual art touch your heart				
Construct	**Questionnaire name**	**Author(s)**	**Questionnaire Type**	**α**
Affect (with sub-scales)	PANAS (German version)	Breyer and Bluemke (2016)	5-point Likert scale; 4 sub-scales were built	
	Positive Affect prior to VR			.76
	Positive Affect after VR			.88
	Negative Affect prior to VR			.77
	Negative Affect after VR			.69
Expertise	Aesthetic fluency scale	Smith and Smith (2006)	5-point Likert scale	.79
Openness to experience	Big Five Inventory	Lang et al. (2001)	5-point Likert scale	.79
Aesthetic Experience	See article 1			
Gender	See article 1			

Article 3 - Reading between lines and pixels				
Construct	**Questionnaire name**	**Author(s)**	**Questionnaire Type**	**α**
Aesthetic Judgement	Aesthetic Judgement	Cupchik et al. (1994)	4-point Likert scale	.93
Affect	See article 2			
Expertise	See article 2			

3.4 Overview of psychophysiological measurements

Psychophysiological signals were measured using the Nexus-10 MKII device and Biotrace+software (Mind Media, 2018). The HR- and HRV-signals were measured using a blood-volume-pulse detector (BVP). Here, the heart rate is measured via the expansion of the peripheral blood vessels (Gramann & Schandry, 2009).

In addition, eye- and head-movement, as well as participants' position in the gallery, was measured using the eye-tracking software of the VR-software (VIVE Developers, 2023). This made it possible to isolate the instances of eye-contact with each painting for each participant. The heart rate and heart rate variability were then calculated using the isolated instances of eye contact with the paintings. Consequently, the variables "HR" and "HRV" represent the average HR and HRV across all instances where a participant viewed any of the ten paintings for more than ten seconds (please refer to article 2 for a detailed explanation).

3.5 The VR-Gallery

The gallery was created with Unity (Unity Technologies, 2022) and launched via SteamVR (Valve Corporation, 2022).

The paintings displayed were painted by the artist Pritte Laschat (1904-2002) and selected by an art educator. A curator was asked to hang the paintings in the gallery. Textual information was presented alongside each painting, enabling participants to either teleport directly in front of the text or click on it to enlarge for reading.

As in Cupchik et al.'s study (1994), either affective ("mood") or stylistic information were provided. Affective information was written based on a pre-study, where participants viewed the ten paintings on a computer screen. They were asked to choose from a list of affective terms (Schindler et al., 2017) the ones that best described each painting. The five affective terms that were chosen most often were then used to write the affective texts for each painting. An art educator was commissioned to write the stylistic information for each painting. He based his approach on the stylistic formulations from Experiment 2 of Cupchik et al. (1994), and on a transcribed interview with the painter discussing his art.

4. Central results of the studies.

The central results of the three studies are presented below. The statistical parameters can be found in the individual articles attached here.

4.1 Central results article 1 – Can the Arts Cure Pandemic Hearts?

Descriptive statistics were calculated to answer the research question of how frequently individuals participated in digital cultural offerings and realizing various types of self-initiated cultural activities during the COVID-19 pandemic (RQ1). The most popular digital offers (meaning they were used "every now and then" and "regularly") were, in this order: movies, music, cultural education, theater, literature, art, and dance. Offers that were used once and were not planned to be used again, were, in this order: music, theater, art, dance, cultural education, literature, and movies. Digital offerings in the music sector simultaneously emerged as the activity most participants wanted to revisit and the one they were least likely to want to engage with again.

For self-initiated activities, participants read either more or the same during the restrictions, making reading the most frequently performed self-initiated activity. Dancing, on the other hand, was the activity that most people did less often than before the pandemic, followed by making music.

Two regression analyses were computed to answer the research question of who was culturally active during the pandemic-related restrictions (RQ 2). Since gender has an important influence on cultural activities (Katz-Gerro, 2002; Upright, 2004), it was also included in the analysis. Participants who appreciate cultural activities for their own development and psychological well-being (attainment/utility value), hold intrinsic values for these activities (intrinsic values), and had to cancel many cultural events due to the pandemic participated more in digital cultural offerings. Appreciating cultural activities for one's own development and psychological well-being (attainment/utility value) also led people to increase their self-initiated cultural activities during the pandemic, but intrinsic value and the number of canceled planned cultural events did not. However, gender had an impact, indicating that women engaged in more self-initiated activities during the pandemic.

A mediation analysis was conducted to answer the research question of whether the participation in digital cultural offerings and self-initiated cultural activities had an impact on psychological well-being during the COVID-19 pandemic via perceived autonomy and relatedness, and via aesthetic experience (RQ3). The influence of gender on optimism was controlled for, due to its impact on optimism during the pandemic (Lengning et al., 2020).

It was anticipated that individuals who participated in digital cultural offerings and increased their self-initiated cultural activities would report more optimism regarding the pandemic (hypothesis 3a, total effect), a hypothesis that proved true for self-initiated activities, but not for digital cultural offerings. Moreover, there was no direct effect of the two types of cultural activities on optimism.

The assumption that participation in digital cultural offerings is connected to higher perceived autonomy and relatedness, and more aesthetic experiences (hypothesis 3b, a-path), was affirmed. Moreover, it was also shown that an increase in self-initiated cultural activities was connected to higher perceived autonomy and aesthetic experience (hypothesis 3b, a-path), but, as expected, not to relatedness.

Expectations that higher perceived autonomy, relatedness and more aesthetic experiences would increase optimism during the COVID-19-pandemic (hypothesis 3c, b-path) were only validated for relatedness, but not for autonomy and aesthetic experiences.

Individuals who participated in digital cultural offerings and self-initiated cultural activities were expected to experience more perceived autonomy and aesthetic experiences, as well as relatedness in the case of digital cultural offerings. In turn, they were expected to be more optimistic about the outcomes of the pandemic (hypothesis 3d, indirect effects). This assumption of a total indirect effect was supported for digital cultural offerings, mostly due to the significant specific indirect effect of perceived relatedness. However, the assumption of a total indirect effect was not met for self-initiated cultural activities (although trending towards significance), and there was no specific indirect effect of any of the three mediators.

4.2 Central results article 2 – Can Virtual Art Touch your Heart?

To test whether digital culture in the form of a visit of a VR-gallery impacts positive and negative affect (RQ1), two paired t-tests were calculated. It was expected that visiting the VR-gallery will lead to an increase in positive affect and a decrease in negative affect, however, positive affect changes did not occur. In contrast, negative affect was reduced significantly after the visit.

To assess whether psychophysiological measurements of aesthetic experience are related to self-assessed aesthetic experience in a VR-gallery setting, (RQ2) two multiple regressions were calculated. Contrary to expectations, higher HR and gender did not show a significant main effect on self-assessed aesthetic experience. However, the interaction between HR and gender was significant, indicating that the relationship between HR and self-assessed aesthetic experiences was stronger in women than in men. Also contrary to expectations, higher HRV did not show a significant main effect on aesthetic experience. However, gender and the interaction between gender and HRV had a significant effect. This indicated that the relationship between HRV and self-assessed aesthetic experiences was stronger in men than in women.

To evaluate the influence of individual prerequisites on positive affect via more intense aesthetic experiences (RQ3), three moderated mediations were calculated, with the mediator being self-assessed aesthetic experience (model 1), HR (model 2) and HRV (model 3). The b-path of the moderation was moderated by gender. Therefore, the indirect and total effects had to be investigated for men and women separately. Here, results for the paths that correspond to the hypothesis (a and b-paths, as well as the indirect effects) are discussed.

It was expected that participants who score higher on openness to experience and expertise, as well as positive affect prior to the study, report more intense aesthetic experiences (measured by questionnaire [model 1], HR [model 2], and HRV [model 3]) (hypothesis 3a, a-Path). In model 1, with self-assessed aesthetic experiences as the mediator, this was proven to be accurate for positive affect prior to the study. In model 2, with HR as the mediator, this was proven to be accurate for expertise. In model 3, with HRV as the mediator, there were no significant effects of any of the exogenous variables on the mediator.

Furthermore, it was assumed that participants who show or report more intense aesthetic experiences (measured by questionnaire [model 1], HR [model 2], and HRV [model 3]) report higher positive affect after the VR experience (hypothesis 3b, b-path). This was found to be true for self-assessed aesthetic experiences (Model 1). For HRV, the opposite was found to be true, with participants with lower HRV reporting higher positive affect after the VR. There was no significant b-path for Model 2, indicating no direct relationship between HR and positive affect after the VR.

An indirect positive effect of the individual characteristics on positive affect after VR experience was expected, mediated by the three measurements of aesthetic experiences (hypothesis 3d). For Model 1, with self-assessed aesthetic experiences as the mediator, for both men and women, openness to experience, as well as affect prior to VR, had an indirect effect on affect after VR. This finding is particularly notable for openness to experience, since higher openness to experience did not directly translate to higher positive affect after the visit (c-path). For Model 2 with HR as the mediator, an indirect effect of expertise on affect after the VR was only shown in women. For both genders, no other indirect effects on positive affect (positive affect prior, openness to experience) were shown. For Model 3 with HRV as the mediator, there were no significant indirect effects.

4.3 Central results article 3 - Reading Between Lines and Pixels

A moderated mediation analysis was calculated to test whether expertise leads to higher positive affect (a-path), moderated by textual information. Positive affect was then expected to increase aesthetic judgement (b-path). Moreover, it was not expected that expertise directly leads to an increase of aesthetic judgement (c-path).

As expected, participants high in expertise reported higher affect after the VR (hypothesis 1, a-path). As a secondary finding, it was also shown that the path from the moderator textual information to the mediator positive affect was significant, indicating that participants that read the affective textual information showed higher positive affect.

Participants low in expertise were expected to show higher affect when exposed to stylistic textual information. Contrary, participants with high art-expertise were expected to show heightened affect when exposed to affective textual information (hypothesis 2, moderation of a-path). Contrary to these expectations, the interaction between type of text and expertise had no influence on positive affect. In addition, the conditional indirect effects for the two types of texts were not significantly different from each other, as indicated by an insignificant index of moderated mediation.

However, as expected, higher positive affect led to higher aesthetic judgement (hypothesis 3, b-path).

Moreover, in line with our expectations, expertise did not directly lead to higher judgement (hypothesis 4, c-path), but rather to higher judgement via heightened affect (hypothesis 4, indirect effect). This was true for both types of texts, since the insignificant index of moderated mediation indicates that the conditional indirect effects are not statistically different for affective and stylistic textual information.

5. Discussion

Amid the ever-evolving landscape of the digital transformation of cultural engagement opportunities, it becomes more and more necessary to give this area the attention it long deserved. This work focused on both the influences and effects of digital cultural engagement, initially regarding general digital cultural engagement, and later specifically regarding virtual reality art.

The first article focused on the beneficial outcomes of digital cultural engagement opportunities during the COVID-19 pandemic, exploring what was being used and by whom, and analyzing to what extent motivational and emotional processes might mediate the relationship between digital cultural engagement and its beneficial outcomes (well-being, optimism). Here, digital cultural engagement was also contrasted against self-initiated (analog) cultural activities during the pandemic. After this initial exploration, the following two articles turned away from a COVID-19 focus and towards a more general approach to mental well-being, coupled with the analysis of a more specific type of a digital cultural engagement opportunity: VR-art.

In the second article, the influence of this VR-gallery on affect was inspected. Three individual predispositions, specifically expertise, openness to experience and positive affect prior to the VR-visit, were expected to increase the positive affect after the VR-visit, and aesthetic experiences were thought to mediate this relationship. Here, three types of aesthetic experiences were assessed, deepening the focus on aesthetic experience of study 1, and broadening the attention to include the psychophysiological

measurements heart rate and heart rate variability. As psychophysiological measurements were involved, gender was included as a moderating factor in the subsequent analysis. Apart from analyzing HR and HRV as an emotional process that might act as a mediator, the influence of these psychophysiological signals on self-assessed aesthetic experiences were investigated in a separate analysis.

The goal of the third and final study was then to focus on the reception of art. Positive affect after the VR-experience was conceptualized as an emotional process here rather than a final outcome, influencing aesthetic judgements of the artworks. As cognitive processes in VR might differ (e.g., Antonietti & Cantoia, 2000), there is a need to assess the validity of established aesthetic theories in digital settings. Including aesthetic judgment as the outcome enabled the analysis of the transferability of several theories of aesthetic processing into VR space. Adding another layer to the examination of aesthetic processes, two different types of textual information (stylistic and affective) were presented to the participants. It was expected that the different information would enable distinct frames of references (Cupchik et al., 1994), which would interact with the level of expertise, consequently enhancing the experience of the participants and thereby judgement of the artworks.

5.1 Digital cultural engagement opportunities

According to the utilization-of-learning-opportunities model (Vieluf et al., 2020) opportunities (here for cultural engagement), can be shaped by several factors. Initially, opportunities for cultural engagement through amount of participation in cultural activities during the COVID-19 pandemic were analyzed. Subsequently, an opportunity to engage directly with digital culture via a VR-gallery was introduced, and a factor that might shape this opportunity, textual information, was manipulated.

During the COVID-19 pandemic, individuals were left with two possible opportunities for cultural engagement: Initiating participation themselves or engaging in external offers via digital cultural offerings. Concerning self-initiated activities, the findings reflect the circumstances at the time, as most participants read more frequently than before the pandemic, followed by producing or creating something. These activities are often engaged in alone, which was more or less a necessity during the time. This is also illustrated by the fact that activities that are more likely performed in groups, such as making music and dancing, were reduced. Participants hence seemingly did not attempt to perform these group activities alone. This might also in part explain the finding that self-initiated activities were not able to increase relatedness, as discussed in more details below.

Concerning digital cultural offerings, the findings were in line with findings from the Creative Industries Policy & Evidence Centre (Creative Industries Policy & Evidence Centre, 2020). In both samples, participants reported that they increased their music consumption the most. For providers of digital cultural offerings, it may be worth noting that for all digital cultural offerings except music and movies, there were more participants that reported not using the offers than participants reporting using

the offer. This shows that, at least during this period, there was still room for improvement regarding these offerings.

Since one cannot enforce active participation in cultural activities, only attendance (Liebau, 2015), it is crucial to investigate this room for improvement to enhance opportunities for active digital cultural engagement. Only then can the positive outcomes be ensured. According to the utilization-of-learning-opportunities model, opportunities can be shaped by several factors (Vieluf et al., 2020). Hence, to potentially improve digital cultural engagement opportunities, possible factors that might enhance the engagement should be analyzed. An important aspect of researching the impact of museum visits is the way in which museums can convey the art they portray (Keuchel & Reinwand-Weiss, 2016). This was explored in article 3 by manipulating a factor in the VR-gallery that is prominent in almost all gallery-related opportunities for cultural engagement: Textual information concerning the artworks. It was expected that textual information would interact with the prerequisite expertise, in such a way that affective texts would enhance the experience for experts and descriptive text would enhance the experience for naïve viewers. However, this assumption was not confirmed by the results. Rather, it appears that affective texts generally enhance the VR-art experience (aka increase positive affect).

This finding is intriguing, since these types of texts are not the norm in analog settings. One possible explanation could lie in the context created in a virtual reality environment. In this rather new and unfamiliar environment, the real world that one is accustomed to is merely a reflection. A visitor of a virtual world might thus hold on to human emotions since this "artificial" environment might lack many aspects of the human experience. This might explain the positive impact that content discussing human emotions seemingly has on affect; the emotional frame of reference (Cupchik et al., 1994) that is provided, possibly encouraging reflection on one's own emotions, might be preferred over more stylistic contents that, at a first glance, have no obvious emotional depth.

The encouragement to reflect on one's own emotions also aligns with Brandstätter's (2013) notion that aesthetic experiences lead to intense self-experience, but also world-experience, so that the two experiences form a unity. However, since the experience of the world might be distorted in virtual reality, there could be an even greater focus on the self-experience. This could make content that encourages you to reflect on your own emotions, i.e. to gain more self-experience, even more important. This also aligns with the notion that humans can be influenced by others' emotions, known as emotional contagion (Hatfield et al., 1993). Since emotional contagion does not necessarily occur through direct contact but can also occur through nonverbal communication on digital platforms (Kramer et al., 2014), the emotional content of the affective text could have had some form of emotional contagion. This might have been even more amplified given the previously mentioned emotionally devoid context of VR, possibly making users even more attached to human emotions.

It is also very interesting to note that although the affective texts in the VR-study also contained negative emotion words, it led to this increase in positive affect. This is evidence of the positivity bias of aesthetic emotions (Menninghaus et al., 2019), which assumes that even negative aesthetic emotions

are predominantly interpreted as positive (e.g., being happy about getting the chills because of an eerie painting). These results could encourage cultural actors to consider emotional content as a factor that could positively influence their cultural offerings. Incorporating this emotional content into highly "artificial" offerings such as VR could therefore benefit both cultural providers through increased participation, and participants through a more positive experience.

On a more general note, comparing only the affect before and after the visit, without the influence or mediating role of other factors, it can be said that the VR-gallery reduced negative affect compared to before the study, but did not increase positive affect, reflecting the results of other digital art studies (Trupp et al., 2022, 2023). This suggests that immersion in the VR-gallery can help escape current negative emotions, which once again speaks to the importance of cultural participation for well-being (Cuypers et al., 2012; Fancourt & Perkins, 2018; Fancourt & Steptoe, 2019a, 2019b; Väänänen et al., 2009). However, it also suggests that participation in the VR-gallery was not sufficient to significantly increase positive affect compared to the affect before, as this may require more than just a change in focus. Future studies might build on this by investigating whether predispositions or mediating processes might also play a role in increasing positive affect after a cultural activity compared to the baseline affect observed prior to the activity.

5.2 Prerequisites of and processes during utilization

Based on Vieluf et al. (2020), prepositional characteristics and current motivational and emotional processes were analyzed, as the prerequisites were expected to influence processes during utilization. It was assumed that the motivational and emotional processes in particular act as mediators between predispositions and a possible outcome. The influence of these factors on the impact of digital culture engagement—namely, well-being (articles 1 and 2) and aesthetic judgement of artworks (article 3)—was then explored. Here, we first delve into the results regarding prerequisites of participants. We then turn to the mediating role of emotional and motivational processes, and their influence on the outcome of digital cultural engagement opportunities.

5.2.1 Digital culture's biggest fans

5.2.1.1 The influence of prerequisites of utilization on motivational and emotional processes. Here, we first delve into values as a prerequisite influencing amount of participation. We then focus on the effect of openness to experience, positive affect prior, and expertise on emotional and motivational processes. At the end of this section we shortly shift our focus from prerequisites influencing the processes to exploring how the level of participation impacts emotional and motivational processes.

The extent to which values affected the number of cultural activities during the pandemic was examined, to see who was taking advantage of these opportunities under the exceptional circumstances. Thus, a regression analysis delved into the influence of two types of values, as well as prior cultural participation, on the participation in cultural engagement opportunities during the pandemic. It was revealed that participants who view cultural activities as important and useful, i.e., with high attainment/utility values (Eccles, 1983) for cultural activities, increased both their self-initiated and digital cultural activities. This contrasts with intrinsic values (Kröner & Dickhäuser, 2009), which only seemed to increase digital cultural participation.

The relationship we build with objects during aesthetic experience does not have any purpose other than the experience in itself, and is therefore deeply intrinsic (Brandstätter, 2012). It can therefore be assumed that people who reported high intrinsic values sought ways to still have these intrinsic experiences during the severe restrictions during COVID-19. It is intriguing to see that they sought these opportunities in the digital space and not in the analog world. Similarly, participants with a lot of cancelled cultural events also seemed to substitute for these by engaging in digital instead of self-initiated culture. The connection between engagement in digital culture and relatedness discussed below could explain this finding. The cultural activities that participants had to cancel may have had a communal aspect. Those who experienced many cancellations during the pandemic may not have seen self-initiated cultural activities as equivalent to these social events, as evidenced by the lack of connection between these activities and relatedness. Consequently, they might have preferred digital cultural engagements, which, as suggested by its link to relatedness, provide some level of social interaction.

Gender was also taken into account in this analysis, as women tend to show higher interest in cultural engagement (e.g., Katz-Gerro, 2002; Upright, 2004). In line with these findings, women reported to engage in self-initiated activities more frequently. However, this effect could not be found for digital cultural engagement. One possibility is that these types of offerings are still so new that such a gender effect is not yet noticeable.

The findings speak for the possibility that people that value cultural engagement, regardless of gender, do not shy away from transferring their engagement into the digital space, and maybe also actively search for these opportunities. The findings that "culture lovers" were interested in alternative cultural engagement opportunities in the digital realm mirrors the ethos of the Council for Cultural Education during that time period: that digitalization must be taken into account without fail (Rat für kulturelle Bildung, 2020). Nonetheless, digital cultural engagement opportunities have the potential to reach people with less cultural engagement, not just “culture lovers.” Our results, however, suggest that it was primarily the latter group that was reached. Consequently, it would be worthwhile to explore new ways to extend these opportunities to reach those who may not be actively looking for them.

Openness to experience, prior positive affect and expertise were included as prerequisites that might influence processes during the experiences. It was assumed that openness to experience would influence emotional processes during the VR-visit, particularly the three measurements of aesthetic experiences (self-assessed, HR, and HRV). However, contrary to expectations, the findings suggest that openness to experience does not directly influence any of the aesthetic experience measurement in VR. This contrasts with previous findings that showed that openness to experience influences psychophysiological aesthetic experiences, such as chills or HRV (Čukić & Bates, 2014; McCrae, 2007; Silvia & Nusbaum, 2011). It was also shown to be related to higher positive reactions to art such as interest and arousal (Fayn et al., 2015), especially regarding novel artworks. Therefore, it was suspected that the relationship might be even stronger in the novel VR environment. However, ultimately, no such relationship was found. While it might be the case that openness to experience has an influence on visitor behavior during VR-experiences, indicating higher immersion (Rodriguez-Boerwinkle & Silvia, 2022), in the current sample it does not appear to directly affect aesthetic experience.

Based on this finding alone, one might assume that openness may not be a necessary prerequisite to consider when analyzing emotional processes arising during engagement with virtual reality art. Nevertheless, there was an indirect effect of openness to experience on positive affect after the VR, mediated by aesthetic experience. The implication of this indirect effect for the inclusion of prerequisites as well as processes during utilization in models of cultural engagement opportunities is discussed below.

Another prerequisite of aesthetic experience during cultural engagement in VR might be the affective state prior to the engagement (e.g., Leder et al., 2004; Weigand & Jacobsen, 2023). Results suggest that during their visit to the VR-gallery, participants that were in a better mood, as indicated by higher affect prior to the VR-visit, reported more aesthetic experiences throughout the visit. This finding aligns with numerous studies (Belke et al., 2006; Konečni & Sargent-Pollock, 1977; Leder et al., 2004; Weigand & Jacobsen, 2023), and this established relationship between prior affect and aesthetic experiences apparently extends into the digital realm. The relationship between prior affect and self-assessed aesthetic experience also ties back to the notion that one cannot enforce active participation in cultural activities, only attendance (Liebau, 2015): If participants are already in a bad mood beforehand, this can have a negative impact on the experience; they might just attend, not participate, regardless of the quality of the offer. Therefore, the findings underline the importance to always consider prior (positive) affect of participants as a prominent factor during engagement with digital cultural opportunities.

However, affect prior to VR had no effect on HR and HRV. This suggests that while a positive emotional state before participating in VR might enhance participants' retrospective perception of their overall aesthetic experiences as high, it does not seem to significantly influence their psychophysiological responses (HR, HRV) during the viewing of the artworks.

Openness and prior positive affect were specifically investigated regarding their influence on aesthetic experiences as an emotional process during utilization. In contrast, expertise was analyzed regarding its influence on two emotional processes: aesthetic experiences as well as positive affect after the VR-gallery, which was treated as an emotional process rather than a final outcome in article 3. Expertise has generally been linked to increased aesthetic experiences (Leder et al., 2004; Smith & Smith, 2006). In study 2, it was found that expertise increased heart rate during viewing of artworks in VR, but not self-assessed aesthetic experiences. This indicates that while experts might not consciously rate their aesthetic experience as higher, arousal in the form of heightened HR during artwork-viewing tends to be more intense, aligning with findings on expertise and physiological responses to art (Silvia & Nusbaum, 2011). For women experts, this increase in heart rate translated into higher positive affect after the VR-experience, as discussed below.

In the moderated mediation models of study 2, expertise had a direct influence on affect after the VR-experience, except for the model where heart rate mediated this relationship, as discussed in more detail below. In study 3, this relationship was further investigated, assuming that expertise might lead to higher affect due to the processing fluency of experts (Reber et al., 2004), which would then increase aesthetic judgement. Similarly, the effort after meaning theory also states that, as experts are more likely to successfully interpret an artwork, they might have higher satisfaction (Russell, 2003). In addition, the model of aesthetic experience also assumes that expertise is an influencing factor during aesthetic processing that eventually leads to increased affect (Leder et al., 2004; Leder & Nadal, 2014). As mentioned above, there is a need to assess the validity of established aesthetic theories and experiences in digital settings, since the reception of digital culture could be very different from that of analog culture (e.g., Antonietti & Cantoia, 2000). Here, the findings suggest that expertise also leads to higher affect in a digital environment, speaking for the transferability of the aforementioned theories into the digital space.

5.2.1.2 The influence of the amount of participation during COVID-19 on motivational and emotional processes. Before delving into the mediating role and the impact of processes during utilization, there is still one direct influence on these mediators that needs to be discussed. Instead of including prerequisites of participants that could influence these processes, in study 1 the amount of cultural participation acted as an influence on them. Specifically, the impact on motivational processes in the form of basic need-satisfaction, and the influence on emotional processes in the form of heightened aesthetic experience was analyzed.

As hypothesized, high engagement in self-initiated activities translated into increased autonomy and aesthetic experiences. However, as expected, it did not heighten relatedness. Digital cultural participation, on the other hand, was able to increase both basic needs and aesthetic experience. It is particularly interesting for those involved in providing digital cultural engagement opportunities during these challenging times to see that they were able to induce aesthetic experiences. It shows that although

activity in digital cultural engagement opportunities could have been higher, those that did participate were able to have a valuable experience. The findings regarding the influence of both types of cultural activities on perceived autonomy aligns with the idea that exposure to culture and cultural education helps individuals to participate autonomously in society (Autorengruppe Bildungsberichterstattung, 2012). Given this, and the fact that other forms of autonomous behavior were greatly limited, it makes sense that the act of willingly selecting cultural activities would result in a strong sense of autonomy.

The outcome that relatedness was enhanced by digital cultural engagement but not by self-initiated cultural activities, demonstrates the opportunity for connection that digital culture can provide. Correspondingly, results during the same time showed that digital communication was socially stimulating, and that students were able to meet their need for relatedness through para-social relationships using narrative media (Manago et al., 2020; Sherrick et al., 2021). Even when consumed individually, digital cultural experiences can seemingly create a sense of relatedness by connecting people virtually, in a safe, socially-distanced way. For example, streaming a live concert might give the viewer a connection to both the band and fellow audience members, possibly through communicative features like live chat.

5.2.2 The middleman: Processes as mediating factors that arise during utilization

In this thesis it is assumed that motivational and emotional processes during utilization act as a mediator between prerequisites and the positive outcome that (digital) cultural engagement might have. Initially, the focus is on motivational processes as a mediator, then the attention shifts to emotional processes. To better understand the potential mediating role of these processes, they are also discussed in light of the direct effects, as well as the indirect effects of the prerequisites and amount of participation.

5.2.2.1 Motivational processes as a mediator. It was expected that, during the COVID-19 pandemic, heightened basic need-fulfillment and aesthetic experiences (due to cultural participation) would increase optimism. However, only relatedness led to increased optimism. This result presumably shows what people have missed most due to the COVID-19 pandemic: authentic relationships. When these were present, i.e., when the need for relatedness was satisfied, they were also more optimistic. This also fits with other findings on the influence of relatedness, such as that after hours of isolation, the desire for social interaction is just as strong as the desire for food after the same number of hours of fasting (Tomova et al., 2020).

Cultural projects with young people have also shown that relatedness is central to the well-being that can be prompted by these projects (Thole et al., 2017). However, the lack of a direct influence on optimism does not mean that the significant influences of cultural participation on autonomy and aesthetic experience discussed previously are not important. Previous research has shown that

autonomous motivation to adhere to the pandemic-related rules increased rule compliance (Guay et al., 2021; Morbée et al., 2021). Therefore, giving individuals the opportunity to feel like they are acting autonomously by being able to engage in (cultural) activities could also have other positive consequences besides optimism, for example helping more people adhere to the restrictions and act safely during a pandemic.

Regarding the mediating role of motivational and emotional processes, participation in digital cultural offerings was also able to increase optimism in individuals who stated that the offers increased all three mediators: relatedness, autonomy, and aesthetic experience. However, higher participation in self-initiated and digital cultural activities did not directly lead to increased optimism. This is consistent with the utilization-of-learning-opportunities model (Vieluf et al., 2020), which states that the outcome of an offering is influenced by many different factors that need to be considered. This is also evident here; the cultural offerings have an influence, but it only became apparent when considering mediating factors.

There was only one specific indirect effect: the influence of participation in digital culture on optimism, mediated by relatedness. This indicates that the most prominent impact on optimism during the pandemic might have been the feeling of connectedness during digital cultural offerings. This further highlights the essential role that digital cultural engagement opportunities can play. The positive influence on social life, already evident in the analog world (e.g., Schumacher et al., 2007; Thole et al., 2017), seems to extend into the digital realm and becomes even more important when other forms of social interaction are limited. Moreover, this beneficial influence seemingly translates into greater well-being. This finding is particularly significant for individuals whose social interactions are consistently restricted, not just due to pandemic-related measures: They can greatly benefit from engaging with culture via digital platforms.

5.2.2.2 Emotional processes as a mediator. Before delving into the effect of aesthetic experiences on positive affect during a VR-visit, let's first delve into the relationship between the three aesthetic experience measurements with each other. It was assumed that the psychophysiological measures during the VR-visit can predict the aesthetic experiences that were self-assessed after the visit. A central finding was that this relationship was mediated by gender, in that a heightened HR predicted higher self-assessed aesthetic experiences in women, and a stronger heart rate variability predicted higher self-assessed aesthetic experiences in men. As higher HR can be linked to arousal (Tschacher et al., 2012) and HRV to a more relaxed state (Stürmer & Schmidt, 2014), it can be assumed that for women, when they felt aroused, they attributed this arousal to heightened aesthetic experience during self-assessment. However, men attributed relaxation to heightened aesthetic experience during self-assessment. This difference in the attribution of physical reactions between women and men becomes important again in the findings of the moderated mediation discussed next.

It was assumed that participants who show or report more intense aesthetic experiences report higher positive affect after the VR experience. This was found to be true for self-assessed aesthetic experiences. Given this relationship, one might assume that frequent participation in digital culture, thereby repeatedly increasing affect through enhanced aesthetic experience, would build up resources (Fredrickson, 2013). However, as discussed before, during the COVID-19 pandemic frequent cultural participants who reported enhanced aesthetic experiences did not report a corresponding increase in optimism which should have resulted from these increased resources. Thus, it appears that while aesthetic experiences are sufficient to boost immediate affect, as seen after the VR-gallery, these experiences alone do not suffice to enhance optimism over the long term. As previously discussed, a significant increase in the two basic needs relatedness and autonomy was also required to achieve improvement in optimism.

While openness to experience had no direct effect on any of the three aesthetic experience measurement, it had an indirect influence on positive affect mediated by self-assessed aesthetic experiences. Moreover, openness did not directly influence positive affect. This finding indicates that participants high in openness to experience might report positive affect after a digital cultural engagement only when they feel that they experienced aesthetic emotions during the experience. Based on the lack of a direct effect of openness to experience on aesthetic experiences alone, one might assume that openness may not be a necessary prerequisite to consider when analyzing emotional processes arising during engagement with virtual reality art. However, when adding up the effect of openness on aesthetic experiences and the effect of these experiences on positive affect, an indirect effect emerged. This speaks to the need to examine both prerequisites and processes during utilization when examining cultural participation (Vieluf et al., 2020), since omitting one or the other might result in an incomplete picture. However, for more objective measures of aesthetic experiences (HR, HRV), such an indirect effect did not emerge, indicating that participants high in openness to experience did not associate elevated HR or HRV with their self-assessment of affect post-VR.

As discussed above, affect prior to VR led to increased aesthetic experience. This in turn increased positive affect after the VR – consistent with the model of aesthetic experiences (Leder et al., 2004) – and indicates an indirect influence of positive affect prior to the VR-gallery on positive affect afterwards, mediated by aesthetic experiences. This finding underlines the need to consider prior affect when wanting to investigate the impact of cultural offers.

It was assumed that higher HRV should result in higher positive affect after the VR experience. However, an opposite effect was found: Participants with lower HRV reported higher positive affect after the VR. Lowered HRV is associated with improved focus and attention (Porges, 1992). Virtual reality (VR) is a relatively new medium, and many participants were inexperienced with it, meaning that those who could maintain their attention on the artworks despite the somewhat distracting environment likely had a more satisfying experience. This, consequently, could have led to reporting a more positive affect afterward.

This unexpected finding once again underlines the need to re-evaluate what we think we know about aesthetic processes in the context of digital culture. For instance, it is a good example of the need to consider additional spaces that might emerge. In addition to the physical space in which the VR-glasses are located and the “aesthetic” space that emerges due to the aesthetic experiences (Brandstätter, 2013), there is a third, virtual space that reflects the "factual" space within the VR-environment (the VR-gallery). Handling three spaces all at once thus might interfere with and require additional attention, which might have been reflected in the HRV results. However, this assumption needs to be investigated by future research, possibly by integrating the amount of immersion in the virtual world as confounding factor.

This relationship between HRV and positive affect was significantly influenced by gender, in that higher HRV in men led to increased positive affect after the VR. This ties back to the findings regarding the relationship between HRV and self-assessed aesthetic experiences in men, where high HRV increased the self-report of aesthetic experiences. The fact that there is a relationship between heightened HRV and self-reported items of positive experiences of cultural engagement (e.g., aesthetic experiences and positive affect) in men, might indicate two things. First, if we assume that sustained attention explains the negative association between HRV and positive affect, but this association is positive in men, sustained attention in digital environments could depend on gender. Secondly, for providers of cultural engagement opportunities, it might be beneficial to keep in mind that factors that might ensure or even increase a receptive and relaxed environment might enhance the possibility of (self-assessed) aesthetic experience and positive affect in men; an environment ensuring an arousing experience might be beneficial regarding (self-assessed) aesthetic experiences for women.

Heart rate did not directly influence positive affect after the VR experience. However, for experts, and more specifically expert women, an increase in HR did lead to positive affect. Processing fluency (Reber et al., 2004) states that successful interpretation and comprehension (i.e., processing) of an artwork result in increased positive affect. A heightened heart rate might reflect this successful processing: a sort of “AHA!” moment. Experts are more likely to have these “AHA!” moments (Reber et al., 2004), and as noted earlier, women seem to link this type of arousal felt while viewing art to more positive emotions, which therefore may result in increased reports of positive affect for women experts. Moreover, expertise might not directly lead to increased positive affect, but only when processing was successful, as indicated by the lack of a significant direct effect in the model where HR acts as a mediator. Notably, in the other models without HR as a mediating emotional process, there is a direct effect of expertise on positive affect. This further underscores the importance of HR in this relationship, suggesting that an increase in HR could be indicative of successful cognitive processing.

The potential role of differential art-processing in explaining the relationship between expertise, positive affect and consequently aesthetic judgement was further analyzed in article 3. Here, positive affect acted as an emotional process, serving as a mediating factor between expertise and aesthetic

judgement. In line with our hypothesis, positive affect increased aesthetic judgement. This is evidence for the transferability of the feelings-as-information model (Schwarz & Clore, 1996); the positive emotions felt during the VR-experience were likely attributed to the quality of the paintings, therefore increasing judgement. The heightened positive affect that is experienced and then attributed to the paintings could be due to factors relating to the artworks, such as processing fluency (Reber et al., 2004), but it cannot be excluded that it is a result of the appreciation of the overall new and exciting VR-experience. However, even if this was the case, it does not affect the importance of the results, as it still fosters a positive experience and results in appreciation of the artworks, which in turn might increase motivation to participate in future cultural activities (Rakoczy et al., 2022).

High expertise led to an increase in positive affect, which then resulted in higher judgement. The concept of processing fluency (Reber et al., 2004) and effort-after-meaning theory (Russell, 2003) propose that successful interpretation and comprehension (i.e., cognitive processing) of an artwork result in increased positive affect, which can then be attributed to the painting (feelings-as-information model, Schwarz & Clore, 1996), leading to increased judgement (Reber et al., 2004). The significant indirect effect here is evidence that these theories might be transferrable into the digital space. The mediating role of HR in the previous model between expertise and positive affect, further reinforced by a non-existent direct effect of expertise on positive affect, could have been an indicator of such successful cognitive processing. Moreover, in line with expectations, there was no direct relationship between expertise and aesthetic judgment, suggesting that experts do not universally appraise all art positively. Instead, they have tastes and preferences that influence their judgements (Leder et al., 2004). This distinction once again reflects the importance of increased affect in this relationship.

5.3 Food for thought for (providers of) digital cultural engagement opportunities

Due to cultural activities possibly having such a positive impact on life, some argue that the responsibility of actors in cultural education lies in supporting the individual in coping and opening up the possibility of a happy life for them (Bockhorst, 2013). As we have seen, digital cultural engagement can help in these aspects. Therefore, it is the responsibility of these actors to not sleep on this form of cultural engagement. This thesis might offer some valuable insights for enhancing digital opportunities for cultural engagement.

First, it may be worth noting that there seemed to be room for improvement regarding the engagement in digital cultural offerings during the COVID-19 pandemic. During the first 6 months of the pandemic, 16% of museums increased their online exhibitions (International Council of Museums, 2020), a number that had increased by at least 15% in a subsequent report in 2023 (International Council of Museums, 2023). Therefore, in a span of three years, cultural providers transferred approximately 31% of their offers into the digital realm, leaving some 70% of potential digital content untouched. This is particularly unfortunate in light of the positive impact that digital cultural offerings that were provided

seemingly had: Engaging in these digital offerings increased aesthetic experiences and met the need for relatedness and autonomy. The increased feeling of relatedness was even able to act as a protective shield against detrimental effects of the pandemic. The room of improvement regarding amount of available offers further ties in with the finding that mainly "cultural lovers," i.e., individuals that already had high attainment/utility and intrinsic values, and that had already planned on participating in a number of cultural events during that time, accessed these digital cultural offers. It can only be assumed that providing more opportunities for digital engagement, or maybe increasing the promotion of existing offers, might have reached a wider audience.

However, it might have been the case that the offers did reach a wide audience, but only "cultural lovers" stuck with them, since these offers need improvement in order to appeal to a more diverse group of people. Integrating emotional content into opportunities of digital cultural engagement might enhance these experiences for experts and novices alike. The results of the present thesis showed that affective texts in a virtual reality environment enhanced the VR-art experience. As VR is, for most people, a new and unfamiliar environment, a visitor might hold on to human emotions since this "artificial" environment might lack many aspects of the human experience. They might also be drawn to content that encourages them to reflect on their own feelings, thereby increasing the self-experience that is normally prominent during exposure to an aesthetic stimuli (Brandstätter, 2013). Moreover, these affective texts might be emotionally contagious (Hatfield et al., 1993), and the contagion might have been even stronger given the emotionally devoid context of VR. Thus, providers of digital cultural engagement opportunities might think about incorporating more emotional content to combat the lack of a "real-world" experience that goes hand in hand with most digital content.

If these factors are integrated to reach a broader audience, this could be a great way to increase engagement with cultural opportunities among those who are less likely to participate. In particular, digital culture could become a third possibility to introduce children to culture, in addition to their school and parents (Nagel, 2010). A child with free access to the internet ("free" as in "still safe for children" of course) is no longer dependent on their parents or school taking them to cultural venues, when the cultural venues stream their offerings right onto his or her computer screen. As "highbrow" culture is often not accessible for everyone and yet "play[s] a role in the maintenance and allocation of high social status positions" (Nagel, 2010, p.2), young people who would otherwise not have access to this sort of culture can also benefit from these social advantages through digital engagement. This restricted access to and idolizing of some forms of culture might result in an individual feeling out of place in the environments where such culture is prevalent, creating even more distance and a form of shame surrounding the topic (Liebau, 2015). As digital culture can be experienced in one's own four walls, it might act as a first exposure within a safe space for many and might be a starting point to navigate around this shame.

The findings indicate that participants with lower heart rate variability, which can be indicative of improved focus and attention (Porges, 1992), showed increased positive affect after the experience.

Virtual reality (VR) is a relatively new medium, and many participants were inexperienced with it, meaning that those who could maintain their attention on the artworks despite the somewhat distracting environment likely had a more satisfying experience. In addition, within VR, a new space emerges that might interfere with and require additional attention: A virtual space that reflects the "factual" space within the VR-environment (the VR-gallery), in addition to the physical space in which the VR-glasses are located and the “aesthetic” space that emerges due to the aesthetic experiences (Brandstätter, 2013). Therefore, providers of digital cultural engagement opportunities should aim to minimize other distractions in their digital offerings as much as possible. However, the association between HRV and affect is positive in men. If we assume that sustained attention explains the negative association between HRV and positive affect, sustained attention in digital environments could depend on gender.

This also introduces the last point of consideration: Differential effects for gender should be kept in mind. For providers of cultural engagement opportunities, it might be beneficial to keep in mind that factors that might ensure or even increase a receptive and relaxed environment might enhance the possibility of (self-assessed) aesthetic experience and positive affect in men, as indicated by a stronger association between HRV and positive self-assessed aesthetic experiences and positive affect. On the other hand, an environment ensuring an arousing experience might be beneficial regarding (self-assessed) aesthetic experiences for women. However, this use of a binary gender construct does not reflect the diversity of gender identities. Therefore, these results should be viewed with caution and the influence of other identities should be examined in further studies.

5.4 Limitations

Considerations to be taken into account when analyzing the results and suggestions for future research are presented below.

As for the comparison between self-initiated culture and digital culture activities, future research could divide the two into equal numbers of receptive and active culture (Cuypers et al., 2012). Here, digital cultural activities contained more receptive cultural activities, while self-initiated activities contained more active activities. A similar level of receptive and active culture could expand the picture.

Likewise, it should be noted that digital culture was compared here with “analog” self-initiated cultural activities, which, as the results showed, were largely carried out alone. Other results, for example on digital formats at universities, showed that participants find digital formats to be disadvantageous in terms of social interaction compared to analog formats. This was the case even though the participants rated the forms of online interaction offered as good (Beretz et al., 2021). This suggests that while these forms of online interaction were valued, they cannot compete with the “real life” experience. Therefore, it might be interesting to compare digital opportunities for cultural engagement with analog options that involve a high level of social interaction, maybe without the pandemic context, in order to make an accurate comparison.

On the subject of pandemic context, it should be noted that the data for the study regarding cultural engagement during the COVID-19 pandemic was collected when some of the lockdown restrictions in Germany had been loosened. For instance, museums were allowed to open their doors again during this period (Landesregierung Nordrhein-Westfalen, 2020). However, since the measurements of the emotional and motivational processes pertained exclusively to self-initiated and digital cultural activities, they should not have been influenced by possible other cultural activities.

The non-occurrence of a direct link between the psychophysiological assessments and self-assessed aesthetic experiences might be first due to different questionnaires being used to assess self-aesthetic experiences compared to other studies (e.g., Siri et al., 2018; Tschacher et al., 2012). In addition, Tschacher et al. (2012) tested whether self-assessed aesthetic experiences have an influence on psychophysiological parameters; here the opposite direction was tested. As discussed below, aesthetic experience was intentionally self-assessed after the study so as not to disrupt the visit to the gallery and thus not to impair the experience. By doing so, it was chronologically coherent that the psychophysiological values that were measured during the VR experience would predict the values that were self-assessed afterwards. Secondly, the focus was specifically on the predictive ability of these psychophysiological measurements on self-assessed aesthetic experiences after the visit was completed, and whether the two types of measurements align. However, the lack of a direct relationship does not mean that the measurements do not align or that one is not predictive of the other. Rather, it suggests that further studies should take a closer look at the direction of the relationship.

Some intervals used to calculate psychophysiological measures had to be excluded due to interference, and the exclusion is assumed to be missing at random. However, some of the exclusions involved people talking, which could be due to emotional states such as astonishment (“Wow!”). Consequently, these exclusions could result in an under-representation of this specific type of emotional encounter during the visit, and it thus cannot be assumed with absolute certainty that the exclusion was missing at random.

Pertaining to the textual information, it should be noted that the affective and stylistic texts were not the same length: The stylistic texts were slightly longer. An attempt was made to shorten them somewhat without losing too much meaning. However, it cannot be ruled out that the positive effect of the affective texts could be due to the fact that they were easier (quicker) to read. Future studies should focus on adjusting the length of the texts being compared.

In general, men were underrepresented in both samples (online and VR- study). This should be kept in mind, especially when interpreting the results of the second article, as the focus here is on the moderating effect of gender. The results suggest that the relationship between psychophysiological responses to art and subsequent self-assessment of emotional processes is influenced by gender. These findings are intriguing but should be confirmed by future studies with larger and more representative numbers of participants who identify as male. On the note of gender, the use of a binary gender construct does not reflect the diversity of gender identities and was only chosen here as a matter of necessity due

to an underrepresentation of other gender identities in the sample. Therefore, these results should be viewed with caution as the influence of other identities should be examined in further studies.

The VR study strived to create a VR-gallery experience that mirrors the natural feel of an actual museum experience as closely as possible. This was done due to a study showing that a laboratory context can distort aesthetic appreciation (Brieber et al., 2014). Therefore, the study avoided any interventions that would have further emphasized the laboratory environment and/or interfered with the flow of the visit. However, this approach came with some drawbacks.

The observation that expertise had no direct influence on self-assessed aesthetic experience in the analysis of study 2, contrary to existing theories, suggests that aesthetic experience might be better measured during, rather than after, the cultural engagement. Perceptions collected retrospectively can only provide limited information about experiences in the moment (Rakoczy et al., 2022). Therefore, aesthetic experiences occurring in the moment of viewing the artworks may not be fully captured if assessed retrospectively. This is also supported by the fact that HR measurement taken during artwork viewing showed the anticipated influence of expertise. This issue also pertains to the measurement of positive affect after the VR as an indicator of an emotional process. In article 3, positive affect was seen as an emotional process of cultural engagement that might lead to aesthetic judgement. Hence, here too it would be beneficial to measure the construct during the gallery visit rather than afterwards, to make sure that an emotional process during the engagement is assessed. This insight could be valuable for future research on digital cultural engagement opportunities, proposing that real-time assessment of aesthetic experiences and positive affect might be better suited to detect effect. However, here it was decided against this approach as it could interfere with the flow of the VR-experience.

Furthermore, participants were not told how long to stand in front of a painting; they were allowed to move around freely. All artwork-viewing intervals for calculating the psychophysiological values should be the same. Therefore, the shortest interval had to be chosen as the standard. This meant that ultra-short intervals had to be selected to calculate the psychophysiological parameters. While these types of intervals were shown to correlate with longer ones (McNames & Aboy, 2006; Nussinovitch et al., 2011; Salahuddin et al., 2007; Shaffer et al., 2016; Thong et al., 2003), short intervals could also represent other emotions than the ones discussed here (Stürmer & Schmidt, 2014). Consequently, this possible ambiguity should be kept in mind; future studies might want to discover ways to include longer intervals without interfering too much with the natural flow of the visit.

Regarding the division of participants into the two different experimental groups, it should be noted that a between-participants design may not be as sensitive to different conditions as a within-participant design (Russell, 2003). This suggests that future research may be able to detect an interaction effect between expertise and textual information utilizing a within-participant design. However, again, the decision was made here against such a design for the same reasons The VR-gallery was supposed to

emulate a museum setting as closely as possible; using two different textual information might have detracted from this.

These points show that it is a balancing act to find the right level of minimal interference with the experience and still receive accurate measurements at the same time. In the future, research should continue to work on finding the right middle ground here.

Lastly, it is important to recognize that there are significant barriers to accessibility in the digital space, too. The use of VR glasses to experience art is currently not a comprehensive solution, as these devices are only available to a limited extent due to their high cost. Museums or educational institutions might offer access, but it is unlikely that many people have these devices at home. Moreover, while it may be true that children no longer rely as much on their parents to take them to cultural venues, research suggests that a child's interest in cultural activities may also depend on the overall value that music has in their home (Krupp-Schleußner & Lehmann-Wermser, 2018). This impact would remain unaffected by digital access to culture.

5.5 Conclusion

Cultural activities have been shown to be related to numerous positive outcomes (Cuypers et al., 2012; Fancourt & Perkins, 2018; Fancourt & Steptoe, 2019b, 2019a; Väänänen et al., 2009). People might use the arts to consciously and purposefully develop their subjective relationships, both with themselves and the world (Bockhorst, 2013). This can now also be accomplished from the comfort of your home in front of a computer screen, as more and more opportunities for cultural engagement have emerged in the digital realm. Digitalization should therefore be acknowledged as a profoundly transformative cultural process which includes new forms of aesthetic expression that have emerged through digital transformation, and have now become a part of the everyday lives of many (Rat für kulturelle Bildung, 2020). Here, we have seen that digital cultural engagement opportunities had the potential to positively impact optimism during the COVID-19 pandemic, and that they influence both positive affect after engagement and aesthetic appreciation in form of aesthetic judgement. However, in line with the utilization-of-learning-opportunities model (Vieluf et al., 2020), this impact depends on various influencing prerequisites and processes during utilization that should be kept in mind, and that were thoroughly discussed here.

So, are “pandemic hearts cured by the arts?”, can they “touch your hearts?”, and does “reading between lines and pixels” influence any of it? Yes, digital cultural engagement opportunities were shown to have these positive outcomes. However, predispositions and processes during utilization, as well as factors shaping the opportunities, were essential. An increase in relatedness, for example, was essential for digital cultural offers to “cure pandemic hearts,” i.e., increase optimism; VR-art’s ability to “touch

your heart" by influencing your heartbeat is seemingly influenced by gender and expertise; and reading "between lines and pixels" might be most beneficial in VR when it involves reading emotional content.

This is just a small selection of the many factors that can influence the experience of digital cultural engagement opportunities. Cultural education continues indefinitely (Reinwand-Weiss, 2013). Hence, the positive outcomes shown here, but also those shown in various other studies, may persist throughout one's life. Therefore, it is essential to investigate the new forms of cultural engagement and education that have emerged through digital transformation and their possible positive outcomes. Experiencing positive processes such as the emotional and motivational ones shown here also increases the likelihood of participating in these types of cultural activities repeatedly (Rakoczy et al., 2022). That's why it is vital to pay attention to factors that can improve participation, thereby creating a self-reinforcing cycle of increased engagement and an overall positive outcome.

6. References

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7. Appendix

7.1 Article 1

Gotthardt, K. A., Rakoczy, K., Tallon, M., Seitz, M., & Frick, U. (2023). Can the arts cure pandemic hearts?-Cultural activity during the COVID-19 pandemic and its consequences for psychological well-being. *Empirical Studies of the Arts*, *41*(1), 3-30.

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Can the Arts Cure Pandemic Hearts? - Cultural Activity During the COVID-19 Pandemic and its Consequences for Psychological Well-Being

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Abstract

Cultural activities might serve as a buffer to the negative effects of the COVID-19 pandemic on mental health. Frequencies of participants' cultural activities in terms of participation in digital cultural offerings or self-initiated cultural activities during the pandemic are examined, and whether prior cultural engagement and valuing of culture have an impact on this participation. It is explored whether both forms of cultural activities are directly connected with psychological well-being, namely, optimism concerning COVID-19, and whether this relationship is mediated by autonomy, relatedness and aesthetic experience. Regression and mediation analysis were calculated (N = 398). Both cultural activities were related to increased aesthetic experience and perceived autonomy, but only participation in digital cultural offerings was connected to increased perceived relatedness. Relatedness, in turn, was connected to increased optimism. The results reflect the protective function of cultural activities on psychological well-being, demonstrating the importance of cultural life in times of adversity.

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Keywords
cultural activity, aesthetic experience, COVID-19, basic needs, values

Introduction

COVID-19, Psychological Well-Being and the Role of Cultural Activities

The current study highlights that engaging in cultural activities, despite the forced closure of cultural institutions, might serve as a buffer against the negative effects of the COVID-19 pandemic on mental health. The first cases of the new Coronavirus disease (COVID-19) were reported in December 2019 in Wuhan, China and declared to be a pandemic on March 11th, 2020 (World Health Organization [WHO], 2020). During the pandemic, everyday life was upended, and the resulting restrictions had drastic consequences for some (Wilke et al., 2021) causing severe repercussions on mental health. Brodeur, Clark, Fleche, and Powdthavee (2020) analyzed Google searches for words such as loneliness, sadness, and worry. They discovered an increase in these searches during the period of restrictions in the US and Europe and concluded the restrictions impacted severely on mental health. Moreover, they found there was almost no difference regardless of whether the countries in question imposed a full or partial lockdown (Brodeur et al., 2020). During the first week of the restrictions in March 2020, calls to German telephone crisis helplines increased by 20% compared to the previous year. Again, the extent of the restrictions did not have a significant influence, with the effect only being slightly more pronounced in those federal states with more severe restrictions (Armbruster & Klotzbücher, 2020). Being quarantined during the pandemic had negative effects on mental health due to stressors such as fear of infection, boredom, false information and financial worries (Brooks et al., 2020). An analysis of COVID-19 related worries showed that in spring 2020, German citizens worried mostly about health and medicine, followed by worries about politics, the economy, and their social lives (Lengning, Rakoczy, Jenisch, Opwis, & Schmidt, 2020).

Much of German cultural life collapsed due to the pandemic-related restrictions that came into effect in March 2020. These restrictions included, among other things, closure of gastronomy, museums, theaters, cinemas, and other cultural establishments, as well as a reduction in social contact. It was forbidden to meet more than one other person not belonging to one's household in public spaces and parties were considered unacceptable (Landesregierung Nordrhein-Westfalen, 2020; Presse- und Informationsamt der Bundesregierung, 2020a). Furthermore, restrictions were subject to change according to the continued spread of the disease (e.g., Presse- und Informationsamt der Bundesregierung, 2020b). 97,1% of European museums were closed in April, according to respondents of an analysis by the International Council of Museums (ICOM), run between 7th of April and 7th of May 2020 (ICOM,

2020). Between the 14th of May until 15th of June, artists reported having to cancel roughly one and a half (active) cultural events per week, equating to a cancelation of six events per month. Regarding visits to cultural events, artists and consumers generally reported cancelation of one event every second week (Frick, Tallon, Gotthardt, Seitz, & Rakoczy, 2021). With these closures and restrictions, the ability to participate in cultural activities was heavily limited. In the present paper we specify cultural activities according to the UNESCO definition, as activities that "embody or convey cultural expressions, irrespective of the commercial value they may have" (UNESCO, 2009, p. 23). In their framework for cultural statistics, UNESCO proposes several cultural domains which represent cultural activities. In the present paper we examine cultural activities from every cultural domain including "performance and celebration" (music, dance and theater), "books and press" (literature), "visual arts and crafts" (art), "cultural and natural heritage" (cultural educational events), "audio-visual and interactive media" (film) and "design and creative services" (creating something) (UNESCO, 2009, p.24).

The loss of cultural activities during the COVID-19 pandemic is unfortunate since cultural activities might serve as a buffer to the pandemic's negative effects on mental health. Studies have shown that engagement in receptive and creative cultural activities are related to better physical and mental health, as well as overall life satisfaction (Cuypers et al., 2012). Correspondingly, Fancourt and Steptoe (2019a) found that adults above the age of 50, who frequently engaged in cultural activities, were less likely to experience depression. The positive effect of cultural activities on mental health also applies to children. It was shown that children at the age of seven to eleven, who showed high creativity during cultural activities as reported by their teachers, were less likely to show behavioral or social maladjustments (Fancourt & Steptoe, 2019b). The authors therefore concluded that enhancing cultural activities in children might reduce the risk of developing these maladjustments. A more causal link between cultural activities and mental health can be drawn from an experimental study which showed that mothers with moderate-severe postnatal depression who engaged in group singing workshops showed a faster reduction in symptoms, compared to mothers who did not engage in this type of cultural activity (Fancourt & Perkins, 2018). Likewise, engagement with culture can be seen as an intentional activity, which has been shown to sustain happiness over a long period of time (Lyubomirsky, Sheldon, & Schkade, 2005). Cultural activities positively impact well-being in the workplace (Tuisku, Pulkki-Råback, Ahola, Hakanen, & Virtanen, 2012), help with work-related stress management (Iwasaki, Mackay, & Mactavish, 2005) and are even associated with a decrease in mortality, including mortality due to external causes (Väänänen et al., 2009).

While cultural institutions were forced to close their doors, cultural life developed quickly in other areas. Many cultural producers moved their content into the digital world (ICOM, 2020) with 16% of Museums increasing their online exhibitions during the pandemic-related restrictions and 11% starting an online-exhibition. In addition, 48% of museums reported an increase in social

media services after the restrictions (ICOM, 2020). This increase in online-content indicates that there has been an opportunity for the emergence of new means for cultural producers to communicate with their recipients. Apart from engaging in the digital cultural space, individuals could continue to be culturally active on their own during the pandemic. Thus, this paper focuses on two types of cultural activity during the restrictions: being culturally active through engaging in digital cultural offerings, or being culturally active on one's own. Here, the difference between engaging in digital cultural offerings or being culturally active on one's own is that the former requires an external offer, while the latter does not. To engage in digital cultural activities in the realm of music, for example, there must be a digital platform providing these cultural activities, such as a platform to stream live concerts. Because these types of external offerings are required to engage in these activities, this engagement is hereafter referred to as engaging in digital cultural offerings. Conversely, being culturally active on one's own does not require these types of external digital offerings. The simple act of making music does not require an external platform that allows you to do so. The individuals themselves can initiate the process of being culturally active. Therefore, these types of cultural activities are referred to as self-initiated cultural activities. If participants in the current study stated that they participated in digital cultural offerings during the restrictions, an increase compared to participation in 2019 was assumed. On the one hand, this is due to the aforementioned increase in the number of digital offerings (ICOM, 2020). On the other hand, this is due to a study that measured the consumption of digital cultural offerings analogous to those measured in the current study (such as music, film, literature, theater, art) not only during, but also before the pandemic in 2019 (Creative Industries Policy & Evidence Centre, August 2020). The study found a significant increase in engagement in these offerings during COVID-19-related restrictions. Since no such data were available for self-initiated cultural activities, we asked participants to describe their self-initiated cultural activities during the pandemic compared to the pre-pandemic period in the present study. Therefore, meaningful conclusions for the development of both types of cultural activities due to the pandemic can be drawn.

Who is Culturally Active in the Scope of Possibilities During the COVID-19 Pandemic?

Individuals differences regarding cultural engagement during the pandemic include values individuals hold for cultural activities and their prior cultural engagement.

First, as regards the impact of values, Kröner and Dickhäuser (2009) found that intrinsic values regarding cultural activities explained 39% of variance in a student's "receptive high-brow cultural activity" (p.53). This is in line with expectancy-value theory (Eccles, 1983), more specifically, situated expectancy-value theory (Eccles & Wigfield, 2020), which suggests that people's choices depend not only on their expectancy of how well they will manage an activity, but on how much they value the

activity. Values were found to be particularly important for freely selectable behavior, such as in cultural activities (Wigfield & Eccles, 2000). Besides intrinsic values, attainment and utility values are assumed to be important for cultural activities, with attainment values mirroring the importance of an activity, and utility values displaying the usefulness of the activity (e.g. Eccles, 1983). Therefore, people who value culture are likely to resort to engaging in self-initiated activities and/or digital cultural offerings to maintain their cultural activity during the pandemic if their individual circumstances allow.

Second, individuals who chose to spend lots of time on cultural activities prior to the pandemic-related restrictions are likely to aspire to also doing so during the restrictions by engaging in self-initiated activities and/or digital cultural offerings.

How Does the Positive Effect of Cultural Activity on Psychological Well-Being Emerge?

Previous studies hint at the possibility that cultural activities might enhance psychological well-being during the pandemic, either through enhancing aesthetic experience or through basic need satisfaction.

First, research in the field of aesthetic experience helps describe how the positive effects of cultural activities might come about. Marković (2010) defined aesthetic experience "as an exceptional state of mind in which a person is focused on a particular object, transcending its everyday uses and meanings and losing the awareness of surroundings and even of himself/herself; in this state a person can have an exceptional emotional experience, that is a feeling of unity with the object" (Marković, 2010, p.58). He later proposed a model of aesthetic information processing. In this model, aesthetic emotions are affective evaluations. Silvia and Nusbaum (2011) divided aesthetic experience into three dimensions: "Touched", "Absorption" and "Chills". Aesthetic emotions have a strong positivity bias (Menninghaus et al., 2019), meaning that most of the time, aesthetic emotions are positive emotions. In line with the broaden-and build-model (Fredrickson, 2013), which suggests that positive emotions increase individual resources, people high in cultural participation, who frequently experience these positive aesthetic emotions, should develop increased resources such as resilience, mindfulness and social closeness. Thus, they may experience more psychological well-being when being confronted with a challenging situation such as a global pandemic.

Second, Self-determination Theory (SDT) (Deci & Ryan, 2012) suggests that the support of three basic needs leads to an increase of "high quality" or intrinsic motivation: the needs for autonomy, competence, and relatedness. If these needs are supported, individuals perceive themselves to act volitionally, effectively, and in connectedness with others. The need for autonomy is met when individuals perceive themselves to have choices regarding the activities they pursue (Niemiec & Ryan, 2009). An example in the cultural activity context would be someone visiting a virtual gallery, not because their friends like her/him to do so and the individual

feels pressured to, but because they want to pursue this activity volitionally. The need for competence is met when individuals feel they can effectively meet the requirements regarding the activity they want to pursue (Niemiec & Ryan, 2009). The individual visiting the virtual gallery would need to feel capable of understanding the paintings in this gallery for their need for competence to be met. Lastly, the need for relatedness is met when the individual feels liked and valued by those surrounding them (Niemiec & Ryan, 2009). Therefore, the individual in the virtual gallery should feel some sort of connection to the other potential visitors for the need for relatedness to be met. Moreover, basic need satisfaction positively impacts psychological well-being, and activities that satisfy basic needs create an environment for better performance, creativity, and persistence (Deci & Ryan, 2012). For example, Schrooyen et al. (2021) showed that parents whose basic needs (in relation to their parental role) were satisfied during the COVID-19 pandemic experienced less stress and more happiness when dealing with their children. Activities that thwart basic need satisfaction have a negative impact on psychological well-being, leading to need frustration and negative consequences such as depression or aggression (Vansteenkiste & Ryan, 2013). The COVID-19 related restrictions created an environment where basic need satisfaction was heavily restricted. Particularly, perceived autonomy and relatedness should have been threatened in a time dominated by restraints, rules and social distancing, where many decisions could not be made by individuals themselves (thus threatening autonomy), and when it was difficult to plan and conduct joint experiences (threatening relatedness). The pandemic-related restrictions may also have threatened competence. As we were interested in a wide range of cultural activities (from listening to music and watching movies to taking part in cultural education) during the pandemic, which differed greatly in the extent to which they potentially promoted the experience of competence, we decided to only focus on the positive impact on perceived relatedness and autonomy in our study.

It has been shown that volitional activities might mitigate basic need frustration that emerges in other areas. For example, Weinstein, Khabbaz, and Legate (2016) showed that refugees with low need satisfaction might win back some need satisfaction by engaging in activities that support those needs, simultaneously decreasing indications of stress and depression. In a similar vein, an intervention study has analyzed the impact of activities that satisfied basic needs, subjective vitality, and perceived stress during the COVID-19 pandemic (Behzadnia & FatahModares, 2020). Participants under experimental conditions were given the opportunity to engage in basic need-enhancing activities for a period of ten days, including some creative activities. Compared to the control condition, participants in the intervention group showed an increase in basic need satisfaction and vitality, and a decrease in perceived stress. Engaging in activities that enhance basic need satisfaction, particularly perceived autonomy and relatedness, might therefore counteract the negative impacts caused by basic need restriction due to the pandemic, hence enhancing psychological well-being. Cultural activities can be considered as activities that have the potential to render individuals' feelings of perceived autonomy and relatedness. For instance,

Koehler and Neubauer (2020) found that, in a sample of hobby musicians, participants reported higher basic need satisfaction, and lower need dissatisfaction, on days where they were making music, compared to days where they were not making music. Thus, during the pandemic-related restrictions, cultural activities may have given individuals an opportunity to perceive themselves acting volitionally by deciding to engage in digital or self-initiated cultural activities. Moreover, engagement in digital cultural offerings might give individuals the feeling of acting in connectedness with others. This is in line with findings that show that the use of narrative media (Sherrick, Hoewe, & Ewoldsen, 2021) or communication via digital technologies (Manago, Brown, Lawley, & Anderson, 2020) can increase perceived relatedness or closeness.

The pandemic-specific aspect of psychological well-being examined in the present study is optimism (Lengning et al., 2020). Optimism regarding the pandemic includes seeing the positive sites of the situation, a new found appreciation for things that were previously taken for granted, optimism towards the development of vaccines, trust in politics, being optimistic that people will support one another, being optimistic towards being able to keep in touch with loved ones, and being optimistic that Germany will survive the crisis well (Lengning et al., 2020).

Purpose of the Present Study and Research Questions

The present study investigates who is culturally active in the scope of possibilities during the pandemic, and whether cultural activity during the pandemic has a positive impact on psychological well-being, namely pandemic-related optimism. In particular, the following three research questions were investigated. While research question 1 was investigated exploratively, hypotheses for research questions 2 and 3 were formulated based on the theoretical background mentioned above:

1. How frequently have individuals been participating in digital cultural offerings and realizing different kinds of self-initiated cultural activities during the COVID-19 pandemic?
2. Who is culturally active during the pandemic-related restrictions? It is expected that individuals who took part in many cultural activities prior to the pandemic-related restrictions and who place a high value on cultural activities attempt to substitute for lost cultural events by participating in digital cultural offerings or self-initiated cultural activities.
3. Does the participation in digital cultural offerings and self-initiated cultural activities have an impact on psychological well-being during the COVID-19 pandemic via perceived autonomy and relatedness, and via aesthetic experience (Figure 1)?
   (a) Individuals who participate in digital cultural offerings and increase their self-initiated cultural activities are expected to report more optimism regarding the pandemic (total effect).
   (b) It is expected that participation in digital cultural offerings is connected to higher perceived autonomy and relatedness, and more aesthetic experiences.

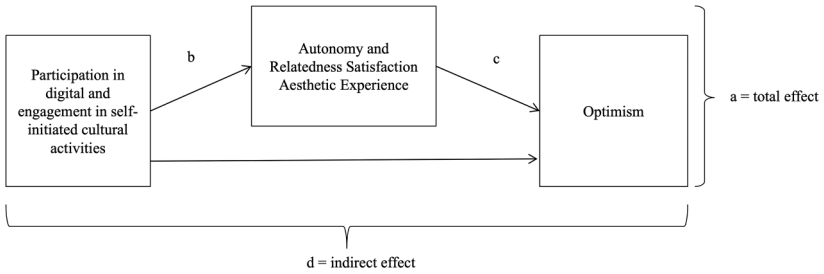

Figure 1. Hypothesis 3 a-d.

An increase in self-initiated cultural activities is expected to be connected to higher perceived autonomy and aesthetic experience.

(c) Higher perceived autonomy and relatedness and more aesthetic experiences are expected to increase optimism during the COVID-19-pandemic.

(d) Indirect effects of both forms of cultural activity on optimism are assumed. Specifically, individuals who participate in digital cultural offerings and self-initiated cultural activities are expected to experience more perceived autonomy and aesthetic experiences, as well as relatedness in the case of digital cultural offerings. In turn, they are expected to be more optimistic about the outcomes of the pandemic.

Methods

The present study is part of the project "Cultural education in rural areas: Investigation of person-related, social space-related and supply-related influencing factors", funded by the Federal Ministry of Education and Research[1] and conducted by a team at HSD University of Applied Sciences.

Sampling

Data were collected in an online questionnaire which was distributed along with another, yet unrelated, online questionnaire (Frick et al., 2021). Therefore, a similar sampling procedure was applied. First, using "facility-based sampling" (Shaghaghi, Bhopal, & Sheikh, 2011), cultural organizations and institutions (galleries, museums, choirs…) in several counties in North Rhine-Westphalia were contacted via E-mail. Moreover, two Facebook-groups that deal with the cultural scene in Germany posted the link. Furthermore, cultural operators in Bavaria, that had been previously singled out for other research questions in the project, were contacted by our research team regarding the other aforementioned online-questionnaire (Frick et al., 2021). 34% of participants were sampled using this sampling method. Second, a convenience sample was used. The link to the study was distributed via the website of the meta-research project, a

project comprising all research projects with the same funding guidelines as the present project. Moreover, the platform "SurveyCircle" (SurveyCircle, 2021) was used, where researchers can submit their online-questionnaires, as well as participate in other online-questionnaires. Students from the university of the research project were also recruited as participants in return for credit points. 22% of participants belong in this convenience sample. Third, using a snowball sampling procedure, the researchers contacted individuals in their own social networks, who then further distributed the survey. Using the snowball sampling method, 39% of participants were recruited. 5% of participants indicated that they received the online-questionnaire through "other" channels of communication. Due to these different channels of distribution, the sample might have obtained ecological validity (for details, see results of Sociodemographic Variables).

501 participants started the questionnaire, with N = 371 (74.1%) finishing it. The cut-off score for including cases was set at page 13 (of 17 pages) of the questionnaire, amounting to N = 398 (79.4%) participants. For an overview of the different cultural activities during the pandemic-related restrictions, the cut-off score was set after the indication of cultural activities. This sample size was deemed appropriate for the calculation of a complex mediation analysis. A medium effect (0.39) was expected for the influence of the two cultural activities on the mediators. Moreover, a medium effect was also expected for the influence of the three mediators on the dependent variable. According to Fritz and Mackinnon (2007), a simple mediation, using bias-corrected bootstrapping, with medium-sized expected effects for the a and b paths, requires a sample size of N = 71. We were confident that the sample size requirements for a complex mediation was satisfied by using a sample size that is almost six times larger than the required sample size for a simple mediation. Moreover, bias-corrected bootstrapping is the test-method that results in the highest power compared to other tests for mediation (Fritz & Mackinnon, 2007).

Procedure

The survey was made available via "SoSci Survey" (Leiner, 2019) and was online from the 13th of May 2020 until 15th of July 2020, when pandemic-related restrictions applied in most regions of Germany. The survey was in German. Informed consent was given by every participant, the data was obtained anonymously, and IP addresses or GPS tracking were not collected. The Ethics Committee approved the study on the 12th of May, 2020.

Participants were asked several demographic questions, including gender, age, federal state of residence, if they are currently in education, living environment, if they were an essential worker, living conditions, feeling burdened by one's living conditions and being at high-risk for COVID-19. A memory anchor was used as a reminder of the date when the pandemic-related restrictions came into effect. This memory anchor displayed the date of the announcement of the pandemic-related restrictions. Since every federal state in Germany announced restrictions at different times, the date was adjusted according to the subject's federal state of residence.

Participants were asked to indicate the day that they first personally felt the impact of the restrictions. They could either choose the date displayed by the memory anchor or could specify dates prior or after the date. Subsequently, subjects were asked to indicate cultural events they canceled due to the restrictions. Intrinsic and attainment/utility values were assessed, and participants indicated their optimism during the COVID-19 pandemic. The memory anchor was displayed once again, and participants were asked to report their cultural activity during the pandemic-related restrictions: They indicated their participation in digital cultural offerings and their self-initiated cultural activity during the pandemic-related restrictions. Subjects reported the amount of basic need-fulfillment they experienced whilst engaging in cultural activities during pandemic-related restrictions, as well as their aesthetic experience during these cultural activities. The items were answered in the described order. The average time spent on the online questionnaire was 18 min (mean: 1092 s; SD: 399 s).

Measurements

Gender. Gender was measured on a scale from zero to one, with zero representing women and one representing men.

Cultural activities prior to the COVID-19 pandemic. To measure cultural activities prior to the pandemic-related restrictions, canceled cultural events were assessed: participants indicated the number of cultural events they had to cancel due to restrictions. Events included concerts, cinema visits, exhibitions, theater and/or ballet and opera, cabaret and educational events. In an open format, subjects could also type in additional events and the number of times they canceled said events. During the analysis, these additional events were then differentiated between cultural and social events, where cultural events were counted and social events not counted. If participants indicated the frequencies of the additional events, these were directly coded. If there was no frequency given, it was estimated. For example, rehearsals were thought to occur once a week, therefore it was coded by taking the integer value of dividing (perceived) duration of the pandemic-related restrictions by seven. The perceived duration of the restrictions was computed by calculating the number of days between the day of the completion of the questionnaire and the day the participants felt the impact of the restrictions. A scale was constructed by dividing the amount of the subject's canceled cultural events by the perceived duration of the restrictions in weeks (Frick et al., 2021).

Value of cultural engagement. The utility of cultural engagement might be closely related to attaining personal goals such as professional or character development, indicating a link between the attainment and utility value regarding cultural engagement (Eccles & Wigfield, 2020). Moreover, attainment values are often empirically inseparable from other value components (e.g. Cambria, Brandt, Nagengast, & Trautwein, 2017; Trautwein et al., 2012). Therefore, we chose to measure attainment and utility

values in one indicator called "attainment/utility value". In order to measure attainment/utility values regarding cultural activities, participants were asked to imagine being an employe who is allowed to attend a free workshop during a paid educational leave, prior to the COVID-19 pandemic. They were asked which three of eleven hypothetical workshops they would choose in order to achieve personal as well as professional development. Moreover, the three workshops had to be ranked regarding their priority. Five of the workshops comprised cultural activities, for example, "improvisation on stage", and six of the workshops involved non-cultural activities, for example "management 101". A scale was built by adding the numbers of rankings given to cultural activities, one (third place), two (second place) or three (first place) and dividing it by six. The mean for workshops comprising cultural activities was 0.405 and the standard deviation was 0.331. Intrinsic values regarding cultural activities were measured by asking participants to imagine picking three fun leisure activities to do on a free day prior to the COVID-19 pandemic. Six of the eleven leisure activities consisted of cultural activities, such as reading or visiting a gallery, the rest consisted of non-cultural activities, for example eating out or shopping. An indicator was constructed by summing up the number of times a subject chose a cultural activity and dividing this number by three. The mean is 0.428 and the standard deviation is 0.264.

Cultural activities during the COVID-19 pandemic. Two indicators for cultural involvement during the pandemic were assessed, namely digital and self-initiated cultural engagement. Participation in digital cultural offerings during the pandemic-related restrictions was determined by asking participants to indicate the amount of digital cultural offerings they participated in since the beginning of the pandemic-related restrictions on a 5-point Likert scale, including the options "never", "once – and I plan on using it again", "once – and I do not plan on using it again", "every now and then" and "regularly". The two different options available for "once" were asked to indicate which digital offerings were well received and which were not. For the analysis, the measurement was reduced to a 4-point Likert scale, by comprising the two "once-…" - options and the "every now and then" - option into one category, indicating that an offering was used once or more. Digital cultural offerings included the realms of music (for example streaming live concerts, streaming past concerts, and sofa-sessions), dance (for example streaming live or past dance performance), literature (for example poetry-slams, book clubs, readings), art (for example digital galleries and tours, VR galleries), theater (for example live-streaming and past theater performances), film (for example streaming of cinema movies at home, streaming on online-platforms), cultural education (for example musical education online, choir practice online) and an open format. Cronbach's alpha indicated adequate reliability ($\alpha = .650$). The scale was built by calculating the mean of all items.

Self-initiated cultural activities during the pandemic-related restrictions were measured on a 4-point Likert scale, including "I engage less since COVID-19", "I engage the same amount since COVID-19" and "I engage more since COVID-19", with an

additional option for "I don't participate at all". Therefore, an increase in these activities during the pandemic-related restrictions was assessed. The activities included making music, dancing, painting, writing, reading, meditating, creating something (for example sewing), as well as an open format. To ensure the assessment of an increase in activities, responses from participants who indicated that they did not participate in any of the self-initiated activities were not included in the calculations ($n = 7$). The scale showed moderate reliability ($\alpha = .571$). A scale was constructed by calculating the mean of all items.

The means and standard deviations of the indicators for cultural activities prior to the pandemic and during pandemic-related restrictions can be found in Table 1 of the results section.

Psychological well-being. Optimism regarding the COVID-19- pandemic was measured by a scale developed by Lengning et al. (2020). The scale mean was 3.520 with a standard deviation of 0.643. Cronbach's alpha indicated good internal consistency ($\alpha = .752$). We focused on measuring optimism regarding pandemic-related restrictions rather than a measurement that indicates overall psychological well-being, in order for the data to particularly speak to the pandemic-related restrictions.

Basic needs. Perceived autonomy and relatedness were measured by two scales. Perceived autonomy was measured with a scale by Brown and Ryan (2003). In the current study, the five items were translated into German and adapted to the cultural content. Cronbach's alpha indicated good reliability in the current sample ($\alpha = .813$), with a mean of 3.484 and a standard deviation of 1.122. Perceived relatedness was measured using the German version of the Basic Psychological Need Satisfaction and Frustration Scale (BPNSFS) (Heissel et al., 2018). The wording of the items was slightly altered. One item was not considered due to its repetitiveness (Item 9). Cronbach's alpha indicated good reliability ($\alpha = .730$), with a mean of 3.781 and a standard deviation of 0.653.

Aesthetic experience. In order to measure aesthetic experience, the Aesthetic Experiences Scale (Silvia & Nusbaum, 2011) was used. The English version was translated into German. In the current sample Cronbach's alpha indicated very good reliability for the whole scale ($\alpha = .906$), with a mean of 2.142 and standard deviation of 0.774.

In the introduction to all of the basic needs items and to the assessment of aesthetic experience, the participants were asked to refer to their cultural activities during the pandemic-related restrictions when answering the questions.

Statistical Analysis

For the computations, MPlus was used (Version 8.5; Muthén & Muthén, 1998–2017). Descriptive statistics were computed to gain an overview of cultural activities performed during the pandemic to answer research question 1. For research question 2 (predictors for cultural activity), two regression analyses were computed.

Both analyses included intrinsic and attainment/utility values, as well as canceled events due to pandemic-related restrictions as independent variables. Participation in digital cultural offerings was included as the dependent variable in Model 1, and increased engagement in self-initiated cultural activities during the pandemic-related restrictions was included as the dependent variable in Model 2. As gender was shown to be an important predictor for cultural activities (Katz-Gerro, 2002; Upright, 2004), it was included in both analyses. To investigate research question 3, a mediation analysis was conducted (Figure 2). As gender was shown to be an important factor regarding optimism during the pandemic (Lengning et al., 2020), the impact of gender on optimism was controlled for. Since the analyzed indirect effects are products of direct paths and since the distribution of product terms is only asymptotically normal (e.g., Mackinnon, Lockwood, & Williams, 2004), the significance test was based on a bootstrapping procedure, using 1000 bootstrap samples and 95% confidence intervals (CIs). CIs are reported for all effects of the mediation analysis, with the null hypothesis being rejected when zero is not included in the CI.

Results

Sociodemographic Variables

72% of participants were female, 28% were male. The age distribution showed that 4.5% of the participants were under 20 years old. 21.6% of the participants were between 20 and 29 years old, 15.3% participants were between 30 and 39 years old. Likewise, 15.3% of the participants were between 40 and 49 years old. 23.4% of the participants were between 50 and 59 years old and 19.8% of the participants were over 60 years old. 19% of participants were currently in education, 65% of the sample had some form of university degree, and 65% of the sample were employed.

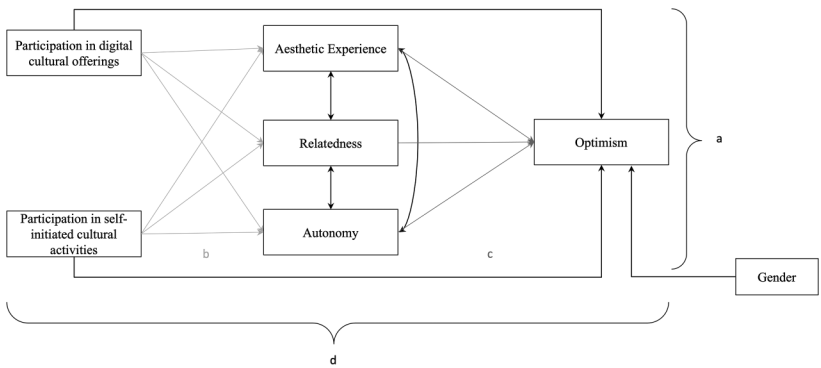

Figure 2. Mediation analysis research question 3 a-d.

What Kind of Cultural Activities Are Frequently Performed or Engaged During the Covid-19 Pandemic? (Research Question 1)

Means and standard deviations of the two cultural activity measurements during the COVID-19-pandemic as well as of the canceled cultural events due to the pandemic can be found in Table 1. As mentioned above, the scale for canceled cultural events was constructed by dividing the amount of the subject's canceled cultural events by the perceived duration of the restrictions in weeks (Frick et al., 2021).

Table 1. Means and Standard Deviations (SD) of the Indicators for Cultural Activities Prior to the Pandemic and During Pandemic-Related Restrictions.

	Mean	*SD*	Answering format	Answering Options
Participation in digital cultural offerings during the pandemic-related restrictions	0.521	0.339	4-point Likert Scale	never- once or more- every now and then- regularly
Engagement in self-initiated cultural activity during the pandemic-related restrictions	1.166	0.550	4-point Likert scale	I engage less since COVID-19 - I engage the same amount since COVID-19- I engage more since COVID-19", -I don't participate at all
Canceled cultural events due to the pandemic-related restrictions	0.644	0.782	Open format	-

Note: Calculation of open format: amount of canceled events divided by duration of the pandemic-related restrictions in weeks.

Figure 3 gives an overview of frequencies of participation in digital cultural offerings with the digital offering most frequently used (every now and then and regularly) being movies (64,8%), followed by music (39.1%), cultural education (27.3%), theater (13.5%), literature (11.3%), art (11%) and dance (9.7%). Most participants who indicated that they used an offering once and were not planning on using it again did so with music (11.8%), followed by theater (7.3%), art (7.3%), dance (4.5%), cultural education (4.3%), literature (3.5%), and lastly movies (2%). Digital offerings in the music sector were at the same time the activity which most of the participants wanted to use again (14%) and the activity most of the participants did not want to use again (11.8%).

Figure 4 gives and an overview of which self-initiated cultural activities were increased during the pandemic-related restrictions. Reading was performed most often, since participants were either reading more, or the same, during the pandemic-related restrictions

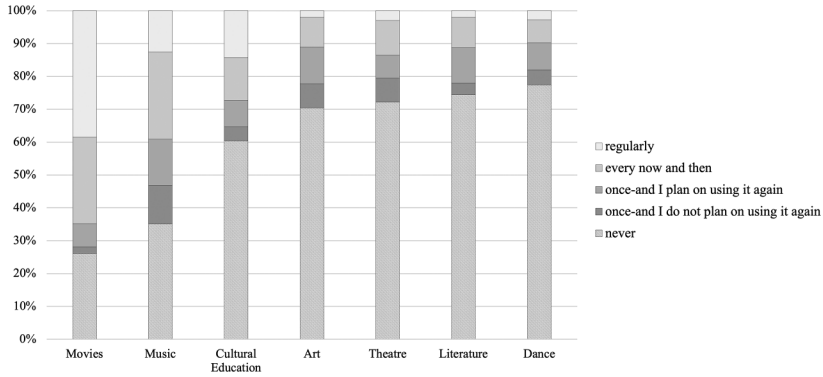

Figure 3. Digital cultural activities performed most often during the pandemic-related restrictions.
Note: The labels given to the activities in this figure are only representative for their realm of digital offerings. Refer to the measurement section for more examples.

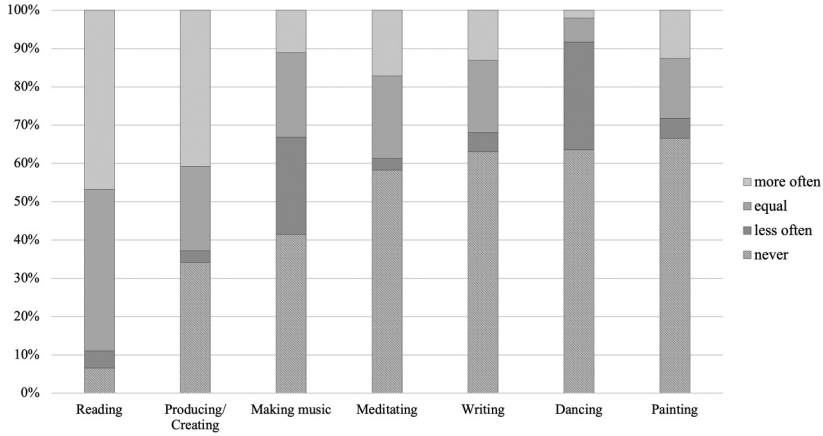

Figure 4. Increase in self-initiated cultural activities during the pandemic-related restrictions.

(summing up to 89%). Dancing was the activity which most participants performed less often than before (28.1%), closely followed by making music (25.4%).

Who is Culturally Active During Pandemic-Related Restrictions (Research Question 2)?

Two regression analyses were run, including valuing of culture and canceled planned cultural activities prior to the COVID-19 pandemic as independent variables, with

participation in digital cultural offerings (Model 1), and increased self-initiated cultural engagement (Model 2) as the outcome variables, controlling for gender in both models (Table 2)

Concerning participation in digital cultural offerings (Model 1), attainment/ utility value had a significant impact, indicating that participants who appreciate cultural activities for their own development and psychological well-being were more likely to participate in digital cultural offerings during the pandemic-related restrictions. Intrinsic values had a significantly positive impact on participation in digital cultural offerings, indicating that participants with intrinsic values were more likely to participate in digital cultural offerings, when controlled for attainment/utility value. Moreover, the amount of canceled cultural events prior to the pandemic had a significant impact on participation in digital cultural offerings. Gender did not have a significant impact.

Attainment/ utility values showed a significant impact on self-initiated cultural engagement (Model 2), indicating that participants who appreciate cultural activities for their own development and psychological well-being were more likely to engage in self-initiated cultural activities. Intrinsic value and the number of canceled planned cultural events had no significant impact on increased engagement in self-initiated cultural activities. This indicates that participants with high intrinsic values for culture and participants with a high amount of canceled cultural events did not increase their self-initiated cultural activities during the pandemic. Gender had a significant impact on self-initiated cultural activities, implying that women engage in more self-initiated activities during the pandemic, when controlled for attainment/ utility and intrinsic values, and canceled planned cultural events.

Table 2. Two Regression Analysis, with Attainment/ Utility Values, Intrinsic Values, Cancelled Planned Cultural Events and Gender as the Independent Variables, and Participation in Digital Cultural Offerings or Increased Engagement in Self-Initiated Cultural Activities as the Outcome.

	Dependent							
	Participation in digital cultural offerings (model 1)				Engagement in self-initiated cultural activities (model 2)			
Independent	β	*SE*	*t*	*p*-value	β	*SE*	*t*	*p*-value
Attainment/ Utility Values	0.140	0.049	2.859	0.004**	0.205	0.048	4.234	0.000***
Intrinsic Values	0.155	0.050	3.116	0.002**	0.015	0.050	0.308	0.758
Canceled planned cultural events	0.100	0.049	2.021	0.043*	0.071	0.049	1.441	0.150
Gender	0.021	0.049	0.428	0.669	−0.171	0.048	−3.531	0.000***

Note. *$p < .05$. **$p < .01$. ***$p < .001$.

Does the Participation in Digital Cultural Offerings and Self-Initiated Cultural Activities Have an Impact on Psychological Well-Being During the COVID-19 Pandemic via Perceived Autonomy and Relatedness, and via Aesthetic Experience (Research Question 3)?

A mediation analyses was carried out (see Table 3, Figure 5) to investigate whether participation in digital cultural offerings and increased engagement in self-initiated cultural activities can increase optimism during the COVID-19 pandemic via aesthetic experience and perceived relatedness and autonomy. The fit of the model was good ($\chi 2 = 3.143$, df = 3, $p = .3701$; RMSEA = 0.011, 90% CI [.000,.087], $p = .708$; CFI = 0.999; SRMR = .013).

As regards to hypothesis 3a, there was a significant total effect of increased engagement in self-initiated cultural offerings on optimism, but not for digital cultural offerings on optimism. Moreover, no direct effect of participation in digital cultural offerings and increased engagement in self-initiated cultural activities on optimism was observed, when controlling for the mediators aesthetic experience, relatedness and autonomy, and gender.

Regarding hypothesis 3b, participation in digital cultural offerings significantly predicted all three mediators, aesthetic experience, perceived relatedness and perceived autonomy. Increased engagement in self-initiated cultural activities predicted the mediators aesthetic experience and perceived autonomy significantly, but not perceived relatedness. This indicates, in line with hypothesis 3b, that participation in digital cultural offerings as well as increased engagement in self-initiated cultural activities were connected with higher perceived autonomy and higher aesthetic experience. As expected, perceived relatedness was only connected to participation in digital cultural offerings. Moreover, the three mediators in the model were significantly correlated with each other (autonomy with

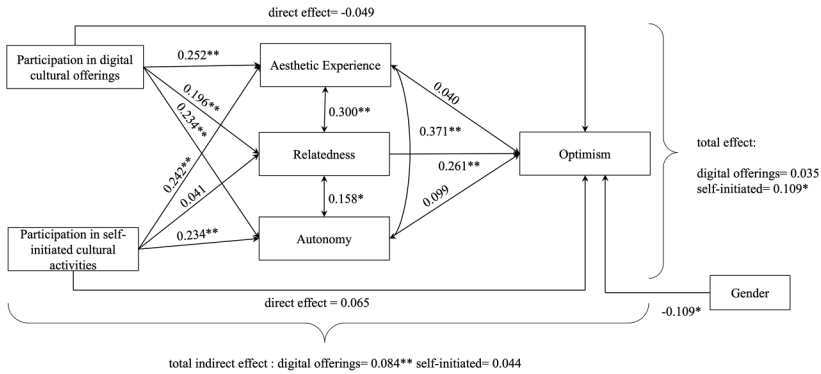

Figure 5. Standardized estimates (ß) of the mediation analysis.
Note: * p < .05. **p < .001.

Table 3. Standard Error (S.E.) and Confidence Interval (C.I.) of the Mediation Analysis.

Mediator	Effect of digital offerings on mediator (b) S.E.	95% CI Lower	95% CI Upper	Effect of self-initiated activities on mediator (b) S.E.	95% CI Lower	95% CI Upper	Unique effect of mediators (c) S.E.	95% CI Lower	95% CI Upper	Specific Indirect Effect of digital offerings via mediator (d) S.E.	95% CI Lower	95% CI Upper	Specific Indirect Effect of self-initiated activities via mediator (d) S.E.	95% CI Lower	95% CI Upper
Aesthetic Experience	0.050	0.153	0.350	0.046	0.151	0.333	0.055	−0.067	0.147	0.014	−0.018	0.038	0.014	−0.017	0.037
Relatedness	0.050	0.097	0.295	0.055	−0.066	0.149	0.053	0.157	0.365	0.017	0.017	0.085	0.015	−0.019	0.040
Autonomy	0.044	0.148	0.321	0.040	0.156	0.312	0.053	−0.005	0.203	0.013	−0.003	0.049	0.013	−0.002	0.048

Independent Variable	Total effect on optimism S.E.	95% CI Lower	95% CI Upper	Direct Effect on Optimism S.E.	95% CI Lower	95% CI Upper	Total indirect Effect S.E.	95% CI Lower	95% CI Upper
Digital offerings	0.054	−0.071	0.141	0.055	−0.157	0.058	0.022	0.042	0.127
Self-initiated activities	0.055	0.001	0.216	0.056	−0.045	0.176	0.022	0.000	0.087

relatedness $\beta = 0.300$, S.E. = 0.044, 95% CI [0.214, 0.387], autonomy with aesthetic experience $\beta = 0.371$, S.E. = 0.044, 95% CI [0.285, 0.457], and relatedness with aesthetic experience $\beta = 0.158$, S.E. = 0.055, 95% CI [0.051, 0.266]).

Hypothesis 3c can be partially maintained, with the mediator perceived relatedness significantly predicting the outcome variable optimism. However, there was no significant effect of perceived autonomy and aesthetic experience on the dependent variable, indicating that only perceived relatedness increased optimism during the pandemic, when the other two mediators are controlled for.

In the path model, the relationship between participation in digital cultural offerings and optimism was significantly mediated by all three mediators (total indirect effect), which can be mostly attributed to the (statistically significant) specific indirect effect of perceived relatedness. There were no significant specific indirect effects of aesthetic experience and perceived autonomy, when all three mediators are included simultaneously. This implies that hypothesis 3d concerning digital cultural offerings is met. Individuals who participate in digital cultural offerings experienced more perceived autonomy and relatedness and aesthetic experiences, and, in turn, were more optimistic about the outcomes of the pandemic, which can mostly be attributed to perceived relatedness.

The relationship between increased engagement in self-initiated cultural activities and optimism was not significantly mediated by the three mediators (total indirect effect), although trending towards significance. There was no specific indirect effect of either aesthetic experience, perceived relatedness or perceived autonomy.

Discussion

The current study aimed to investigate cultural activities during the first pandemic-related restrictions of the COVID-19 pandemic in 2020 in Germany. It examined the use of digital cultural offerings and the increased engagement with self-initiated cultural activities during the pandemic with regard to three research questions: (1) Which kind of cultural activities are performed how frequently during the COVID-19 pandemic? (2) Who is culturally active during pandemic-related restrictions? (3) Does the participation in digital cultural offerings and self-initiated cultural activities have an impact on psychological well-being during the COVID-19 pandemic via perceived autonomy and relatedness, and via aesthetic experience?

Firstly, regarding the frequency of cultural activities during the pandemic-related restrictions, considering all possible self-initiated activities, most participants reported reading more often than before the pandemic. This was followed by producing or creating something. Dancing was the activity that most participants engaged in less often, followed by making music.

These findings mirror the nature of the pandemic-related restrictions, with participants reporting performing the two activities that are typically performed in a group (making music and dancing) less often, indicating that participants did not refer to

engaging in these activities alone. In contrast, activities that can be performed alone were predominantly performed equally frequently or more often.

As regards digital offerings, those associated with movies were used most often, reflecting findings from the Creative Industries Policy & Evidence Centre (August 2020) that found film consumption had the highest increase during the pandemic-related restrictions. Importantly, music and movies were the only two digital offerings that more participants reported using than not using. This indicates that there is clearly an opportunity to strengthen the attractiveness or expand current digital cultural offerings.

As expected in hypothesis 2, participants with high attainment/utility value for cultural activities increased their self-initiated activities and participated in more digital cultural activities during the pandemic. This coincides with the expectancy-value theory (Eccles, 1983), indicating that participants who think of cultural activities as being important and useful still try to engage in these activities during the pandemic. However, intrinsic value of culture did not have any impact on self-initiated cultural engagement but rather influenced participation in digital cultural offerings. This shows that participants who experience lots of enjoyment during cultural activities were more likely to engage in digital cultural offerings, possibly indicating that these participants enjoy cultural activities so much that they actively tried to engage in them in the digital space. For instance, a person that really enjoys going to a specific museum might follow this museum on social media platforms and is therefore more likely to notice and use digital offerings from said museum.

In a similar vein, participants with lots of canceled cultural events also participated in more digital cultural offerings when controlled for intrinsic and attainment/ utility value, as well as gender. This hints at the possibility that prior high cultural engagement might be transferrable into the digital space. For instance, participants that planned a number of museum visits before the start of the pandemic might opt to visit digital museums instead. Therefore, these participants availed of cultural offerings in the same way as before COVID-19, only digitally. In contrast, it appears that most participants did not see participation in self-initiated activities as a good substitute for canceled cultural events. A possible reason for these differential findings is explained below in connection to the findings of relatedness and digital cultural offerings.

Gender had a significant effect on self-initiated activities. This is in line with previous studies. For instance, Upright (2004) found that men's cultural engagement depends on their wives' characteristics, while women's cultural engagement does not dependent on their husbands. Moreover, highbrow culture is more often consumed by women than men (Katz-Gerro, 2002). The reason that gender has no influence on digital cultural offerings could be that these types of cultural activities may be too new to create such an impact, suggesting that everyone is experimenting equally with the relatively new medium.

With regard to research question 3, we found that increased self-initiated cultural activities were altogether connected with more optimism regarding the pandemic, indicated by the expected significant positive total effect, while the total effect for

participation in digital cultural offerings unexpectedly failed significance (3a). The finding for self-initiated activities is in accordance with the literature suggesting that cultural activity results in higher life satisfaction (Cuypers et al., 2012) or sustained happiness (Lyubomirsky et al., 2005). The lack of a total effect for participation in digital offerings can be explained by a (non-significant) negative direct effect from digital offerings on optimism.

Furthermore, as predicted (3b), increased engagement in self-initiated cultural activities led to high aesthetic experience and perceived autonomy and did not increase perceived relatedness. Participation in digital offerings, in contrast, increased aesthetic experience, perceived autonomy and perceived relatedness. This illustrates that aesthetic experiences and basic need satisfaction during the pandemic-related restrictions were possible, either due to self-initiated cultural engagement, or due to digital cultural experiences. The finding that participants report aesthetic experiences while participating in digital cultural offerings has an important implication for cultural players; it shows that their digital offerings still managed to affect people. Moreover, it may be worth consideration for cultural players that have yet to transfer some offerings into the digital space. As an example, 50% of museums reported having no online offerings whatsoever in the first months of the pandemic (ICOM, 2020). The results concerning the impact of both forms of cultural activities on perceived autonomy supports our suggestion that engaging in cultural activities might restore some sort of freedom to choose one's activities according to one's preferences, this being a freedom that the pandemic-related restrictions took away from most people. Previous research has shown that individuals who are autonomously motivated to adhere to the pandemic related restrictions show more compliance to the rules (Guay, Bureau, Boulet, & Bradet, 2021; Morbée et al., 2021). Therefore, providing citizens with opportunities to perceive themselves acting autonomously, for example by providing digital alternatives to common leisure-time activities, might help to ensure that more people adhere to the restrictions.

The distinct results for perceived relatedness, in that it was only increased by digital cultural participation, but not self-initiated activities, demonstrate the connectedness that digital offerings might offer. Although mostly consumed alone, digital cultural offerings allow a connection with other people in a safe, socially distanced way. For instance, live-streaming a band concert connects the viewer in real time not only with the band itself, but also with other viewers as in, for example, via a live-comment section. Correspondingly, Manago et al. (2020) found that communication via digital devices can lead to social stimulation. This is also in line with the finding that students who felt lonely during the pandemic, and thus formed para-social relationships through narrative media, were able to fulfill their needs for relatedness (Sherrick et al., 2021). As mentioned above, the findings regarding relatedness and digital cultural offerings might also explain the differential findings regarding canceled planned cultural events (research question 2). Participants' canceled cultural activities might have been connected to some sort of social happening. Participants with a lot of canceled events due to the pandemic might not regard self-initiated cultural activities

as a substitute for this sort of social happening. Therefore, they rather engage in digital cultural activities, which might entail some sort of social interaction.

Perceived relatedness, in contrast to aesthetic experience and perceived autonomy, increased optimism in participants (3c). This special impact of relatedness on optimism is in line with the finding that, after ten hours of social isolation, the brain craves social interaction similar to craving for food after ten hours of fasting (Tomova et al., 2020). Consequently, participation in digital cultural offerings was connected to more optimism via increased feelings of relatedness (3d), while no specific indirect effects via perceived autonomy or aesthetic experience could be shown. However, as predicted, participation in digital cultural offerings increased optimism indirectly via a common increase of aesthetic experience, perceived autonomy and relatedness (total indirect effect). The findings regarding the impact of digital cultural offerings on optimism mediated by perceived relatedness and autonomy (and aesthetic experiences) are in line with Koehler and Neubauer's (2020) findings which suggest that music making increases positive affect through an increase in the three basic needs autonomy, relatedness and competence. Increased engagement in self-initiated cultural activities, on the other hand, did not result in higher optimism when all three mediators were increased during cultural activities (total indirect effect).

Limitations and Future Directions

Future studies should consider several areas/factors. First, digital cultural offerings and self-initiated activities should be more clearly divided into active and receptive culture (Cuypers et al., 2012). Generally, in the current study, digital offerings included more receptive activities, while self-initiated engagement was more focused on active activities. A clear distinction into receptive and active culture, or an equal distribution of active and receptive culture, might result in more distinctive results, for instance by assessing digital cultural offerings that require an active participation. Second, participants should be asked why they chose not to engage in a digital offering ever again. This might allow for the drawing of inferences about the drawbacks of some digital offerings. Third, we asked about relatedness, autonomy and aesthetic experience in relation to both digital offerings and self-initiated engagement. Future studies may find it more beneficial to ask about relatedness, autonomy and aesthetic experience separately regarding each offering to gain a more precise overview about which offerings influence which mediators. Moreover, the three mediators overlap to some degree, theoretically and statistically: Theoretically, they share some similarities, for example both aesthetic experience and the basic need satisfaction have been linked to the notion of flow (e.g. Wanzer, Finley, Zarian, & Cortez, 2020 for the former; Ilies et al., 2017 for the latter). Statistically, they correlate significantly in our sample. Fourth, the questionnaire was online between 13th of May 2020 until 15th of July 2020. It is important to note that during this time frame, some lockdown restrictions in Germany were relaxed. For example, museums and other cultural institutes reopened from the 30th April 2020 onwards (Presse- und Informationsamt der Bundesregierung, 2020b).

Nevertheless, as mentioned above, relatedness, autonomy and aesthetic experience were asked in relation to digital cultural offerings and self-initiated activities. Therefore, an increase in these items is unrelated to possible physical cultural activities. Large-scale events such as concerts were still forbidden. Fifth, as regards representativeness, sample characteristics revealed that the current sample was predominantly female, middle-aged or older, and highly educated. Specifically, the unequal distribution of male and female participants should be taken into account when interpreting the results, as some of the findings may be particularly true for women. Therefore, the sample might not be representative of the whole population. Lastly, the data was obtained using a cross-sectional design, therefore it would be interesting to see future studies that allow for causal inferences.

Conclusion

The results of the present study show that participation in digital cultural offerings as well as self-initiated cultural activities can fulfill individuals' need for autonomy and relatedness (only when engaging in digital cultural offerings) and can be connected to aesthetic experience. So can the arts cure pandemic hearts? The most efficient buffer regarding worries during the pandemic was the feeling of connectedness to other people in the form of relatedness during digital cultural offerings. These findings advocate for the importance of staying connected to others during national pandemic-related restrictions, and show that engagement in digital cultural offerings might be a small antidote to the social cravings during a worldwide pandemic.

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7.2 Article 2

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Can Virtual Art Touch Your Heart?—The Impact of Virtual Reality Art on Affect Considering Individual Characteristics and Aesthetic Experiences

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Abstract

Since the dawn of digital art, discourse regarding its potential persists. This research investigates how a virtual reality (VR) art gallery impacts positive and negative affect, examining the influences of aesthetic experiences and individual characteristics. It explores the connection between measures of aesthetic experiences (self-assessed, heart rate, and heart rate variability) and how gender influences this relationship. Digital art's beneficial effect is indicated by decreased negative affect after visiting the VR gallery, potentially influencing mental wellbeing. Individual characteristics influence this impact on affect after the VR experience, especially openness to experience and affect before the visit, mediated by aesthetic experience, and expertise mediated by heart rate. The findings highlight the potential impact of gender on subjective interpretations of physiological responses in the VR environment. Specifically, women tend to attribute heightened heart rate, a sign of arousal, while men associate increased heart rate variability, a sign of relaxation, to positive experiences in the VR.

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aesthetic experience, virtual reality, heart rate, heart rate variability, wellbeing, openness to experience, expertise, affect

Introduction

Digital Art and Affect

The long-standing debate on whether digital art viewing can replace traditional analog viewing, or if digital art forms can be considered "real" art at all, gained significance during the COVID-19 pandemic. Almost all cultural institutions, such as museums or galleries, were forced to close, or operate at limited capacity (International Council of Museums, 2020). To compensate for this loss of real-life cultural experience, participation in digital cultural offerings increased significantly during the COVID-19 pandemic (Creative Industries Policy & Evidence Centre, 2020). According to an ICOM report in May 2020, 16% of museums were increasing their online exhibitions at that point in the pandemic (International Council of Museums, 2020). Subsequently, the ICOM stated that museums' digital cultural offerings have increased by at least 15% since the last report, with an even higher increase of up to 50% in terms of social media or other online events (International Council of Museums, 2023). As a result, the debate regarding the purpose and significance of this art form has once again grown louder. Indeed, some voices argue digital art cannot replace traditional art because "it remains virtual without any physical basis" (Trinks, 2020, p. 3). Other studies suggest that, while digital reproductions of paintings can be as exciting as original artworks, they cannot replace the hedonistic values that traditional art provides (Siri et al., 2018). On the other hand, studies also found no differences in pleasure and preferences when comparing the viewing of artworks on a desktop virtual reality (VR), in a head-mounted VR, and in the original form, except for the most popular artworks based on the medium (Lin, Chen, & Lin, 2020).

Regardless of whether digital and analog art trigger identical emotions, art in both forms can have a positive effect on mental wellbeing. Cultural activities have been linked to greater mental and physical health (Cotter & Pawelski, 2022; Cuypers et al., 2012; Fancourt & Steptoe, 2019; Väänänen et al., 2009), more resilience (Chen et al., 2022), and an increased sense of relatedness, which has been linked to increased optimism during the pandemic (Gotthardt et al., 2023). In this study, we examine positive and negative affect as an integral facet of mental wellbeing (Diener, Smith, & Fujita, 1995; Diener, Suh, Lucas, & Smith, 1999; Thapa et al., 2023). Positive affect encompasses emotions like excitement, interest, and enthusiasm (Breyer & Bluemke, 2016). These emotions also play a pivotal role in the concept of flourishing—a multifaceted notion tied to quality of life (Thapa et al., 2023). Conversely, negative affect, which embodies emotions such as guilt, distress, and

fear (Breyer & Bluemke, 2016), can impede the journey to flourishing, leading to "ill-being" opposed to "well-being" (Cotter & Pawelski, 2022). Delving deeper into the dynamics between affect and wellbeing, the Broaden and Build Theory (Fredrickson, 2013) posits that frequently experiencing positive affect leads to an increase in resources by "broadening" ones thought repertoire, leading to improved wellbeing. Therefore, in the sphere of art-related experiences, art can enhance mental wellbeing by increasing positive emotions and decreasing negative emotions. In this study, positive and negative emotions are assessed using the Positive and Negative Affect Schedule (Watson et al., 1988), thus from here on we refer to the concept of positive/negative emotions or mood as affect. Multiple studies have found that exposure to analogous art in hospitals can increase positive affect (Ho, Potash, Fang, & Rollins, 2015; Paddon et al., 2014). Additionally, in two studies conducted by Trupp et al. (2022) and Trupp et al. (2023) participants reported, among other things, decreased negative affect and enhanced wellbeing after a brief exposure to digital art. Similarly participants exposed to a VR art installation in a study by Nisi et al. (2017) reported high positive affect.

An especially promising way to experience art in digital space is through the use of VR. VR provides a three-dimensional experience that aims to realistically replicate the analog world, offering a comparable aesthetic and physical encounter to traditional cultural activities. This technology allows viewers to explore artworks from all angles, potentially leading to works of art being valued more in VR (Usui, Sato, & Horita, 2018), as for example on a two-dimensional (2D) computer screen. Researchers recognized the value of VR in art as early as 1992 when attempts were made to discover how VR could "achieve its promise as a rich and popular artistic form" (Bates, 1992, p. 133). Antonietti and Cantoia (2000) compared mental processes involved when viewing 2D paintings versus those occurring when viewing VR paintings. The findings revealed that the participants viewing the VR paintings adopted a meta-perspective, thinking more abstractly and elaborating more imaginatively on the paintings. This suggests that different ways of interacting with the world in VR can encourage different cognitive activities compared to the "analogue" world (Antonietti & Cantoia, 2000). Consequently, art in VR should not necessarily be seen merely as a substitute for analog culture, but as an opportunity to expand experiences. Therefore, even in times when access to analog culture is fully available, the purpose and significance of VR art remain intact. Here, the influence of digital art in the form of a VR gallery on affect is examined, and it is assumed that visiting the gallery has a positive influence on affect (RQ1).

Aesthetic Experiences During Digital Art Viewing

Aesthetic experiences play a pivotal role in the mechanisms that unfold when encountering art. When confronted with an aesthetic stimulus, such as an artwork, individuals can undergo these experiences such as chills, awe, feeling touched or forgetting one's own surroundings (Silvia & Nusbaum, 2011). Aesthetic experiences can be described

as "an exceptional state of mind in which a person is focused on a particular object, transcending its everyday uses and meanings and losing the awareness of surroundings and even of himself/herself; in this state a person can have an exceptional emotional experience, that is a feeling of unity with the object" (Marković, 2010, p. 47).

There is a growing body of literature that recognizes the importance of psychophysiological measurements when assessing aesthetic experiences. Self-assessed aesthetic experiences were shown to correlate with psychophysiological responses, as for example changes in heart rate (HR) and heart rate variability (HRV) (Menninghaus et al., 2019). HR refers to the number of heart beats per minute, and is therefore synonymous with the notion of "Beats per Minute" (Gramann & Schandry, 2009). HRV is the standard deviation of the time between two consecutive heartbeats, also called Inter-Beat-Interval (Gramann & Schandry, 2009). Tschacher et al. (2012) conducted a study in which participants were allowed to move around freely in a museum. They employed psychophysiological measurements such as HR and HRV to compare these parameters to self-assessment of aesthetic experiences. They found that HR was positively related to self-assessment of curative quality, and HRV was positively related to aesthetic quality. Thus, the study concluded that there is a relationship between self-assessed aesthetic experiences and psychophysiological parameters.

A higher HR is generally associated with arousal, and associated emotions such as joy, but also anger and fear (Tschacher et al., 2012). This link between arousal and aesthetic experiences (Berlyn, 1971) suggests that an increase in HR while viewing an artwork might indicate aesthetic experiences.

Findings suggest that in general, higher HRV is linked to better physical, as well as mental health (Shaffer, McCraty, & Zerr, 2014). Aside from this long-term impact, high HRV is associated with a more positive and receptive state (Stürmer & Schmidt, 2014) and is related to positive mood (Kop et al., 2011). When comparing HR and HRV during baseline versus viewing time, Krauss et al. (2021) found that HRV, as calculated by the Root Mean Square of Successive Differences (RMSSD, explained in detail below), was higher during the viewing of artworks than during baseline. Moreover, high HRV is related to artworks that are "beautiful, high-quality" and "surprising/ humorous" (Tschacher et al., 2012, p. 102). Therefore, an increase in HRV might lead to higher self-assessed aesthetic experiences.

Previous research has established that women on average report more aesthetic experience (Silvia & Nusbaum, 2011), and are more physically responsive to aesthetic stimuli (Benedek & Kaernbach, 2011; Quesnel & Riecke, 2018), as discussed in more detail below. This indicates that if women experience higher HR or HRV while viewing a painting, this responsiveness might translate into higher reports of aesthetic experiences after the VR gallery experience. This study sets out to explore whether the two types of aesthetic experiences (psychophysiological reactions and self-assessed) are related, specifically, whether high HR and HRV leads to higher self-assessed aesthetic experiences after the VR (RQ2). Moreover, the study investigates the influence of gender[1] on self-assessed aesthetic experience, and the influence of gender on the relationship between HR/HRV and aesthetic experiences.

The Role of Individual Characteristics on Aesthetic Experience

It has previously been observed that certain individual characteristics have an impact on the occurrence and intensity of aesthetic experiences. Firstly, expertise is a principal determining factor of aesthetic experiences. Expertise in the arts, or aesthetic fluency, is considered as "the knowledge base concerning art that facilitates aesthetic experience in individuals" (Smith & Smith, 2006, p. 50). Expertise might help to classify the style, content, and interpretation of an artwork, which can lead to a more rewarding outcome (Leder, Belke, Oeberst, & Augustin, 2004). In a similar vein, Reber, Schwarz, and Winkielman (2004) concluded that higher fluency in the processing of artworks is linked to higher gratification. Differences in art processing between experts and lay persons can also be seen in differences of gaze patterns when confronted with paintings (Pihko et al., 2011; Tallon et al., 2021). These differences in processing might also translate into psychophysiological states, as Silvia and Nusbaum (2011) found that people with high art expertise experience aesthetic chills more regularly. However, as mentioned, cognitive processes in VR can differ from the processes that arise in the "real" world (Antonietti & Cantoia, 2000). Therefore, this study intends to determine the extent to which art expertise still influences aesthetic experiences (psychophysiological and self-assessed) in this new context (RQ3a).

Another individual characteristic that numerous studies have shown to influence aesthetic experiences is openness to experience (from here on also referred to as openness). Similar to expertise, this personality trait (John & Srivastava, 1999) is linked to higher rates of psychophysiological responses to art, such as experiencing aesthetic chills (Čukić & Bates, 2014; McCrae, 2007; Silvia & Nusbaum, 2011). When confronted with artworks, people high in openness experience higher arousal, interest, and pleasure, especially when the artworks are high in novelty (Fayn, MacCann, Tiliopoulos, & Silvia, 2015). This link between openness, novelty, and pleasure might suggest that, particularly in the VR environment, where experiencing art in this way is inherently new for most people, subjects with high levels of openness might encounter greater aesthetic experiences. The link between openness and visitor behavior in an online virtual gallery was examined by Rodriguez-Boerwinkle and Silvia (2022). Openness to experience predicted most of the visitor behaviors, such as time spent in the gallery and in front of the artworks and distance traveled in the gallery. The authors concluded this might indicate that people high in openness experience more immersion in the virtual gallery. Previous research has established a link between immersion in a mediated environment, that is, absorption and thereby a sense of presence and focus in those environments, and openness (Weibel, Wissmath, & Mast, 2010). Considering the connection between openness and frequent aesthetic experiences, as well as the link between openness and immersion in digital (art) experiences, and the degree of novelty of these experiences, it is assessed whether people with high openness undergo more aesthetic experiences (psychophysiological and self-assessed) in the VR gallery (RQ3a).

Besides individual characteristics such as openness and expertise, there seems to be some evidence that the affective state can also influence whether and how intensively

aesthetic experiences occur. Dispositional positive affect was shown to be related to the intensity of aesthetic experiences (Weigand & Jacobsen, 2023). Belke, Leder, and Augustin (2006) found that stylistic descriptions of paintings led to increased appreciation when subjects had high levels of positive affect. As mentioned above, classification of the style and content of an artwork, as well as its interpretation, can lead to more rewarding outcomes, and thus a heightened aesthetic experience. Positive affect seemingly positively influences these cognitive processes (Leder et al., 2004). In a similar vein, Konečni and Sargent-Pollock (1977) examined aesthetic judgment after manipulating a positive or a negative mood in participants and found that subjects who were in a more positive mood also rated paintings more positively. In their model of aesthetic experiences, Leder et al. (2004) also included affective state prior to the aesthetic experience, and suggested that affective state should be considered in psychological experiments because of its possible influence on aesthetic experience. Therefore, part of the aim of this study is to explore whether higher affect prior to the VR experience leads to more intense aesthetic experiences (psychophysiological and self-assessed) during the gallery visit (RQ3a)

The Impact of Aesthetic Experiences on Affect

Aesthetic experiences have been instrumental in our understanding of the relationship between exposure to the arts and mental wellbeing. As previously discussed, art consumption, and general engagement in cultural activities is linked to an increase in positive affect (Cuypers et al., 2012; Fancourt & Steptoe, 2019; Gotthardt et al., 2023; Väänänen et al., 2009). One reason for this could be aesthetic experiences during these activities. The (aesthetic) emotions that might be experienced during these experiences are mostly positive, largely independent from the content of the artwork that inspired such emotions (Menninghaus et al., 2019). In connection with their model of aesthetic experience, Leder et al. (2004) proposed that this positivity-bias might explain "an increase in positive affect after the processing of an artwork" (p. 494). In a similar vein, Mastandrea, Fagioli, and Biasi (2019) suggest that experiencing aesthetic experiences can evoke positive emotions, which in turn increase positive affect. Chills, which belong to a family of states that are said to be "unusual" (Silvia & Nusbaum, 2011, p. 208) were shown to predict positive affect in a diary study (Maruskin, Thrash, & Elliot, 2012). In the study concerning brief exposures of digital art previously mentioned, the changes in affect due to the exposure correlated with the aesthetic appraisal of the art (Trupp et al., 2022). In the follow-up study, Trupp et al. (2023) proposed the possibility that trait aesthetic responsiveness influences art experiences during the viewing of digital art, which then influences affect. They indeed found affect was influenced by aesthetic responsiveness, which is composed by, among other factors, the ability to experience intense aesthetic experiences. The researchers also found that this link was mediated by the liking and meaning attributed to the digital artworks. While Trupp et al. (2022, 2023) primarily found influences on negative affect, this study will focus on the relationship between aesthetic experiences and positive affect,

given the aforementioned research and theories on this topic. Therefore, this study sets out to assess whether intense aesthetic experiences (psychophysiological and self-assessed) during viewing of the artworks leads to higher positive affect after VR (RQ3b).

Due to existing literature suggesting different frequency and intensity of aesthetic experiences, as well as differences in participation in cultural activities based on gender, gender was selected as a moderator of this relationship. Research has found that women tend to consume highbrow[2] cultural activities more often than men (Katz-Gerro, 2002) and have a stronger influence on their husbands' participation in cultural activities than the reverse (Upright, 2004). During the COVID-19 pandemic, women were also more likely to engage in self-initiated cultural activities, that is, activities that do not require an external offer, such as reading a book (Gotthardt et al., 2023), albeit gender had no influence on coping with the restrictions experienced during lockdown (Frick et al., 2023). Regarding aesthetic experiences, Silvia and Nusbaum (2011) found that women scored significantly higher on the Aesthetic Experiences Scale in general, and significantly higher on the "Touched" subscale. Furthermore, other studies showed similar differences in gender, with women exhibiting chills more frequently than men (Benedek & Kaernbach, 2011). This reinforces the idea that women may be more physically responsive to aesthetic stimuli. Moreover, research shows that chills occur more frequently in women during VR experiences, further supporting the choice of gender as a moderator in the VR environment (Quesnel & Riecke, 2018). Therefore, the observation that women participate more often in cultural activities might be because they experience aesthetic experiences more frequently in line with the motivational approach tendencies of aesthetic experiences (Menninghaus et al., 2019). This would also suggest that the connection between aesthetic experiences and affect is higher in women than in men, since a higher positive affect would increase these approach tendencies. Taken together, these points suggest that gender may serve as a relevant moderator in the relationship between aesthetic experiences (psychophysiological and self-assessed) and positive affect after VR (RQ3c). Further, considering the influence of openness, expertise, and affect prior to exposure to art, we explore whether individuals with higher levels of these characteristics experience heightened positive affect after engaging with VR, as a result of stronger aesthetic experiences (RQ3d).

Purpose of the Present Study and Research Questions

In this study, a VR exhibition was developed, exhibiting 10 digitalized pictures of an artist. The aesthetic experience of participants was evaluated through questionnaire items and psychophysiological responses as they observed the paintings. Eye-tracking was utilized to pinpoint the instances when participants focused on the artworks. Subsequent research questions were posed:

1. Does digital culture in the form of a visit of a VR gallery impact positive and negative affect?

   We expect that visiting the VR gallery will lead to an increase in positive affect and a decrease in negative affect.

2. Are psychophysiological measurements of aesthetic experience related to self-assessed aesthetic experience in a VR gallery setting?

   We expect that a higher HR and HRV during viewing time of the artworks leads to higher self-assessed aesthetic experience after the visit of the virtual gallery. Moreover, we expect that this relationship is stronger in women.
3. Do individual characteristics influence positive affect via more intense aesthetic experiences?
   (a) We expect that participants who score higher on openness to experience and expertise, as well as positive affect prior to the study, report more intense aesthetic experiences (measured by questionnaire [model 1], HR [model 2], and HRV [model 3]) (a-Path of the mediation model).
   (b) We expect that participants who show or report more intense aesthetic experiences (measured by questionnaire [model 1], HR [model 2], and HRV [model 3]) report higher positive affect after VR experience (b-path of the mediation model).
   (c) We expect that this relationship between aesthetic experiences and positive affect after the VR experience is influenced by gender, assuming that the connection is stronger in women.
   (d) We expect an indirect positive effect of the individual characteristics (openness, expertise, and positive affect prior to VR) on positive affect after VR experience, mediated by aesthetic experiences (measured by questionnaire [model 1], HR [model 2] and HRV [model 3]). Participants with high openness to experience and expertise, as well as positive affect prior to the study, are expected to show more intense aesthetic experiences, which then results in higher affect after the VR experience (indirect effects).

The study is part of a controlled experiment that aimed to investigate the influence of setting and individual characteristics on the impact of digital culture. This was done using a $2 \times 2 \times 2$ factorial experimental design, where the following factors were manipulated: the artist's origin (half of the participants were shown a video portraying an urban background of the artist; the other half viewed a video portraying a rural background), the type of information accompanying the paintings (half of the participants read informational texts for each painting containing formal-stylistic descriptions, the other half read affective descriptions) and the social presence in the VR (half of the participants were able to communicate with other people in the VR via a guestbook, the other half was unable to communicate). The allocation of participants into the resulting eight groups is depicted in Figure 1. These differences in the setting, as well as the corresponding questionnaire-items, are only briefly mentioned here as they are not the subject of this article and will be addressed in future publications.

Methods

The present study is part of a project funded by the Federal Ministry of Education and Research[3] and was approved by the responsible Ethics Committee on 29 November 2021. It was registered at the Open Science Framework.[4]

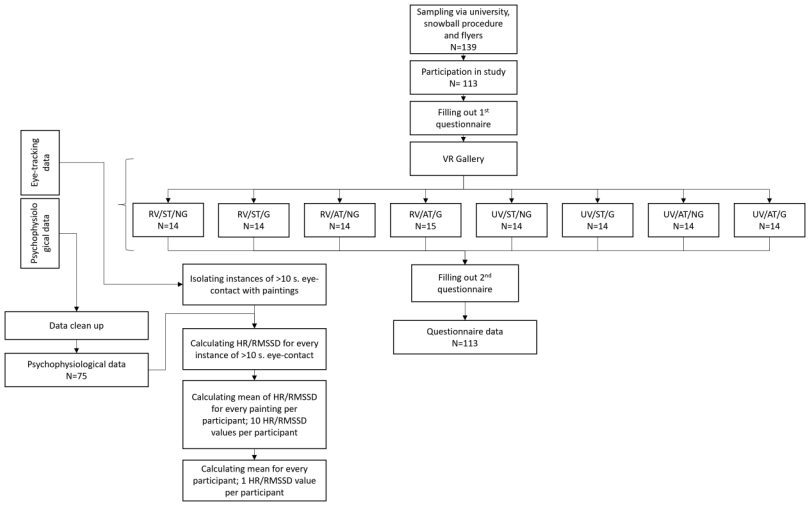

Figure 1. Composition of the final sample size for questionnaire and psychophysiological data, allocation across the eight groups of the 2*2*2 design, and calculation of HR/RMSSD values for >10 s. intervals.
Note: AT = Affective Text; G = Guest Book; HR=heart rate; NG = No Guest Book; RMSSD=Root Mean Square of Successive Differences; RV = Rural Vide; ST = Stylistic Text; UV = Urban Video.

Sampling

Probands from our host institution were contacted via the university mailing list. Flyers were distributed in nearby cafés and small galleries, to attract art-interested volunteers. Moreover, the researchers utilized a snowball sampling procedure, reaching out to people within their personal social circles, who subsequently shared the survey with others. Due to these varied sampling strategies, there is potential for ecological validity in the sample. Enrollment was completed using a short online questionnaire, which was then followed by a schedule of available time slots. Participants registered for their appointments via e-mail and received an information leaflet and the informed consent form.

Sample Size

A chart that depicts the formation of the final sample size for the questionnaire and psychophysiological data, as well as the allocation across the eight groups of the 2 $\times 2 \times 2$ design mentioned above, can be found in Figure 1.

To test effects in the $2 \times 2 \times 2$ design, a minimum sample size of $N = 90$ was calculated. This calculation was performed to achieve 80% power, with a medium effect size $f = 0.3$ (Cohen, 1988), and an error probability of $\alpha = 0.05$, using G*Power

(Faul, Erdfelder, Buchner, & Lang, 2009). Assuming a missing-at-random 25% dropout rate of participants regarding the psychophysiological measurements,[5] N was increased to 113 participants.

After data collection the Kubios software (Kubios Oy, 2022) was used to detect noise or artifacts in psychophysiological measurements. First, whole recordings with more than 15% noise and more than 4% corrected beats[6] were entirely excluded from further analysis and 30 participants were excluded this way, in line with the expected dropout rate. For the remaining subjects, individual episodes were examined for noise and artifacts. In the software, noisy data was excluded from the analysis. In addition, HR and HRV data were only calculated from when there were at least 10 beats (Kubios, 2022). Therefore, the software did not calculate episodes where there was noise, since due to the shortness of the episodes, noisy episodes did not pass the 10-beat threshold.

Moreover, during five recordings, the Biotrace + software experienced unexpected interruptions, and the affected participants were excluded to ensure a comprehensive analysis of the entire experience for every participant. Since the HR was normalized, outliers were controlled for. Three participants had a very high HR during the baseline measurement compared to the VR gallery. This could be due to nervousness during the baseline measurement. These individuals were deemed outliers by calculating the upper and lower bounds using the interquartile range and the quartiles of the data. These three participants were excluded, resulting in a final sample size of $N = 75$ for HR/HRV analysis. As a result, $N = 113$ subjects (78% female) were used for the research question that only concerned variables that were collected with the questionnaire, and $N = 72$[7] subjects (78% female) for research questions that also concerned the HR/HRV parameters.

Procedure

On arrival the procedure was briefly explained. After the first questionnaire was completed, the participants were connected to the Nexus (Mind Media, 2018) device. The nondominant arm was placed on an armrest provided for this purpose, and the participants were asked not to move their arms. A baseline was measured for 2 minutes before the structure of the gallery was explained. After placing the VR glasses on the participants' head, the visual acuity was correctly adjusted, and the eye tracking and height was calibrated and adjusted using SteamVR (Valve Corporation, 2022). Afterwards, the participants were taken to a VR rehearsal room where they could practice moving around in VR. Movement in VR was accomplished using the point-and-teleport technique, where participants could point to a position in the space and then teleport to it. This type of movement was chosen because it is considered one of the least nauseating in VR (Buttussi & Chittaro, 2021). However, to allow sensitive changes in position, the joystick could also be used to move backwards. Once the rehearsal was completed, participants entered the virtual gallery. There, they first watched a video about the artist's life (as briefly mentioned above) in the entrance area.

After finishing the video, the doors to the exhibition rooms opened and the participants were allowed to move around freely. During the tour of the gallery, participants were instructed to speak as little as possible so as not to construe the psychophysiological parameters. However, if they did speak or other interferences (e.g., a loud noise) occurred, it was marked in the psychophysiology software. Once participants wanted to end the VR experience, they told the researcher, who then removed the glasses and released the person from the device. Finally, the second questionnaire was completed.

VR Set-Up

The gallery was created with Unity (Unity Technologies, 2022) and launched via SteamVR (Valve Corporation, 2022). Using SteamVR, the height of the subjects was adjusted, and the eyes were calibrated for eye tracking. Eye tracking was done via SRanipal (VIVE Developers, 2023).

Curatorial Arrangement in the VR Gallery

The paintings were painted by the artist Pritte Laschat (1904–2002) and were kindly made available to the researchers by his family. On the one hand, the artist's paintings were selected because personal contact with the Laschat family enabled access to the paintings. The artist was also chosen due to his exploration of various artistic styles throughout his career. An art historian selected the paintings for display and had thus a range of artistic styles at his disposal. A variety of different styles were chosen, as the aim was not to examine the distinct impact of each of the 10 paintings, but rather to generalize the findings to a broader population of paintings. Therefore, the selection was made to ensure a representation of different styles, moving away from a fixed effect associated with any particular painting, to a more random selection that could provide insights applicable to a wider range of artworks. After selecting the ten paintings, a curator was tasked with choosing how to hang the paintings in the gallery. The paintings were displayed at a consistent height, with their centers aligned to a uniform level above the ground. Since the paintings have very different formats, it was decided not to use a top edge or bottom edge hanging. A lot of space was left between the works because the accompanying texts should be easy to read, and each work should stand on its own. Excerpts from the gallery can be seen in Figure 2.

Figure 3 shows a floorplan of the gallery. The gallery encompassed an entrance area where participants started at the point between the four boxes F2, E2, F3, and E3 (marked by black box). The video and guest book (see "Purpose of the Present Study and Research Questions" section) were displayed here. The paintings were hung in two rooms of equal size, with five paintings depicted in each room. All 10 paintings can be found in Supplemental Appendix 3, along with the height and width of the paintings, which have been translated into the digital world at a 1:1 scale.

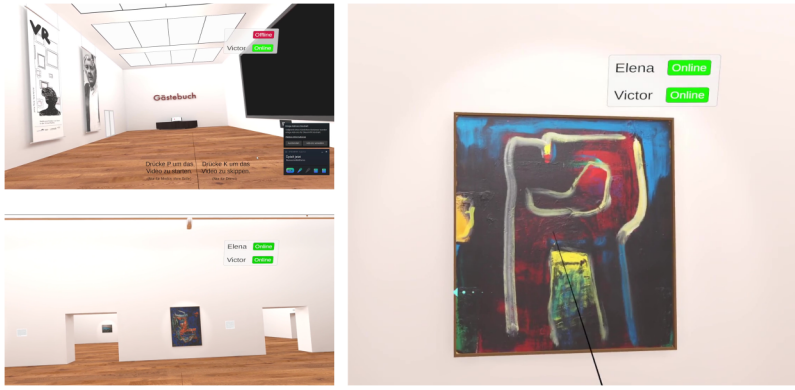

Figure 2. Excerpts from the VR gallery. Top left: Entrance area including guest book (straight ahead, "Gästebuch") and video (right wall). Bottom left: Exhibition room. Right: Painting in the exhibition room. VR=virtual reality.

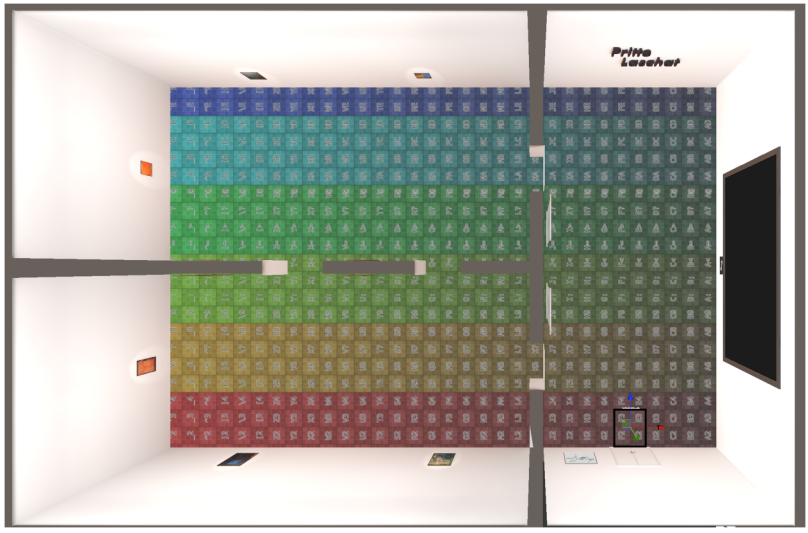

Figure 3. Floorplan of gallery and position of paintings, floor depicted as a grid.
Note: One box ≈ 1 m. Given the way the floorplan is depicted, the paintings on the middle wall appear as thin lines (one side of this middle wall can be seen in Figure 2, bottom left).

Measures: Questionnaire

The following variables were collected using two questionnaires (one prior to and one after the VR experience). All built scales are considered as manifest variables.

Affect. Affect was measured prior to and after the VR experience. The German version of the PANAS (Breyer & Bluemke, 2016) was used. The 20-item scale assesses positive and negative affect. Items are rated on a five-point Likert scale, ranging from "not at all" to "extremely." Four scales were built: Positive affect prior to the experience ($\alpha = .764$), positive affect after VR experience ($\alpha = .883$), negative affect prior to the experience ($\alpha = .765$), and negative affect after VR experience ($\alpha = .686$).

Self-Assessed Aesthetic Experience. Self-assessed aesthetic experience was measured after the VR experience. A German translation (Gotthardt et al., 2023; $\alpha = .906$) of the Aesthetic Experiences Scale (Silvia & Nusbaum, 2011) was used. The 10 items are rated on a five-point Likert scale ranging from "never" to "always." Cronbach's alpha in the current sample indicated good internal consistency ($\alpha = .821$).

Art Expertise. Expertise was measured on a 10-item scale by Smith and Smith (2006). The items consist of artistic terms and artists. Participants assess how well they know these terms and artists on a five-point Likert scale, ranging from "I've never heard of this artist or term" to, "I can speak intelligently about this artist or idea in art." Cronbach's alpha in the current sample indicated satisfying internal consistency ($\alpha = .786$).

Openness to Experience. The subscale openness to experience of the Big Five Inventory by Lang, Lüdtke, and Asendorpf (2001) was used. The 10 items are measured on a five-point Likert scale, ranging from "not applicable at all" to "very applicable." Item 9 was not included in the scale since the item-total correlation (corrected for overlap) was merely 0.12.[8] In the current sample, the items Cronbach's alpha indicated good internal consistency ($\alpha = .79$).

Sociodemographic Variables. Gender was initially categorized into three groups: female (1), male (2), and diverse (3). However, since no participants indicated "diverse," this option was omitted from the analysis. Consequently, the binary variable was recoded for ease of interpretation, with 0 representing female and 1 representing male. Further sociodemographic variables included employment (student [school], in training, student [university], employee, civil servant, self-employed, unemployed/job seeker, other [open format]), age (measured in intervals) and living environment (rural/municipality, small town or medium-sized city, suburban/"urban sprawl" around a major city, major city).

Psychophysiological Measurements of Aesthetic Experiences

Psychophysiological signals were recorded using the Nexus-10 MKII device and Biotrace + software (Mind Media, 2018). HR and HRV were measured using a blood-volume-pulse detector (BVP). With a BVP device, the HR is measured via the expansion of the peripheral blood vessels (Gramann & Schandry, 2009). When, as in this case, the BVP device is attached to the finger, the device emits an infrared

light on one side of the finger, and on the other side measures how much light has passed through the finger. The individual heartbeats can be derived from the level of absorption of the light (Mind Media, 2018). The sampling rate was 256 samples per second.

Isolating the Instances of Eye-Contact With Paintings. Eye and head movement were recorded using VIVE Pro eye-tracking software (VIVE Developers, 2023). In addition, the participants' positions in the gallery were recorded. These three parameters were recorded at a sampling rate of 90 samples per second.

Eye-tracking was employed to precisely capture the moments when participants looked at the paintings. This is crucial as the HR and HRV variables analyzed here are reflective of these specific instances, rather than the overall HR/HRV throughout the entire visit. The primary objective was thus to capture each instance where a participant looked at an artwork or its accompanying informational text for a duration exceeding 10s.

The length of the episodes used to calculate the HR and HRV were set at a minimum of 10s due to the nature of the design. The participants could move around freely and decide on their own how long they viewed an artwork. To achieve valid comparisons between episodes, it is necessary to determine the duration of episodes based on the shortest distances, to ensure that each episode is of the same length. After careful consideration, 10s intervals proved to be the most suitable length for calculation. This choice allows for the inclusion of the majority of episodes. Additionally, empirical studies suggest that 10s intervals are effective for conducting HR and HRV studies. The Root Mean Square of Successive Difference (RMSSD) is an HRV parameter that reliably assesses HRV from ultrashort episodes, such as 10s, in that it correlates with the assessment of longer intervals (McNames & Aboy, 2006; Nussinovitch et al., 2011; Salahuddin, Cho, Jeong, & Kim, 2007; Thong et al., 2003) Therefore, RMSSD was chosen as the HRV parameter, but to prioritize seamless reading fluency, the term "heart rate variability" is predominantly employed here. Regarding HR, 10s measurements also seem to correlate with longer measurements (Salahuddin et al., 2007; Shaffer, Shearman, & Meehan, 2016).

For each instance where a participant looked at an artwork or its accompanying informational text for a duration exceeding 10s, the participant's HR and HRV were calculated. The subsequent sections provide a detailed description of the process, starting from the isolation of the 10s intervals of eye contact and ending with the computation of the HR and HRV of these intervals. The process is also roughly outlined in Figure 1.

Structure of eye-tracking data. After ending the VR session, a file was automatically generated with the x, y, and z coordinates of the eye and head-tracking parameters, and x and y coordinates of the position tracking parameters. The generated file automatically translated the coordinates into their corresponding objects for eye and head-tracking (e.g., Wall, Painting 1…) and positions for position-tracking (e.g., Video room) in the VR. The translation of the coordinates into their corresponding objects and positions is illustrated in Table 1. In this example, the participant's head and eye-tracking coordinates reveal that he or she looked at the video ("Object"), while the position coordinates reveal that the participant stood in the video room at

Table 1. Coordinates of Position, Eye-Tracking and Head-Tracking.

Time	Object	Head_x	Head_y	Head_z	Eye_x	Eye_y	Eye_z	Position	Playercoord_x	Playercoord_z
00:01:08	Video	−1.82	1.75	8.13	4.9	3.2	7.4	Video Room	−1.78	8.14
00:01:08	Video	−1.82	1.75	8.12	4.9	3.2	7.4	Video Room	−1.78	8.14
00:01:08	Video	−1.82	1.75	8.12	4.9	3.1	7.2	Video Room	−1.78	8.14

Table 2. Aggregated Data Table With Identified Episodes.

InitTime	Tag	Duration
00:14:21	InfoCard Painting 10	5
00:14:26	Painting 10	1
00:14:29	InfoCard Painting 10	20
00:14:49	Painting 10	11
00:15:00	Wall	1
00:15:01	Painting 3	4
00:15:02	Wall	1
00:15:03	Painting 3	5

that time ("Position"). The three rows in the table display the nonaggregated data, hence three samples of 90 samples per second are represented. Thus, there are only minimal changes to be observed, particularly in the head's position along the z-axis, showing slight movement during this brief period.

Aggregation of the eye-tracking data. To isolate instances of eye contact with the paintings, the coordinates, and corresponding objects of the eye-tracking data were used. However, before identifying the moments of eye contact, the data were aggregated, using the R-Software (R Core Team, 2016). As mentioned, coordinates at a rate of 90 samples per second were sampled. We consolidated this data to retain only one set of coordinates and its corresponding object for each second, selecting the set of coordinates that occurred most frequently within the 90 samples of this second. Subsequently, all consecutive seconds in which an object was looked at were added up, resulting in a table which contained the time in hh:mm:ss (starting time: 00:00:00), the object (tag), and the length of time the participant looked at the object (duration) (see Table 2; for further details see Supplemental Appendix 1).

Identifying minimum of 10s episodes. Using the aggregated eye-tracking data, only episodes were chosen where a painting or its corresponding informational text was viewed for more than 10s. A single artwork (or accompanying text) might be associated with multiple 10s observational episodes. This arose when a participant engaged with an artwork for a duration exceeding 10 s, subsequently shifted their attention to another object, and then re-engaged with the initial artwork for another period surpassing 10 s. Therefore, a single painting, viewed by one participant, could yield multiple episodes. The episodes were named according to the order in which they were viewed (e.g., "Information Text 1 after Painting 1"; see Supplemental Appendix 1).

Deletion of episodes with interferences. Next, it was essential to avoid episodes with interferences. During the VR visit, the researcher marked any interferences that occurred, such as loud noises from outside, participants talking, etc., in the software. Episodes containing such interferences were omitted from further processing and were excluded from the dataset.

Choosing the final episodes. If several episodes of the same event remained (e.g., twice: Image 1 after Information Text 1), the episode that came first was selected.

The reason for not simply averaging these episodes was to ensure that each event consists of exactly one corresponding episode.

Calculating the Heart Rate and Heart Rate Variability Using the Isolated Instances of Eye Contact With Paintings

After instances of eye contact were obtained, the resulting episodes, and the BVP data of all participants, were read into the Kubios HRV Scientific Software (Kubios Oy, 2022). To normalize the HR data, 10s episodes of the baseline measurement were also collected. The software was then used to detect noise or artifacts, described in the "Sampling Size" section, and the HR and HRV of every episode of eye contact was calculated.

After obtaining the HR and HRV for each painting and informational texts, these parameters were once again loaded into the R-Software. There, the HR was normalized by subtracting the HR measured at baseline from the different episodes, as in Siri et al. (2018).[9] As noted, given that participants looked at each artwork multiple times, this resulted in several HR/RMSSD values for each painting per participant. For each participant and each painting, we averaged these HR/RMSSD values. This process ensured that for every participant, we had one HR and one RMSSD value for each of the 10 paintings. We then further averaged these 10 values for each participant. This provided us with a single HR and RMSSD value for each participant, representing their average response across all the paintings they viewed. These values were used in the statistical analysis related to the psychophysiological data.

Statistical Analysis

To test whether positive and negative affect changed after the VR visit, two paired t-tests were calculated. Concerning the influence of HR (1) and HRV (2) on self-assessed aesthetic experience, two multiple regression analysis were calculated. Lastly, to test for the effect of openness to experience, expertise, and affect prior to VR on affect after VR, mediated by self-assessed aesthetic experience (model 1), HR (model 2) and HRV (model 3), three moderated mediations were calculated, using the Lavaan-package (Rosseel, 2012). A bootstrapping procedure was applied, using 5000 bootstrap samples and 95% confidence intervals (CI). For the effects of the moderated mediation analysis, the CI is reported, and the null hypothesis is rejected when the CI does not include zero. All statistical analysis were performed in R (R Core Team, 2016).

Results

Sociodemographic Variables

Out of the 113 participants, approximately 78% were female. Most of the participants, 74%, fell within the range of 20 to 29 years. Approximately 10% were under the age of 19.16% of participants were older than 30 years.

RQ1: What Is the Effect of Digital Culture?

Positive affect prior to ($M = 3.27$, $SD = 0.51$) and after ($M = 3.24$, $SD = 0.69$) the VR gallery visit remained nearly unchanged ($t(112) = 0.46$, $p = .68$). Negative affect by contrast was reduced significantly from pre- ($M = 1.37$, $SD = 0.37$) to post- ($M = 1.23$ $SD = 0.25$) visit ($t(112) = 4.74$, $p < .001$).

RQ2: Are Psychophysiological Measurements of Aesthetic Experience Related to Self-Assessed Aesthetic Experience?

To gain an initial overview of the relationship between the self-assessed and the psychophysiological measurement of aesthetic experiences, two multiple regression analysis were calculated. Three subjects were excluded from the analysis because they did not stand in front of any of the paintings for at least 10s, and therefore no mean HR/HRV could be calculated during the viewing.

In the first regression model, self-assessed aesthetic experience was included as the dependent variable, and HR was included as the independent variable. Moreover, gender and the interaction between gender and HR were included. HR ($\beta = 0.22$, $t(68) = 1.56$, $p = .12$) and gender ($\beta = -0.14$, $t(68) = -1.15$, $p = .25$) appear not to have significant main effects on self-assessed aesthetic experience. However, the interaction between HR and gender is significant ($\beta = -0.31$, $t(68) = -2.13$, $p = .04$), indicating that the relationship between HR and self-assessed aesthetic experiences is stronger in women than in men.

In the second regression model, self-assessed aesthetic experience was included as the dependent variable, and HRV was included as the independent variable. Moreover, gender and the interaction between gender and HRV were included. Gender had a significant effect on self-assessed aesthetic experience ($\beta = -0.61$, $t(68) = -2.3$, $p = .02$). HRV ($\beta = -0.22$, $t(68) = -1.72$, $p = 0.09$) could not be shown to have a significant main effect on self-assessed aesthetic experience. However, the interaction between HRV and gender had a significant effect on self-assessed aesthetic experience ($\beta = 0.54$, $t(68) = 2.1$, $p = .04$).This indicates that the relationship between HRV and self-assessed aesthetic experiences is stronger in men than in women.

RQ3: Do Individual Characteristics Influence Positive Affect via Self-Assessed and Psychophysiological Aesthetic Experiences?

Three moderated mediation models were formulated to test the effect of openness to experience, expertise, and affect prior to VR, on affect after VR, mediated by self-assessed aesthetic experience (model 1), HR (model 2), and HRV (model 3). Moreover, the influence of gender on the relationship between the mediators of the models and the dependent variable was investigated.

Figure 4 gives an overview of the three moderated mediations. A conceptual diagram is included to illustrate the theoretical framework, while the statistical diagram represents the actual paths that are included in the analysis. The models

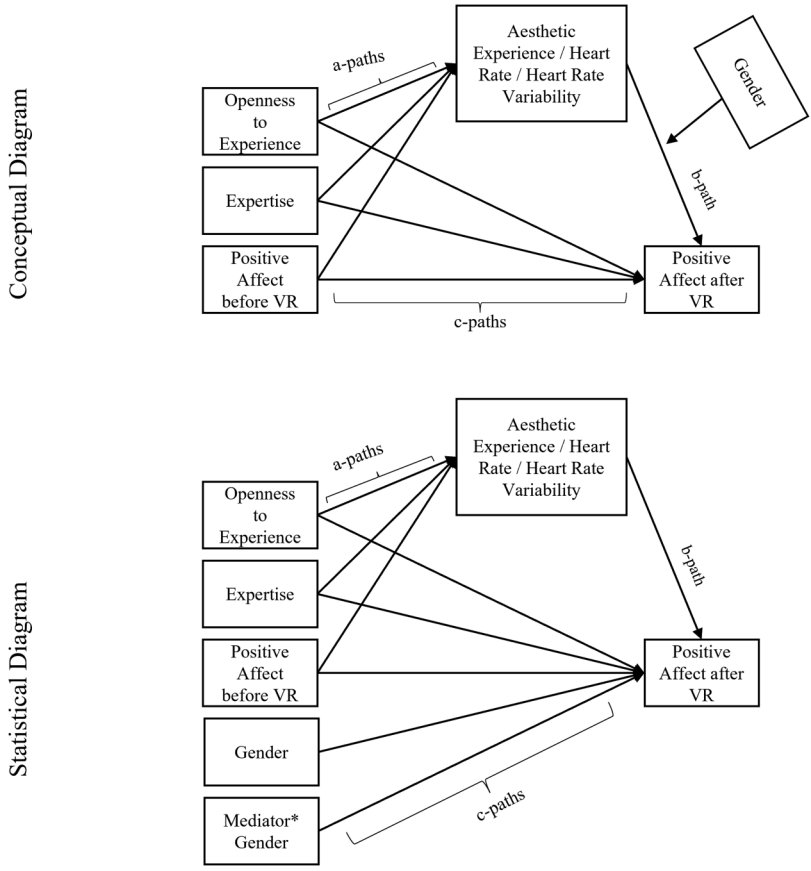

Figure 4. Conceptual and statistical model of the three moderated mediation analysis.

correspond to model 14 of Hayes' model templates (Hayes, 2013), that is, a mediation with a moderation of the b-path. In Supplemental Appendix 2, Figures A2.1–A2.3 present the statistical diagrams for all three models, showcasing the estimates and highlighting significant direct and indirect paths. This visual representation aims to enhance comprehension and facilitate a better understanding of the relationships.

Since the b-path is moderated by gender, the partial indirect effects and total effects will be examined separately for women and men. Table 3 shows the estimates, standard errors, and lower and upper intervals for the a-path, b-path, and c-path, as well as for the partial indirect and total effects of all three models.

Self-Assessed Aesthetic Experience as the Mediator (Model 1). The fit of the model was good ($\chi^2 = 5.95$, df = 6, $p = .43$; root mean square error of approximation (RMSEA) = 0.00, 90% CI [.00, .12], $p = .6$; comparative fit index (CFI) = 1; standardized root

Table 3. Estimates (B), Standard Error (SE) and Confidence Interval (CI) of the three Moderated Mediation Analysis.

		Aesthetic experiences				Heart rate				Heart rate variability			
Paths	Mediators	B	SE	Lower CI	Upper CI	B	SE	Lower CI	Upper CI	B	SE	Lower CI	Upper CI
A-paths	Affect prior to VR	0.34	0.12	0.10	0.57	−0.69	0.60	−1.84	0.56	−1.15	4.43	−9.39	8.28
	Openness to experience	0.15	0.09	−0.01	0.33	0.36	0.74	−1.11	1.87	0.18	3.29	−6.10	7.09
	Expertise	0.00	0.10	−0.18	0.21	2.27	0.99	0.18	4.13	−1.21	5.74	−11.02	11.38
B-path	Mediator on affect after VR	0.48	0.10	0.27	0.67	0.05	0.02	−0.00	0.09	−0.01	0.00	−0.02	−0.00
C-paths	Affect prior to VR	0.52	0.11	0.30	0.73	0.71	0.16	0.41	1.02	0.62	0.15	0.33	0.91
	Openness to experience	−0.02	0.10	−0.21	0.16	−0.03	0.13	−0.29	0.20	0.02	0.12	−0.24	0.24
	Expertise	0.32	0.10	0.11	0.52	0.24	0.18	−0.09	0.63	0.31	0.17	0.00	0.68
	Gender	0.40	0.40	−0.35	1.19	0.20	0.16	−0.08	0.52	−0.69	0.34	−1.31	0.01
	Interaction	−0.14	0.15	−0.44	0.16	−0.04	0.05	−0.13	0.05	0.03	0.01	0.00	0.04
Women indirect effects	Affect prior to VR	0.16	0.06	0.06	0.31	−0.03	0.04	−0.13	0.02	0.01	0.05	−0.08	0.13
	Openness to experience	0.07	0.04	0.00	0.17	0.02	0.04	−0.04	0.13	−0.00	0.04	−0.07	0.08
	Expertise	0.00	0.05	−0.09	0.10	0.11	0.06	0.01	0.26	0.01	0.07	−0.16	0.12
Women total effect	Affect prior to VR	0.68	0.13	0.43	0.93	0.68	0.15	0.37	0.99	0.63	0.15	0.33	0.92
	Openness to experience	0.05	0.10	−0.14	0.24	−0.01	0.13	−0.28	0.22	0.02	0.12	−0.26	0.22

(continued)

Table 3. Continued.

Paths	Mediators	Aesthetic experiences				Heart rate				Heart rate variability			
		B	SE	Lower CI	Upper CI	B	SE	Lower CI	Upper CI	B	SE	Lower CI	Upper CI
Men indirect effects	Expertise	0.32	0.11	0.09	0.54	0.35	0.18	0.02	0.71	0.33	0.17	0.02	0.68
	Affect prior to VR	0.12	0.06	0.02	0.27	−0.00	0.04	−0.11	0.05	−0.02	0.07	−0.19	0.12
	Openness to experience	0.05	0.04	0.00	0.15	0.00	0.03	−0.04	0.10	0.00	0.06	−0.10	0.14
Men total effects	Expertise	0.00	0.04	−0.07	0.08	0.01	0.09	−0.15	0.23	−0.02	0.10	−0.23	0.17
	Affect prior to VR	0.63	0.13	0.40	0.90	0.71	0.16	0.39	1.03	0.60	0.17	0.28	0.93
	Openness to experience	0.03	0.10	−0.16	0.23	−0.02	0.13	−0.29	0.21	0.02	0.13	−0.25	0.28
	Expertise	0.32	0.11	0.10	0.53	0.25	0.22	−0.16	0.71	0.30	0.21	−0.08	0.76

Note. VR=virtual reality.

mean square residual (SRMR) = .05). Regarding the effects of the independent variables (openness to experience, expertise, and affect prior to VR) on the mediator self-assessed aesthetic experience (a-path), affect prior to VR had a significant effect. This indicates that individuals with more positive affect prior to the visit had higher self-assessed aesthetic experiences while viewing the artworks. The mediator self-assessed aesthetic experience, on the other hand, had a significant effect on affect after VR (b-path), indicating that participants who reported higher aesthetic experiences while viewing the artworks also reported higher affect after the VR visit. Regarding the direct effects of the exogenous variables on affect after VR (c-path), only expertise and affect prior to VR had a significant effect on affect after VR, indicating that participants with high expertise and high positive affect prior to the visit reported higher positive affect after the visit. Openness to experience did not show a direct effect on affect after VR. Moreover, the moderator gender and the interaction between gender and the mediator self-assessed aesthetic experience did not show a direct effect on affect after VR.

Regarding the partial indirect effects, for both men and women, openness to experience, as well as affect prior to VR, had an indirect effect on affect after VR. This indicates that in both genders, higher openness to experience and affect prior to the visit lead to higher self-assessed aesthetic experience, which in turn lead to higher positive affects after the visit. This finding is particularly notable for openness to experience since higher openness to experience does not directly translate to higher positive affect after the visit. In both genders, the analysis revealed significant total effects of expertise and affect prior to VR on affect after VR. However, no significant total effects of openness to experience on affect after VR was shown in either gender.

Heart Rate as the Mediator (Model 2). The fit of the model was good ($\chi^2 = 7.87$, df = 6, $p = .25$; RMSEA = 0.06, 90% CI [.00, .18], $p = .35$; CFI = 0.98; SRMR = .06). When examining the effects of the independent variables (openness to experience, expertise, and affect prior to VR) on the mediator variable (HR; a-path), only expertise was found to have a significant effect. This indicates that participants with more expertise had a higher HR when viewing the artworks. HR, on the other hand, had no significant effect on affect after VR (b-path), though the confidence interval barely encompasses zero. Regarding the direct effects of the exogenous variables on affect after VR (c-path), only affect prior to VR had a significant effect on affect after VR, indicating that participants with high positive affect prior to the visit reported higher positive affect after the visit.

Regarding the partial indirect effects, women higher in expertise showed higher HR during viewing of the artworks, which in turn led to reports of higher affect after the visit. For men, no such partial indirect effect occurred. Moreover, for both genders no partial indirect effects of openness to experience and affect prior to VR were shown. For women, there is a significant total effect of expertise and affect prior to VR on affect after VR, but no significant total effect of openness to experience on affect after VR was found. For men, there is only a significant total effect of affect prior to VR on affect after VR.

Heart Rate Variability (RMSSD) as the Mediator (Model 3). The fit of the model was good ($\chi^2 = 7.3$, df = 6, $p = .3$; RMSEA = 0.05, 90% CI [.00, .17], $p = .41$; CFI = 0.99; SRMR = .05). No significant effects of the independent variable (openness to experience, expertise, and affect prior to VR) on the mediator HRV (a-path) were shown. HRV, on the other hand, had a significant negative effect on affect after VR (b-path), indicating that participants with lower HRV while viewing the artworks reported higher affect after VR visit. Regarding the direct effects of the exogenous variables on affect after VR (c-path), affect prior to VR and expertise had a significant effect on affect after VR. This indicates that participants with high positive affect prior to the visit and high expertise reported higher positive affect after the visit. Moreover, the interaction between gender and HRV also had a significant positive effect on affect after VR, indicating that the effect of HRV on affect after VR differs between men and women. As gender is coded 0 for women and 1 for men, this signifies that the relationship between HRV and affect after VR may be more pronounced in men than in women.

In this model, no significant partial indirect effects could be shown of the exogenous variables on affect after VR for both men and women. However, for women, there was a significant total effect of expertise and affect prior to VR on affect after VR. For men, there was a significant total effect of affect prior to VR on affect after VR.

Discussion

This study aimed to understand the effect that digital art in the form of a virtual art gallery has on affect, the relationship between different measurements of aesthetic experiences in VR, and the influences that aesthetic experiences (self-assessed and psychophysiological) and individual characteristics have on affect. For this purpose, a virtual art gallery was developed, in which participants could move around freely, while psychophysiological parameters and self-report items were collected.

Concerning the changes in affect pre-VR and post-VR (research question 1), our findings suggest that negative affect decreases, while positive affect remains almost the same. These results reflect those of Trupp et al. (2022) and Trupp et al. (2023) who, in both studies, also found no increase of positive affect after exposure to online digital art but rather a decrease in negative affect. The reduction in negative affect without the enhancement of positive affect might suggest that the immersive nature of VR technology can provide a distraction or an opportunity for emotional regulation through the escape from participants' current emotion state, thus leading to a reduction in negative affect. However, this may not translate into an enhanced experience of positive affect as it may require more than just a change in focus to elicit a positive emotional response. Moreover, the decrease in negative mood further supports the idea that cultural activities are linked to greater mental health (Cuypers et al., 2012; Fancourt & Steptoe, 2019; Väänänen et al., 2009). As mentioned, negative affect can hinder progress toward flourishing, possibly culminating in "ill-being" (Cotter & Pawelski, 2022). The mitigation of these negative emotions may explain why digital

art consumption during COVID-19 has served as a buffer against the negative effects of lockdown (Gotthardt et al., 2023).

One interesting finding is that the relationship between physiological responses and self-assessed aesthetic experience (research question 2) seemingly differs between genders, with HR being more strongly associated with aesthetic experience in women, while HRV appears to be more strongly associated with aesthetic experience in men. As discussed, a heightened HR can be attributed to emotions that are related to arousal, negative as well as positive (Tschacher et al., 2012). Therefore, arguably women might attribute this arousal while viewing artworks in VR to more positive emotions, thus reporting heightened aesthetic experiences. In contrast, men seemingly report heightened aesthetic experiences in VR when they are in a more relaxed state, as indicated by the link between heightened HRV and higher self-assessed aesthetic experience.

Three moderated mediation models were constructed to test the effect of individual characteristics on affect after VR, mediated by self-assessed aesthetic experience, HR and HRV (research question 3a, b, and d). Moreover, the influence of gender on the relationship between the mediators of the models and the dependent variable was investigated (research question 3c).

Within the context of this moderated mediation analysis, we examined how openness to experience relates to positive affect following the VR experience, factoring in the potential mediating effects of HR, HRV, and aesthetic experiences. The results suggest that the relationship between openness and affect after VR is mediated by self-assessed aesthetic experience. As mentioned above, these indirect effects must be examined for men and women separately, since the b-path of the mediation is moderated by gender. In this case, this result applies to men and women alike. This finding is in accord with previous findings that showed openness is linked to higher arousal and pleasure when confronted with artworks (Fayn et al., 2015), which might directly translate into higher reported affect. The lack of a direct effect of openness further points toward a mediating role of aesthetic experiences, as it implies that people high in openness do not directly report higher positive affect after the VR gallery, but only when they experience high self-assessed aesthetic experiences. However, the nonsignificant direct effect outweighs the influence of the significant indirect effect, leading to a nonsignificant total effect. Contrary to aesthetic experiences, the results indicate that HR and HRV do not mediate the relationship between openness and affect. It is probable therefore that participants who scored high on openness assessed their affect to be elevated after their VR session, largely because they also judged their aesthetic experiences as elevated. However, their self-assessment of affect post-VR was seemingly not influenced by more objective measures of these aesthetic experiences, such as HR and HRV. The findings further suggest that openness to experience does not directly influence any of the three mediators. The lack of influence is in contrast with findings that report an influence of openness on psychophysiological aesthetic experiences, such as chills or HRV (Čukić & Bates, 2014; McCrae, 2007; Silvia & Nusbaum, 2011). In our VR gallery context, openness seems to not have such an influence.

Another intent of the moderated mediation analysis was to explore the connection between expertise and subsequent positive affect after engaging in a VR experience, with HR, HRV, and aesthetic experiences functioning as mediating factors. The study suggests that expertise is linked to higher HR, but not to higher self-assessed aesthetic experience. Strikingly, this increase in HR seemingly translates into higher reported affect after VR only for women. Regarding the lack of effect of expertise on self-assessed aesthetic experience, studies indicate that expertise is linked to higher aesthetic experiences (Smith & Smith, 2006), especially through top-down processes (Leder et al., 2004). However, cognitive processes in VR might differ from processes in the "real" world (Antonietti & Cantoia, 2000). Due to this change in cognition, lay persons and experts may exhibit a greater degree of similarity in VR, since in this environment the lay person might use cognitive processes usually only attributed to experts, hence reporting a similar amount of self-assessed aesthetic experience. However, in this model, expertise had a significant direct effect on affect after VR, indicating that while self-assessed aesthetic experiences were similar between experts and lay persons, the outcome was still more satisfying for experts, translating into a higher positive affect. Despite the lack of an indirect effect, this significant direct effect is strong enough that expertise has a significant total effect on affect after VR for both genders. A possible explanation for the effect of expertise on HR is that participants high in expertise might not directly self-assess more aesthetic experience, but their body may nevertheless react more to the artworks, which seems to be consistent with previous findings on expertise and physiological responses to art (Silvia & Nusbaum, 2011). Concerning the potential mediating role of HR in women, expertise might lead to higher gratification due to top-down processes that might help with the classification of the artworks (Leder et al., 2004). As previously mentioned, women tend to associate arousal experienced during art viewing with more positive emotions, which could possibly lead to more reports of positive affect afterwards. Therefore, expertise might lead to more rewards, potentially leading to more arousal. Women with expertise might then be more inclined to relate this arousal to positive affect. For women, our data hints that expertise might be linked to a positive affect after the VR experience, particularly when paired with an elevated HR. This suggests an indirect relationship, where expertise alone might not directly lead to increased positive affect, as indicated by the lack of a significant direct effect—a mediator, such as a raised HR, might be involved. However, regarding the other two measurements of aesthetic experiences, expertise has no indirect effect on positive affect after VR.

Regarding the last individual characteristic, the moderated mediation aimed to uncover how affect preceding a VR experience impacts subsequent positive affect, again considering the three mediators. The results imply that higher affect before the VR gallery leads to higher self-assessed aesthetic experiences, presumably resulting in higher reported affect after the VR gallery. Consistent with established frameworks in the field, such as the model proposed by Leder et al. (2004), our results thus reaffirm the influential role pre-affect might have in shaping (self-assessed) aesthetic experiences. Furthermore, these findings align with contemporary developments

in the field, potentially enriching the theoretical understanding as seen in recent models like the one suggested by Trupp et al. (2023). This highlights the ongoing relevance of exploring how affective states prior to the exposure of aesthetic stimuli might influence the subsequent aesthetic experiences. The implied link between high affect prior and self-assessed aesthetic experience aligns with numerous prior studies (Belke et al., 2006; Konečni & Sargent-Pollock, 1977; Leder et al., 2004; Weigand & Jacobsen, 2023), and this relationship apparently translates into the virtual world. Regarding the indirect effect, participants with higher affect prior to VR reported more affect after VR when they experienced an increase in self-assessed aesthetic experiences, aligning with models of aesthetic experiences (Leder et al., 2004), that showed that a positive mood prior to the aesthetic experience might heighten the experience, which in turn might lead to a more positive outcome. The total effect of affect prior to VR, mediated by self-assessed aesthetic experience, is fully explained by the significance of all paths (a, b, c, and indirect). The influence of affect prior to VR on affect after VR implies that affect prior to VR might also directly impact affect afterwards irrespective of aesthetic experiences. The lack of influence of affect prior to VR on HR and HRV suggests that, while positive affect prior to VR may contribute to participants retrospectively perceiving their overall aesthetic experiences as high afterwards, it does not seem to have a strong enough effect to directly impact the psychophysiological reactions while viewing the artworks. In all three models, affect prior to VR had a significant influence on affect after VR. Regarding HR and HRV, this effect was strong enough that there is a total effect of affect prior to VR on affect after VR in both models, despite there being no indirect effects. Our findings of research question 1 show that the means of pre- and post-positive affect do not significantly differ. However, the current finding implies that pre-positive affect influences post-positive affect, indicating that participants who already had high positive affect see an enhancement in that affect.

Besides the indirect effects of the individual characteristics on affect after the VR, the direct effects of the three mediators on affect after the VR were of interest (research question 3b). This study suggests that self-assessed aesthetic experiences may have a significant positive impact on affect after VR, but there appears to be a significant negative relationship between HRV and positive affect after VR. The former finding is in line with ample literature suggesting that aesthetic experiences positively impact affect. Notably, this relationship apparently carries over into self-assessed aesthetic experiences in a virtual environment. The finding that lowered HRV might lead to higher reported positive affect after VR is contradictory to our initial expectations, since higher HRV is generally linked to a more positive state (Kop et al., 2011; Stürmer & Schmidt, 2014). Since lower HRV correlates with focus and attention (Porges, 1992), this discrepancy could be attributed to sustained attention. VR is a relatively new medium, and most of the participants were quite unexperienced. Participants who managed to sustain attention during viewing of the artworks despite the relatively "distracting" surroundings might have a more satisfying experience, plausibly translating into more positive self-assessed affect afterwards. HR does

not seem to significantly impact positive affect after VR. It is noteworthy, though, that the confidence interval, although not fully excluding zero, tends to be almost greater than zero at the lower bound, suggesting a potential near-significant effect. Nevertheless, the lack of significance suggests that participants with high HRs during viewing of the artworks might not attribute this heightened HR to positive affect afterwards.

Lastly, the moderating role of gender in the relationship between the mediators (HR, HRV, and aesthetic experiences) and the independent variable offers intriguing points for discussion (research question 3c). The findings indicate that the relationship between HRV and affect after VR may be more pronounced in men than in women. This is notable, since we can already observe that higher HRV may lead men to report more self-assessed aesthetic experiences. In a similar vein, higher HRV, which is linked to a receptive and relaxed state, seemingly leads men to report having a more positive affect after VR. This again supports the notion that men potentially interpret the relaxed state associated with high HRV into self-assessed positive experiences, such as self-assessed aesthetic experience and positive affect. Regarding self-assessed aesthetic experience and HR, their relationship with affect is presumably not dependent on gender. This infers that, at least in VR, there is no higher connection between these two measurements of aesthetic experiences and affect in women, suggesting that the experience might be similarly satisfactory for both of the genders.

Limitations and Future Directions

One of the primary limitations of this study pertains to the relatively small sample size of men included in the analysis. It is essential to approach the findings and conclusions derived from this subgroup with caution. Smaller sample sizes can lead to inflated type II errors, potentially rendering some results statistically insignificant, thus failing to detect actual significant effects. Moreover, smaller samples limit the generalizability of the findings, as the sample might not adequately represent the broader male population. This is particularly salient given that we found a significant moderating effect for gender in our second and third research questions. While this moderating effect is undoubtedly intriguing and suggests potential gender-based differences regarding psychophysiological reactions to aesthetic stimuli, the limited male sample size underscores the need for caution when interpreting these results. However, despite these inherent limitations, the detected moderation effect is noteworthy. It provides a compelling direction for future research, particularly for studies that can employ larger and more diverse male samples. Such subsequent investigations would be essential in not only validating or refining our initial findings but also in offering a more nuanced understanding of gender dynamics in the context of our research. We recommend that future studies prioritize recruiting larger male cohorts to delve deeper into these initial observations and to ensure the robustness and reproducibility of the findings.

This study is consistent with the notion that aesthetic experiences should be measured in environments that are as realistic as possible (Tröndle, Greenwood,

Kirchberg, & Tschacher, 2014). Therefore, as little intervention as possible was made regarding the behavior of participants in the virtual environment. However, this approach comes at the expense of controlling certain factors. For instance, it necessitated the use of ultrashort-term intervals to calculate the episode for the psychophysiological parameters. While these intervals show correlations with longer intervals according to previous studies (McNames & Aboy, 2006; Nussinovitch et al., 2011; Salahuddin et al., 2007; Shaffer et al., 2016; Thong et al., 2003), the interpretation of the parameters calculated from these episodes might be ambiguous. For example, a heightened HR during a very short episode might also be interpreted as anger or fear, while a decline of HR might indicate delight, but also disgust (Stürmer & Schmidt, 2014). Given the circumstances of this study, emotions such as anger, fear, or disgust may not be expected, however, it is essential to bear in mind the aforementioned ambiguity when interpreting the results.

The exclusion of episodes is assumed to be missing at random. However, it is essential to exercise caution in assuming complete randomness—for instance, episodes were also omitted when participants talked, possibly triggered by feelings of amazement, confusion, realizations, and other emotional experiences. Consequently, there is a potential underrepresentation of this specific type of emotional encounter in the data due to these exclusions. As a result, the assumption of missing completely at random might not hold entirely in this context.

The lack of a significant direct relationship between the psychophysiological measures and self-assessed aesthetic experience in contrast to other studies might be due to two reasons. First, different measurements of self-assessed aesthetic experiences were used in this article compared to similar studies (e.g., Siri et al., 2018; Tschacher et al., 2012). Here, the Aesthetic Experience Scale was used, while for example Tschacher et al. (2012, p. 99), used measurements of aesthetic assessments such as "Aesthetic Quality" or "Surprise/ Humor." Second, opposed to Tschacher et al. (2012) who tested whether aesthetic assessment influences psychophysiological parameters, this study examined the reversed relationship: Here, we focused on the influence of (objective) psychophysiological assessments of aesthetic experiences on self-assessed aesthetic experiences after the gallery. To not interfere with the experience, we refrained from asking participants to self-assess aesthetic experiences during viewing of the artworks, in contrast to Tschacher et al. (2012). Therefore, from a solely chronological perspective, HR and HRV should be the independent variables, as they were assessed before the aesthetic experience. Moreover, our focus was different; we sought to investigate the extent to which physiological responses during the viewing of artworks align with participants' subjective assessment of their aesthetic experience once the gallery visit is concluded. However, the lack of a relationship between psychophysiological and self-assessed measures of aesthetic experience does not mean no direct relationship exists between the two measurements. Rather it points to the direction of the relationship being a different one, which future studies might want to further investigate.

Lastly, in this study, due to a lack of reported alternative gender identities among participants, individuals were solely categorized as men or women. This use of a

binary gender construct is an oversimplification and does not represent the diverse range of gender identities. Future research should aim to include a more comprehensive examination of gender diversity and its relationship to aesthetic experiences.

Conclusion

The results of the present study suggest that digital art presented in a VR art gallery can have a positive impact on emotional wellbeing by reducing negative emotions. This highlights the potential value of engaging with digital art to promote overall mental health. Notably, such possible interventions are particularly promising because they provide access to the positive benefits of cultural engagement for those who may face challenges in visiting physical museums. Moreover, the results point to the idea that psychophysiological measurements of aesthetic experiences can predict self-assessment of said experiences in the VR environment, as well as positive affect, but the results seem to differ for men and women. Women might attribute arousal (heightened HR) while viewing artworks in VR to more positive emotions, thus reporting heightened aesthetic experiences and affect, while men presumably report heightened aesthetic experiences and affect in VR when they are in a more relaxed state, as indicated by heightened HRV. However, due to the small sample size of men, further research is essential to validate these results. Expertise, openness to experience and affect also show differential effects on the psychophysiological and self-assessed aesthetic experiences, especially regarding the positive influence of openness and prior positive affect on the relationship between aesthetic experience and positive affect after the VR. A noteworthy finding is that the well-documented direct impact of positive affect on aesthetic experiences seems to extend into the virtual world. The findings also suggest a significant relationship between expertise and the link between HR and positive affect, while simultaneously implying that expertise might not correspond to an increased self-reported aesthetic experience. This infers that while participants with higher expertise may not self-report enhanced aesthetic reactions, their physiological responses to artworks are more pronounced. Taken together, these findings highlight the importance of considering individual characteristics when studying aesthetic experiences and affect in VR.

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Supplemental Material

Supplemental material for this article is available online.

Notes

1. The questionnaire utilized in this study requested information on gender, yet it remains challenging to distinctly determine whether any observed influence of this variable is attributed to (sociological) gender or (biological) sex, owing to the potential overlap or ambiguity between these two concepts. This should be kept in mind when interpreting the results.
2. Highbrow culture often refers to activities such as visits to the opera, ballet, and theater or listening to classical music (Katz-Gerro, 2002). However, "The use of terms like highbrow culture usually implies value judgement" (Katz-Gerro, 2002, p. 220), and should therefore be used with caution.
3. Project name: "Cultural education in rural areas: Investigation of person-related, social space-related and supply-related influencing factors"; Funding code 01JKL1908.
4. https://doi.org/10.17605/OSF.IO/3XR5B
5. For exemplary studies with similar drop-out rates regarding psychophysiological measurements, see Koskinen et al. (2009), Lenski and Großschedl (2022), Schmidt and Martin (2020).
6. Corrected using the automatic beat correction offered in Kubios, for details see Lipponen and Tarvainen (2019).
7. The statistical analysis concerns HR/HRV during painting viewing. Three participants viewed the paintings for less than 10 s and are thus excluded due to NA values. Nonetheless, they remain in the overall count as they read the informational texts beyond 10 s, resulting in a consistent total of N=75.
8. This can also be explained in terms of content because the German translation of Item 9 reads: "Prefers routine and simple tasks." The expression "simple tasks" does not appear in the original English version, and this aspect may not necessarily be associated with openness to experience, as also implied by the item–total correlation.
9. RMSSD was not normalized because, especially in participants who are very excited at the beginning of the experiment, the baseline HRV can be significantly lower at the beginning of the measurement than during the course of the experiment, which can later lead to distortion of the values.

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7.3 Article 3

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Reading Between Lines and Pixels: The impact and interplay of expertise, textual information, and affect for aesthetic judgement of VR Art

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Reading Between Lines and Pixels: The impact and interplay of expertise, textual information, and affect for aesthetic judgement of VR Art

Abstract

This study delves into the transferability of aesthetic judgment influences from analog art viewing to a Virtual Reality (VR) setting, recognizing that expertise typically enhances aesthetic judgement through increased positive affect. Additionally, it was anticipated that the relationship between expertise and positive affect would be moderated by the type of textual information provided (stylistic versus affective), positing that different types of texts would activate different processing routes in naïve viewers versus experts that are not normally used. Specifically, stylistic texts were expected to enhance style or art-specific processing in naïve viewers, while affective texts were anticipated to foster content or self-related processing in experts. Since these unusual routes of processing add an additional dimension to the experience, they should enhance positive affect and, consequently, aesthetic judgment. Our findings reveal that while expertise continues to play a crucial role in shaping aesthetic judgment through positive affect, the anticipated moderation by textual information type did not materialize, indicating that the VR context might uniquely amplify the impact of emotionally charged content, irrespective of viewers' expertise levels. These results underline how virtual art could leverage human emotions to enhance the viewer's experience.

Introduction

Since the emergence of digital artworks, a debate has ensued as to whether they can compete with “analog” artworks (e.g. Trinks, 2020). Furthermore, this debate has only been exacerbated by the COVID-19 pandemic, as many traditional cultural venues have been forced to close and as a result, many art forms have moved into the digital space (Creative Industries Policy & Evidence Centre, 2020; International Council of Museums, 2020, 2023). A promising way to view art in digital space is virtual reality (VR). Since it allows art to be viewed from all angles similar to the “real” world, it can be assumed that VR can reproduce the artworks more realistically than, for example, in 2D on a computer screen. In fact, studies suggest that artworks are more appreciated in VR than on a computer screen (Usui et al., 2018). When engaging with paintings in desktop-virtual reality, the viewer adopts a meta-perspective, characterized by a more abstract thought process and a heightened imagination during elaborations on the artworks (Antonietti & Cantoia, 2000). Moreover, this finding can be assumed to be even more pronounced in the more immersive head-mounted VR. Although some studies point to there being few differences between VR and analogue artwork-viewing (Lin et al., 2020), the adoption of a meta-perspective might imply that the distinct modes of engagement offered by virtual reality can foster cognitive activities that differ from those typically experienced in the "analogue" world (Antonietti & Cantoia, 2000). Hence, it now appears necessary to reassess models previously accepted in the context of cognitive processes during analogue artwork viewing, within the realm of virtual reality. For instance, Cotter et al.’s (2022) investigation into the concept of flourishing,

traditionally linked with analog art, in a VR gallery, serves as an example of the necessity of continuously re-evaluating every concept previously validated in analogue art viewing as we navigate through the digital transformation of the arts.

One of the most studied outcomes of cognitive processes while viewing artworks in the analogue world is the aesthetic evaluation of these artworks. Aesthetic judgement almost never refers to evaluating an aesthetic stimulus simply as "beautiful", but rather to "judgments like figural goodness, pleasantness, liking, and preference" (Reber et al., 2004, p. 365). This article focuses on aesthetic judgement as one of the final outcomes of the cognitive processes during artwork viewing (Leder et al., 2004; Leder & Nadal, 2014) in a virtual gallery. Several factors relevant to the process of aesthetic appreciation have been shown to influence aesthetic judgement, and here we explore if these relationships hold true in a virtual reality setting. Specifically, we examine an indirect effect of expertise on judgement via positive affect after a VR-gallery visit. Moreover, this study investigates whether different (experimentally varied) textual information concerning the paintings in the VR-gallery moderate the relationship between expertise and positive affect. Since the moderation affects the initial link between expertise and positive affect, it should naturally also alter the indirect impact of expertise on judgment through positive affect.

Impact of positive affect on aesthetic judgement

In the model of aesthetic appreciation (Leder et al., 2004; Leder & Nadal, 2014), success in the cognitive mastering stage results in higher cognitive and affective states, which then result in higher aesthetic judgement. This aligns with the concept of processing fluency (Reber et al., 2004) and effort after meaning theory (Russell, 2003) explained in more detail below. These theories suggest that successful processing in terms of interpretation and understanding of an artwork leads to higher affect. With regard to their model, Leder et al. (2004) added that "an artwork is judged as positive if the process it elicited is experienced as emotionally positive" (Leder et al., 2004, p. 502). This assumption is also consistent with the feeling-as-information model, which states that in some cases emotions serve as information (Schwarz & Clore, 1996). The positive emotions elicited during the process of viewing art give the viewer the information that the image was received positively, thereby attributing the positive affect to the artwork (Reber et al., 2004). Consequently , Reber et al. (2004) conclude that affect mediates the relationship between fluency and aesthetic judgment. Therefore, throughout this work we expect that higher positive affect leads to higher aesthetic judgment.

Expertise influences affect

Given that positive affect is an important predictor of aesthetic judgment, analyzing potential influences on positive affect hold promise as a way to understand how aesthetic judgment develops and can be supported in the VR setting. Previous research indicates that art expertise might heighten positive affect, and consequently shape aesthetic judgement. Several models and theories seeking to

clarify reception of artworks indicated that heightened expertise in the arts may lead to intensified emotional experiences during artwork viewing. The concept of processing fluency (Reber et al., 2004) suggests that the ease and fluency with which a painting is processed influences the affect experienced by the viewer. This concept is supported by a facial electromyography (EMG) study, where processing ease was deliberately manipulated by modifying target recognition and exposure time. Results showed that high fluency during stimuli processing activated the areas of the zygomaticus major, the "smiling muscle", which is tied to positive affect (Winkielman & Cacioppo, 2001). Since heightened expertise and training in the processing of artworks is associated with higher fluency (Reber et al., 2004) and fluency is related to more positive affect, art expertise should also be related to higher positive affect. In a similar vein, the effort after meaning theory proposes that accomplished interpretation of an artwork partially explains the satisfaction gained from art-viewing (Russell, 2003). In addition, the model of aesthetic appreciation (Leder et al., 2004; Leder & Nadal, 2014) proposes that several stages are involved in the processing of artworks. The level of expertise influences several of these stages, predominantly explicit classification as well as cognitive mastering of an artwork. The last stage of the model is the evaluation stage, which includes affective state. Successful completion of the previous stages, which is enhanced by expertise, may thus lead to an increased affective state. Therefore, in this model, higher expertise is also associated with increased affect (Leder et al., 2004; Leder & Nadal, 2014). *blind review* found (based on the same data set as the present study) that participants with high expertise showed an increase in heart rate while viewing artworks in a VR-gallery, although this increase in heart rate only resulted in an increase in positive affect for women. This outcome might tentatively suggest that the heightened heart rate observed in experts could be indicative of their enjoyment and fluency of processing while viewing the artworks, which in turn also resulted in heightened affect among women. The relationship between art expertise and affect might be further deepened by forming a self-reinforcing cycle: The affective responses associated with the exposure to art due to expertise might enhance intrinsic motivation for repeated exposure to art (Deci & Ryan, 2012). This facilitates further learning and deepening expertise, which then once again amplifies affective experiences.

To sum up, distinct modes of engagement in analogue and virtual reality can initiate different cognitive activities (Antonietti & Cantoia, 2000) . It remains to be explored how far models of aesthetic processing of analogue art in which expertise plays an important role can be applied to the virtual world. *blind review* tested whether expertise influenced affect in a virtual reality setting via increased aesthetic experience. The findings revealed that there was no mediation effect, but a direct influence of expertise on affect subsequent to the exposure to artworks. Therefore, this study seeks to delve deeper into the impact of expertise and explore if it continues to be an indirect influence on aesthetic judgement in virtual reality environments, or if the unique nature of the medium leads to a convergence between laypersons and experts.

Impact of textual information on processing of artworks (in interaction with expertise)

Building upon established links between expertise, positive affect, and aesthetic judgement, previous studies have explored the potential effect of textual information on the perception of artworks. Cupchick et al. (1994) differentiated between stylistic information, which underlines the stylistic qualities of the artwork, and mood information, highlighting the emotional content. These different types of information provide different frames of reference, aiding in interpretation and understanding. While stylistic information provides a stylistic frame of reference, therefore possibly enhancing cognitive judgements, mood-based details might provide an emotional frame of reference, therefore highlighting emotional judgements. Providing additional textual information about a painting, such as a metaphorical title, can enhance the artwork's aesthetic appreciation (Millis, 2001). This is due to the "elaboration effect", in which textual information adds to individual interpretation of artworks, but only if the added information is additional (Millis, 2001).

Reviewing the theories and research presented so far, one might expect a positive influence from stylistic information on affect and, in turn, indirectly on aesthetic judgement, since the additional information given should facilitate processing. However, research found quite the opposite: Leder et al. (2006) found that descriptive titles, such as "Fine curved lines in colour" (p.195) did not influence the judgement of paintings. It was also found that descriptive information about works of art reduced cognitive and affective judgement, and even formalist (stylistic) information reduced affective judgements (Cupchik et al., 1994). In light of these findings, Belke et al. (2006) proposed that expertise might influence how textual information is perceived and processed. Since experts show more style-related processing (Cupchik & László, 1992), they should be able to independently retrieve the knowledge conveyed by descriptive and/or stylistic information; stylistic information adds nothing new to their experience (elaboration effect, Millis (2001)). In contrast, novices are more likely to show content and emotional processing (Cupchik & László, 1992). Therefore they might benefit from the stylistic information during their art-processing (Belke et al., 2006). This finding aligns with Leder et al.'s (2004) model of aesthetic appreciation. In this model, during the "explicit classification" and "cognitive mastering" stages, there is a clear distinction. Naïve viewers tend to focus on content classification in the explicit classification stage and on self-related interpretation in the cognitive mastering stage. In contrast, experts often engage in style classification and art-specific interpretation during these same stages. Differences in gaze patterns when viewing works of art (Pihko et al., 2011; Tallon et al., 2021) also suggest that experts and lay persons have different modes of processing. Belke et al. (2006) investigated whether stylistic information has an effect on aesthetic appreciation, considering level of expertise. As expected, stylistic information increased appreciation in naïve viewers, but not in experienced viewers. The authors concluded that the information might oversimplify the artworks, or conflict with pre-existing knowledge for experts.

But how do we enhance processing in experts, leading to a more positive experience (higher affect) and consequently more favorable judgement? Experts might have a better experience with the addition of new information that complements rather than conflicts with pre-existing knowledge, encouraging them to use different approaches (Belke et al., 2006). Studies show that exposing novices to stylistic information can enhance their aesthetic appreciation (Belke et al., 2006), likely by triggering new processing paths such as style classification or art-specific interpretation. Similarly, introducing experts to affective textual information could encourage them to engage in unfamiliar processing routes, such as content classification or self-related interpretation, which they typically do not use.

Here, we explored this possibility by trying to elicit either style classification and art-specific interpretations of artworks or content classification and self-related interpretations. Specifically, we provided participants with either stylistic textual information or affective information about the paintings. The textual information was inspired by Cupchik et al. (1994), assuming that stylistic information provides a stylistic frame of reference, potentially enhancing cognitive judgements. Conversely, mood-based details might provide an emotional frame of reference, therefore highlighting emotional judgements. The stylistic texts are similar in length and type of description to the formalistic texts from Study Two, while the affective texts go beyond the mood information from Study One, which only consisted of one or two words. As with the stylistic texts, the affective texts were presented for reading as a coherent text (see Methods section). We propose that the type of textual information moderates the relationship between expertise and positive affect. People with low expertise are expected to show higher affect when exposed to stylistic information (Belke et al., 2006) because the information is additional and prompts a type of interpretation not normally employed. Individuals high in expertise are expected to show higher affect when exposed to affective information because, again, the information is additional and may result in a self-related type of interpretation that is not normally employed.

The present study: The influence of expertise and textual information on aesthetic judgement via affect

Reber et al. (2004) concluded that affect mediates the relationship between fluency, which is higher in experts, and aesthetic judgment. Higher expertise and therefore fluency elicits more positive emotions during the processing of an artwork (processing fluency, Reber et al., 2004)). These positive emotions are attributed to the paintings, which are therefore judged more positively, in accordance with the feelings-as-information model (Schwarz & Clore, 1996). Likewise, in the model of aesthetic appreciation (Leder et al., 2004; Leder & Nadal, 2014), an aesthetic judgement is influenced by the evaluation stage which includes the affective state. This means that "an artwork is judged as positive if the process it elicited is experienced as emotionally positive" (Leder et al., 2004, p. 502). Cupchik et al. (1994) found that stylistic and affective texts had no impact on their rating scales. However, we

propose that an influence might be observed if the role of heightened affect is considered as a mediating factor. Similarly, regarding Belke et al.'s 2006 study, one could assume that different results would have emerged if affect had been considered as an additional mediating factor that was influenced by expertise - which in turn influences liking/ judgement - instead of treating affect change and liking as dependent variables that do not influence each other. In this regard, it is assumed that higher expertise only leads to higher aesthetic judgement when affect is increased. Due to these arguments for mediation, we do not expect expertise to influence judgement directly. In addition, it would be an oversimplification to assume that people with high expertise always evaluate all paintings positively. There are many additional variables that can influence the evaluation of a painting, such as personal taste (Leder et al., 2004). When an expert encounters an artwork they personally dislike, they are likely to give it a low rating, regardless of their expertise level. This suggests that expertise alone does not necessarily result in higher evaluations; rather, it is the presence of positive affect that mediates the relationship between expertise and evaluation.

This study examines the relevance and interplay of factors previously identified as predictors of aesthetic judgement in analogue artwork processing, within a virtual reality gallery setting. Therefore, we analyze the influence of expertise on aesthetic judgement via positive affect and investigate how textual information moderates the path between expertise and positive affect. For this purpose, several models and theories evolving around aesthetic processing have been integrated (see Figure 1).

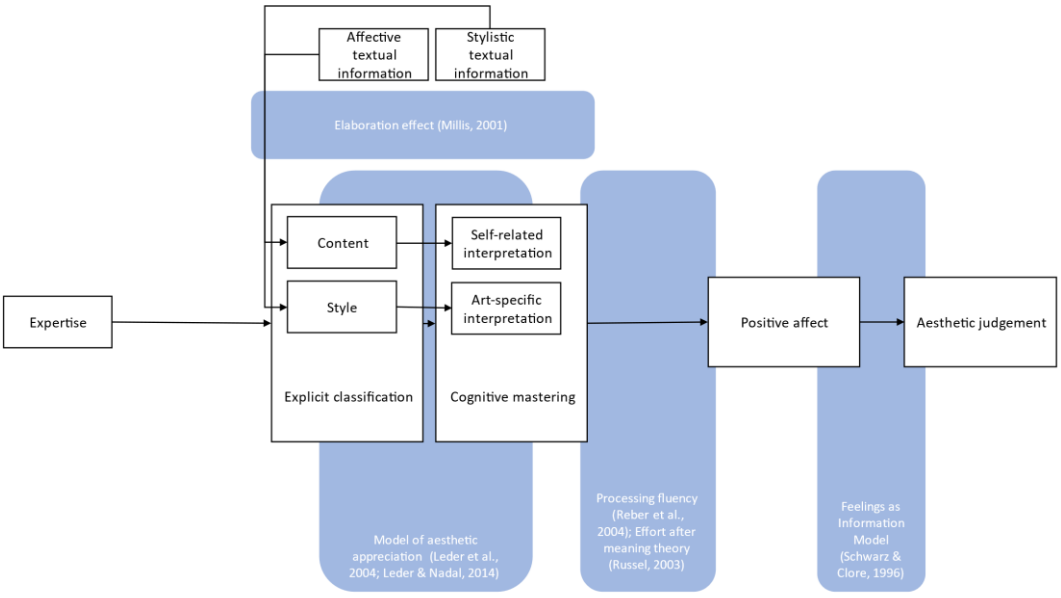

Figure 1. Interplay of several theories of aesthetic appreciation.

The model of aesthetic appreciation and the concept of processing fluency and effort after meaning (Leder et al., 2004; Leder & Nadal, 2014; Reber et al., 2004; Russell, 2003) propose that successful processing of an artwork, more likely seen in art-experts (Reber et al., 2004), results in heightened affect. However, the relationship between expertise and affect could be influenced by textual information, since additional textual information can add to individual interpretation of artworks if the information is new (elaboration effect, Millis, 2001). In this regard, we expected to prompt different routes of processing by letting participants read either affective or stylistic texts. For novices who typically employ self-related interpretations and content classifications (Leder et al., 2004; Leder & Nadal, 2014), stylistic textual information could prompt them to also employ art-specific interpretations and style classifications, resulting in an even greater affect. For experts who typically employ art-specific interpretations and style classifications (Leder et al., 2004; Leder & Nadal, 2014), affective textual information might lead them to additionally employ self-related interpretations and content classifications, resulting in even higher affect. This heightened affect is then attributed to the artwork, resulting in better aesthetic judgement of the artwork (feelings as information model, (Reber et al., 2004; Schwarz & Clore, 1996).

Therefore, we expect that:

1. Expertise leads to higher affect (a-path).
2. The relationship between expertise and affect is moderated by the type of textual information that is given (moderation of a-path). Participants low in expertise are expected to show higher affect when exposed to stylistic textual information. Contrary, participants with high art-expertise are expected to show heightened affect when exposed to affective textual information (moderation of a-path).
3. Higher affect leads to higher judgement (b-path).
4. Expertise does not directly lead to higher judgement (direct effect, c-path), but rather to higher judgement via heightened affect (indirect effect), considering the differential effects of the moderation.

The conceptual moderated mediation model to analyze these hypotheses is depicted in Figure 2.

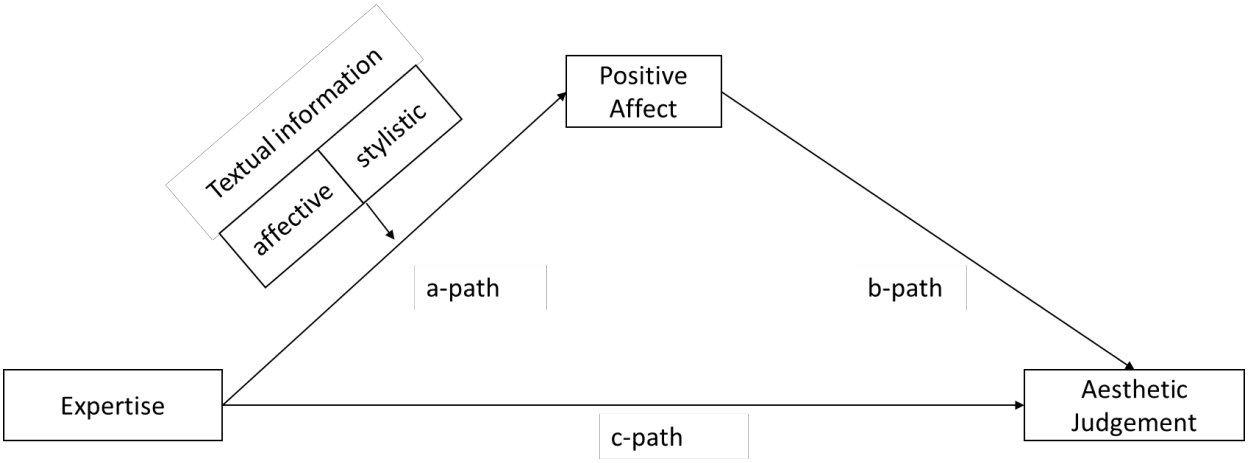

Figure 2. Conceptual path model of moderated mediation analysis.

Methods

The present study is part of a project funded by the Federal Ministry of Education and Research[1] and was approved by the responsible Ethics Committee on 29th of November 2021. It is registered at the Open Science Framework (OSF)[2]. The study is part of a controlled experiment that sought to highlight the influence of context and individual characteristics on how digital art is received in the form of a VR-gallery. Utilizing a 2x2x2 factorial design, the research manipulated three distinct factors. First, the artist's background, with participants either viewing a video showcasing an urban or a rural background of the artist. Second, the degree of social interaction within the virtual reality setting, where participants either could interact with others through a guestbook or had no communication options. Finally, the nature of textual information paired with the paintings, divided between formal-stylistic and affective descriptions. The latter manipulation is the subject of this article. The factorial design resulted in eight participant groups, as illustrated in Figure 3. Psychophysiological measures, such as heart rate (HR) and heart rate variability (HRV) were recorded; however, these measurements are only briefly mentioned in this article, as they were extensively covered in a previous article by *blind review*.

Sampling

Sampling was done by contacting probands from the researchers host institution via the university mailing list. Moreover, flyers were distributed to attract art-interested volunteers. Lastly, a snowball sampling procedure was used, reaching out to people within the researchers' personal social circles. The varied sampling strategies means there is potential for ecological validity.

[1] Project name: "***blind review***"; Funding code ***blind review***
[2] ***blind review***

Sample Size

Figure 3 depicts the allocation across the eight groups of the 2x2x2 design. To achieve 80% power for testing effects in a 2*2*2 design, with an error probability of $\alpha = 0.05$ and a medium effect size of $f = 0.3$ (Cohen, 1988), a sample size of N=90 was derived using G*Power (Faul et al., 2009). N was increased to 113 participants, since a missing-at-random 25% dropout rate concerning the psychophysiological measurements was anticipated (Koskinen et al., 2009; Lenski & Großschedl, 2022; Schmidt & Martin, 2020).

Procedure

For a short overview of the procedure, refer to Figure 3. Upon arrival, participants were given a quick overview of the procedure. Once the VR-glasses were positioned on the participants' heads, they were then fine-tuned for visual clarity and height-adjustment using Steam VR (Valve Corporation, 2022). Following this, participants practiced navigating in a VR training environment. Participants moved using the point-and-teleport method, where they would point to a position and then teleport to it, in order to reduce nausea (Buttussi & Chittaro, 2021). Nevertheless, for more precise positioning adjustments, participants had the option to use the joystick for backward movements. After the rehearsal, participants were connected to the psychophysiological measuring devices. They then entered the virtual gallery, where they initially watched a video about the life of the artist in the entrance area. Afterwards they were allowed to move around freely. To conclude the VR experience, participants informed the researcher, who then helped them remove the glasses and detach from the device. The session ended with the completion of a second questionnaire.

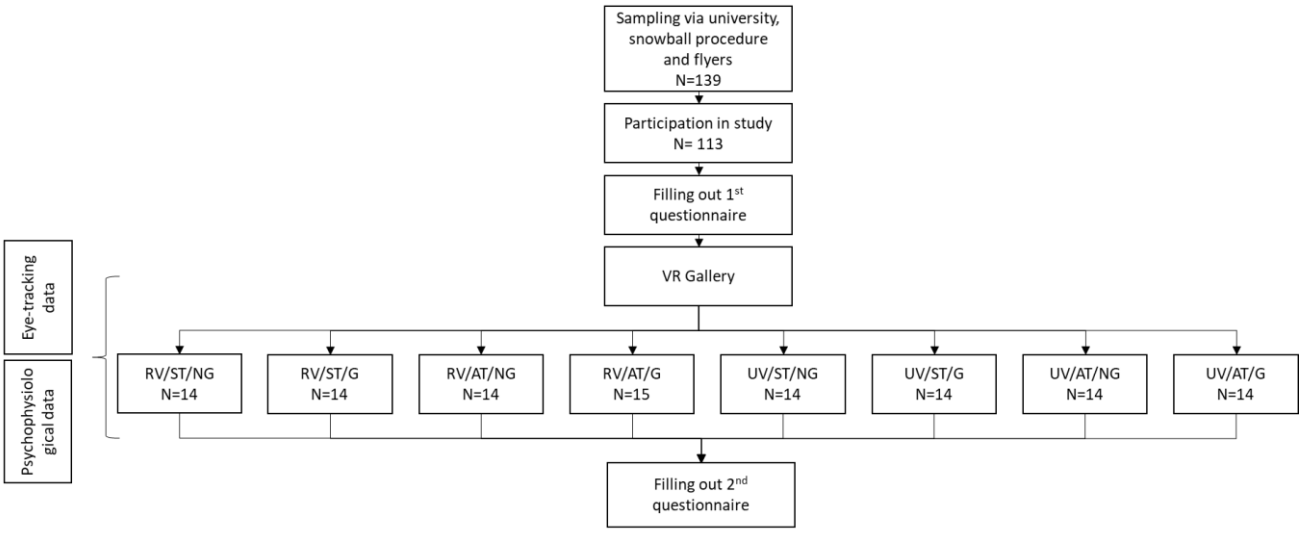

Figure 3. Allocation across the eight groups of the 2*2*2 design.
Note: UV= Urban Video, RV= Rural Vide, ST= Stylistic Text, AT = Affective Text, G= Guest Book, NG= No Guest Book.

VR set-up

The gallery was created with Unity (Unity Technologies, 2022) and launched via SteamVR (Valve Corporation, 2022).

Curatorial arrangement in the VR-gallery

The paintings displayed were painted by the artist Pritte Laschat (1904-2002), who explored different artistic styles throughout his career. The display of various styles in the gallery was vital to generalize the findings to a broad population of paintings instead of investigating a fixed effect associated with a particular art genre/ movement. An art historian selected the paintings and a curator[3] was asked to hang the paintings in the gallery. To acquire detailed information about the hanging and the structure of the gallery, as well as a depiction of the ten paintings used, please refer to *blind review*. The textual information was displayed next to the painting, and participants could teleport in front of the information to read it. However, it was also possible to click on the textual information, which was then enlarged in the field of view to make it easier to read (Figure 4)

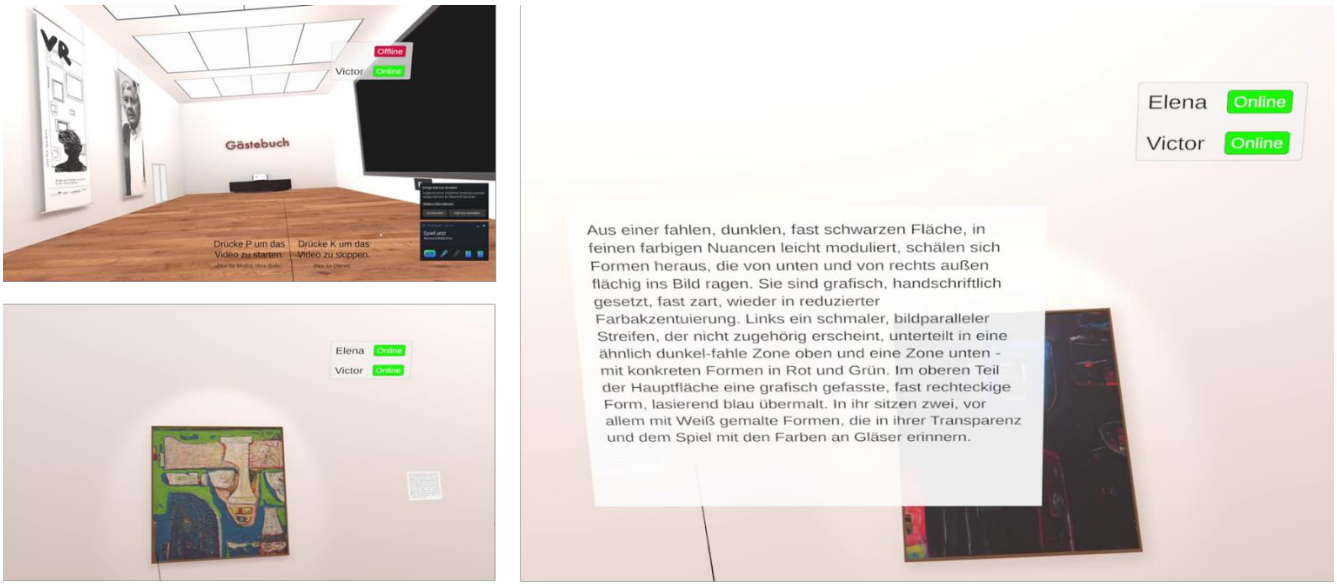

Figure 4. Excerpts from the VR gallery. Top left: Entrance area including guest book (straight ahead, "Gästebuch") and video (right wall). Bottom left: Exhibition room with textual information displayed on the wall. Right: Painting in the exhibition room, with textual information enlarged.

Textual information

As in Cupchik et al.'s study (1994), either affective ("mood") or stylistic information were provided. In the current study, the affective texts were created based on a preliminary study, while the stylistic texts were written by an art historian (for examples see Table 1).

[3] We would like to thank *blind review*for her work and expertise on the curatorial arrangement of the virtual reality gallery.

To ensure that the affective information's emotional words accurately reflect the emotions individuals experience when viewing the painting, a preliminary study was conducted. The participants in the pre-study were presented with the ten paintings in an online-survey and had to choose from a list of affective terms that best represented the paintings. The terms were chosen based on the German version of the AESTHEMOS (Schindler et al., 2017), which includes 42 emotion items. To maintain a concise questionnaire and encourage ensure high participation rates, 23 items were chosen. We ensured that at least one word from each of the 21 categories was included. In accordance with Cupchik et al. (1994), we also included words with negative connotations. This is based on the understanding that negative emotional words can also simplify the processing and comprehension of an artwork, and, in the realm of art, it is generally assumed that negative emotions do not necessarily result in diminished positive affect or lower evaluations (Menninghaus et al., 2019). After data collection, the five most frequently selected emotional terms were then selected for each artwork and incorporated into a short text.

For the stylistic information, an art historian was commissioned with writing sentences about the formal and stylistic features of each picture[4]. In terms of length and content, he based his sentences on Cupchik et al. (1994), in particular the stylistic formulations from Experiment 2 and on a transcribed interview with the painter discussing his art. After the texts were written, they were reviewed and, where necessary, shortened to adapt them to the length of the affective texts as closely as possible without losing too much meaning.

Table 1. Exemplary stylistic and affective information for one of the paintings.

Stylistic	Presumably a Mediterranean landscape viewed from an elevated position. Constructed in clear spatial layers. Muted colors prevent a clichéd postcard atmosphere. The artist's brushwork sets the rhythm: broad, calm, and planar in the sea, it contrasts with the rapid staccato in the trees, the controlled stroke in the buildings contrasts with the dissolving one in the sky. Nature, geometry, and the painter's hand interpenetrate, thus creating a harmonious whole.
Affective	One can quickly take a liking to this Mediterranean landscape viewed from an elevated position. Sky and sea are recognizable. This scenery evokes sentimental feelings and is relaxing. Upon closer inspection, one can make out trees and houses. The nature depicted may touch and move the viewer.

Note: The original texts were written in German, and efforts were made to translate them with the utmost accuracy. However, it's possible that some nuances of meaning might have been lost in translation.

[4] We would like to thank *blind review*for his assistance in selecting the ten paintings for the virtual reality gallery and crafting the stylistic descriptions that accompany them.

Measurements

Variables were assessed with two questionnaires (one before and one following the VR-experience).

Affect

Affect was measured using the German version of the PANAS (Breyer & Bluemke, 2016), which contains 20items assessing positive and negative affect. Responses were recorded on a 5-point Likert scale ranging from 'not at all' to 'extremely'. Affect was measured before and after the VR gallery visit, resulting in four scales: positive affect before the experience (α = .764), positive affect after the VR experience (α = .883), negative affect before the experience (α = .765), and negative affect after the VR experience (α = .686). In the analysis, the positive affect after the VR-experience-scale was used.

Art expertise

Expertise was measured after the VR experience using the 10-item scale by Smith and Smith (2006), which consists of artistic terms and artists. Participants assess their knowledge about these terms and artists on a 5-point Likert scale, ranging from "I've never heard of this artist or term" to, "I can speak intelligently about this artist or idea in art". Cronbach's alpha indicated satisfying internal consistency (α=.786).

Aesthetic Judgement

Aesthetic Judgement was measured on an 8-item scale developed by Cupchik et al. (1994). Four of the items were rated on a 7-point Likert scale, ranging from "not at all" to "extremely". The other four items were rated on a 7-point Likert scale, with the opposite adjectives on each side (e.g. interesting – uninteresting). Participants were asked to evaluate each of the ten paintings individually; therefore, every painting was displayed at the top of the questionnaire page, with the eight items listed below it. Cupchik et al. (1994) examined each item independently, conducting separate ANOVAs with each as a dependent variable. In contrast, we built a scale for aesthetic judgement by averaging the eight items. This methodological decision was driven by our objective to assess the impact of our independent variables on the whole construct of aesthetic judgement rather than effects on individual items. This approach is supported by the high reliability coefficient found by Cupchik et al. (1994) for the items, indicating consistency across different artworks on the scales (Cronbach's alpha was .92 for figurative artworks and .96 for rhetorical artworks). The high reliability coefficients suggest that it is methodologically sound to aggregate these items into a single scale. Cronbach's alpha, computed across all 80 items in the current sample (derived from 8 items across 10 images), demonstrated high reliability, α= .929. Similarly, Cronbach's alpha calculated as the average of the Cronbach's alphas for each of the 10 images, also indicated high reliability (α= 0.813).

Statistical Analysis

A mediation analysis with moderation of the a-path was conducted using the Lavaan package (Rosseel, 2012), with 5000 bootstrap samples and 95% confidence intervals (CIs). The analyses were performed using R (R Core Team, 2016). To reduce multicollinearity, mean centering was performed on the continuous variable that is part of the product term of the interaction (Hayes, 2018), namely expertise. The estimates reported here are non-standardized values (B) because the moderator is binary and interpreting standardized estimates is only meaningful for continuous predictors.

Results

The indirect effect of expertise on aesthetic judgement through positive affect contrasting two types of textual information

The fit of the model was good ($\chi2$= 0.616, df =2, p=.735; RMSEA=0.000, 90% CI [.000,.131], p=.792; CFI =1; SRMR =.015). The estimates, standard errors, p-values, as well as upper and lower CIs for all paths can be found in Table 2. Figure 5 shows the statistical model with the (standardized) estimates.

As hypothesized (hypothesis 1, a-path), expertise has an effect on positive affect (B = 0.53, 95% CI [0.28, 0.8]), indicating that participants high in expertise reported higher affect after the VR.

Moreover, textual information has a negative effect on affect (B = -0.27, 95% CI [-0.51, -0.04]), suggesting that participants that read the affective textual information showed higher positive affect. Given that this path from the moderator to the mediator primarily exists in the statistical model rather than on our conceptual framework/ model, we did not initially propose a hypothesis about this relationship. Nonetheless it is an interesting secondary finding.

However, contrary to our expectations (hypothesis 2, moderation of a-path), there was no interaction between type of text and expertise (B = 0.01, 95% CI [-0.52, 0.53]), indicating that textual information does not moderate the path between expertise and positive affect. The index of moderated mediation is also not significant (B = 0.00, 95% CI [-0.21, 0.21]), indicating that the conditional indirect effects are not statistically different for affective and stylistic textual information.

As expected, (hypothesis 3, b-path), the b-path from affect to aesthetic judgement was significant (B = 0.37, 95% CI [0.22, 0.56]). Also, in line with our expectations (hypothesis 4, c-path), the direct effect from expertise to aesthetic judgement was not significant (B = 0.15, 95% CI [-0.12, 0.435]). Concerning the conditional indirect effect (hypothesis 4, indirect effect), for both types of text expertise , as predicted, a significant indirect effect on aesthetic judgement (affective text: B = 0.2, 95% CI [0.09, 0.38]; stylistic text: B = 0.2, 95% CI [0.05, 0.45]). Moreover, for both types of text, there is a significant total effect of expertise on aesthetic judgement (affective text: B = 0.35, 95% CI [0.08, 0.65]; stylistic text: B = 0.35, 95% CI [0.07, 0.66]).

Table 2. Estimates, standard errors, p-values, upper and lower Cis of the moderated mediation model.

Direct Effects						
Endogenous variables	**Exogenous variable**	**B**	**SE**	**p-value**	**Lower CI**	**Upper CI**
Positive Affect after	Expertise	0.531	0.133	0.000***	0.279	0.803
	Textual information	-0.265	0.119	0.025*	-0.507	-0.035
	Interaction	0.01	0.265	0.97	-0.523	0.531
Aesthetic Judgement	Positive Affect after	0.374	0.088	0.000***	0.216	0.56
	Expertise	0.153	0.141	0.275	-0.12	0.435
Index of Moderated Mediation						
		B	**SE**	**p-value**	**Lower CI**	**Upper CI**
		0.004	0.103	0.972	-0.212	0.213
Indirect and Total effects						
		B	**SE**	**p-value**	**Lower CI**	**Upper CI**
Indirect Affective Text		0.198	0.071	0.005**	0.092	0.377
Total Affective Text		0.352	0.147	0.017*	0.081	0.65
Indirect Stylistic Text		0.202	0.101	0.045*	0.047	0.449
Total Stylistic Text		0.355	0.15	0.018*	0.072	0.662

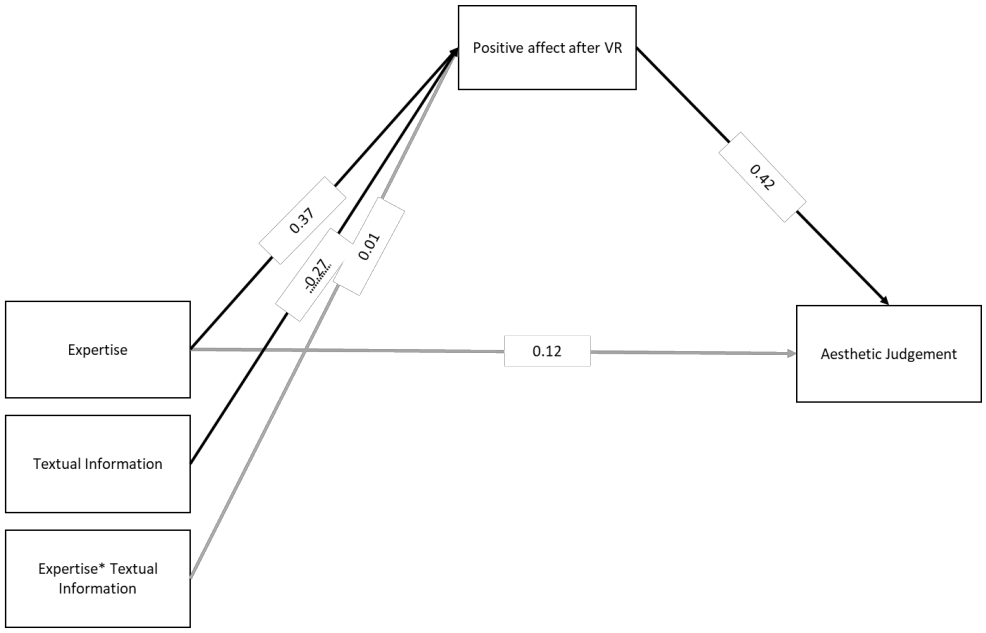

Figure 5. Statistical Models with standardized estimates (for dichotomous variable textual information, unstandardized estimate is displayed)
Note: Grey= Not significant; Black= significant.

Discussion

This study examined influences on aesthetic judgment in a virtual reality setting. It proposed that expertise should have a positive effect on aesthetic judgments, but only if positive affect acts as a mediator. In addition, it was hypothesized that the type of textual information should influence the relationship between expertise and positive affect. Specifically, we anticipated that individuals with high expertise would exhibit higher affect after reading affective texts, and individuals with low expertise would show higher affect after reading stylistic texts.

As hypothesized (hypothesis 1), participants high in expertise report higher affect after the VR-gallery. This is consistent with the notion of processing fluency. Experts can process artworks more easily and fluently, resulting in a more positive experience (Reber et al., 2004; Winkielman & Cacioppo, 2001). Furthermore, the effort after meaning theory states that successful interpretation, which is more likely among experts, leads to greater satisfaction (Russell, 2003). Leder et al.'s (2004) model proposes that successful completion of multiple stages in their model results in increased affect, and that increased expertise increases the likelihood of successfully completing these stages. Reflecting the findings of a related study (***blind review***,***), we found that expertise directly led to increased affect. Present findings, observed within a different context and statistical model, further exacerbates this result. Notably, the influence of expertise on affect seems to continue to exist in VR. In the analog realm, the aforementioned theories explain this relationship through the amplified cognitive processing capabilities of experts. However, research indicates that cognitive processes in VR differ (Antonietti & Cantoia, 2000). Consequently, one might have expected experts and lay persons to converge in their cognitive processing when engaging with artworks in VR. Intriguingly, this convergence does not occur, suggesting that cognitive processes in VR show similarities to those encountered in the analog world.

Moreover, as a secondary result, the study shows that reading affective textual information heightens positive affect. This result is intriguing because these types of affective texts are uncommon in the analogue artworld but seem to have a positive effect on visitors' experience. Thus, these findings could serve as a catalyst for future virtual art projects, and perhaps also inspire analog art exhibitions. However, further research into the impact of affective texts within an analog setting is essential to support this notion. Indeed, the context of virtual reality could account for these results. For many, the virtual world is a rather new and unfamiliar environment, merely mirroring the real world they are accustomed to. In such a "sanitized", or "artificial" environment, potentially devoid of the richness of human experience, individuals may be more inclined towards human emotions. As a result, they could prefer engaging with content that discusses emotions and prompts them to reflect on their own feelings, over a more sterile stylistic analysis lacking in emotional depth.

Similarly, the idea that individuals may be more inclined towards human emotions in VR might relate to emotional contagion, where individuals' emotions are influenced by the emotions of others (Hatfield et al., 1993). Studies show that contagion can also occur through nonverbal cues and does not

necessitate direct interaction, with research demonstrating its occurrence even through digital platforms such as Facebook (Kramer et al., 2014). In the context of VR, users may seek connections to anything that feels authentically human, allowing the emotional contagion of affective texts to become significantly magnified. Given that emotions within an aesthetic context are predominantly positive, a point elaborated on below, the contagion effect facilitated by affective texts could have contributed to the heightened positive affect observed. However, these explanations concerning the context of VR and emotions remain speculative and require further investigation.

On a different note, it is also interesting to keep in mind that the affective texts also contained emotional words with “negative” connotations. This builds on the work of Cupchik et al. (1994), who utilized mood information accompanying the artworks, some of which contained negatively connoted words such as "threatening" (p.65). The fact that texts that also contain negative emotional words still increase positive affect is consistent with the idea that aesthetic emotions have a positivity bias. This bias means that even when negative aesthetic emotions are evoked by an artwork, they can still be interpreted as positive (Menninghaus et al., 2019). This phenomenon can be explained by theories such as processing fluency (Reber et al., 2004). Reading about negative emotions that might be associated with the artwork could result in a feeling of successful processing of the artwork (e.g. “I also thought that this aspect of the painting is rather boring!”), and therefore amplifying the overall affect.

However, contrary to our expectations (hypothesis 2), there was no significant interaction between type of text and expertise, indicating that textual information does not moderate the path between expertise and positive affect. Furthermore, the insignificant index of moderated mediation also indicates that the indirect effects for affective and stylistic textual information on aesthetic judgement do not differ. These findings are contrary to Belke et al. (2006), who found that stylistic information increased appreciation in naïve viewers. In our study, participants high in expertise who read stylistic text, still showed an increase in affect and consequently judgement. This might indicate that activating different routes of processing using textual information does not work in this context. We expected stylistic textual information to prompt usage of art-specific interpretations and style classifications, elevating the experience for naïve viewers. Conversely, affective textual information was anticipated to elevate the experience for experts by fostering self-related interpretations and content classifications (Leder et al., 2004; Leder & Nadal, 2014). Since virtual reality is such a new medium and many other factors might influence the cognitive processes in VR, it might be useful to first test the activation of routes of processing via textual information in the analog world. Nevertheless, this might again reflect the potency of affective texts in VR, as previously discussed. It suggests that, in the context of VR, differences in expertise become irrelevant, with individuals generally more drawn more to texts with emotional content in VR.

As expected (hypothesis 3), positive affect seemed to increase aesthetic judgement. This evidence again supports the idea that processes identified in analog art viewing, such as the feeling-as-

information model proposed by Schwarz and Clore in 1996, are applicable to virtual art. This model suggests that emotions can act as feedback, meaning that positive emotions upon viewing an artwork might serve as an indicator of high quality of said artwork, leading to more favorable judgement (Reber et al., 2004). It appears crucial that this concept also seems to extend to virtual art experiences. The fact that positive affect could enhance appreciation of the artwork suggests that emotional responses to art in VR are not exclusively tied to the VR technology but are also a reflection of the artwork itself. This insight is valuable for artists exploring VR as a medium, indicating that art in VR transcends being a mere entertainment experience; it retains the capacity for genuine artistic appreciation. However, even if it were the case that aesthetic judgement is high due to the general newness and appreciation of the VR-experience (aka. VR inherently makes all experiences more impressive), it does not diminish the value of this appreciation. Even if the heightened affect and consequently judgement is influenced by the context of VR, it still fosters a positive art experience. Ultimately, whether due to the VR environment or the artworks themselves, the increased appreciation for art in VR can serve as a bridge, drawing more individuals to engage with and value art in its many forms.

In line with our hypothesis (hypothesis 4), expertise increased positive affect, which then increased aesthetic judgement. The significance of this indirect effect is further underscored by the lack of a direct effect from expertise to aesthetic judgment, in line with our expectations. Furthermore, there is a total effect of expertise on aesthetic judgment across both types of text, which becomes even more prominent in the absence of a direct effect. These findings are in line with Reber et al. (2004) who found that affect mediates the relationship between fluency (more likely in experts) and judgement. Furthermore, the lack of a direct effect reflects that participants with a high level of expertise have tastes and preferences (Leder et al., 2004). Therefore, a high level of expertise should not directly lead to a positive evaluation, but only through increased positive affect. Once again, this finding indicates that cognitive processes that are assumed to occur in the analogue world (Figure 1) might be transferrable into the virtual realm. In general, these findings also underline the importance of considering the influence of affect when researching aesthetic appreciation.

Limitations

While this study provides valuable insights into aesthetic appreciation in VR, it also has certain limitations that warrant consideration. One limitation is that the texts in both conditions were not the same length. This discrepancy raises the possibility that the affective texts exerted a stronger influence on participants' emotions due to their greater readability, a factor that cannot be entirely discounted. An attempt was made to shorten the stylistic texts as much as possible, without losing too much information. One potential approach could have been to extend the length of the affective texts. However, the five most frequently selected emotional words from the preliminary study were already included (refer to the Methods section under "Textual Information"). Including more than five emotional words seemed

excessive. Researchers wishing to build on this study should place emphasis on adjusting the length of the two texts.

Another limitation relates to how positive affect and aesthetic judgment were measured following the VR experience. Both variables were assessed in close succession using a questionnaire after the VR gallery. While it was ensured that affect was measured before judgment, the temporal sequencing of the study's model could have been further ensured, for example by measuring positive affect in real-time during the gallery visit. Moreover, between-participant designs show limited sensitivity to varying evaluative conditions (Russell, 2003). Therefore, a within-participant design could have detected an interaction effect between expertise and textual information. Nonetheless, recognizing that a laboratory context can influence aesthetic appreciation (Brieber et al., 2014), our goal was to simulate as closely as possible an actual gallery visit. Therefore, we avoided measuring positive affect during the gallery visit and using a within-subjects design that would have required participants to view the same artworks multiple times and thus interfered with free movement in VR.

Conclusion

As in the analog world, expertise appears to influence aesthetic judgment, but only by increasing positive affect. This effect is observed with exposure to both affective and stylistic texts, suggesting that text type does not interact with expertise as expected. However, affective texts led to higher affect in participants. This could be due to the "artificial" context of VR, where participants may be more receptive to human emotions than to more neutral, emotionless stylistic texts. Future virtual art projects could leverage these insights to improve the experience.

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