The visual language of pain: the role of rendering style and pain type in aesthetic and empathetic appraisals of painful images

Keywords

Visual art; aesthetic appreciation; empathy, pain perception,

Abstract

Art is capable of evoking empathetic and aesthetic responses in the presence of negative content like pain and suffering. The impact that artistic modes of depiction have on aesthetic and empathetic responses to painful stimuli has not been fully explored. In this study, participants viewed neutral and painful stimuli depicting humans with visible and invisible injuries across plain and artistic rendering styles. The results of an ANOVA and mediation analysis suggested that an artistic rendering style impacts empathetic responses in two ways: 1) An artistic rendering style communicates visual pain information which directly increases cognitive empathy, 2) An artistic rendering style impacts affective empathy, but this relationship is mediated by how much the viewer likes the image. This study illustrates the capacity of images to modulate multidimensional empathy by utilizing visual aids and aesthetic appeal. This has important implications for any discipline that treats, trains, informs, or entertains through use of images depicting pain.

Introduction

Aesthetics, as a discipline, is concerned with the perception of objects, scenes, and stimuli that evoke sensations of pleasure or create aesthetic experiences. (Chatterjee, 2011) The phenomenology of aesthetic experience is governed by formal features of the object itself and the context surrounding it, its ability to arouse and capture attention, the associative value extracted by the viewer, how readily or fluently it is processed, and the emotions elicited, among other aspects (Iseminger, 2000; Reber, 2004). Because its philosophical origins stem partially from the notion of hedonic pleasure, aesthetic experiences are often measured through the positive emotions they evoke (Winkielman & Chenier, 2018). Feelings of satisfaction and pleasure have been discussed as major factors in aesthetic experiences since Hume and Kant laid the philosophical groundwork for what would ultimately become the psychological discipline of aesthetics (Kulenkampff, 1990). However, the history of art and aesthetics is tied to pain as much as it is to pleasure: art's unique relationship to pain manifests through its widespread use in alleviating and coping with pain and negative emotions (Hass-Cohen & Clyde Findlay, 2009; Mitchell et al. 2008; de Tommaso et al., 2008). Aesthetic emotions vary beyond positive or negative valence, and art may trigger a variety of responses spanning interest, surprise, disgust, anger, pride, and more (Silvia, 2009). Whether or not some or all of these emotions qualify as aesthetic emotions is an ongoing debate in the psychology

of art (Fingerhut & Prinz, 2020), where some scholars see interest (Tan, 2000) or disinterested pleasure (Robinson, 2005) as the focal point of aesthetic emotions, while others regard all emotions as aesthetic emotions (Lazarus, 1991).

These debates around the nature of aesthetic emotions notwithstanding, it is well established that negative emotions are an important aspect of experiences with art. In music psychology, for example, sadness is a critical, yet paradoxical characteristic that can cause listeners to feel moved, find meaning, and perceive a piece of music as beautiful (Eerola et al., 2018). Aristotle, in his Rhetoric, described the "paradox of tragic pleasure," reflecting on how a Greek tragedy plays out on stage and transforms an audience's tragic pathos into enjoyment (Destrée, 2014). These paradigms can also be applied to the visual arts. The same way that a piece of music or performance might stir us, so too do painful images have the power to elicit shock and awe (Eaton, 1973). Not only are these negative experiences brought forth by art accepted, but they are also actively sought out – horror films, for example, are designed to elicit feelings of fear and shock (Smuts, 2007). This curiosity for unpleasant stimuli has led scholars to consider depictions of pain and violence as objects of contemplation and aesthetic interest (Nouzeilles, 2016; Marković, 2012).

Pleasure, Pain, and Aesthetic Appreciation

Many artworks depicting pain, suffering, and distress are held in high regard – Edvard Munch's iconic painting "The Scream" is one such example. Some of Frida Kahlo's most creative and renowned works creatively depict her sufferings with chronic illness (Courtney et al., 2017). Beyond art galleries, images of pain are so salient in contemporary society that for decades researchers have been investigating the effects of violent photos used in media coverage of humanitarian crises, (Campbell, 2004; Tan et al., 2018) in video games consumed by adolescents, (Browne & Hamilton-Giachritsis, 2005) as well as charity and sporting advertisements (Nunn, 2004; McDaniel et al. 2007). In many of these cases, the referent or context of the image - where it originated and the circumstances surrounding the negative content depicted - is dislocated from its presentation. Viewers consuming the image must imbue it with their own pictorial meaning, bringing their own ideas and experiences into their interpretations (Campbell, 2004; Nunn 2004), which consequently shapes their emotional response (Vartanian & Goel, 2004).

Why do viewers often engage with images depicting negative and painful content? As far as philosophers and pleasure theorists on this matter are concerned, the ability to enjoy a painful artwork is either a product of 1) the painfulness being controlled enough (by virtue of being fictional) that it cannot pass the threshold which would make the aesthetic experience unpleasant, 2) the pain is converted into or compensated by a secondary, positive response (dispelling of worries, intellectual pleasure, etc.), or 3)

that people do not seek out painful art for pleasure, but rather for the opportunity to safely experience robust emotional experiences without the threat of realness (Smuts, 2007). Each of these perspectives suggest that the use of a visual medium to transmit painful or violent content allows audiences to maintain physical and mental distance from the source of pain itself (Hillard, 2014). Art is just one context in which top-down regulation of emotional responses to negatively valenced stimuli are engaged in this way (Gross, 2002). Thus, a detached "art mode" form of spectatorship may impact viewers' ability to engage with and aesthetically appreciate painful images. This conjecture is based on previous research demonstrating that manipulating art framing alters emotional and aesthetic processing of negatively valenced images (Gerger et al. 2014; Wagner et al, 2014; Kirk et al. 2020). This line of research can help to identify where art can aid understanding of complex, subjective and often hidden physical experiences. The use of artistic practice to represent pain has implications for applied settings such as medicine, in which communication of pain can be a barrier between patient and clinician, and enhancing empathy for pain may impact on treatment outcomes (Gleichgerrcht, & Decety, 2014; Howick et al. 2018). It has been suggested that using visual aids for pain communication could be most effective in a clinical context (Padfield et al. 2011) but the efficacy of these aids and how this might be mediated by viewer characteristics and design aesthetics have yet to be explored. The style of an artistic image – its forms, colors, and composition – can be altered by the artist in order to manipulate a viewer's response to its content. Artistic renderings of pain may therefore facilitate alternative responses not just in framing (inducing "art mode"), but through introducing an element of expressiveness about the experience of pain that provides more robust information to viewers (or clinicians). The distinction between inducing different kinds of empathy (cognitive and affective) using artistic representations is also highly relevant for clinical practice (Decety, 2020; Gleichgerrcht, & Decety, 2014).

The current study aimed to investigate how an artistic mode of representation may impact distinct kinds of empathy for pain (cognitive and affective) and how these forms of empathy relate to aesthetic judgments (Gerger et al. 2019). We aimed to tease apart the complicated issue of the capacity of images and art to elicit empathetic responses by employing design incorporating two sets of digital illustrations: One "plain" set designed to resemble the kind of cartoon illustrations used in research of this nature – simple, flat line drawings with muted color palettes, minimal shading or detail – and a second "artistic" set, derived from the composition of the first set, that employed interesting textures, vibrant colors, and, most notably, utilized the strengths of the illustrative medium by using imagery, form, and color to indicate different qualities of pain. Essentially, neither set represents a stimulus reality and both could be considered as art, but one is constrained to mimic strictly what is available in reality, where the other introduces novel information about the pain depicted by way of its rendering style – the prediction being that the latter would draw out more empathetic responses, while the former comparatively would lack

information about reality itself and the pain depicted. By assessing behavioral empathy and aesthetic appraisals through stimuli that vary in their pain content and rendering style, the aim of the study is to add needed nuance about the role and nature of fictional and real images in overcoming barriers inherent to painful stimuli that ultimately allow viewers to like and find beauty in them. What follows is a review of the elements of focus in the current study, including the role of empathy in evaluations of painful images, the distinction between different kinds of images in depicting pain, and the role of beauty in shaping responses to painful images.

Empathy and Depicted Pain

Research that has explored, in some capacity, the behavioral or neural correlates of viewers' responses to pain within visual stimuli have often used empathy as a measure for the viewer's experience of pain. Empathy, a nebulous but ever-present term in this discourse, has always been central to aesthetics – philosopher Robert Vischer coined the German term Einfühlung, the word for aesthetic sympathy, which later became translated as empathy (Vischer, 1893). Empathy stands out amongst other emotional-sharing states in humans because it also has the capacity to motivate observers to alleviate suffering on top of adopting an emotional state (Bernhardt & Singer, 2012). Empathy remains a somewhat ambiguous term, used in different ways by artists and scientists, but can generally be broken down into motor (automatic mirroring), cognitive (understanding another's mental state), and affective empathy (feeling or sharing their emotions) (Cuff et al., 2016; Leiberg & Anders, 2006; Zaki & Ochsner, 2012). That is, being able to understand or share someone's pain (empathize with them) is a distinctly different phenomenon than compassion or sympathy (feeling badly for them) (de Vignemont & Jacob, 2012). Due to the ambiguous nature of the definition of empathy since its conception, (Wispé, 1986) and existing studies which indicate the presence or absence of various empathy-related neural correlates in response to these kinds of stimuli, it was pertinent to measure empathy in a specific, defined manner for a behavioral study of this nature. The measures reflect Zaki & Ochsner's (2012) definitions of cognitive empathy as a form of mentalizing or inferring pain, captured by asking participants of the study to rate how painful an image looked to them – and affective empathy or shared self-other representation, reflected by participants' self-reported ability to share the pain of person depicted. These measures are the two most widely collected components of multidimensional empathy in contemporary research (Neumann et al., 2015).

To observe empathetic responses to artwork, it is natural to turn to depictions of pain, which has been a popular choice of content throughout art history (Schott, 2015). Picture-based neuroimaging studies have documented that the simple act of viewing a painful action occurring to a body or limb can prompt neural responses related to affect and somatosensory processing that mirrors firsthand pain responses. Such studies illustrate that this vicarious experience of pain is a neurological reality (Bernhardt

& Singer, 2012; Lamm et al., 2007; Morrison et al., 2004). Viewers also perceive images of embodied pain more negatively than other kinds of stimuli with negative valence (Corradi-Dell'Acqua et al., 2011). A simple photograph of a needle being inserted into a hand can elicit a visceral reaction such as this, yet bodily depictions of pain in a painting hanging at an art museum will be sought out and enjoyed by viewers and considered beautiful (Lamm et al., 2007; Ogino et al., 2007). As suggested previously, such responses could be tempered by the psychological distance created by utilizing artistic techniques to augment and stylize aspects of pain, or by the presence of framing which induces an art mode of perception (Hillard, 2014; Thorburn, 1925). Visual representations are also pertinent here because pain is difficult to verbalize and subjective in nature, making painful content a compelling candidate for exploring and elucidating through visualization (McMahon et al., 2008; Pither, 2002).

Kesner & Horáček (2017) suggest that responses to empathetically resonant images are derived from a framework consisting of three contextual frames: the spatial-experiential, social-cultural, and pictorial context of the image. It is well researched that several environmental factors can impact a viewer's aesthetic experience, from something as small as a title displayed with an artwork (Millis, 2001; Leder et al., 2006) to as large as the layout of gallery space (Krukar, 2014; Hubbard, 2018). Moreover, personal qualities, such as disposition and cultural background, also contribute to forming expectations and responses to art (Kesner & Horáček, 2017). Last among these frames, pictorial context refers specifically to how affective features in the image are allocated space in the composition – i.e. the nature and prominence of facial expressions, gestures, postures that convey pain and any visible injuries (Fuchs & Koch, 2014; Rigato & Farroni, 2013). Each of these factors prime the way images are consumed and can be so influential as to direct patterns of gaze and attention when exploring a visual stimulus (Kesner & Horáček, 2017).

Notably, empathetic responsiveness to an image is also driven by individual viewer proclivities: trait anxiety, (Wangelin et al., 2012) dispositional empathy, (Davis, 1983) and art expertise, (Else et al., 2015) to name a few. Further, while viewers may not readily relate to a classical painting depicting an obscure form of torture or mutilation, (Guzik, 2014) viewers with past trauma or personal experience relating to the pain can be severely distressed by even a proximate depiction (Price, 2000). Personal experience with depicted pain dictates a viewer's empathetic response (Rameson et al., 2011) through their ability to imagine a reference point for the kind of pain they are viewing, and then amplify it through a process called intentional empathetic projection, which allows viewers to approximate the intensity of a less familiar pain (de Greck et al., 2012). The impact of a viewer having experience of a particular kind of pain on aesthetic and empathic responses to painful images was a supplementary element of interest in the current study.

Pictorial methods for depicting pain

Several studies have explored different styles of images on responses to pain, usually comparing photoreal depictions of pain to illustrated versions of the same painful stimuli (Jamrozik et al., 2019; Gu & Han, 2007), while others have observed the effects of embodiment, in the form of motor mimicry, on aesthetic judgments (Ardizzi et al., 2018; Ardizzi et al. 2021). Some scholars suggest that hand-rendered and photographic depictions represent a meaningful epistemic gap because the information that can be extracted by them differs necessarily due to the medium (Perini, 2012). For example, characteristics of artworks such as brush strokes or handwritten letters can enhance aesthetic appreciation (Ticini et al., 2014; Longcamp et al., 2003). For this reason, a focal point of the current study is rendering style, and how altering the visual style of an image may influence viewers' ability to like images of pain and, by extension, empathize with them. It can be argued that photographs can elicit more empathetic responses due to having a clearer link to reality (Parisi, 2012). In an fMRI study by Gu and Han (2007) where participants viewed cartoons and pictures of hands in neutral and painful positions, researchers found that neural activity associated with pain in the anterior cingulate cortex (ACC) was higher for photographic depictions than cartoons. The cartoon illustrations failed to evoke responses in the right insula and putamen (often, but not exclusively, associated with negative emotions), which the authors cite as a product of reality constraints, i.e. the cartoon depictions lacked the robust color and texture information needed to make it a stimulus reality and produce the same neural signature (Gu & Han, 2007). These findings suggest there are differing neural responses to pain according to whether it is represented as a real or fictional stimulus, which is modulated by the presentation style. Another study examined the effect of fictitious presentation of unpleasant images on viewers. It suggested that the insula and amygdala are involved in the process of regulating emotional reappraisals of mutilation images with fictitious precedent depictions (Mocaiber et al., 2011). Previously discussed evidence demonstrated the strength that illustrated visuals (both computer-made and hand-depicted) have to enhance the aesthetic experience (Maciejewski et al., 2007; Ticini et al., 2014; Longcamp et al., 2003). Cognitive processes, such as inference of mental states, and empathy-related patterns of fMRI activity in the ACC and amygdala are shown to be present in cartoon depictions of social scenes, suggesting that illustrated images can simulate realistic emotional or mental states (Völlm et al, 2006).

Because assessments of pain in the realm of visual stimuli rely exclusively on what can be seen by the research participants, it is important to consider the semantic and iconographic aspects of visualized pain to express pain in images even where it cannot be depicted in a literal sense (Schott, 2015) by invoking visual analogy and making use of symbols and colors. Since pain is so varied, and unseen kinds of pain, such as chronic illness or internal injuries, are often underestimated or dismissed as purely

psychological (Tsay et al., 2015; Ojala et al., 2015), the stimuli in the current study were subdivided into explicit, implicit, and neutral (no pain control) categories for the purpose of exploring the effects of visible and invisible pain content on empathy and aesthetic judgment in the two rendering styles.

The role of beauty in artistic depictions of pain

Hume argued that the perception of beauty is essential for transforming pain into pleasure in aesthetic appraisals (Hume, 1907). While it is beyond the scope of this study to address the crux of this age-old philosophical paradox, the idea that judgments of beauty have the potential to modulate a viewer's perception of pain is a focus of the current research. Measures of aesthetic judgment were therefore collected to reflect liking and perception of beauty, with the anticipation that aesthetic appreciation would mediate the corresponding empathy responses to the illustrations. Ardizzi et al. (2018) demonstrated that aesthetic appraisals were directly related to empathy by exploring sensorimotor reactions to depictions of pain in Renaissance artworks, specifically using isolated human faces over other body parts. Participants who were not asked to suppress their facial expressions when viewing painful artworks (i.e. able to enact motor mimicry), measured by activation of the corrugator supercilii muscles, rated artworks as more beautiful. A study by Jamrozik et al. (2019), which examined observers' responses to photos of people with facial disfigurements pre (with disfigurement) and posttreatment (no disfigurement), showed that observers judged pretreatment individuals with disfigurements more negatively in several measures from a test battery relating to personality and ability, but that this difference in pre and posttreatment was not significantly contributed to by judgments of attractiveness. In a personal correspondence about the stimuli used in this study, the authors explained that another set of images was also generated by applying an oil painting filter to the images of individuals with facial disfigurements pre and posttreatment. The findings from this exploratory extension of the study suggested that the artistic depiction attenuated the negative bias against individuals with disfigurements in personality measures (agreeableness and extraversion). (F. Hartung, email communication, November 1, 2019).

To summarise, the current study aimed to evaluate the impact of artistic depictions of pain on cognitive and affective empathy, exploring the potentially mediating role of beauty and liking judgements. It was hypothesized that the artistic styling of painful stimuli would increase cognitive and affective empathy responses and make painful stimuli more likely to be received as likable and beautiful by viewers. It was also predicted that this effect would be more pronounced for implicit pain stimuli than explicit pain stimuli across the two conditions, where artistic rendering can better communicate the felt aspects of implicit pain. Additionally, it was predicted that ratings of beauty and liking would act as mediators between the impact of the rendering style and reports of cognitive and affective empathy. That

is, differences in experiences of beauty and liking would partly explain why artistic renderings give rise to increased cognitive and affective empathy for painful stimuli.

Methods

Participants

Participants (N = 338, with n_{Plain} = 173, $n_{Artistic}$ = 165 for independent samples) were recruited online through social media and participant recruitment services such as survey swap platforms. Of the participants, 66 identified as men, 268 as women, two as non-binary, and two preferred not to disclose, with a mean age of 36.48 years (SD = 15.39) and ages ranging 18 to 85. The plain rendering group consisted of 132 women, 40 men and one who preferred not to disclose, with a mean age of 36.36 years (SD=15.39) ranging from 18-85. The artistic group consisted of 136 women, 26 men, two non-binary and one preferred not to disclose, with a mean age of 36.60 years (SD=15.45) ranging from 18-71. The demographic characteristics of the two independent groups were thus comparable. While there were originally 473 total respondents; any surveys which were started and left incomplete were discarded. Two additional participants who completed the survey were excluded after being identified as extreme outliers in the control condition (having rated the neutral set of images as highly painful, demonstrating a deviation that did not reflect the overall behavior of the sample). The sample had a power of approximately 90% for detection of medium effect sizes for all measures at $p < 0.01$ (detailed further in the results), in alignment with previous studies. All participants provided informed consent. The study was approved by the XXXX Research Ethics and Integrity Sub-committee.

Stimuli

The stimuli (provided as supplementary materials) consisted of 60 hand-drawn digital illustrations of humans in painful and neutral scenarios, half of which were rendered in style A (“plain”) and style B (“artistic”) (see Figure 1 for example stimuli). The illustrations (implicit, explicit, and neutral categories) contained figures in a mix of poses and pains inspired by the International Affective Picture System’s (IAPS) standardized emotionally evocative stimuli (Lang et al., 1999). The images for set B of the images were derived from the illustrations in style A, so that each image was part of a pair. To create the images for style B, a filter from a popular artificial intelligence photo editor, Painnt, was applied to each illustration to give the artistic set a cohesive visual style. Each illustration was then individually edited to incorporate other forms, colors, and imagery relevant to the kind of pain depicted. Both sets of stimuli (A and B) contained 30 images: 10 implicit pain, 10 explicit pain, and 10 neutral images used as a control. The kinds of pain depicted in the illustration set were chosen to ensure variety among the images and universal recognizability. That is to say, illness or injuries were selected so that each image within the set

was visually distinct from other types of pain in the set, and so that a single image of pain could be interpreted in multiple ways, allowing viewers to relate their own experiences to them. The stimulus set contained an even mixture of pains associated with different parts of the body. Each pain was illustrated based on accounts of pain described in various online health forums (e.g. Veritas Health, PhysioForum, etc.) The personal descriptions of pain were also considered in conjunction with assessments of chronic and acute pain using the McGill Pain Questionnaire, (Reading, 1982) which details pain through descriptors in a variety of sensory pain quality categories such as a temporal (flickering, pounding), pressure (drilling, pinching, crushing), thermal, brightness (tingling, stinging), dullness (sore, aching), among numerous other affective and evaluative qualities (Melzack, 1975). The explicit pain images, on the other hand, mostly depicted acute injuries, many times including lacerations, scrapes, bruising, and burns. The neutral stimuli represented a series of bodies at rest, in a variety of poses and angles, with neutral expressions in instances where faces were shown.

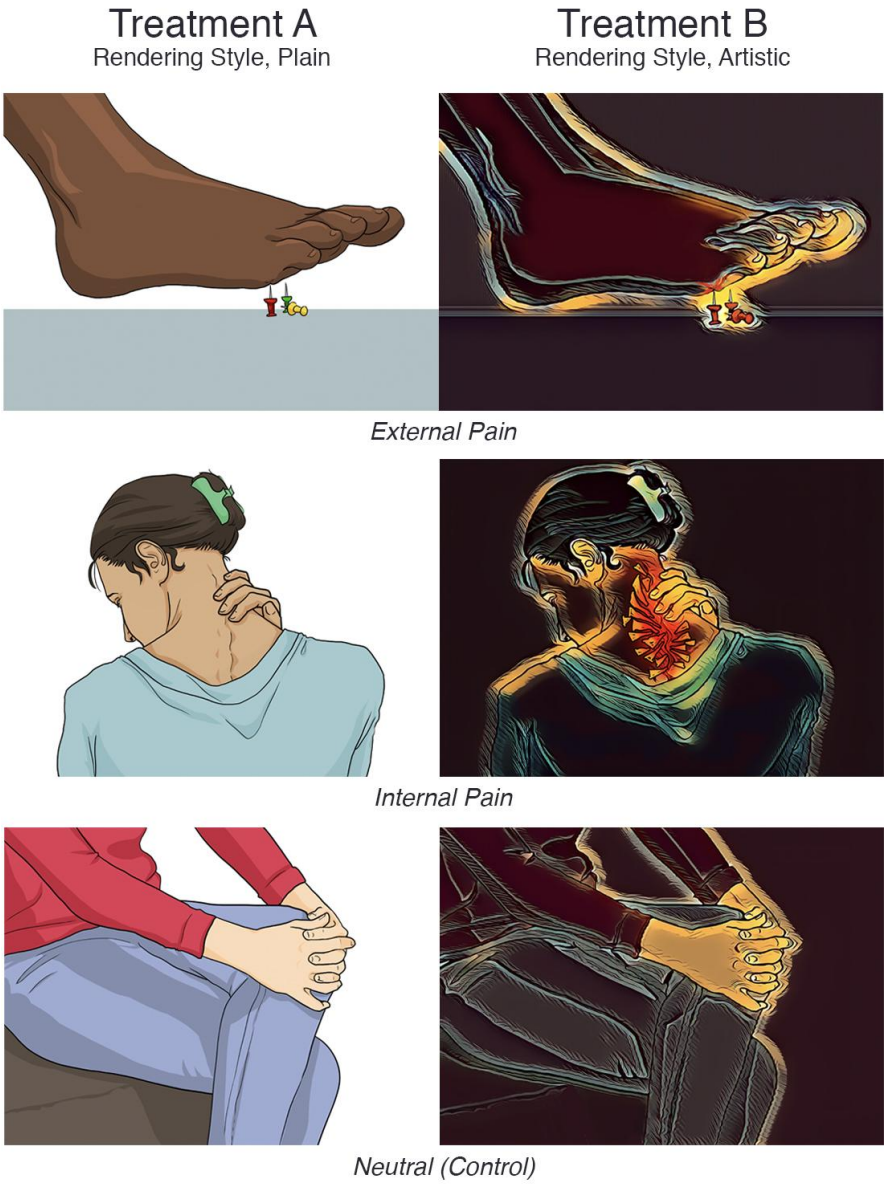

Figure 1. Examples of Painful and Neutral Stimuli in Two Styles of Rendering

Procedure

Before beginning the online study, participants provided basic demographic information and basic information about their arts background, training, and interest. Participants were told they would see 30 images of human bodies in various poses and kinds of pain, and some not in pain at all. They were instructed to take as much or little time as needed to complete the survey and to not overthink their answers, but simply record their initial responses to the images. They were given adequate warning about the nature of the stimuli (depictions of physical injury, blood), and were provided the option to withdraw

from the study at any point and directed to appropriate resources should they experience discomfort. Each participant was assigned randomly to one of the two blocks (plain vs. artistic) of stimuli. No information or context was presented with any of the images, and participants evaluated each stimulus separately (each image accompanied by the rating scales for empathy, aesthetic judgment and personal experience of the pain depicted, presented simultaneously), before viewing the next stimulus in the sequence. The stimulus order was randomized for every participant to avoid order effects (Englund & Hellström, 2012). Each image was rated on a 5-point Likert scale for the two types of empathy (Cognitive = How painful does this image look? / Affective = How well can you imagine (or feel) this pain?) and two types of aesthetic judgment (Liking = How much do you like this image? / Beauty = How beautiful do you find this image?). There was an additional measure allowing participants to categorically indicate whether they had experienced the pain depicted (Would you say you have personally experienced the pain depicted here (if any)?) on a 3-point scale (No / Somewhat / Yes).

Data Analysis

The data were analyzed with IBM SPSS version 24.0 and R Statistical Software (R Core Team 2020). Clusters of MNAR data formed where there was an incongruity between the question asked and image (usually in neutral images where participants did not perceive pain but were asked to indicate their experience with it) – in these instances values were imputed to represent "not applicable".

The main analysis assessed whether rendering style interacted with empathetic and aesthetic appraisals of different pain types using a mixed factorial ANOVA with a 3 (Factor: Implicit, Explicit, Neutral; within-subjects) × 2 (Rendering style: Plain, Artistic; between-subjects) design. Where sphericity assumptions were not met Huyhn-Feldt or Greenhouse-Geisser results were used to report effects within-subjects and corrections made where Levene's test was violated (Howell, 2009). Where appropriate, post-hoc tests using paired / between samples t-tests were carried out to determine significance of specific differences between and within groups. A Bonferroni-corrected α value was used for all follow-up tests where significant interactions were observed (see Tables 2 and 3).

Causal mediation analyses using linear mixed effects modelling were performed to investigate the possible mediating effects of beauty and liking on the relationship between rendering style and cognitive and affective empathy ratings, using the lme4 (Bates, Machler, Bolker, & Walker, 2015) and Mediation (Tingley et al. 2014) packages in R.

Results

Effect of rendering style and pain type on empathy and aesthetic judgment

After being screened for univariate and multivariate outliers, the data were found to be mostly normally distributed and variables to have linear, homoscedastic relationships in histograms, Q-Q plots, and residual plots. However, some variables were found to be skewed – predictably, measures for cognitive and affective empathy for neutral images were strongly positively skewed. To account for this, all variables were transformed logarithmically for the purposes of comparison. The data reported here reflect the transformed data; however, the untransformed data are used here to more clearly graphically represent the scale of differences. Descriptive statistics are shown in Table 1 and the results are visualized in Figure 2.

Cognitive empathy. A mixed factorial ANOVA on the transformed cognitive empathy scores indicated that there was a main effect of pain type on overall cognitive empathy scores ($F(1.53, 515.18) = 4215.52$, $p < 0.01$, $\eta_p^2 = 0.926$). There was a main effect of rendering style on cognitive empathy scores, with artistic renderings rated higher for cognitive empathy ($F(1, 336) = 36.66$, $p < 0.01$, $\eta_p^2 = 0.098$). There was also a significant interaction between pain type and rendering style ($F(1.53, 515,18) = 31.33$, $p < 0.01$, $\eta_p^2 = 0.085$). Following-up on the interaction between pain type and rendering style for cognitive empathy, it was found that cognitive empathy ratings were significantly higher for implicit pain stimuli compared to explicit pain stimuli in the artistic rendering style (Table 2; Figure 2). The opposite relationship was found in the plain rendering style, where cognitive empathy scores were significantly lower for implicit compared with explicit painful stimuli (Table 2). Furthermore, there was a significant difference in cognitive empathy scores between the rendering styles for implicit pain, but there was no significant difference in cognitive empathy ratings between rendering styles for explicit pain (Table 3).

Affective empathy. In relation to affective empathy scores there was a main effect of pain type ($F(1.26, 421.46) = 1810.76$, $p < 0.01$, $\eta_p^2 = 0.084$), but no main effect of rendering style on affective empathy scores ($F(1, 336) = 3.05$, $p = 0.082$, $\eta_p^2 = 0.009$). There was a significant interaction between pain type and rendering style ($F(1.26, 421.46) = 5.92$, $p < 0.01$, $\eta_p^2 = 0.017$). Affective empathy scores were lower for implicit painful stimuli than explicit painful stimuli in the plain rendering style, while there was no difference in affective empathy scores between implicit and explicit painful stimuli in the artistic rendering style (Table 2; Figure 2). Affective empathy scores were also significantly higher in the artistic rendering style than the plain rendering style for implicit painful stimuli, but responses to explicit painful stimuli were not significantly different between the two rendering styles (Table 3).

Aesthetic judgments. Among the aesthetic judgments, a main effect was found for pain type on liking scores ($F(1.46, 491.86) = 120.18$, $p < 0.01$, $\eta_p^2 = 0.263$), a main effect of rendering style with artistic renderings liked more than plain renderings ($F(1, 336) = 12.08$, $p < 0.01$, $\eta_p^2 = 0.035$), as well as a significant interaction between rendering style and pain type ($F(1, 336) = 9.97$, $p < 0.01$, v = 0.029).

Liking scores were significantly higher for implicit painful stimuli for both the plain and artistic rendering styles (Table 2; Figure 2). Liking ratings were higher for the artistic rendering style compared with the plain rendering style for implicit and explicit painful stimuli, but there was no difference in liking ratings between rendering styles for neutral stimuli (Table 3).

For beauty scores, there was a main effect of pain type ($F(1.52, 510.96) = 134.01$, $p < 0.01$, $\eta_p^2 = 0.285$), a main effect of rendering style with artistic renderings judged as more beautiful than plain renderings ($F(1, 336) = 36.66$, $p < 0.01$, $\eta_p^2 = 0.057$) and a significant interaction effect ($F(1.52, 510.96) = 6.97$, $p < 0.01$, $\eta_p^2 = 0.020$). Beauty scores were higher for implicit vs. explicit painful stimuli in both the artistic and plain rendering styles (Table 2; Figure 2). Beauty ratings were higher for the artistic rendering style compared with the plain rendering style for implicit and explicit painful stimuli, but there was no difference in beauty ratings between rendering styles for neutral stimuli (Table 3).

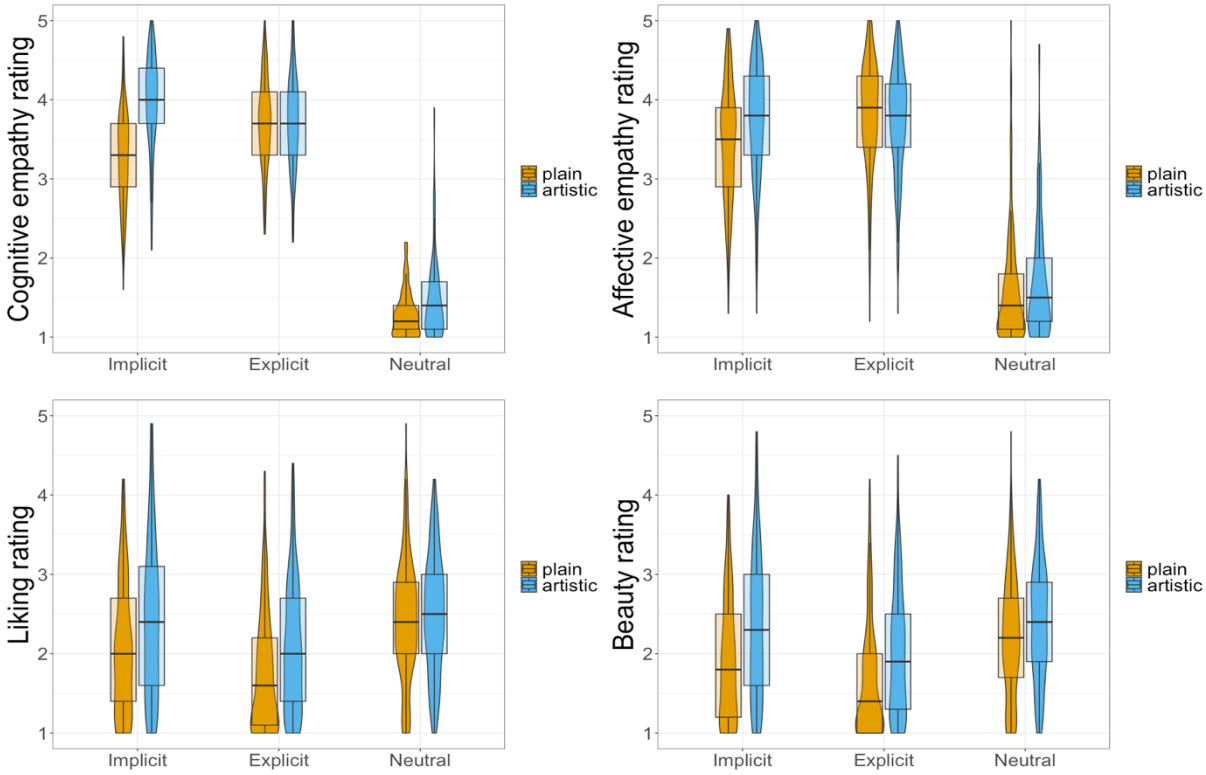

Figure 2. Empathetic and Aesthetic Appraisals of Pain Types Across Rendering Styles

Table 1

Descriptive Statistics for Cognitive and Affective Empathy, Liking and Beauty for Implicit, Explicit and Neutral Stimuli in Plain and Artistic Rendering Styles

		Mean *(SD)*		
		Implicit	Explicit	Neutral
Cognitive Empathy	Plain	3.27 (0.60)	3.71 (0.56)	1.30 (0.29)
	Artistic	3.96 (0.60)	3.72 (0.58)	1.49 (0.51)
Affective Empathy	Plain	3.45 (0.74)	3.82 (0.69)	1.61 (0.72)
	Artistic	3.74 (0.72)	3.74 (0.68)	1.70 (0.71)
Liking	Plain	2.07 (0.83)	1.75 (0.76)	2.42 (0.76)
	Artistic	2.44 (0.98)	2.09 (0.82)	2.49 (0.74)
Beauty	Plain	1.93 (0.79)	1.65 (0.73)	2.20 (0.77)
	Artistic	2.37 (0.93)	2.02 (0.79)	2.42 (0.76)

Table 2

Follow-up Tests for the Main Effect of Pain Type Separated by Rendering Style

		Implicit vs. Explicit	Implicit vs. Neutral	Explicit vs. Neutral
Cognitive Empathy	Plain	$t(172) = 11.06$*	$t(172) = 58.40$*	$t(172) = 63.13$*
		$d = 0.84$	$d = 4.44$	$d = 4.80$
	Artistic	$t(164) = 5.56$*	$t(164) = 44.43$*	$t(164) = 40.65$*
		$d = 0.44$	$d = 3.46$	$d = 3.17$
Affective Empathy	Plain	$t(172) = -9.63$*	$t(172) = 31.96$*	$t(172) = 33.72$*
		$d = 0.52$	$d = 2.13$	$d = 2.25$
	Artistic	$t(164) = 0.02$	$t(164) = 30.61$*	$t(164) = 29.08$*
		$d<0.01$	$d = 2.38$	$d = 2.26$
Liking	Plain	$t(172) = 10.61$*	$t(172) = 6.41$*	$t(172) = 10.96$*
		$d=0.81$	$d = 0.49$	$d = 0.83$
	Artistic	$t(164) = 9.01$*	$t(164) = 2.07$	$t(164) = 7.54$*
		$d = 0.70$	$d = 0.16$	$d = 0.59$
Beauty	Plain	$t(172) = 11.52$*	$t(172) = 6.13$*	$t(172) = 11.04$*
		$d=0.80$	$d = 0.47$	$d = 0.84$
	Artistic	$t(164) = 11.01$*	$t(172) = 1.94$	$t(172) = 8.70$*
		$d = 0.86$	$d = 0.15$	$d = 0.68$

*Bonferroni-corrected $p < 0.002$

Table 3

Follow-up Tests for the Main Effect of Rendering Style Separated by Pain Type

		Implicit	Explicit	Neutral
Cognitive Empathy	Plain vs. artistic	$t(332.24) = 10.02$* $d = 1.09$	$t(336) = 0.04$ $d < 0.01$	$t(290.74) = 3.80$* $d = 0.42$
Affective Empathy	Plain vs. artistic	$t(336) = 3.46$* $d = 0.38$	$t(336) = 0.99$ $d = 0.11$	$t(336) = 1.51$ $d = 0.16$
Liking	Plain vs. artistic	$t(336) = 3.55$* $d = 0.39$	$t(336) = 4.24$* $d = 0.46$	$t(336) = 0.93$ $d = 0.10$
Beauty	Plain vs. artistic	$t(336) = 4.52$* $d = 0.49$	$t(336) = 4.85$* $d = 0.53$	$t(336) = 2.68$ $d = 0.29$

*Bonferroni-corrected $p < 0.004$

Personal experience of pain types

Analysis of the role of personal experience with pain (participants who responded 'yes' to having personally experienced the pain depicted in each image) showed inverted patterns between cognitive and affective empathy based on self-reports of experience with the type of pain depicted. The results from a mixed ANOVA indicated that there was a significant interaction between empathy type and personal experience ($F(1.53, 515{,}18) = 31.33$, $p < 0.01$, $\eta_p^2 = 0.085$). There was a main effect of personal experience on empathy scores, ($F(1, 336) = 36.66$, $p < 0.01$, $\eta_p^2 = 0.098$). Furthermore, liking and beauty scores were significantly higher in cases where the participant personally experienced than pain compared to when they did not ($t(7837.03) = -3.61$, $p < 0.01$ for liking, ($t(7898.59) = -2.45$, $p < 0.01$ for beauty).

Mediation of beauty and liking on relationship between rendering style and empathy

Before conducting the mediation analyses, the relationships between the four dependent variables were explored within the two rendering styles. The correlation matrix (Table 4) shows the four main measures and denotes how correlations differed between the same variables depending on the rendering style. Conservative Fisher r-to-z transformations did not reveal any significant differences in the correlation coefficients between the two rendering styles, entailing that empathy and aesthetic judgment

were similarly related in the plain and artistic rendering styles. Excluding variable pairs which were highly multicollinear (such as external and internal cognitive empathy), significant correlations in either rendering style were between most commonly found between affective empathy and liking.

Table 4

Correlations Between Dependent Measures (Cognitive Empathy, Affective Empathy, Liking, and Beauty) Within Rendering Styles

	M	SD	1	2	3	4	5	6	7	8
1. (I) Cognitive Empathy	3.60	0.69	.	.662*	.140	.140	.589*	.516*	.164	.125
2. (I) Affective Empathy	3.59	0.74	.764*	.	.200*	.172	.412*	.757*	.206*	.156
3. (I) Liking	2.25	0.92	.181	.243*	.	.914*	.092	.202*	.868*	.817*
4. (I) Beauty	2.15	0.89	.205*	.232*	.880*	.	.070	.186	.810*	.875*
5. (E) Cognitive Empathy	3.71	0.57	.600*	.430*	.042	.090	.	.488*	.014	.024
6. (E) Affective Empathy	3.78	0.68	.570*	.736*	.161	.185	.600*	.	.228*	.195*
7. (E) Liking	1.91	0.80	.129	.169	.874*	.787*	.066	.166	.	.891*
8. (E) Beauty	1.83	0.78	.147	.175	.788*	.899*	.060	.171	.857*	.

*Significant at $p < 0.01$ level, two-tailed

Note. Table shows correlations between treatment groups with the top half (light gray) representing Plain (A) and bottom half of the diagonal representing Artistic (B), with means and standard deviations for the overall sample (N = 338). (I)=Implicit; (E)=Explicit

Mediation of beauty and liking on relationship between rendering style and cognitive empathy

Empathy (criterion) and beauty / liking (mediator), and a dichotomous dummy variable for rendering style (predictor) covarying for experience of pain were implemented in causal mediation models using the Mediation package for R using a percentile bootstrap estimation with 1000 samples (Tingley et al. 2014). We implemented a series of linear mixed effects models that included participants as random effects and experience of pain for each stimulus as a covariate. The full model was expressed as:

Cognitive / Affective empathy ~ Liking / Beauty + Rendering Style + Experience of pain + (1| Participant)

The first mediation model included rendering style as a predictor, cognitive empathy as the criterion, liking as the mediator and experience with the pain depicted in each stimulus as a covariate. The direct effect of rendering style on cognitive empathy was significant ($b = 0.37$, 95% CI [0.26, 0.47], $p < 0.001$), but the indirect of rendering style on cognitive empathy through liking was non-significant, suggesting that liking did not mediate the relationship between rendering style and cognitive empathy ($b = -0.007$, 95% CI [-0.02, 0.00], $p = 0.15$). A second mediation was performed, using rendering style as a predictor, cognitive empathy as the criterion, beauty as the mediator and experience with the pain depicted in each stimulus as a covariate. The direct effect of rendering style on cognitive empathy was significant ($b = 0.37$, 95% CI [0.26, 0.49], $p < 0.001$), but the indirect of rendering style on cognitive empathy through beauty was non-significant, suggesting that beauty did not mediate the relationship between rendering style and cognitive empathy ($b = -0.007$, 95% CI [-0.02, 0.01], $p = 0.26$).

The third mediation model included rendering style as a predictor, affective empathy as the criterion, liking as the mediator and experience with the pain depicted in each stimulus as a covariate. The direct effect of rendering style on affective empathy was significant ($b = 0.19$, 95% CI [0.07, 0.30], $p < 0.001$). The indirect of rendering style on affective empathy through liking was also significant, suggesting that liking partially mediated the relationship between rendering style and affective empathy ($b = -0.01$, 95% CI [<0.001, 0.02], $p < .05$), with 5% (95% CI [0.003,0.17]) of the effect mediated by liking. A fourth mediation was performed, using rendering style as a predictor, affective empathy as the criterion, beauty as the mediator and experience with the pain depicted in each stimulus as a covariate. The direct effect of rendering style on affective empathy was significant ($b = 0.19$, 95% CI [0.08, 0.30], $p < 0.001$), but the indirect of rendering style on affective empathy through beauty was non-significant, suggesting that beauty did not mediate the relationship between rendering style and affective empathy ($b = -0.006$, 95% CI [-0.005, 0.02], $p = 0.30$).

Discussion

The aim of the study was to determine if artistic rendering of painful images impacts viewers' ability to affectively or cognitively empathize with depictions of pain. The results of the current study revealed that cognitive and affective empathetic responses to implicit and explicit pain differ when these forms of pain are rendered in an artistic compared with a plain rendering style. Furthermore, rendering style modulated beauty and liking but only for painful stimuli (not neutral stimuli). The mediation analyses revealed that liking mediated the relationship between rendering style and affective empathy. Rendering style also directly predicted cognitive empathy. Therefore, the results from this study support the hypothesis that artistic style can influence liking judgments which in turn influence our ability to feel emotionally connected to depicted pain, and that artistic style also directly impacts our ability to cognitively understand depicted pain.

Our analyses of pain type (implicit/explicit) and rendering style (plain/artistic) on cognitive empathy revealed an interesting relationship between cognitive empathy ratings and renderings of implicit and explicit pain, which was inverted depending on whether participants were in the plain or artistic rendering group. In the plain rendering style, cognitive empathy ratings were higher for explicit pain (where injury is rendered clearly, making it easier to judge) compared to implicit pain (where pain is largely invisible, save for indicators like facial expression or posture). This may explain why chronic, unseen pain is often underrated by observers in terms of its painfulness (Ojala et al. 2015). By contrast, in the artistic rendering style, which utilizes the strengths of the medium through imagery, colors, and forms to convey more information about pain intensity and quality (without any literal pain analogies), implicit pain was rated higher on average than explicit pain. The pattern of results was similar for affective empathy ratings, with higher ratings for implicit vs. explicit pain in the artistic rendering style condition, but no difference between explicit vs. implicit pain in the plain rendering style. Our results also revealed that liking and beauty scores were significantly higher in the artistic rendering style than the plain one, but only for painful stimuli. The artistic rendering style elevated aesthetic appraisals of painful stimuli to a level similar to neutral images, which are usually rated more pleasant than painful images in studies of this kind, as reflected in the lower aesthetic evaluations of painful images compared to neutral images in the plain rendering style (Corradi-Dell'Acqua et al., 2011; Gu & Han, 2007). These findings suggest that painful and neutral stimuli differ in how they are liked between the rendering styles, with the artistic style transforming aesthetic judgments for only painful content.

Implicit pain images in the artistic rendering style may have increased cognitive and affective empathy ratings due to increased information about the pain, or improved pain signals. Pain signals refer to any aspect of an illustration which conveys a visual indicator of intensity or quality of pain, adding to

visual information available in an illustration that allows viewers to estimate the mental state of the person depicted. Our results suggest that pain signals appeared to be most effectively communicated in the artistic renderings of implicit pain compared to explicit pain. However, it is worth considering that lower cognitive empathy scores for explicit compared to implicit pain images in the artistic rendering style may be partly due to an attentional effect, wherein the complex textures and colors distracted from or obscured the injuries, making the pain harder to parse for viewers. The effect of artistic rendering on empathy for implicit pain has important implications for pain communication in clinical settings, suggesting that internally experienced pain (with no clear explicit pain-referent) would be most suitable for artistic rendering, in which the visual symbols and signs of the medium can be used to effectively enhance empathic understanding. Although from a creative perspective, considerable planning went into the colors and shapes used to articulate pain in the artistic set, it does not necessarily mean that viewers would be able to translate these visual aids into the kind of pain which the image intended to represent. Further research is needed to explore observer responses to different kinds of visual symbols and signs used to represent pain in order to maximise their impact on empathic responses.

Individual liking judgments mediated the association between rendering style and affective empathy, suggesting that an individual's aesthetic preferences provide a route to personally engaging with depicted pain. This contrasted with the relationship between rendering style and cognitive empathy, which was not mediated by aesthetic judgments. Our findings suggests that individual differences in aesthetic judgment will play a role in shaping some responses to depicted pain. If an image creator's intention is to induce feelings of personal engagement with pain (feeling or imagining it), they must consider the impact of individual aesthetic judgments. Cognitive empathy on the other can be enhanced purely through the use of an expressive medium. Again, this issue is of relevance in clinical contexts, in which cognitive empathy may be more important than affective empathy in establishing positive clinical outcomes and protecting clinicians from the negative impacts of engaging with pain (Decety, 2020; Gleichgerrcht, & Decety, 2014). It is worth highlighting that the casual direction of the relationship between empathy and aesthetic judgment cannot be determined in this study. It is certainly possible that modulations to the ability to empathize with the painful images could have impacted on liking and beauty judgments and it is likely there is a bi-directional relationship between empathy and aesthetic judgments in which ability to engage with pain depicted in artistic images informs perceptions of liking and beauty, and vice-versa.

The relative roles of cognitive and affective empathy are reflected in the findings of the role of personal experience of pain in responses to the images. People who reported having experienced the pain depicted had significantly higher empathy scores to those who reported not personally experiencing the

pain. Those with experience (and, thus, much higher affective empathy scores) also made significantly higher aesthetic ratings than those who had not, aligning with the findings that aesthetics judgments impact empathy. This is counterintuitive in some capacity: If someone understands an image with a negative valence well (i.e. having some impression of the reality of the pain it holds), it could be inferred that they would also like the stimulus less, but this was not the case.

The data from the current study suggest that art as a medium can both 1) enhance visual information in such a way that communicates pain qualities better, impacting cognitive empathy and 2) impact individuals' aesthetic appraisals, in turn implicating affective empathy through liking. These findings also speak to the importance of treating empathy as a multidimensional measure (Neumann et al., 2015) with subcategories referring to discrete phenomena, such as cognitive and affective empathy, which behaved differently in relation to aesthetic appraisals in this study. Affective and cognitive empathy are not artificial divisions. For example, research suggests that individuals with psychopathic traits have the capacity for cognitive, but not affective empathy – i.e. are able to describe another's pain but not share it (Dadds et al., 2009). This study reiterates the importance of distinguishing between these forms of empathy, especially in the context of pain and images.

Limitations

A limitation of this study is its online nature, which may have impacted the sample by way of self-selection bias (Eysenbach, 2005). Individuals with an interest in the arts, social science or psychology, and empathy may have been more likely to take the survey, although efforts were made to distribute the survey to individuals in many disciplines within and outside the institution the study was conducted through. Due to the relationship between contemplation, aesthetic interest, and liking (Cattaneo et al., 2017), it may have also been worthwhile to examine these relationships in the context of temporal exposure to images between rendering styles, data which could not be measured accurately in this study. Other research suggests that patterns in neural and subjective empathy (measured through self-reports) can differ using the same stimuli (such as photographic and illustrated) (Gu & Han, 2007). While it is possible neural correlates for empathy and aesthetic judgment may have been different between the two image rendering styles, it is unknown what neural processes were at play due to the purely behavioral measures of this study. It is also difficult to account for the overall effects of repetition and novelty on stimulus appraisals, where repetition of the rendering style may facilitate liking by way of processing fluency, (Reber et al., 2004) but due to humans' sensitivity in detecting handmade images, (Schott, 2015) this study may have also benefited from using a unique handmade image set, rather than applying a uniform painterly filter, though this was not feasible in terms of labor. Other variables concerning the nature of the pain depictions, such as object-referent pain, where the source of pain depicted (e.g. a

thumbtack, a knife) or the anticipatory nature of images (e.g. about to step on at thumbtack, compared to having already stepped it), which we did not explore at length, are further lines of inquiry to pursue. Finally, as mentioned previously and as with any studies of this nature utilizing mediation in analysis, it is difficult to make a plausible causal inference about aesthetic judgments and affective empathy (and which one predicts the other) due to lack of directional evidence on the relationship (Pieters, 2017). Due to the correlational nature of the study, we acknowledge that the directionality of this indirect relationship is difficult to pinpoint. Whether aesthetic preference begets empathetic response, or the inverse, is a call to further research.

Conclusion

The intuition underlying the use of images to communicate pain is reflected in the simple cartographic way in which a patient might draw their pain on a map of the body in a clinical setting (Schott, 2010). Pain is uniquely hard to articulate, and visual aids are one of few avenues available to convey its many sensations in lieu of being able to physically feel another's pain. Despite visualizations lending themselves well to expressions of pain (MacMahon et al., 2008), the scientific community's understanding of the interplay between images, empathy, and pain, is lacking. The results of this study supported the hypothesis that utilization of artistic tools and techniques in generating images of pain has a significant influence on both empathetic responses to and aesthetic appraisals of painful stimuli, particularly representing implicit pain. The results from the mediation analysis suggest that artistic rendering style communicated visual pain information, which predicted cognitive empathy directly, while individual aesthetic judgments in the form of liking acted as partial mediators of the relationship between rendering style and affective empathy. Analysis of the illustrations revealed that painful stimuli could be perceived as equally or more beautiful than neutral stimuli only after they had been transformed by the rendering style. Collectively, the study provides evidence that artistic style modulates empathetic responses to painful stimuli on cognitive and affective levels through two different pathways: through visual aids communicating pain quality and through aesthetic appraisals that may mitigate the negative valence of painful stimuli. This has important clinical, educational, and creative implications due to the salience and resonance of painful images in society and the variety of ways and reasons they are propagated throughout culture.

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