the VISUAL LANGUAGE of PAIN

The role of rendering style and pain type in governing aesthetic and empathetic appraisals of novel painful images.

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Abstract

This study sought to address a gap in the literature surrounding what kind of images have the capacity to evoke empathetic behavior, and what characteristics of those images enable them to be perceived as beautiful. To explore this, participants viewed a series of neutral and painful stimuli depicting humans with visible and invisible injuries across two different rendering styles, plain and artistic. The results suggested that art impacts empathetic responses via two streams: one where rendering style acts as a proxy for visual pain information which can predict cognitive empathy, and another where individual aesthetic judgments themselves, in the form of liking and beauty, fully mediated the relationship between rendering style and affective empathy. This study illustrates the capacity of images to modulate multidimensional empathy through art by utilizing visual aids and aesthetic appeal to mitigate the negative valence of painful stimuli. This has important implications for any discipline that compels, trains, informs, or entertains through use of images depicting pain.

Keywords: art, beauty, neuroaesthetics, aesthetic appreciation, empathy, pain, pleasure

> “Where perception is, there also are pain and pleasure, and where these are, there, of necessity, is desire.”
>
> \- Aristotle

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1.

Introduction

Neuroaesthetics, as a discipline, has always been concerned with the perception of objects, scenes, and stimuli that evoke sensations of pleasure or create aesthetic experiences.[1] Aesthetic experiences are phenomena in which a perceiver experiences an alternative mental state in response to a sensory object, usually one of visual or auditory nature, though it may also engage gustatory, olfactory, and kinesthetic senses. The phenomenology of aesthetic experience is governed by formal features of the object itself, its ability to arouse and capture attention, the associative value extracted by the viewer, how readily or fluently it is processed, the emotions elicited, among other aspects.[2,3]

1 *Chatterjee (2011) describes aesthetic experiences as being three part: first, hierarchical processing of a stimulus in the brain, and the subsequent emotional repsonse and aesthetic judgment following intitial perceptual assessment.*

Because its philosophical origins stem partially from the notion of hedonic pleasure, aesthetic experiences are often measured in part through the positive emotions they evoke.[4] Feelings of satisfaction and pleasure have been discussed as major factors in aesthetic experiences since Hume and Kant were laying the philosophical groundwork for what would ultimately become the discipline of neuroaesthetics.[5] 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.[6,7,8] Aesthetic emotions vary beyond positive or negative valence, and art may trigger a variety of responses spanning interest, surprise, disgust, anger, pride, and more.[9] Whether or not some or all of these emotions qualify as aesthetic emotions is an ongoing debate in the psychology of art, where some scholars see interest[10] or disinterested pleasure[11] as the focal point of aesthetic emotions, while others regard all emotions as aesthetic emotions.[12] The Kantian concept of *disinterestedness* – that judgments of beauty are a detached pleasure – formed a structural foundation for many models in neuroaesthetics,[13] though some argue that affective experiences necessarily modulate aesthetic appraisals.[14]

13 *Pelowski et al. (2017) notes that engaging an object as an "artwork" or an "aesthetic" can give rise to different levels of liking, detachment, and pleasure in response to it.*

It is well established that negative emotions are an important aspect of experience 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.[15] 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.[16] 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.[17] 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.[18] This curiosity for unpleasant stimuli has led scholars to consider depictions of pain and violence as objects of contemplation and aesthetic interest.[19,20]

1.1 Pleasure, Pain & Aesthetic Appreciation

It's not unheard of for artworks depicting pain, suffering, and distress to be 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 depict her sufferings with chronic illness.[21] 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,[22,23] in video games consumed by adolescents,[24] as well as charity and sporting advertisements.[25,26] In many of these cases, the referent or context of the image is dislocated from its presentation, and the viewers consuming the image must imbue it with their own pictorial meaning, bringing their own ideas and experiences into their interpretations.[22,25]

21 Some of Kahlo's most striking works blended depictions of literal injuries and traumas to her body (somatic pain), as well as representations of unseen pain sensations (neuropathic pain) that resulted as a consequence of the many medical procedures she underwent in her lifetime.

The use of digital media as a medium to transmit these images allows audiences to maintain physical and mental distance from the source of pain itself.[27] It is worth investigating the properties of images depicting any form of pain or violence and the kinds of aesthetics judgments viewers make in response to them. Whether hung and framed in an art gallery or viewed on the screen of a smartphone, viewers will always bring their unique experiences and tastes to the valuation of images, and the ultimate appraisal of images as artworks or mere spectacles.[13] Aside from these external factors which come to bear on appreciating images of pain, the content of the image – its forms, colors, and composition – also acts as a feature that can be manipulated to elicit different responses to images. Disgust responses to visual depictions of sickness, injury, or bodily gore are well documented physiological and affective phenomena.[28] Art overcomes this exceptionally well, despite pain being an aversive and unpleasant emotional experience for those in pain and observers alike.[29] To that end, this study aims to explore what aspects of a painful stimulus allow viewers to overcome the unpleasantness of the pain, and appreciate the image, and, in some cases, even consider it to be beautiful.[†]

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.[18] Hume argued that the perception of beauty is essential for transforming pain into pleasure in aesthetic appraisals.[30] 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 in images is a concept central to the design of this study. Regardless of what theory one subscribes to regarding the motivations of humans to experience or extract pleasure from painful art, art is, whether overtly or subtly, necessarily a departure from reality. Experiencing an emotional response

† *This is aligned with the Kantian notion of disinterestedness, which says that an aesthetic object is pleasurable because it is beautiful, rather than beautiful because it is pleasurable. This study attempts to build on this concept by taking a an unpleasant aesthetic stimulus and enhancing its likability by making the stimulus more aesthetically resonant. It also attempts to illustrate that liking and perception of beauty beget empathy.*

to it, painful or not, entails imagining the realness of the subject depicted.[31] For this study to investigate how painful qualities nested within fictitious images might be perceived as beautiful, then, it is also necessary to establish viewers' ability to imagine or internally simulate the states of those depicted – to measure empathy.

1.2 Empathy and Depicted Pain

Research that has explored, in some capacity, the behavioral or neural correlates of beauty and pain in 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.[32] It has only been in the last two decades that empathy and other sharing-based behaviors, such as emotional contagion and mimicry, have been studied in depth from a neuroscientific standpoint.[29] Freedberg & Gallese's extensive body of work on this topic often implicates the human brain's mirror neuron system (MNS), which they argue to be the basis for humans' ability to empathize by internally mimicking the actions of others.[33] However, the idea of motor simulation as the basis of empathy, and the importance of it in appreciating art, is criticized by many scholars as simplistic.[34,35] 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.[29] That said, 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).[36,37,38] 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).[39]

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.[35] 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.[29,40,41] Viewers also perceive images of embodied pain more negatively than other kinds of stimuli with negative valence.[42] 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 not only be sought out by laypeople, but can even be enjoyed by viewers and considered beautiful.[40,43] Such responses could be tempered by the psychological distance created by utilizing art as a medium over a photoreal one.[27,44] 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.[45,46]

42 Other kinds of negative valence (eliciting negative emotions) and neutral images from Corradi-Dell'Acqua et al. (2011) depicted, for example, hands in hand cuffs (for which an object-matched neutral version is simply hands holding open handcuffs), holding a knife pointed at the viewer (with an object matched version being hands peeling a potato with a knife). The use of neutral images in such studies is important to establish a baseline.

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.[34] 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[47,48] to as large as the layout of gallery space.[49,50] Moreover, personal qualities, such as disposition and cultural background, also contribute to forming expectations and responses to art.[34] 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.[51,52] All of these factors prime the way images are consumed and can be so influential so as to direct patterns of gaze and attention when exploring a visual stimulus.[34]

Notably, empathetic responsiveness to an image is also driven by individual viewer proclivities: trait anxiety,[53] dispositional empathy,[54] and art expertise,[55] to name a few. Further, while viewers may not readily relate to a classical painting depicting an obscure form of torture or mutilation,[56] viewers with past trauma or personal experience relating to the pain can be severely distressed by even a proximate depiction.[57] Personal experience with depicted pain dictates a viewer's empathetic response[58] 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.[59]

1.3 Investigating Perception and Reality

Keeping in mind the numerous factors that determine an individual's ability to empathize with a painful image, it is difficult to disentangle what aspects of the surroundings, viewer, and artwork itself that allow the notion of beauty to enter the picture. Based on the literature, there are a number of levels at which a stimulus can be manipulated to impact aesthetic and empathetic behavior in response to a visual depiction of pain, spanning rendering and representational style, environment and framing, culture, personality, and expertise.[34] For the sake of this study, investigating responses according to visual properties and kind of pain depicted provides an opportunity to observe differences in responses due to bottom-up (stimulus-driven perception) processing, outside of higher order top-down (cognition-driven perception).[60] Several studies have explored this through the use of different styles of images, usually comparing photoreal depictions of pain to illustrated versions of the same painful stimuli,[61,62] while others have observed the effects of embodiment, in the form of motor mimicry, on aesthetic judgments.[63] Collectively, these provide the experimental foundation for this behavioral study, exploring the relationship between painful visual stimuli and both aesthetic and empathetic appraisals.

As far as visual stimuli are concerned, 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.[64] For example, even characteristics of artwork as minute as brush strokes or handwritten letters can enhance aesthetic appreciation.[65,66] For this reason, a focal point of the study is rendering, and how altering the visual style of an image may influence viewers' ability to like images of pain and, by extension, empathize with them. Research on empathy and painful images is not always concerned with the exact properties of the visual stimulus, though it can be argued that photographs can elicit more empathetic responses due to having a clearer link to reality.[60] In a 2007 fMRI study by Gu and Han 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 (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.[62] Fuchs and Koch put forth that complete embodiment is an essential aspect of empathy, and the disembodied nature of such stimuli (detached limbs) may affect the outcomes.[34,51] Another study, by Han et al. (2005), showed stronger activation in the medial prefrontal cortex (MPFC) when viewers watched clips from realistic vs. virtual worlds, although this study did not specifically look at empathy or emotion, and used a diverse stimulus set (real and cartoon humans and animals)[67] – similar to a study by Vemuri and Surampudi (2015) which showed that animated and live-action video clips held the same patterns of activation for motor and cognitive empathy, but not emotional empathy.[68]

These findings suggest there are neural distinctions

62 Though it is important to note that Gu & Han (2007) specifically observed neural signatures of empathy, but did not find differences in behavioral empathy reported by particpants between cartoon and photographic stimuli.

68 Vemuri & Surampudi (2015) suggested that the distinction of the self and the other was necessary for cognitive empathy, but that too much distinction (as in the case with animated characters) could prevent adequate affective sharing, leading to lower activation in the thalamus, a key site for empathy.

here, with fiction and reality being an important factor.[69] Previously discussed evidence demonstrates the strength that illustrated visuals (both computer-made and hand-depicted) have to enhance the aesthetic experience.[65,66,70] 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.[71]

71 *Völlm et al. (2005) suggest that theory of mind and empathy neural networks have significant overlap by way of attributing mental states to others.*

The current study aims to tease apart this 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,* 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.

Due to the ambiguous nature of the definition of empathy since its conception,[72] 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. Using a between-subjects design, each set of images was presented to participants along with measures to different facets of empathy. The measures reflect Zaki & Ochsner's definitions of cognitive empathy as a form of mentalizing or inferring pain,[38] 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.[73]

Measures on aesthetic judgment were also collected to reflect liking and perception of beauty, with the anticipation that empathy would modulate the corresponding aesthetic appraisals of 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.[63] A study by Jamrozik et al. in 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 a number of 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.[61] This suggests that even though there is a clear difference in conventional attractiveness of the before and after treatment photos, an aesthetic judgment does not necessarily mediate the negative appraisals of personal qualities in the individuals with facial disfigurements. 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).

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 in order to express pain in images even where it cannot be depicted in a literal sense[35] by invoking visual analogy and making use of symbols and colors. Since understanding and interpreting pain which is represented symbolically, but physically unseen, employs processes like mentalizing and imagination more than motor empathy or mirroring,[35,38] reinforcing the importance of gauging multidimensional empathy. 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,[74,75] the stimuli in this study were subdivided into external, internal, and neutral (control) categories for the purpose to exploring the effects of pain content. Other content-related aspects shown to be pertinent to empathetic and aesthetic appraisals were also recorded in stimuli, such as the presence of faces,[52] objects associated with pain (such as a needle and syringe, compared to an innocuous cotton swab),[76] or demographic factors (perceived gender and race).[77,78]

These studies each offer a unique perspective on the perception of images and their neural or physiological empathetic or aesthetic counterparts in some form. The current study will seek to address a gap in the literature surrounding what kind of images have the capacity to evoke empathetic behavior, and what characteristics of those images enable them to be perceived as beautiful. Gu and Han (2007) examined neural correlates of empathy using cartoons and photographs[62], Ardizzi et al. (2018) explored the relationship between physiological empathy and aesthetic appraisals using art,[63] and Jamrozik et al. (2019) used photographic and artistic renderings to show emotional responses to stimuli with a negative valence.[61] As such, this study represents a convergence of these inquiries by way of examining differences in aesthetic and empathetic responses to pain across rendering styles, at a behavioral level. It was hypothesized that the artistic styling of painful stimuli would increase cognitive and affective response 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 internal pain stimuli than external pain stimuli across the two conditions. 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. In doing so, the hope is to contribute to the existing body of work on pain, pleasure, art, and empathy.

2.

Methods

2.1 Participants

Participants (N = 338, with n_a = 173, n_b = 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. 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.[61] All participants provided informed consent. The study was approved by the Goldsmiths, University of London Research Ethics and Integrity Sub-committee.

2.2 Stimuli

The stimuli 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"). 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 internal pain, 10 external pain, and 10 neutral images used as a control. Figure 1 provides an example of each kind of pain stimulus in both rendering styles.

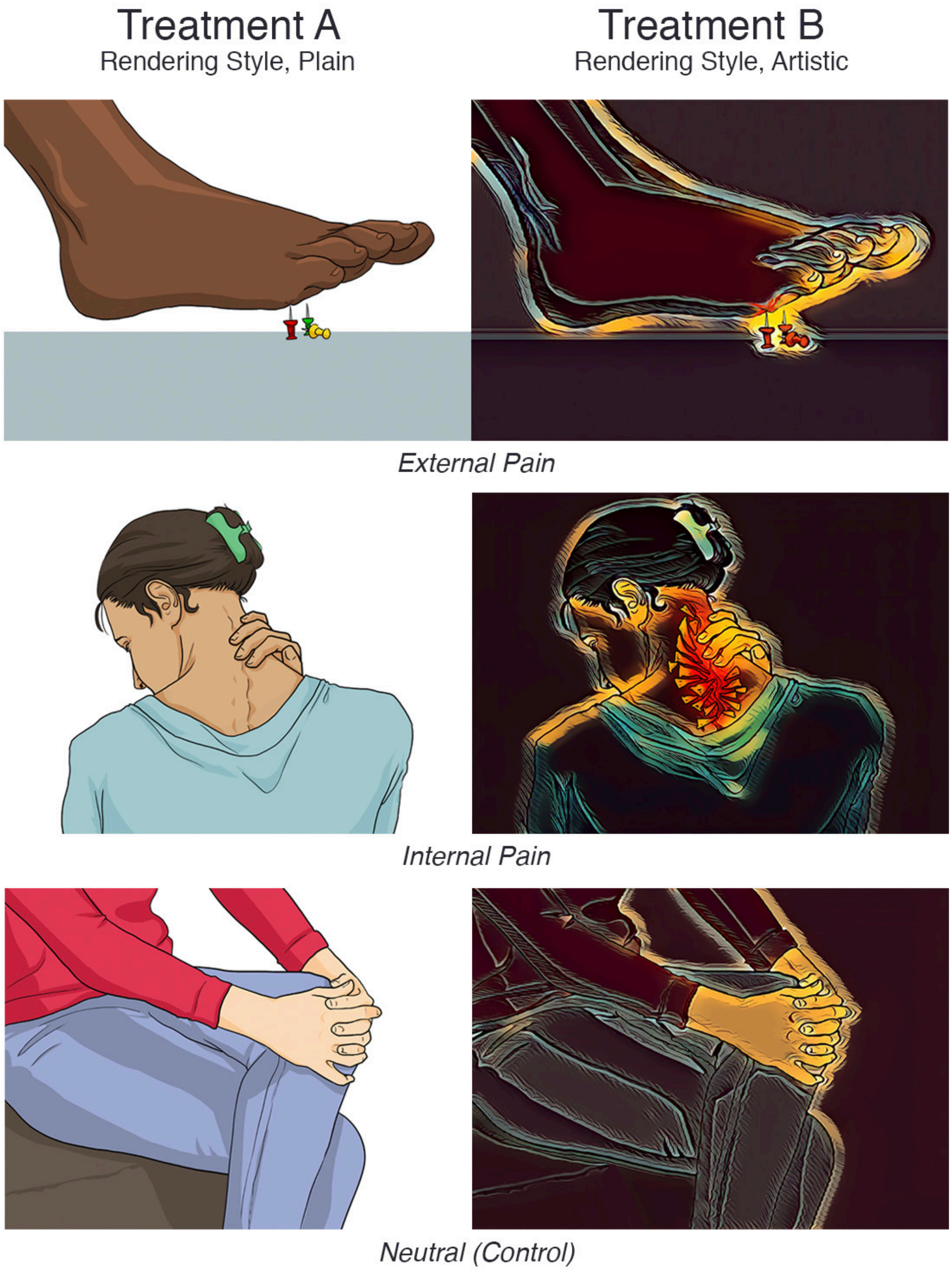

Figure 1

Examples of Painful and Neutral Stimuli in Two Styles of Rendering

The use of hand-drawn images over readily available stock images or existing stimuli was deliberate considering that most experimental visual stimuli used in scientific literature were not created by visual artists or designed to be standalone art, making them inherently different in their emotional and embodied qualities.[35] There is evidence that viewing artworks and viewing images of "everyday life" engages different neural networks,[79] informing the choice to use a set of images in both an artistic rendering style and a mundane, generic style. While there are a great many artworks in existence that depict pain and injury, it has also been observed that authorship impacts aesthetic evaluation, so novel stimuli were created to avoid the unnecessary introduction of confounding variables relating to recognizability and prestige associated with existing artwork.[80,81]

79 Cupchik et al. (2005) suggest that, not only does top-down orientation of attention impact how viewers might see artworks as compared to everyday images, but also that bottom-up perception driven processes dealing with stylistic and sctructual properties of a stimulus are equally as important to the aesthetic experience.

Although previous studies using similar stimulus sets (photographic and illustrated conditions) have suggested that the difference in empathetic responses is due to constraints surrounding stimulus reality, they have not taken into account discrete differences in two-dimensional media that make images compelling, interesting, and unique in their ability to convey information about pain that reality alone cannot.[62,64] In the interest of exploring the capacity of images to evoke behavioral empathy, each image between the two rendering conditions was paired, meaning that image content was held constant across each pair of illustrations (e.g. poses, facial expressions, composition) and any additional information extracted about the pain was due to the rendering style.

As far as the content is concerned, the illustrations (internal, external, 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.[82] The stimuli used in this experiment captured a range of faces, bodies, and extremities, all of different races and genders – although race was considerably more ambiguous (if detectable at all) due to the color scheme of the artistic image set. Because research has shown that perceived race and gender is important both as a feature of the sample and in the illustrations themselves (e.g. women's pain tends to be underestimated, and women tend to rate pain more intensely and are more negatively aroused by unpleasant images), this information about images was stored as metadata to be explored in post hoc analysis.[77,78,83]

The presence of faces and facial expressions in comparison to isolated limbs or bodies and the presence of blood or bodily fluids are other signals of pain recorded in image metadata for their demonstrated relevance to embodiment, and empathy, and pain accordingly to the literature.[43,51,84,85,86] Highly salient aspects of painful images like facial expressions are also prone to empirical differences when the images are deceptive (i.e. the image is of someone not genuinely in pain), but benefit from the illustrative medium where this does not apply on account of being harder to detect by viewers.[35,87] Some research has shown that the brain encodes the intensity of painful images differently when the facial expressions perceived represent provoked pain compared to chronic pain,[88] making the presence of a facial expression an important characteristic for viewers to extract information from in the illustrations.

The pain depicted in each illustration - 10 external and 10 internal types of pain – was carefully chosen based on its unique balance of specificity and universal recognizability. That is to say, illness or injuries were selected so that each image within the set of 10 per category 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 (e.g. one of the internal pain images intended to portray menstrual cramps could also conceivably be interpreted as stomach pain or another kind of lower abdominal pain). The stimulus set contained an even mixture of pains associated with different parts of the body.

Due to the nature of internal pain, the images could represent both chronic illnesses and acute pain. Each pain was illustrated based on accounts of pain described in various

79 Hill & Craig (2002) demonstrated that humans' sensitivity to masked and exaggerated pain is so well developed that people can infer acute and chronic pain from facial expressions alone. This is known to create problems in a clinical settings, wherein physcians tend to assign greater weight to embodied indicators of pain rather than patients' self-reports, even though pain can be intentionally misrepresented.

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,[89] 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.[90] For example, scoliosis pain and other back pains including arthritis were described often as sharp, burning pain, or stinging in the spine, so for this illustration, care was taken to use visual imagery that matched these descriptions. However, for internal pain illustrations, any visual effects were limited to the abstract, and visual metaphors utilizing real-life objects were avoided (e.g. the pain of peripheral neuropathy can be described as walking on sharp rocks) so as not to conflate them with the external pain condition. The external pain images, on the other hand, mostly depicted acute injuries, many times including lacerations, scrapes, bruising, and burns. A concern in depicting external injuries lies in the responsiveness of mirror neurons to different kinds of actions that result in pain and how static images can evoke pain.[35,91] To circumvent this, stimuli representing external pain were a mix of literal injury and anticipated injury, inspired by stimuli used in previous studies,[62,92] where an individual is shown in a position the implies pain but does not explicitly show it happening, e.g. seeing a foot about to step on a thumbtack. 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.

89 The McGill Pain Questionnaire, developed in 1975, is designed to describe patients' subjective experiences of pain (at the sensory, affective, and evaluative levels) and is sufficiently sensitive to detect discrete differences in pain relief methods. For the purposes of this study, sensory descriptors of pain were most pertinent (and lent themselves best to visualization).

2.3 Measures

The questionnaire measures included two measures for empathy (cognitive and affective) and two measures for aesthetic judgment (liking and beauty), all scored on a 5-point Likert scale, with an additional measure allowing participants to categorically indicate whether they had experienced the pain depicted (based on their interpretation of pain in the image, if any). Each of the 30 stimuli seen by participants in each group was rated on these five dimensions as follows:

1. Cognitive empathy: How painful does this image look? Scored 1-5 from *Not Painful* to *Very Painful*.

2. Affective empathy: How well can you imagine (or feel) this pain? Scored 1-5 from *Not At All* to *Very Much*.

3. Liking: How much do you like this image? Scored 1-5 from *Not At All* to *Very Much*.

4. Beauty: How beautiful do you find this image? Scored 1-5 from *Not At All* to *Very Much*.

5. Experience category: Would you say you have personally experienced the pain depicted here (if any)? *No, Somewhat, Yes*.

Batson (2009) conceptualizes the multidimensionality of empathy as eight distinct phenomena ranging from knowing another's state, feeling the same, physically mirroring, projection, imagining how another feels and how one might feel in another's situation, among others.[93] Due to these varied interpretations of empathy, it is often inadequately and inconsistently addressed in the literature, though the division of empathy into two subcomponents, cognitive and affective dimensions, is shown to be an effective and parsimonious way of representing empathy.[73,94] The first measure reflects cognitive empathy by asking participants to gauge how painful images look, while the second measure for affective empathy asks participants to rate the extent to which they can feel this pain themselves. Regarding the aesthetic measures, the literature suggests collecting more than one measure rating of aesthetic judgments,[95] so measures for liking and beauty were chosen for their ability to contrast artworks that observers generally find broadly likable (to themselves and others) with artworks they experience specifically to be beautiful.[96]

2.4 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 (refer to Appendix A for complete consent and debrief materials). 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 on the five measures for empathy, aesthetic judgment, and experience before viewing the next stimulus in the sequence, which was randomized for every participant in order to account for order effects.[97]

2.5 Data Analysis

The data were analyzed with IBM SPSS version 24.0. 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: Internal, External, Neutral; within-subjects) × 2 (Treatment: Plain, Artistic; between-subjects) design. The results of this analysis were investigated further using paired samples t-tests. A mediation regression analysis was also performed to investigate the effects of different variables in mediating the relationship between the main variable of interest (treatment group) and participant appraisals which were significantly different, as established in the ANOVA, using the PROCESS Version 3.5 macro extension for SPSS.[98] For these tests, new variables were created by averaging scores across each illustration to compute average scores on each of the four primary measures (cognitive and affective empathy, liking, and beauty) and within each pain type (internal, external, and neutral). These variables were also logarithmically transformed to meet normality assumptions and, where applicable, both the raw and transformed scales are included in results for the sake of clarity. 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," but the empathetic metrics on pain were not analyzed for neutral images in any meaningful capacity. Exploratory tests on the individual illustrations were also run in SPSS to compare the effects of illustrative features (presence of facial expressions, blood, objects) on average participant ratings. A significance threshold of $p < 0.01$ was used for all statistical tests.

3.

Results

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 empathy in neutral images were strongly positively skewed (where measures 1 and 2 were not applicable if pain was not present). 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 (though the relationships remain unchanged in the transformed data, included in Appendix B).

The mixed factorial ANOVA run on the transformed data indicated that there was a significant 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 also a significant interaction between pain type and treatment group ($F(1.53, 515,18) = 31.33$, $p < 0.01$, $\eta_p^2 = 0.085$). There was a significant main effect of treatment group on cognitive empathy scores, ($F(1, 336) = 36.66$, $p < 0.01$, $\eta_p^2 = 0.098$). Affective empathy scores followed suit, with a siginificant main effect of pain type ($F(1.26, 421.46) = 1810.76$, $p < 0.01$, $\eta_p^2 = 0.084$) and significant interaction between pain type and treatment ($F(1.26, 421.46) = 5.92$, $p < 0.01$, $\eta_p^2 = 0.017$). However, there was no main effect of treatment group on affective empathy scores ($F(1, 336) = 3.05$, $p = 0.082$, $\eta_p^2 = 0.009$).

Among the aesthetic judgments, a significant main effect was found for pain type on liking scores ($F(1.46, 491.86) = 120.18$, $p < 0.01$, $\eta_p^2 = 0.263$), as well as significant interaction ($F(1, 336) = 9.97$, $p < 0.01$, $\eta_p^2 = 0.029$) and a significant main effect ($F(1, 336) = 12.08$, $p < 0.01$, $\eta_p^2 = 0.035$). In beauty scores, a signficant main effect of pain type ($F(1.52, 510.96) = 134.01$, $p < 0.01$, $\eta_p^2 = 0.285$), interaction effect ($F(1.52, 510.96) = 6.97$, $p < 0.01$, $\eta_p^2 = 0.020$), and main effect of treatment group ($F(1, 336) = 36.66$, $p < 0.01$, $\eta_p^2 = 0.057$) were also found. Sphericity assumptions were

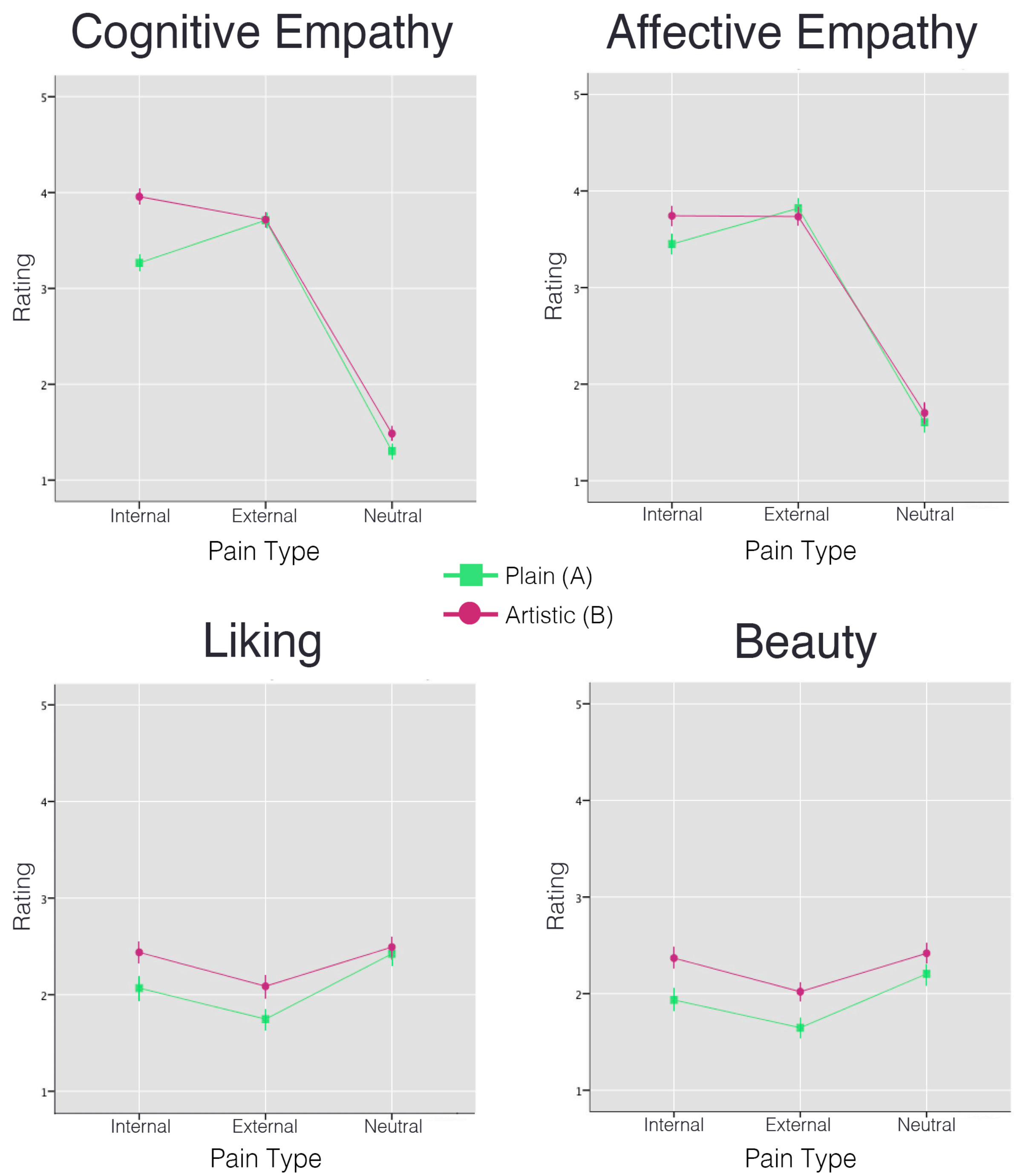

Figure 2

Means of Empathetic & Aesthetic Appraisals of Pain Types Across Rendering Styles

Graphs of (untransformed) variables for 1) cognitive empathy, 2) affective empathy, 3) liking, and 4) beauty showing differences in average scores across treatment groups A) plain and B) artistic and between pain types (internal, external, neutral).

not met in each of the previous tests, so Huyhn-Feldt (for cognitive empathy, beauty tests) and Greenhouse-Geisser (for affective empathy, liking tests) results were used to report effects within-subjects.[99] Levene's statistics were all > 0.01 in this series of ANOVAs using the logarithmically transformed data, save for a violation from the neutral level of the within-subjects variable in cognitive empathy.

Since many of these main effects and interactions were significant, post tests were carried out to determine significance of specific differences between and within groups. A Bonferroni-corrected α value of 0.005 was used as appropriate for analyses between internal and external pain within the same treatment group in a dependent variable. Looking at the interaction in cognitive empathy, the decrease in scores from internal (M = 3.96, SD = 0.60) to external (M = 3.72, SD = 0.58) painful stimuli was significant with a $t(164) = 5.87$, $p < 0.005$, $d = 0.41$ in treatment B, as was the opposite relationship in Treatment A, where there was an increase in scores from internal (M = 3.27, SD = 0.60) to external (M = 3.71, SD = 0.56) painful stimuli ($t(172) = -11.06$, $p < 0.005$, d = 0.76). The difference in internal cognitive empathy scores (M_A = 3.27, SD_A 0.60; M_B = 3.96, SD_B = 0.60) was also significantly different between treatments ($t(336) = -10.54$, $p < 0.01$, d = 1.15), but was nonsignificant in relation to external stimuli ($t(336) = -0.09$, $p = 0.93$). Treatment A also saw an increase in affective empathy scores similar to cognitive empathy from internal (M = 3.45, SD = 0.74) to external (M = 3.82, SD = 0.69) painful stimuli ($t(172) = -9.79$, $p < 0.005$, $d = 0.52$). Internal pain affective empathy scores were also significantly higher in Treatment B than A (M_A = 3.45, SD_A 0.74; M_B = 3.74, SD_B = 0.72; $t(336) = -3.69$, $p < 0.01$, $d = 0.40$), but were not significantly different from responses to external pain within Treatment B ($t(164) = 10.90$, $p = 0.843$). Liking scores were also significantly higher on average in internal (M_A = 2.07, SD_A = 0.83; M_B = 2.44, SD_B = 0.98) and external (M_A = 1.75, SD_A 0.76; M_B = 2.09, SD_B = 0.82) painful stimuli ($t(336)$ = -3.76, $p < 0.01$, $d = 0.41$ for internal; $t(336) = -3.96$, $p <$ 0.01, $d = 0.43$ for external), but neutral stimuli were not liked more between image treatments ($t(336) = -0.85$, $p = 0.40$). This same trend also held for average beauty scores, where there was a significant difference between groups for painful stimuli ($t(336) = -4.62$, $p < 0.01$, $d = 0.51$ for internal; $t(336) = -4.50$, $p < 0.01$, $d = 0.49$ for external), but not for neutral stimuli ($t(336) = -2.57$, $p = 0.011$).

Additional analysis on the role of personal experience showed that the relationship between cognitive and affective empathy is inverted between reports of experience and no experience in relation to painful stimuli (see means plot in Appendix B for differences in experience), and that raw liking scores were significantly higher in cases where the participant personally experienced than pain compared to when they did not ($t(7837.03) = -3.61$, $p < 0.01$), but beauty scores were not ($t(7898.59) = -2.45$, $p < 0.01$).

Correlations were also gathered to further probe the data for worthwhile post-hoc investigations. The correlation matrix (Table 1) captures the four main measures and also denotes how correlations differed between the same variables depending on the treatment group. (Other variables such as gender, art expertise, etc. were not shown to be significantly correlated with the dependent variables, so they excluded here for brevity, but detailed further in Appendix B.)

Excluding variable pairs which were highly multicollinear, (such as external and internal cognitive empathy), most significant correlations in either treatment were between affective empathy and liking, as well as beauty and cognitive empathy in Treatment B. Conservative Fisher r-to-z transformations did not reveal any significant differences in the correlation coefficients between the independent treatment groups. The consistent significant correlation in both groups of affective empathy with liking and beauty, in addition to the results of the ANOVAs and simple main effects t-tests, informed which variables from the empathetic and aesthetic categories would be used to conduct a mediation regression analysis to better model the relationship between these measures in relation to the treatment groups.

	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 $p < .01$ level, two-tailed

Table 1

Means, Standard Deviations, and Pearson Correlation Matrix Across Groups (n_a = 173, n_b = 165) for Measures in Internal (I) and External (E) Pain Categories

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).

For the purpose of mediation, measure scores inclusive of both internal and external painful stimuli were used. The data were restructured so that the five measures repeated for each of the 30 stimuli presented to the 338 participants were stacked, yielding 338 responses to each of the 30 stimuli for a total of 10,140 responses to all stimuli, with an $N = 6760$ (excluding neutral stimuli) for the purposes of regression.[†] The raw scores for affective and cognitive empathy, beauty, liking, and a dichotomous dummy variable for the treatment group were implemented in a regression mediation model using PROCESS Version 3.5 macro for SPSS using a percentile bootstrap estimation with 5000 samples.[98] VIF values were below 10 and greater than 0.1, no autocorrelation based on an in-range Durbin-Watson statistic (approximately 1.7 for a sample of this size), and normality observed in the dependent P-P and residuals plots, which exhibited no funneling.

The results of the first mediation regression indicated that treatment group was a significant predictor of affective empathy ($b = 0.10$, $t(6758) = 3.52$, $p < 0.01$), and that treatment group predicted beauty scores ($b = 0.40$, $t(6758) = 15.31$, $p < 0.01$). The mediator, beauty, was also a significant predictor of affective empathy when controlling for treatment group ($b = 0.12$, $t(6757) = 8.77$, $p < 0.01$). When controlling for beauty, treatment was no longer an effective predictor of affective empathy ($b = 0.06$, $t(6757) = 1.88$, $p = 0.06$), which is indicative of full mediation. The indirect effects of treatment on affective empathy through the mediator beauty accounted for 46.60% of the total effect of treatment on affective empathy ($b = 0.05$, 95% [LLCI 0.036, ULCI, 0.061]).

A second mediation was performed, again using beauty as the mediator and treatment group as the predictor, but cognitive empathy as the criterion. In this case, treatment group significantly predicted cognitive empathy scores ($b = 0.35$, $t(6758) = 13.79$, $p < 0.01$), as well as beauty (as above). And while beauty did significantly predict cognitive empathy when treatment group was controlled for ($b = 0.03$, $t(6757) = 2.80$, $p < 0.01$), beauty only accounted for 3.73% of the indirect effects of treatment on cognitive empathy ($b = 0.01$,

[†] *It did not make sense to create a regression model based on average scores for dependent variables across 30 stimuli for each case. This would only allow for predictions to be made about, for example, a participant's average beauty rating score on their average affective empathy score, due to the aggregate nature of scores used previously in analysis. To directly measure the relationships between the variables, then, raw scores on each illustration were used here.*

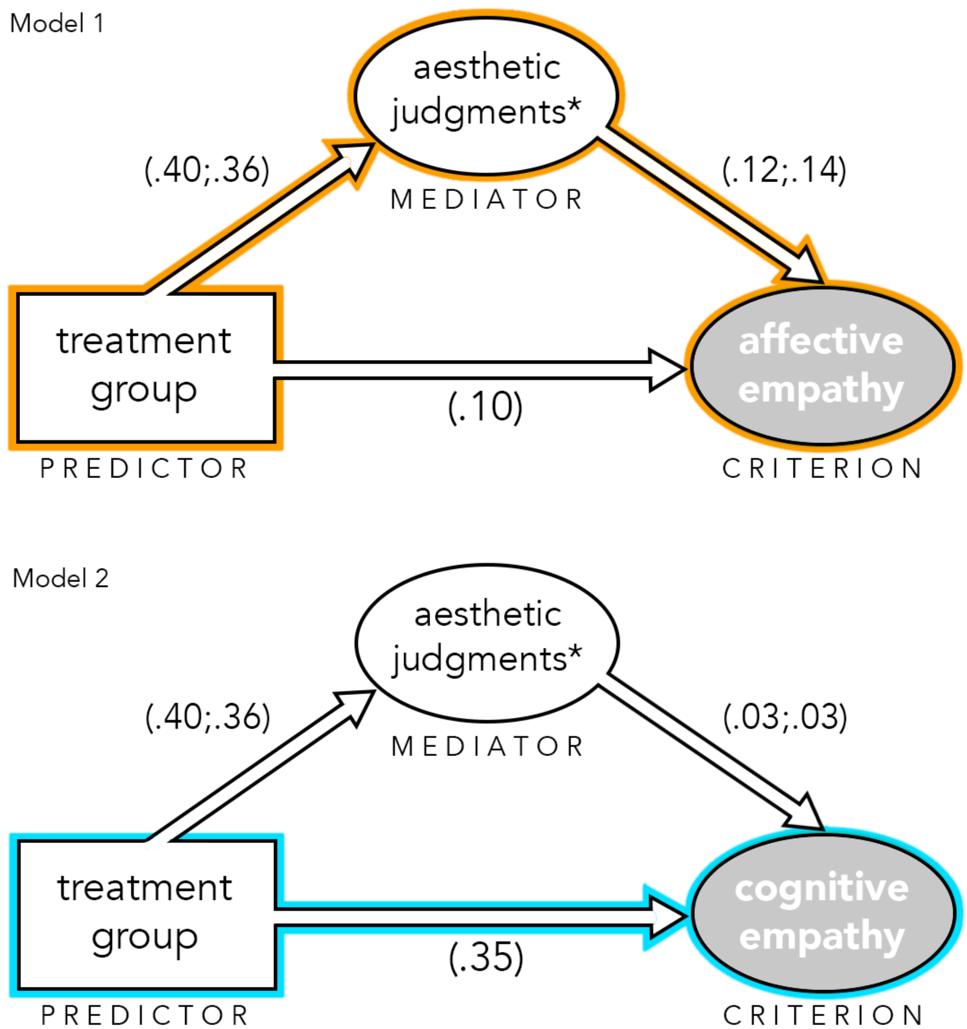

Figure 3

Patterns in Mediation Regression Models

Mediation analyses revealed that the relationship between rendering style (treatment group) and empathy varied depending on which type of empathy was used as a criterion. Model 1 highlights the indirect path mediated by aesthetic judgments as the most useful relationship to model how treatment group impacts affective empathy, due to observed full mediation, nearly 50% for both beauty and liking variables. (The coeffcient for the relationship of treatment to affective empathy, c = .10, p < .01 becomes insignificant when aesthetic judgments are accounted for: c' = 06, p = 0.06 for beauty and c' = .05, p = 0.07 for liking.)

In comparison, Model 2, using cognitive empathy as the criterion, was significantly mediated by aesthetic judgments, but only slightly (beauty and liking accounting for merely 3% of indirect effects), making the direct relationship a more useful predictor for cognitive empathy.

*Coefficients between aesthetic variables are shown with beauty first, then liking (e.g. in .40;.36, .40 is the coefficient for beauty, and .36 for liking).

95% [LLCI 0.004, ULCI, 0.023]). Analyses exhibited the same trend when using liking as a meditator for both cognitive and affective empathy, wherein liking fully mediated (48.54% of) the relationship between treatment group and affective empathy (as with beauty), and while liking did significantly mediate the relationship between treatment group and cognitive empathy, its effect was negligible (2.87%). The output for these mediations is available in Appendix B for inferential statistics.

Further investigation on the factors contributing to empathetic measures 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 significant main effect of personal experience on empathy scores, (F(1, 336) = 36.66, $p < 0.01$, $\eta_p^2 = 0.098$).

Data on the individual illustrations were also investigated to complement behavioral findings. Figure 4 captures the ten most beautiful stimuli from the artistic treatment group (B) in comparison to their average beauty scores from the plain treatment group (A), which contains painful and neutral stimuli alike. Of two highest-scoring illustrations here, depicting an individual experiencing menstrual cramps (internal pain) and another laying down (neutral), the beauty rating for the painful stimulus increased significantly between treatment groups (t(336) = -2.74, $p <$ 0.01, d = 0.30), whereas the neutral stimulus did not (t(336) = -1.38, p = 0.17).

Illustrations contained a variety of characteristics such as perceived race and gender of the depicted figures, the presence of dangerous objects, facial expressions, and blood, the most salient of which were the latter two. Other exploratory charts for characteristics that were not further investigated can be found in Appendix B. Concerning depictions of blood, external pain illustrations with blood had higher aggregate scores in affective empathy (M = 4.01, SD =

0.81) compared to those that did not show blood (M = 3.46, SD = 0.77), but did show other externally visible injuries such as bruising, swelling, burns, etc. ($t(337) = 14.17$, $p < 0.01$, d = 0.70). The presence of blood caused aggregate liking scores to drop significantly ($t(172) = -3.64$, $p < 0.01$, $d = 0.19$) in the plain image treatment, but no difference was observed in the artistic treatment ($t(164) = 0.164$, $p = 0.70$). Composite scores were computed for all painful stimuli containing and lacking faces. While cognitive empathy scores were shown to increase with the presence of a face ($t(337) = 8.79$, $p < 0.01$, $d = 0.34$), affective empathy scores decreased ($t(337) = -8.08$, $p < 0.01$, $d = 0.28$).

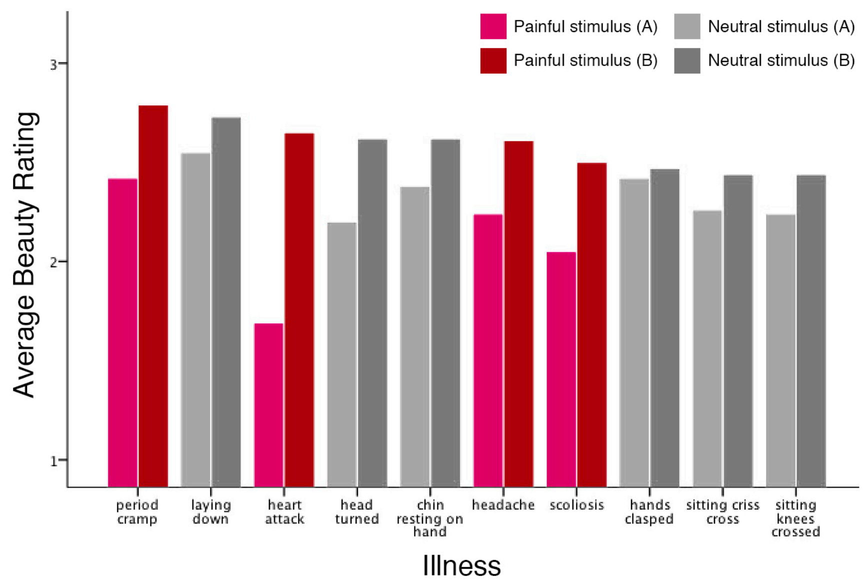

Figure 4

Most Highly Rated Images for Beauty

Average scores for beauty were computed using participants' ratings of individual ratings of each illustration, which were plotted on a graph based on highest beauty rating in Treatment B (artistic rendering). Illustrations containing painful stimuli are coded red here, and netural illustrations are gray. The differences in beauty rating between treatment groups are also shown through the coupled bars for each illustration.

To summarize, the mixed factorial ANOVAs run for each dependent variable (cognitive and affective empathy, liking, and beauty) showed significant main effects and interactions between treatment groups (rendering styles) and pain types (internal, external, and liking). Further post hoc analyses on these relationships revealed that empathetic responses to internal and external pain behave differently in Treatment B (artistic rendering) than A, and that treatment group modulates aesthetic responses but only for painful stimuli (not neutral stimuli). The consistent correlation of liking and beauty with affective empathy informed the selection of affective empathy as a criterion for mediation regression, where treatment group could always predict the mediator (beauty or liking), which in turn predicted affective empathy, though treatment group alone could not predict affective empathy. Treatment group could, however, predict cognitive empathy and liking or beauty as the mediator, but liking or beauty could not predict cognitive empathy. Analysis of the illustrative qualities of the stimuli indicated that the presence of pain signifiers such as blood or facial expressions significantly impacted empathetic scores depending on treatment group. The results surrounding these images and the responses to them provide useful insights into the nature of empathetic and aesthetic appraisals of painful stimuli.

4.

Discussion

The results from this study support the hypothesis that aesthetic evaluation tempers empathetic responses, and that rendering style also uniquely impacts the perception of beauty and understanding of pain. Each stage of the data analysis adds dimensionality to this hypothesis and helps to tease apart the relationship between cognitive and affective empathy in the context of painful images.

The mixed factorial ANOVAs illustrated distinct relationships that reemerged later in analysis. The most interesting relationship lies within the cognitive empathy responses, where the relationship between pain rating and pain type is inverted between groups. In the plain rendering style, predictably, ratings increase from internal pain (where pain is largely invisible, save for indicators like facial expression or posture) to external pain types (where injury is rendered clearly, making it easier to judge). Then, 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), internal pain images are not merely rated on par with external pain – internal pain is rated higher on average than external pain in the artistic treatment group. At the same time, this initial series of ANOVAs (Figure 2) revealed that liking and beauty scores were significantly higher in the artistic treatment group than the plain one, but only for painful stimuli. That is, if stimuli were neutral – not depicting any pain – people tended to like them similarily regardless of what treatment group they were assigned. These findings suggest that that not only do painful and neutral stimuli behave differently in how they are liked between the rendering style, with the artistic style transforming aesthetic judgments for only painful content, but also that the type of signals available about the pain (internal or external) impact people's ability to understand and relate to it.

Although from a creative perspective, considerable planning went into the colors and shapes used to articulate pain in the artistic set, it's not likely that viewers would be able to translate these visual aids into the kind of pain was supposed to be represented, and would instead project their own experiences onto their evaluation of the pain (see Appendix B for outputs illustrating the effect of experience on empathy). It could also be said that our visual vocabulary for invisible types of pain is less well-defined,[100] making it easier for participants to identify with the more ambiguous internal pain images, which could account for the discrepancy in scores internal and external pain in the artistic set. However, this improved means of vicariously experiencing the pain would likely translate to increased affective empathy scores, though the difference surfaced in cognitive empathy scores.[101] The abstraction of pain in the artistic image set (for internal pain, in particular) could lead viewers to contemplate the images longer and like them more, which research shows viewers tend to do when viewing artistic creations compared to typical images presented in experiments.[102] The literature has long suggested that merely extending viewers' exposure to images can increase liking,[103] so it's possible that the visual interest of images in the artistic treatment group resulted in overall higher liking by way of time spent lingering on images.

Research on the involvement of brain regions in forming motion cues in pictorial objects has demonstrated that implied motion impacts aesthetic appraisals, so using stimuli with implied action (such as an image of someone about to step on a thumbtack, which does not explicitly depict the resulting injury) creates additional information for viewers to process.[104] Similarly, the artistic set provides extra information about pain qualities that are absent entirely from internal pain images for the plain treatment group. In this sense, internal pain images receive a "boost" in the artistic treatment group in cognitive empathy rating, which asks participants to assess how painful an image looks, due to increased information about the pain, or improved *pain signals.*[†] The role of specific pain signals in modulating empathetic and affective measures is discussed later.

[†]Pain signals, for the purposes of this discussion, refer to any aspect of an illustration which conveys a visual indicator of intensity or quality of pain, adding to visual information available in a given illustration that allows viewers to estimate the mental state of the person depicted.

Affective empathy scores fall into a pattern similar to that of cognitive empathy in the plain rendering style, wherein participants are less able to feel or share the pain depicted with internal pain images due to the plain style rendering, where it is largely invisible compared to external pain.[75] The artistic rendering style facilitated affective empathy here, as there was no significant difference in the affective ratings for internal and external pain types in the artistic treatment group, fixing the discrepancy observed in the plain images. There was also no main effect of treatment group on affective empathy. These findings suggest that the treatment group was not an exact proxy for liking or beauty themselves, but rather for information, which enhances participants' ability to assess or gauge pain by introducing visuals aids, directly impacting cognitive empathy, but not necessarily affective empathy.

75 *It is for this reason that chronic, unseen pain is often underrated by observers in how painful it is or considered imaginary, according to Ojala et al. (2015), making it that much more interesting that internal injuries were rated more painful than external injuries in the artistsic style.*

As far as liking and beauty go concerning treatment, the findings suggest, as previously discussed, there is some aspect of the rendering style that improved aesthetic judgments for painful content, but not neutral content. 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.[42,62] Liking and perception of beauty improved proportionally for internal and external pain types from plain to artistic treatments, so the difference was likely not due to a change in information or pain signals, which disproportionally affected internal pain and cognitive empathy responses. It could be said, then, that this discrepancy between the change in perception of beauty between painful and neutral stimuli was content driven, rather than solely aesthetic. As such, it was of interest whether or not observed differences in treatment groups was due to rendering style impacting cognitive and affective empathy directly or through aesthetic judgments.

Due to the consistent correlations between affective empathy with liking (and to a lesser extent, beauty) in painful stimuli across both treatment groups, affective empathy was considered for mediation regression (see Table 1 correlation matrix). In both mediations using affective empathy as the criterion and either liking or beauty as the mediator, the treatment group was found to predict liking and beauty, which, in turn, were both found to significantly predict affective empathy. Treatment group also predicted affective empathy directly, with liking and beauty mediating nearly 50% of the effects of treatment group on affective empathy, suggesting near full indirect mediation, a form of mediation that is widely accepted by statisticians.[105,106] This mediation makes sense considering that rendering style does not necessarily beget higher or lower aesthetic appraisals – some individuals may have disliked the artistic style, while others may have enjoyed the plain style. While rendering does largely influence aesthetic appraisals, it is the individual's personal evaluation of an image as likable or beautiful that predicted affective empathy, thus making aesthetic judgments (both liking and beauty) mediators of the relationship between rendering style and affective empathy.

On the other hand, treatment style does significantly predict cognitive empathy (and predicts it to a greater extent than it does affective empathy, with a much larger effect size), however, the extent to which aesthetic judgments mediated the relationship between rendering style and cognitive empathy was much smaller (only around 3% for both liking and beauty). This is a significant finding because it demonstrates that the rendering style, acting a proxy for visual information, is not mediated by aesthetic judgments in its ability to predict cognitive empathy, but is in predicting affective empathy.

This meaningful relationship is also reflected by findings on the role of experience in responses to the images (Appendix B): People who reported having experienced the pain depicted had significantly higher, but similar, cognitive empathy scores to those who reported not personally experiencing the pain. However, there was a sharp increase from cognitive to affective empathy scores for those who experienced the depicted pain, whereas there was a decrease for those who had not. Those with experience (and, thus, much higher affective empathy scores) also made significantly

†This is counterinutive 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 - it was the opposite.

higher aesthetic ratings than those who had not,† aligned with the findings that aesthetics judgments impact affective empathy.

Though the exact mechanics of this can only be speculated, the data suggest that the plain and artistic rendering styles were not completely synonymous with lower and higher aesthetic judgments, so it is worth considering 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 directly through the perception of beauty. These findings also speak to the importance of treating empathy as a multidimensional measure[73] 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.[107] This study reiterates the importance of distinguishing between these forms of empathy, especially in the context of pain and images.

All these relationships considered, there were still several other features among the participants and the illustrations themselves that could contribute to variation in scores, some of which were not significantly correlated and others which were beyond the scope of the study. Among this information, the two most salient characteristics of the stimuli, or pain signals, that revealed additional insights into the relationship between aesthetic and empathetic evaluation were the presence of blood and facial expressions. Depicted blood in illustrations was associated with a heightened affective response, aligned with the literature.[85] However, in the plain treatment group, there was a significant difference in the average liking scores for images with and without blood, but in the artistic rendering style, there was no significant difference in liking between images with and without blood.

This is interesting because prior research suggests that context (art and non-art reality contexts) have little influence over liking when negative emotional reactions were involved.[108] It likely comes down to nuance in the rendering style, where the stylization of the images in the artistic group containing blood attenuates liking by muddling the reality of depicted blood and making it seem less real.

Interestingly, the presence of a face in a stimulus (some of which had mild expressions, others with prominent grimaces) significantly increased average cognitive empathy scores, but decreased affective empathy. Because the literature overwhelmingly cites facial expressions as important features of recognizing pain in others,[84,86] this could be interpreted to mean that facial expression informs viewers of the pain intensity, but that the presence of a face inhibits their ability to feel or share the pain compared to images depicting only limbs, potentially due to psychological distance[27] and the effect of otherizing, or observing depicted individuals with characteristics incongruent to the viewer's traits, inhibiting empathetic responses.[77]

77 Avenanti et al. (2010) also make a clear case that perceived otherness between the viewer and the depicted person (e.g. in race, gender) does interact with evaluations of pain. Although this was not investigated in any depth in this study, it is reasonable to assume this was among many factors which could contribute to shaping empathetic responses.

Research suggests the potential of art contexts to yield more positive judgments of stimuli with negative valence than non-artful counterparts.[108] This can be observed in Figure 4, showing the most beautiful stimuli from the artistic rendering style, where there are a number of painful stimuli amidst neutral images, which also shows the influence of treatment group on painful stimuli though the change in perceived beauty. The first clear inference that can be made from this graph is that the impact of rendering style on perceived beauty is much more pronounced in painful stimuli than neutral ones, which is supported throughout the findings. Liking scores tended to be higher than beauty scores across the board, making it particularly noteworthy that some painful images were not merely liked at the level of neutral images, but considered beautiful.[95,96] From this, it can be understood that it is possible to mitigate the negative valence associated with painful stimuli enough to be received by viewers as equally, if not more, beautiful than neutral stimuli (see Figure 4).

4.1 Limitations

A limitation of this study is its web-based nature, which may have impacted the sample by way of self-selection bias.[109] 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,[104] it may have also been worthwhile to examine these relationships in the context of temporal exposure to images between treatment groups, 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).[62] While it's possible neural correlates for empathy and aesthetic judgment may have been different between the two image treatments, 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,[3] but due to humans' sensitivity in detecting handmade images,[35] 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. Finally, 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.[110]

4.2 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.[111] 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,[46] the scientific community's understanding of the interplay between images, empathy, and pain, is lacking. The results of this study supported the hypothesis that rendering style of images as plain or artistic has a significant influence on both empathetic responses to and aesthetic appraisals of painful stimuli representing internal and external pain. The results from mediation suggest that treatment acted as a proxy for visual pain information, which could predict cognitive empathy directly, while individual aesthetic judgments themselves in the form of liking and beauty acted as full mediators in the indirect 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 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.

5. References

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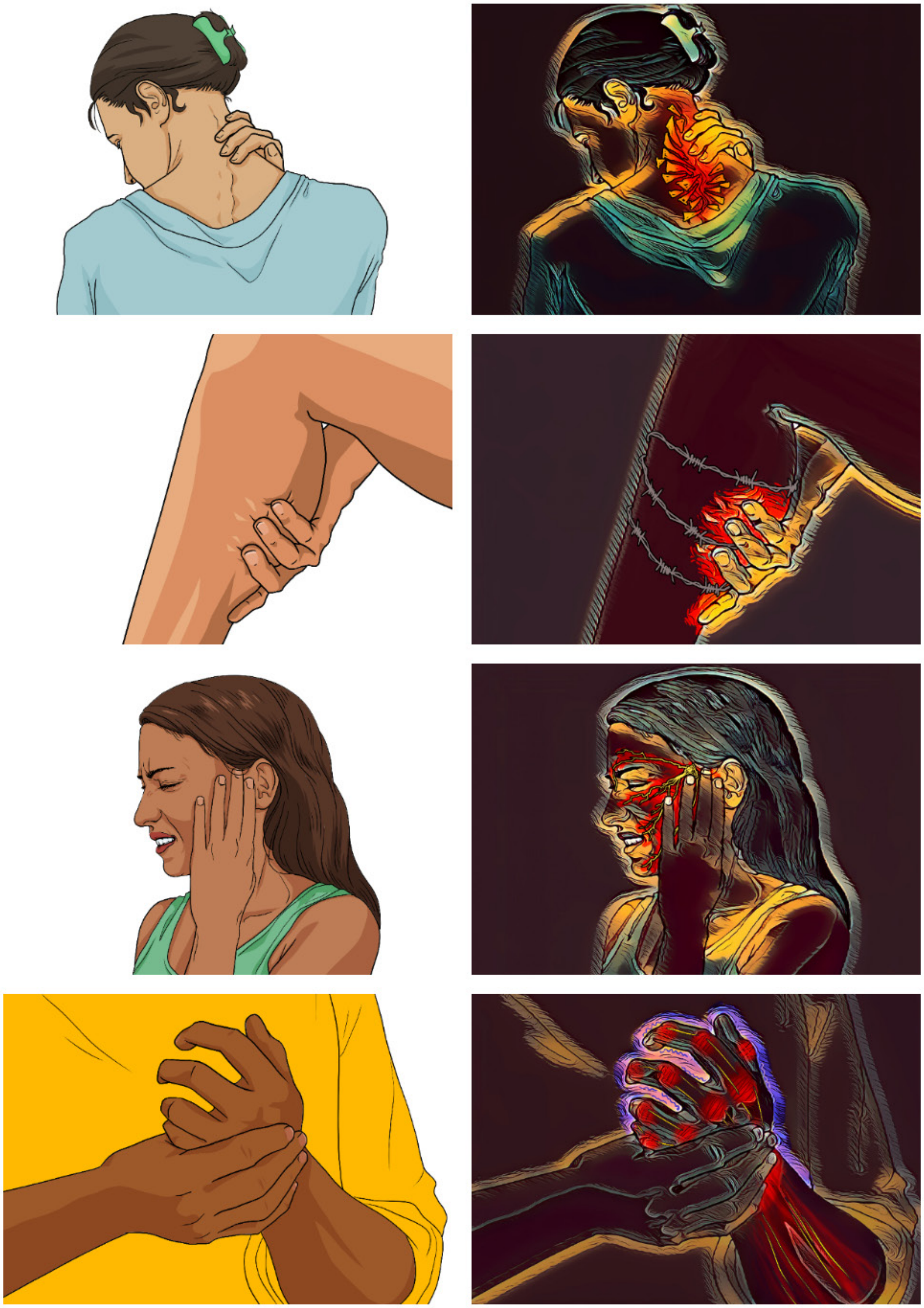
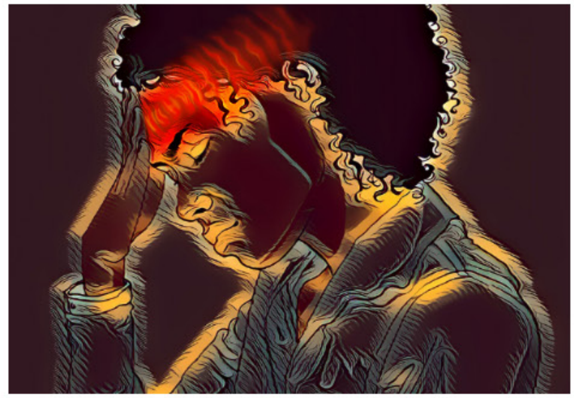
6.

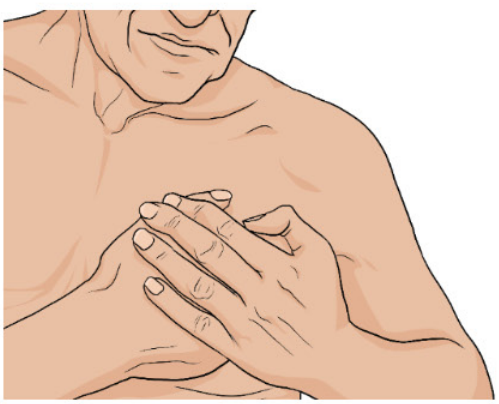
Appendices

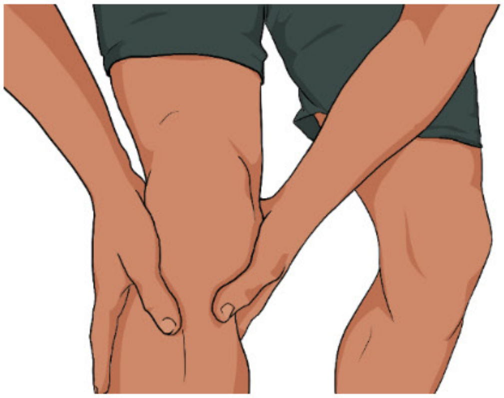
6.1 Appendix A for Study Materials

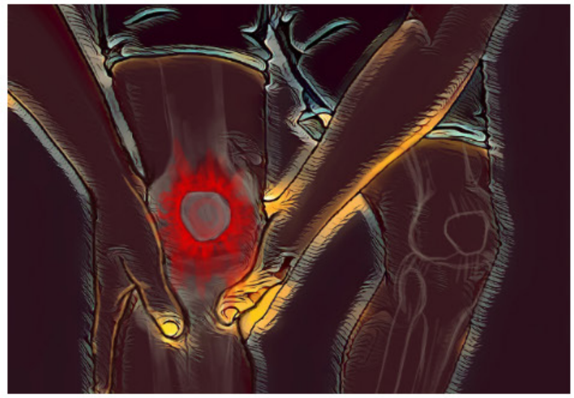
Stimuli

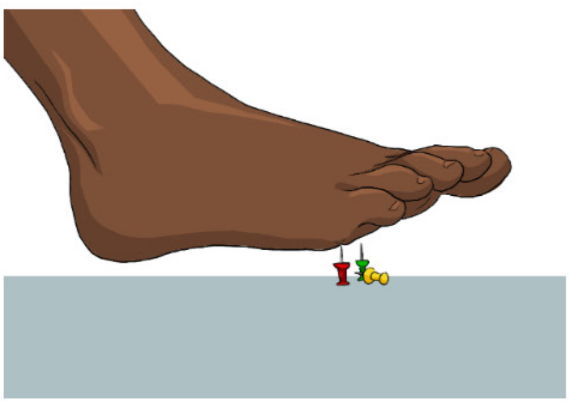


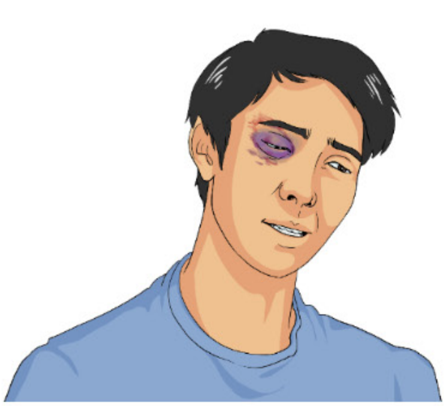


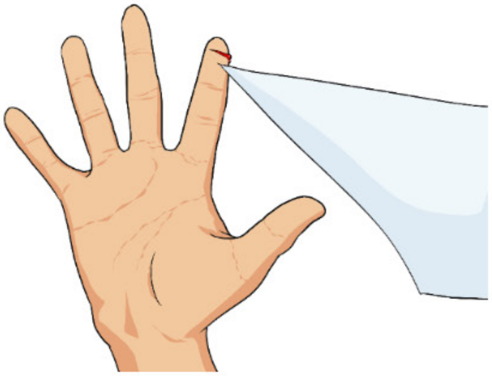


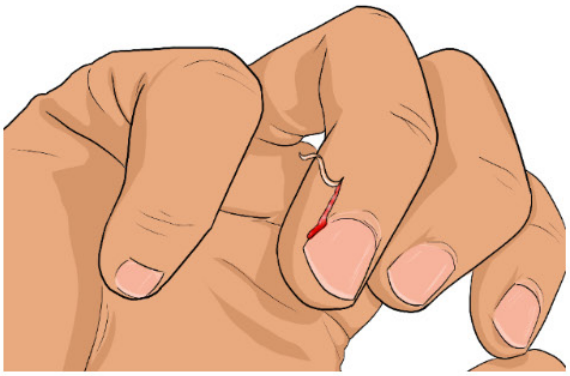


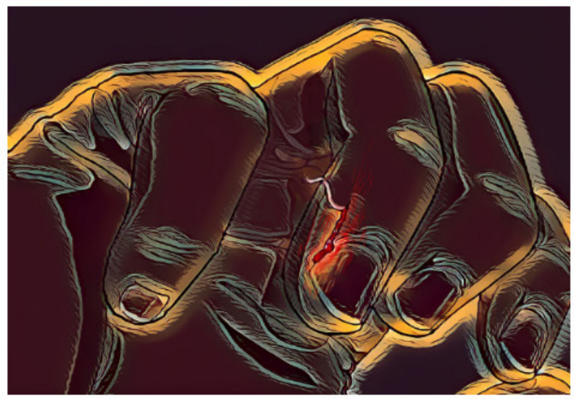


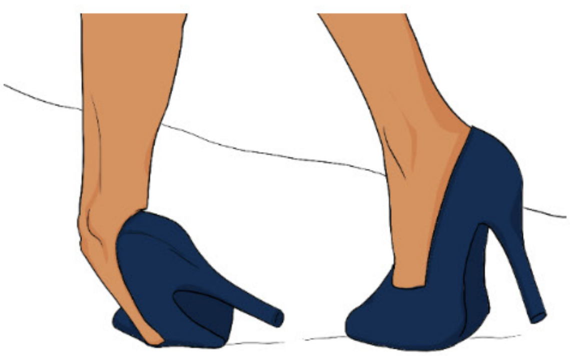


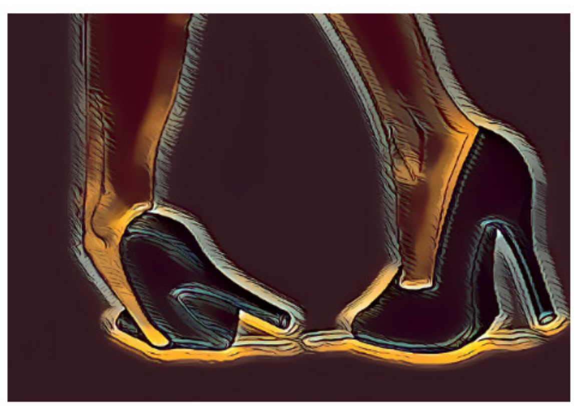


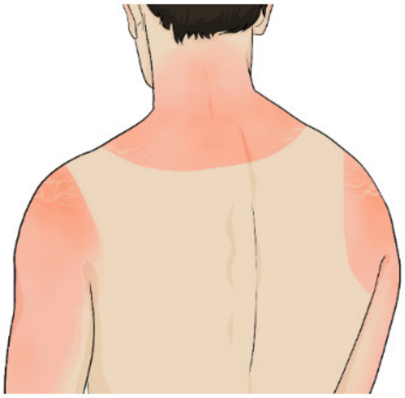
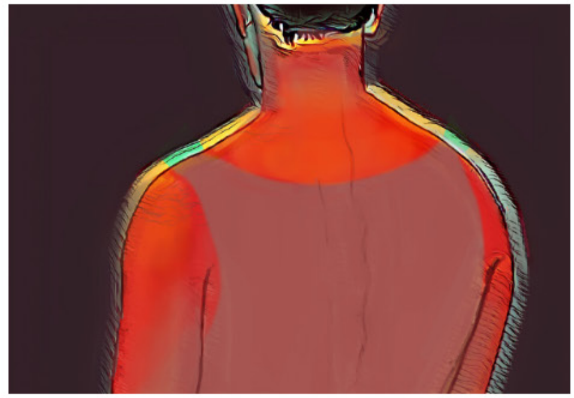
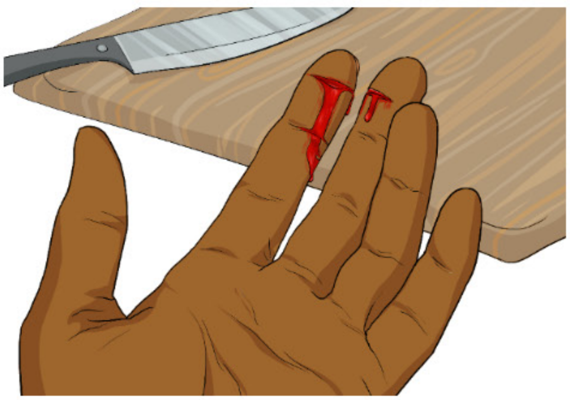
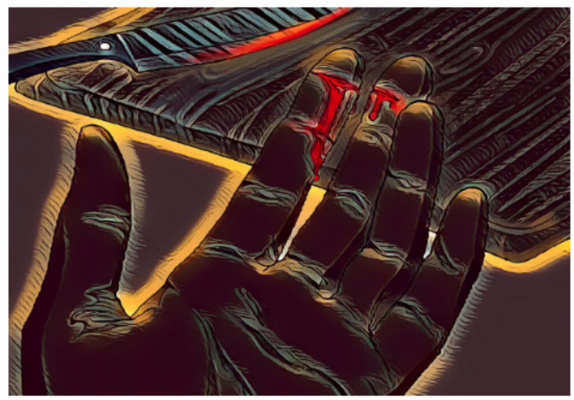


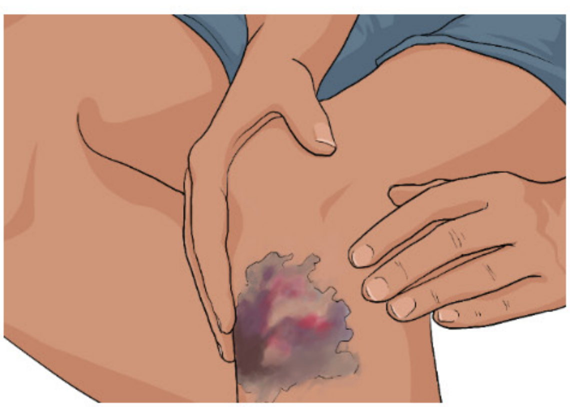




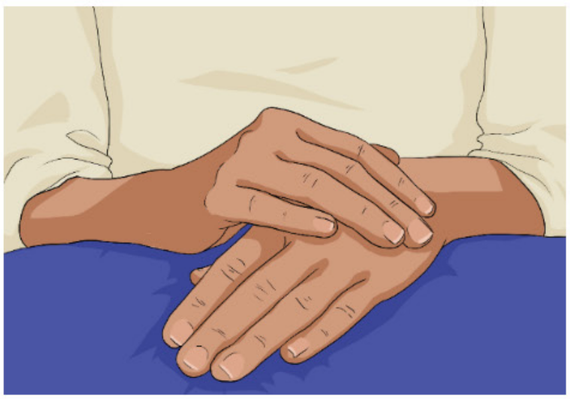


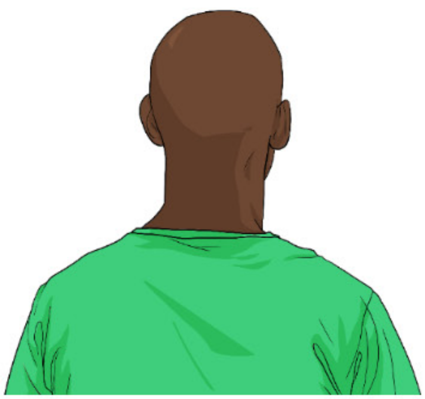


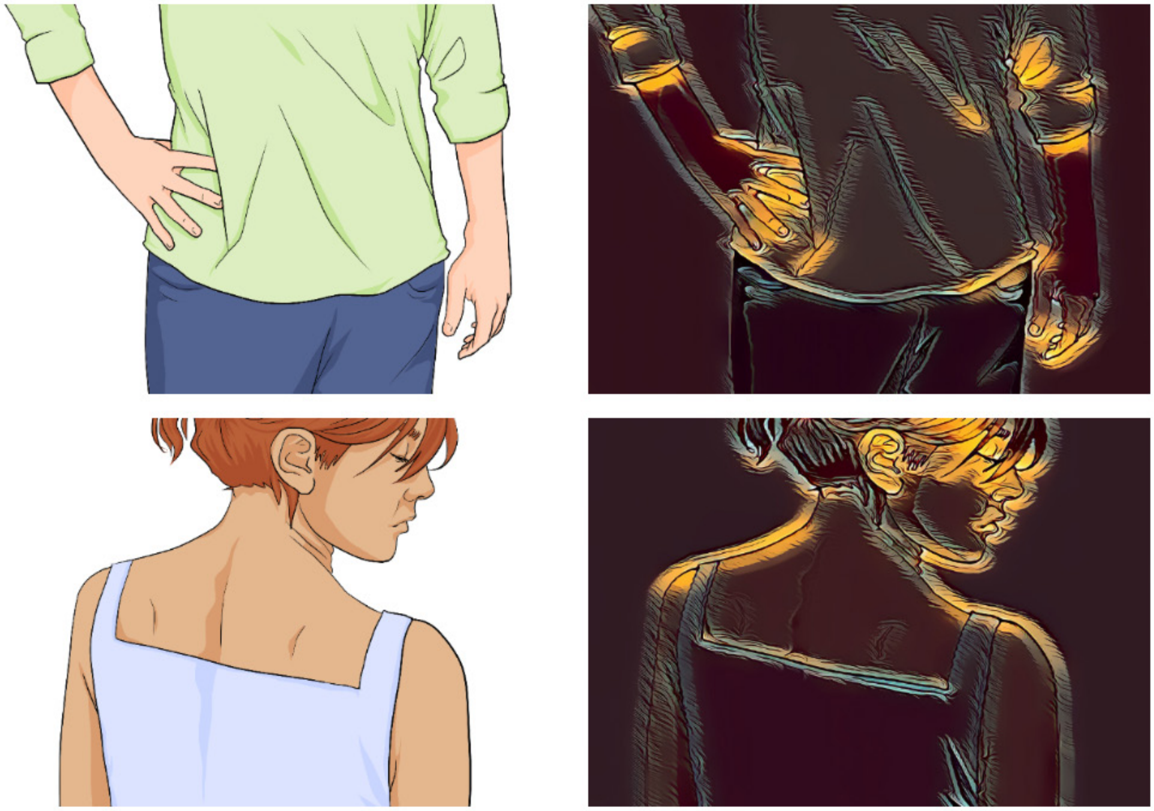









In order: 10 internal, 10 external, 10 neutral. Left column = Plain Treatment (A), Right = Artistic Treatment (B).

Ethical Approval

Academic Year: 2019-2020

Project Type: MSc/MRes Project

Project Title: The Visual Language of Pain: Beauty, Empathy & Pain in Art

Supervisor: Rebecca Chamberlain

Date	Time	From	Message
12/08/2020	08:36:04	Admin	Approval status set to: APPROVED
06/08/2020	16:03:19	Student	Form submitted by student Kelsey Laura Graywill (kgray001) to supervisor Rebecca Chamberlain

Information Sheet & GDPR

You are being invited to participate in an MSc research dissertation project, which will take approximately 30 minutes to complete. Before you decide to take part, please read the following to gain an understanding of what this study and your participation entail. Thank you for reading.

What is the purpose of this study? What will I be asked to do?

The experience of pain varies greatly from person to person in its intensity and quality, making it difficult to describe, despite its pervasive presence in our lives. We consume pain depicted visually through social media, news, and entertainment on a regular basis. The aim of this study is to shed light on the relationship between images of pain and what viewers experience in response to them, their ability to relate to and appreciate them. This will be done by examining your responses to a selection of illustrations (30 images) that render humans or bodies in various kinds of pain. The short questions you will answer about the images involve your liking of them and ability to relate to them.

Why have I been chosen? Do I have to take part?

In order to better understand this topic, we have to examine responses across many individuals, all of whom must be at least 18 years old and fluent in English. Your participation in this study is entirely voluntary and will not be compensated financially, and you can withdraw from the study at any time by closing your internet browser. If you decide to participate, you will be asked to provide your consent below.

What are the risks or benefits of participating?

Because this study is about pain, you should consider if you are easily disturbed by images depicting pain and injury. The images are not photographic or photoreal, and whilst there is no self-injury rendered, some illustrations do depict bodily injury, including blood. If you feel discomfort from this at any time during the survey, you are free to withdraw, and you may omit questions you are uncomfortable answering. If you experience distress, you may wish to seek counsel from Samaritans. Should you participate, you are helping to contribute to a growing body of scientific knowledge on how humans can appreciate and relate to depictions of pain.

What will happen to my data?

All data collected are kept strictly anonymous. You will enter some basic biographical data at the beginning of the survey, but no names, addresses, or other identifying personal information will be collected by the survey. All participants will receive a unique ID number after the survey that they may keep should they wish their data to be withdrawn later. You may request a copy of your data, have it corrected, or deleted entirely. The data will not be shared with other studies without permission, or used for any marketing or commercial purposes. The data in this study may result in scientific publications or presentations, which participants will not be notified of. Any data published will not be identifiable. Should you be interested in updates on this research, you may contact the researcher at the address below. For further information about the General Data Protection Regulation (GDPR) and Goldsmiths research, please click here.

This study was reviewed and approved by the Goldsmiths Psychology Departmental Ethics Committee (DEC). Goldsmiths, University of London, is committed to compliance with the Universities UK Research Integrity Concordat.

For any queries or complaints, you may contact:
Kelsey Graywill (Postgraduate Researcher)
kgray001@gold.ac.uk
Dr. Rebecca Chamberlain (Supervisor)
r.chamberlain@gold.ac.uk

Thank you for taking part!

To begin, you must acknowledge and agree to the following:

- I have read the information presented above and understand what my contribution to this research will entail.
- My participation in this study is entirely voluntary.
- I am at least 18 years of age.
- I understand any potential risks and that I may withdraw my participation at any time without providing a reason.
- I understand that I will not be referred by name in any report concerning the study.

>I consent. Begin the study.

>I do not consent.

Before you start...

You will see **30** illustrations. You may take as much time as you need, but plan for ***20-30 minutes***.

Bear in mind, these illustrations portray pain and sometimes *depict bodily injury* (including blood). If this disturbs you at any point, you may stop the survey.

End of Survey Debrief

Thank you for participating!

Read on to learn more about the study you've contributed to.

We appreciate you taking the time to complete the survey. Rest assured, all data collected will be treated in the strictest confidence. If you would like to withdraw your data at any point please contact postgraduate student researcher Kelsey Graywill (kgray001@gold.ac.uk) or supervisor Dr. Rebecca Chamberlain (r.chamberlain@gold.ac.uk), whom you may also contact should you feel unexpectedly affected by the study. Alternatively, you may also wish to seek support through the service Samaritans.

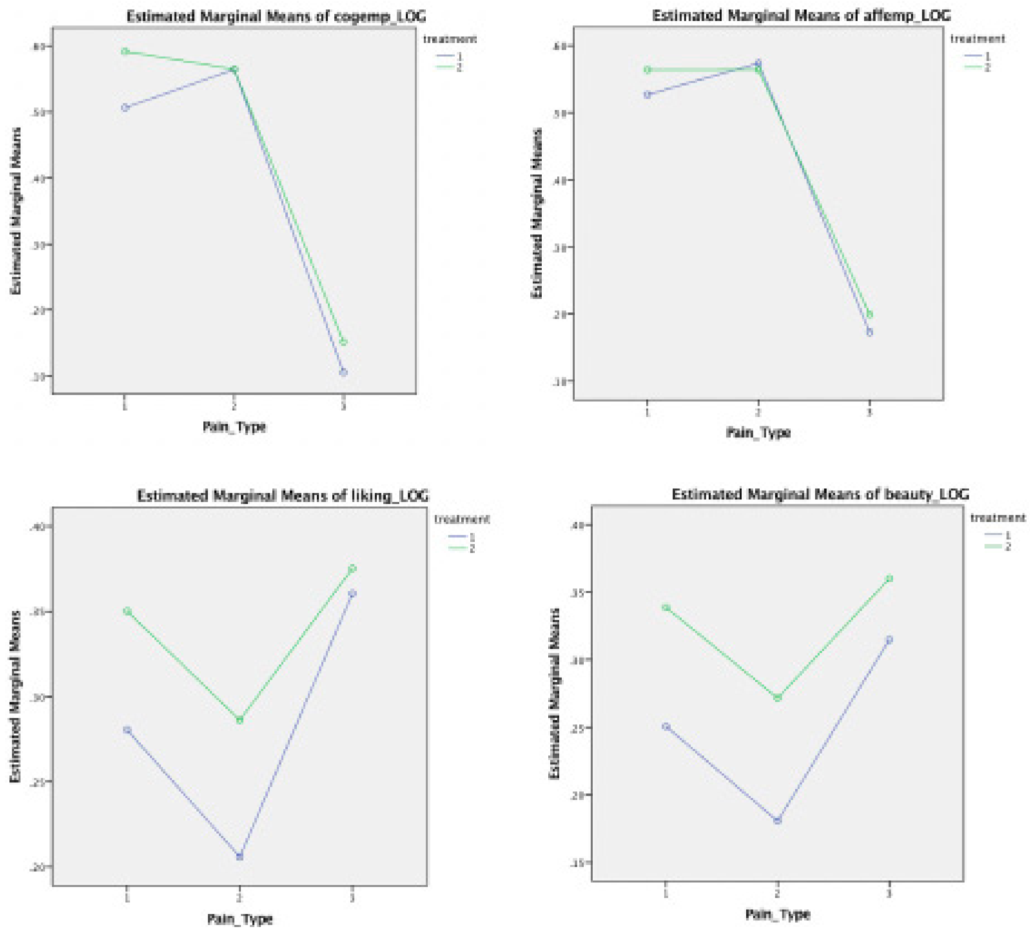
This study is part of an MSc dissertation exploring the capacity of images to convey different kinds of pain, both seen and unseen. Each respondent to this survey was randomly assigned to view images of pain in one of two styles, the left style being flat and neutral-colored, and the right style being vibrant, rich in color, texture, and imagery.

Each image was hand-drawn carefully (by the postgraduate researcher conducting this study) to reflect a specific kind of pain based on the accounts of those who have experienced it. For example - the image above depicts pain from scoliosis, described as burning, sharp, stinging pain in the spine, so the visual imagery and colours reflect this. In analysis of the data, we will examine how illustrations modulate our ability to appreciate and relate to depictions of others in pain. In a world where images of graphic violence and human suffering are so salient, we hope that this study may shed light on the visual language we use to communicate pain.

Thank you again for taking the time to contribute!

6.2 Appendix B for Inferential Statistics

Transformed Data in Mixed Factorial ANOVAs



Transformed data exhibit equivalent relationships to the untransformed data in marginal means plots.

ANOVA - Cognitive Empathy

Mauchly's Test of Sphericity[a]
Measure: cogemp_LOG

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.	Epsilon[b] Greenhouse-Geisser	Huynh-Feldt	Lower-bound
Pain_Type	.687	125.774	2	.000	.762	.767	.500

Tests of Within-Subjects Effects
Measure: cogemp_LOG

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Pain_Type	Sphericity Assumed	41.383	2	20.691	4215.521	.000	.926
	Greenhouse-Geisser	41.383	1.523	27.168	4215.521	.000	.926
	Huynh-Feldt	41.383	1.533	26.990	4215.521	.000	.926
	Lower-bound	41.383	1.000	41.383	4215.521	.000	.926
Pain_Type * treatment	Sphericity Assumed	.308	2	.154	31.329	.000	.085
	Greenhouse-Geisser	.308	1.523	.202	31.329	.000	.085
	Huynh-Feldt	.308	1.533	.201	31.329	.000	.085
	Lower-bound	.308	1.000	.308	31.329	.000	.085
Error(Pain_Type)	Sphericity Assumed	3.298	672	.005			
	Greenhouse-Geisser	3.298	511.798	.006			
	Huynh-Feldt	3.298	515.180	.006			
	Lower-bound	3.298	336.000	.010			

Levene's Test of Equality of Error Variances[a]

	F	df1	df2	Sig.
i_1avg_LOG	6.066	1	336	.014
e_1avg_LOG	.301	1	336	.584
n_1avg_LOG	18.480	1	336	.000

Tests of Between-Subjects Effects
Measure: cogemp_LOG
Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Intercept	173.649	1	173.649	13002.795	.000	.975
treatment	.490	1	.490	36.655	.000	.098
Error	4.487	336	.013			

ANOVA - Affective Empathy

Mauchly's Test of Sphericity[a]

Measure: affemp_LOG

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.	Epsilon[b] Greenhouse-Geisser	Huynh-Feldt	Lower-bound
Pain_Type	.406	302.346	2	.000	.627	.630	.500

Measure: affemp_LOG

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Pain_Type	Sphericity Assumed	31.107	2	15.553	1810.785	.000	.843
	Greenhouse-Geisser	31.107	1.254	24.799	1810.785	.000	.843
	Huynh-Feldt	31.107	1.261	24.677	1810.785	.000	.843
	Lower-bound	31.107	1.000	31.107	1810.785	.000	.843
Pain_Type * treatment	Sphericity Assumed	.102	2	.051	5.921	.003	.017
	Greenhouse-Geisser	.102	1.254	.081	5.921	.010	.017
	Huynh-Feldt	.102	1.261	.081	5.921	.010	.017
	Lower-bound	.102	1.000	.102	5.921	.015	.017
Error(Pain_Type)	Sphericity Assumed	5.772	672	.009			
	Greenhouse-Geisser	5.772	421.461	.014			
	Huynh-Feldt	5.772	423.550	.014			
	Lower-bound	5.772	336.000	.017			

Levene's Test of Equality of Error Variances[a]

	F	df1	df2	Sig.
i_2avg_LOG	1.723	1	336	.190
e_2avg_LOG	.039	1	336	.844
n_2avg_LOG	.241	1	336	.624

Tests of Between-Subjects Effects
Measure: affemp_LOG
Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Intercept	190.348	1	190.348	7182.983	.000	.955
treatment	.081	1	.081	3.053	.082	.009
Error	8.904	336	.026			

ANOVA - Liking

Mauchly's Test of Sphericity[a]
Measure: liking_LOG

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.	Epsilon[b] Greenhouse-Geisser	Huynh-Feldt	Lower-bound
Pain_Type	.634	152.795	2	.000	.732	.737	.500

Tests of Within-Subjects Effects
Measure: liking_LOG

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Pain_Type	Sphericity Assumed	2.527	2	1.264	120.178	.000	.263
	Greenhouse-Geisser	2.527	1.464	1.726	120.178	.000	.263
	Huynh-Feldt	2.527	1.473	1.716	120.178	.000	.263
	Lower-bound	2.527	1.000	2.527	120.178	.000	.263
Pain_Type * treatment	Sphericity Assumed	.210	2	.105	9.967	.000	.029
	Greenhouse-Geisser	.210	1.464	.143	9.967	.000	.029
	Huynh-Feldt	.210	1.473	.142	9.967	.000	.029
	Lower-bound	.210	1.000	.210	9.967	.002	.029
Error(Pain_Type)	Sphericity Assumed	7.065	672	.011			

	Greenhouse-Geisser	7.065	491.857	.014			
	Huynh-Feldt	7.065	494.941	.014			
	Lower-bound	7.065	336.000	.021			

Levene's Test of Equality of Error Variances[a]

	F	df1	df2	Sig.
i_3avg_LOG	.242	1	336	.623
e_3avg_LOG	.444	1	336	.505
n_3avg_LOG	.053	1	336	.819

Tests of Between-Subjects Effects
Measure: liking_LOG
Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Intercept	97.178	1	97.178	1534.455	.000	.820
treatment	.765	1	.765	12.081	.001	.035
Error	21.279	336	.063			

ANOVA - Beauty

Mauchly's Test of Sphericity[a]
Measure: beauty_LOG

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.	Epsilon[b] Greenhouse-Geisser	Huynh-Feldt	Lower-bound
Pain_Type	.676	131.061	2	.000	.755	.760	.500

Tests of Within-Subjects Effects
Measure: beauty_LOG

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Pain_Type	Sphericity Assumed	2.133	2	1.067	134.008	.000	.285
	Greenhouse-Geisser	2.133	1.511	1.412	134.008	.000	.285
	Huynh-Feldt	2.133	1.521	1.403	134.008	.000	.285
	Lower-bound	2.133	1.000	2.133	134.008	.000	.285

Pain_Type * treatment	Sphericity Assumed	.111	2	.055	6.973	.001	.020
	Greenhouse-Geisser	.111	1.511	.073	6.973	.003	.020
	Huynh-Feldt	.111	1.521	.073	6.973	.003	.020
	Lower-bound	.111	1.000	.111	6.973	.009	.020
Error(Pain_Type)	Sphericity Assumed	5.348	672	.008			
	Greenhouse-Geisser	5.348	507.640	.011			
	Huynh-Feldt	5.348	510.959	.010			
	Lower-bound	5.348	336.000	.016			

Levene's Test of Equality of Error Variances[a]

	F	df1	df2	Sig.
i_4avg_LOG	.001	1	336	.977
e_4avg_LOG	.000	1	336	.989
n_4avg_LOG	1.295	1	336	.256

Tests of Between-Subjects Effects
Measure: beauty_LOG
Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Intercept	82.947	1	82.947	1182.864	.000	.779
treatment	1.418	1	1.418	20.224	.000	.057
Error	23.562	336	.070			

Paired and Independent Samples T-Tests for Measures

All Measures Between Treatments
Group Statistics

	treatment	N	Mean	Std. Deviation	Std. Error Mean
i_1avg	1	173	3.2665	.60341	.04588
	2	165	3.9576	.60225	.04688
i_2avg	1	173	3.4503	.73727	.05605
	2	165	3.7430	.71944	.05601
i_3avg	1	173	2.0682	.82805	.06296
	2	165	2.4382	.98026	.07631

i_4avg	1	173	1.9347	.79076	.06012
	2	165	2.3679	.93149	.07252
e_1avg	1	173	3.7110	.55880	.04249
	2	165	3.7164	.57703	.04492
e_2avg	1	173	3.8214	.68790	.05230
	2	165	3.7352	.67920	.05288
e_3avg	1	173	1.7468	.75526	.05742
	2	165	2.0873	.81907	.06376
e_4avg	1	173	1.6468	.72877	.05541
	2	165	2.0200	.79489	.06188
n_1avg	1	173	1.3029	.28983	.02204
	2	165	1.4861	.51406	.04002
n_2avg	1	173	1.6052	.71814	.05460
	2	165	1.7024	.71286	.05550
n_3avg	1	173	2.4231	.76222	.05795
	2	165	2.4927	.74396	.05792
n_4avg	1	173	2.2046	.76704	.05832
	2	165	2.4176	.75563	.05883

Independent Samples Test

EVA = Equal Variances Assumed, EVNA = Equal Variances Not Assumed

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
i_1avg	EVA	.177	.675	-10.535	336	.000	-.69110	.06560	-.82014	-.56207
	EVNA			-10.536	335.304	.000	-.69110	.06560	-.82013	-.56207
i_2avg	EVA	.330	.566	-3.692	336	.000	-.29274	.07929	-.44870	-.13678
	EVNA			-3.694	335.822	.000	-.29274	.07924	-.44861	-.13687
i_3avg	EVA	5.447	.020	-3.755	336	.000	-.36997	.09854	-.56380	-.17614
	EVNA			-3.740	321.293	.000	-.36997	.09893	-.56461	-.17534
i_4avg	EVA	5.717	.017	-4.617	336	.000	-.43320	.09383	-.61777	-.24862
	EVNA			-4.599	321.915	.000	-.43320	.09420	-.61852	-.24788

e_1avg	EVA	.423	.516	-.087	336	.931	-.00538	.06178	-.12691	.11615
	EVNA			-.087	333.888	.931	-.00538	.06183	-.12701	.11624
e_2avg	EVA	.001	.974	1.159	336	.247	.08624	.07439	-.06010	.23257
	EVNA			1.160	335.594	.247	.08624	.07437	-.06006	.23253
e_3avg	EVA	1.409	.236	-3.975	336	.000	-.34045	.08564	-.50892	-.17199
	EVNA			-3.968	330.563	.000	-.34045	.08581	-.50925	-.17165
e_4avg	EVA	2.714	.100	-4.502	336	.000	-.37318	.08289	-.53623	-.21013
	EVNA			-4.493	330.080	.000	-.37318	.08306	-.53658	-.20978
n_1avg	EVA	26.641	.000	-4.059	336	.000	-.18317	.04513	-.27194	-.09440
	EVNA			-4.009	256.076	.000	-.18317	.04568	-.27314	-.09320
n_2avg	EVA	.409	.523	-1.249	336	.213	-.09722	.07787	-.25039	.05594
	EVNA			-1.249	335.460	.213	-.09722	.07785	-.25036	.05592
n_3avg	EVA	.036	.850	-.849	336	.396	-.06961	.08198	-.23086	.09165
	EVNA			-.850	335.818	.396	-.06961	.08193	-.23077	.09156
n_4avg	EVA	.014	.905	-2.570	336	.011	-.21295	.08286	-.37595	-.04996
	EVNA			-2.571	335.646	.011	-.21295	.08283	-.37589	-.05001

I vs. E for Empathy, Treatment A Only

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	i_1avg	3.2665	173	.60341	.04588
	e_1avg	3.7110	173	.55880	.04249
Pair 2	i_2avg	3.4503	173	.73727	.05605
	e_2avg	3.8214	173	.68790	.05230

Paired Samples Test

		Paired Differences							
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig. (2-tailed)
Pair 1	i_1avg e_1avg	-.44451	.52842	.04018	-.52381	-.36521	-11.064	172	.000
Pair 2	i_2avg e_2avg	-.37110	.49881	.03792	-.44595	-.29624	-9.785	172	.000

I vs. E for Empathy, Treatment B Only

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	i_1avg	3.9576	165	.60225	.04688
	e_1avg	3.7164	165	.57703	.04492
Pair 2	i_2avg	3.7430	165	.71944	.05601
	e_2avg	3.7352	165	.67920	.05288
Pair 3	i_3avg	2.4382	165	.98026	.07631
	e_3avg	2.0873	165	.81907	.06376
Pair 4	i_4avg	2.3679	165	.93149	.07252
	e_4avg	2.0200	165	.79489	.06188

Paired Samples Test

	Paired Differences							
				95% Confidence Interval of the Difference				
	Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig. (2-tailed)
Pair 1 i_1avg - e_1avg	-.24121	.52765	.04108	.16010	.32232	5.872	164	.000
Pair 2 i_2avg - e_2avg	-.00788	.50930	.03965	-.07041	.08617	.199	164	.843
Pair 3 i_3avg - e_3avg	-.35091	.47788	.03720	.27745	.42437	9.432	164	.000
Pair 4 i_4avg - e_4avg	-.34788	.41002	.03192	.28485	.41091	10.898	164	.000

I vs. E for Empathy/Liking Overall

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	i_1avg	3.6038	338	.69429	.03776
	e_1avg	3.7136	338	.56694	.03084
Pair 2	i_2avg	3.5932	338	.74215	.04037
	e_2avg	3.7793	338	.68402	.03721
Pair 3	i_3avg	2.2488	338	.92298	.05020
	e_3avg	1.9130	338	.80415	.04374
Pair 4	i_4avg	2.1462	338	.88793	.04830
	e_4avg	1.8290	338	.78324	.04260

Paired Samples Test

	Paired Differences							
				95% Confidence Interval of the Difference				
	Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig. (2-tailed)
Pair 1 i_1avg - e_1avg	--.10976	.62916	.03422	-.17708	-.04245	-3.207	337	.001
Pair 2 i_2avg - e_2avg	--.18609	.53778	.02925	-.24363	-.12856	-6.362	337	.000
Pair 3 i_3avg - e_3avg	-.33580	.44567	.02424	.28812	.38348	13.852	337	.000
Pair 4 i_4avg - e_4avg	-.31716	.39770	.02163	.27461	.35971	14.662	337	.000

Correlations
(Pain Stim and Art Interest; Treatment A and B)

Descriptive Statistics

	Mean	Std. Deviation	N
art_interest	65.98	24.870	165
ie_total_1_LOG	.5782	.06407	165
ie_total_2_LOG	.5639	.08678	165
ie_total_3_LOG	.3181	.17255	165
ie_total_4_LOG	.3052	.17255	165

Correlations

		art_interest	ie_total_1_LOG	ie_total_2_LOG	ie_total_3_LOG	ie_total_4_LOG
art_interest	Pearson Correlation	1	.116	.106	.133	.154*
	Sig. (2-tailed)		.137	.177	.088	.048
	N	165	165	165	165	165
ie_total_1_LOG	Pearson Correlation	.116	1	.709**	.048	.073
	Sig. (2-tailed)	.137		.000	.545	.349
	N	165	165	165	165	165
ie_total_2_LOG	Pearson Correlation	.106	.709**	1	.157*	.179*
	Sig. (2-tailed)	.177	.000		.044	.021
	N	165	165	165	165	165
ie_total_3_LOG	Pearson Correlation	.133	.048	.157*	1	.877**
	Sig. (2-tailed)	.088	.545	.044		.000
	N	165	165	165	165	165
ie_total_4_LOG	Pearson Correlation	.154*	.073	.179*	.877**	1
	Sig. (2-tailed)	.048	.349	.021	.000	
	N	165	165	165	165	165

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Descriptive Statistics

	Mean	Std. Deviation	N
art_interest	56.53	25.348	173
ie_total_1_LOG	.5353	.06850	173
ie_total_2_LOG	.5503	.09127	173
ie_total_3_LOG	.2430	.17025	173
ie_total_4_LOG	.2156	.16926	173

Correlations

		art_interest	ie_total_1_LOG	ie_total_2_LOG	ie_total_3_LOG	ie_total_4_LOG
art_interest	Pearson Correlation	1	.026	.104	-.028	.008
	Sig. (2-tailed)		.736	.174	.710	.915
	N	173	173	173	173	173
ie_total_1_LOG	Pearson Correlation	.026	1	.647**	.117	.104
	Sig. (2-tailed)	.736		.000	.124	.174
	N	173	173	173	173	173
ie_total_2_LOG	Pearson Correlation	.104	.647**	1	.219**	.182*
	Sig. (2-tailed)	.174	.000		.004	.016
	N	173	173	173	173	173
ie_total_3_LOG	Pearson Correlation	-.028	.117	.219**	1	.916**
	Sig. (2-tailed)	.710	.124	.004		.000
	N	173	173	173	173	173
ie_total_4_LOG	Pearson Correlation	.008	.104	.182*	.916**	1
	Sig. (2-tailed)	.915	.174	.016	.000	
	N	173	173	173	173	173

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Mediation Regression Analyses

Beauty Mediator, Affective Empathy Criterion

```
Run MATRIX procedure:

***************** PROCESS Procedure for SPSS Version 3.5 *****************

          Written by Andrew F. Hayes, Ph.D.       www.afhayes.com
    Documentation available in Hayes (2018). www.guilford.com/p/hayes3

**************************************************************************
Model  : 4
    Y  : aff_emp
    X  : trtmnt
    M  : beauty

Sample
Size:  6760

**************************************************************************
OUTCOME VARIABLE:
 beauty

Model Summary
          R       R-sq        MSE          F        df1        df2
p
       .183       .034      1.171    234.514      1.000   6758.000
.000

Model
              coeff         se          t          p       LLCI       ULCI
constant      1.388       .041     33.571       .000      1.307      1.469
trtmnt         .403       .026     15.314       .000       .352       .455

**************************************************************************
OUTCOME VARIABLE:
 aff_emp

Model Summary
          R       R-sq        MSE          F        df1        df2
p
       .114       .013      1.435     44.703      2.000   6757.000
.000

Model
              coeff         se          t          p       LLCI       ULCI
constant      3.369       .049     68.146       .000      3.272      3.466
trtmnt         .056       .030      1.876       .061      -.002       .114
beauty         .118       .013      8.767       .000       .092       .144

************************** TOTAL EFFECT MODEL ****************************
```

```
OUTCOME VARIABLE:
 aff_emp

Model Summary
          R       R-sq        MSE          F        df1        df2
p
      .043       .002      1.452     12.406      1.000   6758.000
.000

Model
              coeff         se          t          p       LLCI       ULCI
constant      3.533       .046     76.760       .000      3.442      3.623
trtmnt         .103       .029      3.522       .000       .046       .161

************* TOTAL, DIRECT, AND INDIRECT EFFECTS OF X ON Y *************

Total effect of X on Y
     Effect         se          t          p       LLCI       ULCI       c_ps
       .103       .029      3.522       .000       .046       .161       .086

Direct effect of X on Y
     Effect         se          t          p       LLCI       ULCI      c'_ps
       .056       .030      1.876       .061      -.002       .114       .046

Indirect effect(s) of X on Y:
           Effect     BootSE   BootLLCI   BootULCI
beauty       .048       .006       .036       .061

Partially standardized indirect effect(s) of X on Y:
           Effect     BootSE   BootLLCI   BootULCI
beauty       .039       .005       .030       .050

********************** ANALYSIS NOTES AND ERRORS ***********************

Level of confidence for all confidence intervals in output:
  95.0000

Number of bootstrap samples for percentile bootstrap confidence intervals:
  5000

------ END MATRIX -----
```

Beauty Mediator, Cognitive Empathy Criterion

```
Run MATRIX procedure:

***************** PROCESS Procedure for SPSS Version 3.5 *****************

          Written by Andrew F. Hayes, Ph.D.       www.afhayes.com
    Documentation available in Hayes (2018). www.guilford.com/p/hayes3

**************************************************************************
Model  : 4
    Y  : cog_emp
    X  : trtmnt
```

```
    M   : beauty

Sample
Size:  6760

**************************************************************************
OUTCOME VARIABLE:
 beauty

Model Summary
          R       R-sq        MSE          F        df1        df2
p
       .183       .034      1.171    234.514      1.000   6758.000
.000

Model
              coeff         se          t          p       LLCI       ULCI
constant      1.388       .041     33.571       .000      1.307      1.469
trtmnt         .403       .026     15.314       .000       .352       .455

**************************************************************************
OUTCOME VARIABLE:
 cog_emp

Model Summary
          R       R-sq        MSE          F        df1        df2
p
       .169       .029      1.076     99.127      2.000   6757.000
.000

Model
              coeff         se          t          p       LLCI       ULCI
constant      3.095       .043     72.329       .000      3.011      3.179
trtmnt         .335       .026     13.053       .000       .285       .385
beauty         .033       .012      2.798       .005       .010       .055

************************** TOTAL EFFECT MODEL ****************************
OUTCOME VARIABLE:
 cog_emp

Model Summary
          R       R-sq        MSE          F        df1        df2
p
       .165       .027      1.077    190.230      1.000   6758.000
.000

Model
              coeff         se          t          p       LLCI       ULCI
constant      3.140       .040     79.230       .000      3.063      3.218
trtmnt         .348       .025     13.792       .000       .299       .398

************** TOTAL, DIRECT, AND INDIRECT EFFECTS OF X ON Y *************
```

```
Total effect of X on Y
     Effect         se          t          p       LLCI       ULCI       c_ps
       .348       .025     13.792       .000       .299       .398       .331

Direct effect of X on Y
     Effect         se          t          p       LLCI       ULCI      c'_ps
       .335       .026     13.053       .000       .285       .385       .318

Indirect effect(s) of X on Y:
           Effect     BootSE   BootLLCI   BootULCI
beauty       .013       .005       .004       .023

Partially standardized indirect effect(s) of X on Y:
           Effect     BootSE   BootLLCI   BootULCI
beauty       .013       .005       .003       .022

*********************** ANALYSIS NOTES AND ERRORS ************************

Level of confidence for all confidence intervals in output:
  95.0000

Number of bootstrap samples for percentile bootstrap confidence intervals:
  5000

------ END MATRIX -----
```

Liking Mediator, Affective Empathy Criterion

```
Run MATRIX procedure:

***************** PROCESS Procedure for SPSS Version 3.5 *****************

          Written by Andrew F. Hayes, Ph.D.       www.afhayes.com
    Documentation available in Hayes (2018). www.guilford.com/p/hayes3

**************************************************************************
Model  : 4
    Y  : aff_emp
    X  : trtmnt
    M  : liking

Sample
Size:  6760

**************************************************************************
OUTCOME VARIABLE:
 liking

Model Summary
          R       R-sq        MSE          F        df1        df2
p
       .156       .024      1.257    169.529      1.000   6758.000
.000

Model
```

```
                 coeff          se           t           p        LLCI        ULCI
constant         1.552        .043      36.245        .000       1.468       1.636
trtmnt            .355        .027      13.020        .000        .302        .409

**************************************************************************
OUTCOME VARIABLE:
 aff_emp

Model Summary
          R       R-sq        MSE          F        df1        df2
p
       .137       .019      1.427     65.078      2.000   6757.000
.000

Model
                 coeff          se           t           p        LLCI        ULCI
constant         3.314        .050      66.466        .000       3.217       3.412
trtmnt            .053        .029       1.813        .070       -.004        .111
liking            .141        .013      10.841        .000        .115        .166

************************** TOTAL EFFECT MODEL ****************************
OUTCOME VARIABLE:
 aff_emp

Model Summary
          R       R-sq        MSE          F        df1        df2
p
       .043       .002      1.452     12.406      1.000   6758.000
.000

Model
                 coeff          se           t           p        LLCI        ULCI
constant         3.533        .046      76.760        .000       3.442       3.623
trtmnt            .103        .029       3.522        .000        .046        .161

************** TOTAL, DIRECT, AND INDIRECT EFFECTS OF X ON Y **************

Total effect of X on Y
     Effect         se          t          p       LLCI       ULCI       c_ps
       .103       .029      3.522       .000       .046       .161       .086

Direct effect of X on Y
     Effect         se          t          p       LLCI       ULCI      c'_ps
       .053       .029      1.813       .070      -.004       .111       .044

Indirect effect(s) of X on Y:
           Effect     BootSE   BootLLCI   BootULCI
liking       .050       .006       .038       .062

Partially standardized indirect effect(s) of X on Y:
           Effect     BootSE   BootLLCI   BootULCI
liking       .041       .005       .032       .051
```

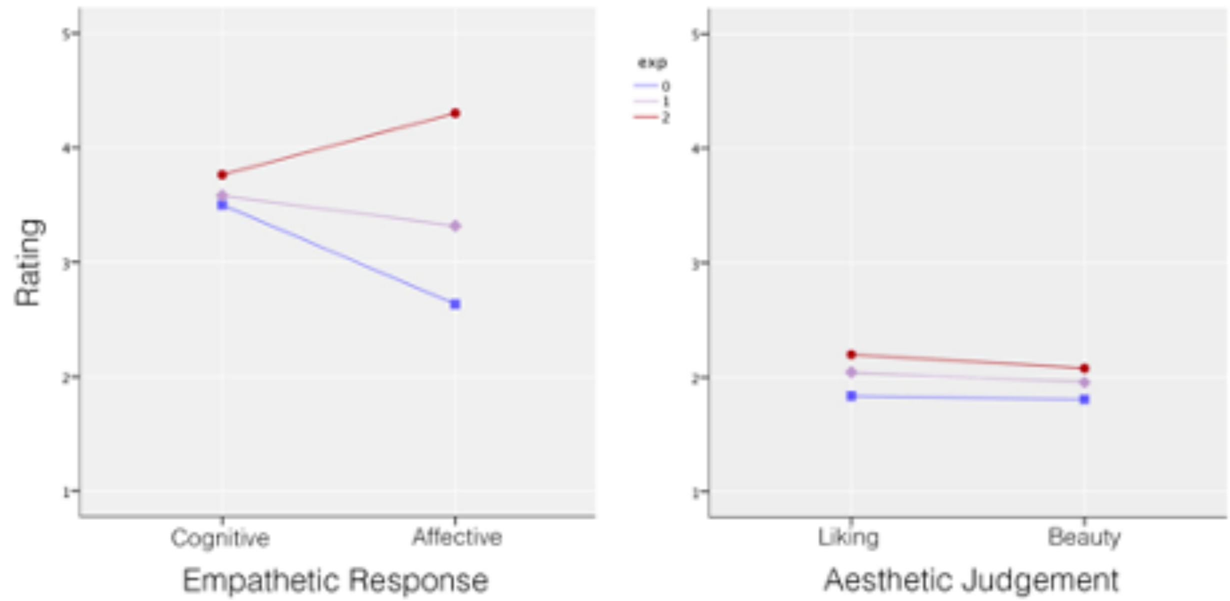
```
********************** ANALYSIS NOTES AND ERRORS ***********************

Level of confidence for all confidence intervals in output:
  95.0000

Number of bootstrap samples for percentile bootstrap confidence intervals:
  5000

------ END MATRIX -----
```

Liking Mediator, Cognitive Empathy Criterion

```
Run MATRIX procedure:

***************** PROCESS Procedure for SPSS Version 3.5 ****************

          Written by Andrew F. Hayes, Ph.D.       www.afhayes.com
    Documentation available in Hayes (2018). www.guilford.com/p/hayes3

**************************************************************************
Model  : 4
    Y  : cog_emp
    X  : trtmnt
    M  : liking

Sample
Size:  6760

**************************************************************************
OUTCOME VARIABLE:
 liking

Model Summary
          R       R-sq        MSE          F        df1        df2
p
       .156       .024      1.257    169.529      1.000   6758.000
.000

Model
              coeff         se          t          p       LLCI       ULCI
constant      1.552       .043     36.245       .000      1.468      1.636
trtmnt         .355       .027     13.020       .000       .302       .409

**************************************************************************
OUTCOME VARIABLE:
 cog_emp

Model Summary
          R       R-sq        MSE          F        df1        df2
p
       .168       .028      1.076     98.525      2.000   6757.000
.000

Model
```

```
                coeff         se          t          p       LLCI       ULCI
constant        3.095       .043     71.486       .000      3.011      3.180
trtmnt           .338       .026     13.225       .000       .288       .388
liking           .029       .011      2.581       .010       .007       .051

************************** TOTAL EFFECT MODEL ****************************
OUTCOME VARIABLE:
 cog_emp

Model Summary
          R       R-sq        MSE          F        df1        df2
p
       .165       .027      1.077    190.230      1.000   6758.000
.000

Model
                coeff         se          t          p       LLCI       ULCI
constant        3.140       .040     79.230       .000      3.063      3.218
trtmnt           .348       .025     13.792       .000       .299       .398

************* TOTAL, DIRECT, AND INDIRECT EFFECTS OF X ON Y *************

Total effect of X on Y
     Effect         se          t          p       LLCI       ULCI       c_ps
       .348       .025     13.792       .000       .299       .398       .331

Direct effect of X on Y
     Effect         se          t          p       LLCI       ULCI      c'_ps
       .338       .026     13.225       .000       .288       .388       .321

Indirect effect(s) of X on Y:
           Effect     BootSE   BootLLCI   BootULCI
liking       .010       .004       .002       .019

Partially standardized indirect effect(s) of X on Y:
           Effect     BootSE   BootLLCI   BootULCI
liking       .010       .004       .002       .018

********************** ANALYSIS NOTES AND ERRORS ***********************

Level of confidence for all confidence intervals in output:
  95.0000

Number of bootstrap samples for percentile bootstrap confidence intervals:
  5000

------ END MATRIX -----
```

Differences in Experience



Self-reported experience levels: 0 = None (have not experience pain), 1 = Somewhat, 2 = Yes (have personally experienced the pain)

Group Statistics (Empathy Measures)

	exp	N	Mean	Std. Deviation	Std. Error Mean
cog_emp	0	3875	2.02	1.421	.023
	2	4025	3.56	1.133	.018
aff_emp	0	3875	1.70	1.118	.018
	2	4025	4.20	1.003	.016

Group Statistics (Aesthetic Judgements)

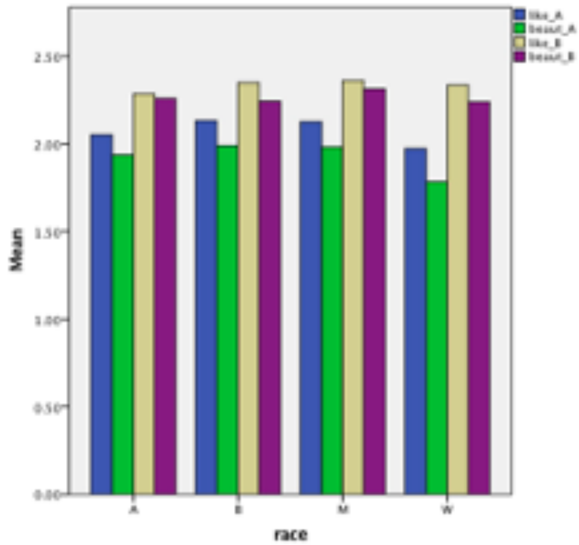
	exp	N	Mean	Std. Deviation	Std. Error Mean
liking	0	3875	2.18	1.083	.017
	2	4025	2.27	1.229	.019
beauty	0	3875	2.08	1.059	.017
	2	4025	2.14	1.191	.019

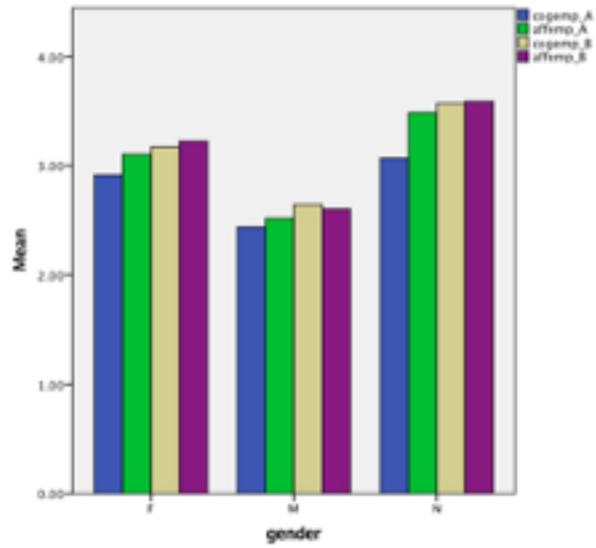
Independent Samples Test

EVA = Equal Variances Assumed, EVNA = Equal Variances Not Assumed

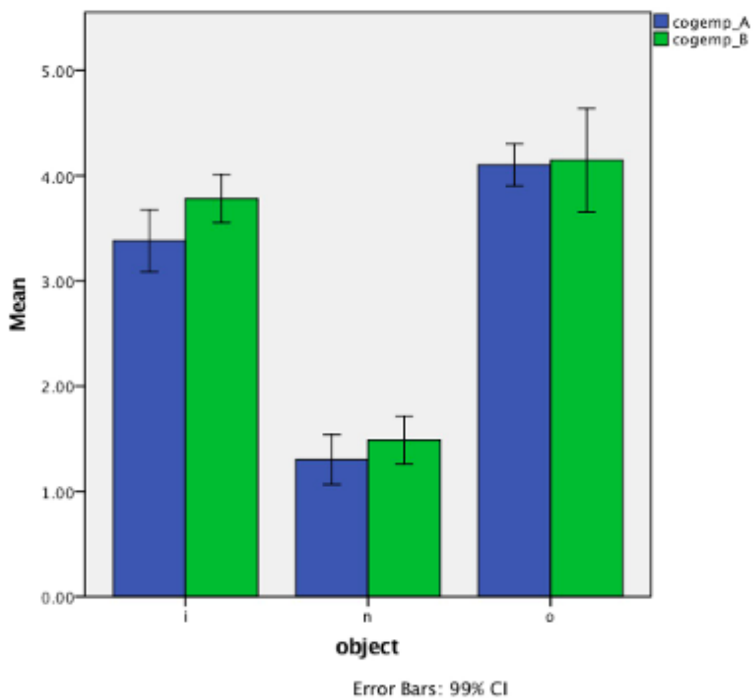
		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
liking	EVA	96.532	.000	-3.601	7898	.000	-.094	.026	-.145	-.043
	ENVA			-3.609	7837.031	.000	-.094	.026	-.145	-.043
beauty	EVA	88.189	.000	-2.442	7898	.015	-.062	.025	-.112	-.012
	EVNA			-2.447	7848.594	.014	-.062	.025	-.112	-.012

Exploratory Charts
(Depicted Race & Gender, Harmful Objects)





LEFT: Perceived race of depicted figure: A = Asian, B = Black, M = Mixed/Ambiguous, W = White
RIGHT: Perceived gender of depicted figure: F = Woman, M = Man, N = Ambiguous Gender



Presence of dangerous/harmful object: present = o, not present = i, neutral image = n

T-Tests on Illustration Features
(Presence of Blood, Faces)

Effect of Treatment on Change in Beauty Score for Highest Rated Stimuli
Group Statistics

	trtmnt	N	Mean	Std. Deviation	Std. Error Mean
i6_4	1	173	2.42	1.276	.097
	2	165	2.79	1.219	.095
n7_4	1	173	2.55	1.163	.088
	2	165	2.73	1.207	.094

Independent Samples Test
EVA = Equal Variances Assumed, EVNA = Equal Variances Not Assumed

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
i6_4	EVA	1.859	.174	-2.736	336	.007	-.372	.136	-.639	-.104
	EVNA			-2.739	335.999	.006	-.372	.136	-.639	-.105
n7_4	EVA	.248	.619	-1.382	336	.168	-.178	.129	-.432	.075
	EVNA			-1.381	333.660	.168	-.178	.129	-.432	.076

Blood vs. No Blood on Aff_emp in Treatment A
Paired Samples Test

		Paired Differences							
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig. (2-tailed)
Pair 1	blood_3 - noblood_3	-.15077	.54493	.04143	-.23255	-.06899	-3.639	172	.000

Blood vs. No Blood on Aff_emp in Treatment B
Paired Samples Test

		Paired Differences							
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig. (2-tailed)
Pair 1	blood_3 - noblood_3	.01566	.52741	.04106	-.06542	.09673	.381	164	.703

Face vs. No Face on Aff_emp and Cog_emp
Paired Samples Test

		Paired Differences							
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig. (2-tailed)
Pair 1	face_1 - noface_1	.20207	.42247	.02298	.15687	.24727	8.794	337	.000
Pair 2	face_2 - noface_2	-.22278	.50679	.02757	-.27700	-.16856	-8.082	337	.000