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“The most frequently expressed of the new distinctions uses emotions to draw a line between computers and people” (Turkle, 2018, p.63)

In October of 2018, the auction house Christie’s sold the “Portrait of Edmond Belamy” for $ 432,500. This is common price for art, and both the artwork—a representational portrait of a man in a loose expressionist style similar to that of Francis Bacon—and the purchase itself would otherwise be not all that remarkable, except for one key point: this particular portrait was created by an artificial intelligence (AI) algorithm by the art group “obvious” in Paris. Reactions were diverse, but also often negative with a common theme from many critics suggesting a missing artistic value of the AI created pictures. As put by Jerry Saltz, (2018), epitomizing the anger about the price and the selling of the picture, “*An Artwork Made by Artificial Intelligence Just Sold for $400,000. I Am Shocked, Confused, Appalled.”*(Saltz, 2018, para.1). One of the arguments postulated by critics was the missing emotional component, because of which Art made by an AI can, in their view, not be art (Jones, 2018; Kreye, 2018).

Emotional components and thus emotional reception of art – a key aspect of interpretation of human and computer made art are touched here and raises several interesting issues. A core aspect of art might be some sort of shared communion or connection itself. Art is seen as one of the characteristics distinguishing the human from machines. It tends to be considered as a core aspect of human communication—which in turn presumes a sender (the artist) for the message that is picked up by a “receiver”, as assumed in the expressionists’ concept (e.g. Langer, 1954). Presumably, especially because art viewing is a complex, sometimes challenging activity, wherein one goes to the trouble of linking to another mind, putting themselves in the shoes of another. If that other does not really exist, art is a false message. It violates some sort of covenant between humans. One individual is making a connection in good faith to another—who was never actually a sender. Gombrich (1963) challenges the expressionists' concept of a simple connection between sender and receiver. He emphasizes that signals and their interpretation can vary among individuals, for example, due to cultural differences (such as different connotations of the colour black or red in different cultures). He questions the assumption that an artist's emotional world is consciously or unconsciously conveyed to the viewer through the artwork. He points out that if this assumption about art as a form of communication is right though, it should then be very easy to test. In this study, we will investigate exactly that by comparing the emotions and intentions of the artist and the observer during the creation respective viewing of the painting.

In regard to the sender receiver concept, (Foucault, 2019) argues that art, rather than a creator needs an “author function”. This author function is not only the individuum behind the artwork but includes different egos of the creator. This idea suggests that there only needs to be a perceived artist behind the artwork. If one were to elaborate this concept, is, above all, an acceptance necessary, that the creator is an artist? And can this role also be taken by an artificial intelligence or does this artist have to be a human being for a perceived connection? With this discussion fundamental questions are raised:

Is emotion transmission an indispensable component of art experience and art thus also a distinguishing criterion between human, other living beings or even the machine?

If AI indeed produces art and is accepted not only as tool but as artist in its own rights it challenges our hitherto existing self-image of the uniqueness of humans in this context. If, on the other hand, AI is defined as not being capable of making art, then this ought to be detectable in the lack of emotion transmission.

This leads to a second question, which addresses the psychological level: how do we emotional expectations and reception of art? When alleged emotion transmission in AI art is reported back by the viewer without there being a human sender, it suggests that our previous concept of sharing an emotional connection and emotion transmission might exist only in our heads.

And thirdly from this derives the pragmatic question of empirical research on AI and computer generated Art. AI art takes an increasing relevance in the artworld and at least the buyer of the picture “Edmund Belamy” found it an engaging piece. Therefore, AI art might become an integral part of existing art forms and research on this new artform is needed: What are (if any) the underlying processes of emotion sharing when experiencing this form of art? This is also highlighted by Nori (2018), when she asks: *“Wenn jüngere Generationen mit technologischen Autoren aufwachsen, entsteht da ein wechselseitiger Anpassungseffekt? “* ("*When younger generations grow up with technological authors, is there a reciprocal adaptation effect?*") (Nori & Kuhn, 2018, para. 13)

However, although the importance of emotion transmission in art creation and experience has been critically argued, only very few studies have investigated this empirically, even more so in regard to computer generated art.

The Present Thesis

This thesis examined, how people respond to art generated by computer versus human on a behavioural and brain level. We used a paradigm in which we examined the emotions and intentions of the artist during the creation of a work of art, as well as the emotions and intentions perceived by the viewer (see also Pelowski et al., 2018). To produce a highly similar set of stimuli for this, we designed an art template with a squared grid, where squares were either black or white. For the computer pictures we used random generated pictures by an algorithm, for the human pictures we worked with artists and asked them to produce similar black and white grids as the random generated computer pictures, although with the intention to transmit emotion(s) and report these in a follow up questionnaire. An online survey was used to investigate participants emotional (feeling) and cognitive (evaluation, understanding intention) response to these stimuli across conditions where they are: (1) told the art is all by humans, (2) all by computer. Furthermore, we investigated the assumed author of the artworks by asking participants to make their own determinations (human or computer generated).

To investigate the responses to the two types of stimuli also at the level of the brain, functional near infrared spectroscopy was planned to be used to look at the activation of empathy regions in the cortex, in a second part of the study, which we did not do empirically due to the Corona pandemic in 2020/21.

With this experimental setup we tested the first two of the following research questions, leaving the third for future studies, when the use of neurophysiological methods is possible again:

1. Following art critics, if someone believes or is told that an artwork is human generated (even though it is computer generated), do they report emotions during their experience? (Critics would say, no, they should not).
2. Alternatively, if we use an artwork that actually looks computer generated (grid of squares), but is made by an artist and does have specific emotions that the artist felt while making and also wished to communicate, can people pick this up, or is it all determined by priming/context?
3. How does priming or actual art provenance, impact empathy regions of the brain?

It is expected that the emotional experience is less intensive for the computer generated pictures and that less empathy is experienced towards the “emotional state” of the computer while making the artwork. If the results show emotion transfer in human-made art, but a lack of emotional understanding and transfer in AI-generated art, this could be seen as a distinction between these two types of artwork. If, on the other hand, computer generated art evokes the same or a similar emotional experience, further research could investigate whether and how computers can simulate and transmit emotions, or what characteristics or processes lead us to believe they are capable of doing so.

In the next chapter we will review the theoretical background and the state of the art that led to the above questions. In a first step we introduce the role of agency, first in general, then in relation to computers and finally in regard to computer and AI art. We then examine an AI algorithm as an example to understand the way it works and the resulting possibilities and limitations of AI art making. We review previous research on art perception and emotion transmission in art on the behavioral level as well as studies that have investigated these topics on a (neuro-) physiological level.

Review – Agency, Art Perception, Emotion Transmission, and AI

The discussion of interactions with computer art and emotion sharing or empathy, as manifest in the specific example above, can also be connected to a number of more general topics, which inform the research questions of this thesis.

Our General Tendency to Ascribe Agency

First, before talking of art, it is instructive to consider the general penchant for humans to find empathic connections or to see intentions in even non-human agents. The question of agency is not limited to the creator of a work of art as discussed above, on the contrary, our tendency to anthropomorphize non-human agents and objects and therefor ascribe agency has been widely researched (e.g. Aggarwal & McGill, 2007; Guthrie, 1995; Müller et al., 2018; Waytz et al., 2010). Even when watching a simple stop motion video of triangles, circles and a rectangle, participants projected agency and social interaction in the geometric forms (Heider & Simmel, 1944). This phenomenon is explained by Gell (1989) through the concept of "abduction of agency" which was inspired by Wittgenstein's understanding of human relations. Guided by our intuition, when observing behaviour, we assume that our counterpart has a mind and that his behaviour therefore follows rules that we can understand. To understand the intention behind an object, helps us understand the object itself. Furthermore, from an evolutionary standpoint, Gell (1998) argues, it is always safer to assume the highest possible agency.

Bosch describes things and machines as an extension of the human body, as a fiction to escape the finiteness and vulnerability of human existence which results in an continues wish for new things, new technology and fashionable objects (Bosch, 2019). We define ourselves as humans not only through our relations with others, but also through our relations with things (Böhme, 2006). This identification and identity giving character of artefacts is often not realized and leads to a denial of our dependence on objects and thus to a false sense of superiority (Böhme, 2006). In consequence, the authors of the present thesis postulate, if a machine produces an artefact, this sense of superiority is attack and endangered therefore leading to rejection of AI art, while the thrive for new objects and technologies pushes the further exploration and creation of AI art.

For Bosch, objects are our "anchors of the world". She highlights therefore next to the functional aspect of objects their social, cultural and psychological role (Bosch, 2019). Applied to Art, including AI artworks, it means that artefacts reflect part of our momentary society and time. AI artworks, therefore, should be studied on their social, cultural and psychological dimension, regardless if they can be categorized in our present understanding of art.

Agency in Computers

A new level of anthropomorphizing emerged with the rise of computers. They enable a new kind of interaction characterized by responsiveness and a seemingly specific reference to the individual (Turkle, 2018).

Weizenbaum (1966) for example, wrote the natural language processing computer program ELIZA, which was able to simulate natural language conversations with humans by chatting with them. Users type and enter a statement, which is subsequently analysed by ELIZA. The program uses keywords in the Users statement and generates a response based on these. Weizenbaum was repelled by the emotional connection people made with his conversation program. In fact, so repelled that he wrote a book about, in his eyes, the misperception of his program ELIZA and why people should not engage with it emotionally (Weizenbaum, 1976). Explaining the inner workings of ELIZA, resulted in a loss in interest in the program by many users (Weizenbaum, 1966). Others tried to protect their relationship with ELIZA by avoiding to evoke a not lifelike answer (Turkle, 2005). The reaction towards ELIZA showed an important aspect of the computer-human relationship or even more basic the human object relationship, the attribution of agency and intention. Turkle comes to a similar conclusion although in a more descriptive way. She points out that the processes and functioning of computers are often described through metaphors of human functioning and vice versa, thereby anthropomorphizing computers and using computers to better understand our minds (Turkle, 2005). This might be partly because of a similarity between mental processes and computer processes, both the mind and the computer can be seen as a black box, since when opening a brain or a computer the interior does not show the actual activity.

Computer-Art and Agency in the Past

To explore the question of art experience and emotion transmission in AI generated art we take a look at the origins of computer art and its similarities but also differences to the camera and photography.

The Camera and Photography

The question of the role of agency in art was raised anew with the invention of the camera and photography. Can an artist use a camera to create a work of art that makes an emotional connection with the viewer? One leading opinion was, pictures made with a camera could never do art, because cameras were machines and not humans. Following this opinion, it was feared, should photography be accepted as an artform, it would replace art as it was known then (Hertzmann, 2018). Benjamin (2008) describes the loss of the aura of an artwork through the replicability of the artwork for example as a result of modern mass photography. Following Benjamin, an artwork loses its authenticity through its technical replicability, which leads to a decay of value of art. Benjamin, (2008) thus addressed the possible loss of a quality of emotional experience and connection between artist and recipient. Interestingly, the camera is also made responsible for the development of abstract art, because the capture of the environment as it had been the focus of representational art, was now served by the camera (Hertzmann, 2018). Furthermore, the camera itself opened up new possibilities to express oneself (Elgammal, 2020). This underlines possibilities and chances coming with the introduction of a new tool for artists.

Computer Art and Agency

With the upcoming of computer generated art and its first exhibition in 1965, the discussion around computer generated art evolved quickly on a public scale. Already then, computer art was seen as ambiguous (Nake, 1971). Computer art is often compared to the invention of the camera and the emergence of photography (e.g. Hertzmann, 2018; Elgammal, 2020) as a new artform made by a machine. In the beginning computer generated art, as created by e.g. Max Bense, Georg Nees, Michael Noll and Vera Molnár, the focus lay in experimenting with computer graphics.

Max Bense highlights the benefits of the missing emotional component, which is a result of the mathematical nature of computers, because it hinders the art, in his view, to be politically abused (Offert, 2019). Bense points out this characteristic of computer generated art to have no emotions, which is now the point of critique. Nake (1971) underlines the role of computers in art as tools, for him the question of the creativity of a computer is pointless as there should be not more production of aesthetically pleasing objects, especially not by a computer. Rather, computers should be used in art to transport information in an aesthetically pleasing way (Nake, 1971). Nake (1971) states, that computer art, as it was presented at that time, is merely a fashion and criticizes the hype around computer art. "*It seem to me that "computer art" is nothing but one of the latest of these fashions, emerging from some accident, blossoming for a while, subject matter for shallow "philosophical" reasoning based on prejudice and misunderstanding as well as euphoric over-estimation, vanishing into nowhere gibing room to the next fashion*." (Nake, 1971, p.18)

Agency in AI Art

In the following section we will now look at AI art, to which the image of Edmund Belamy - the image that has caused so much excitement in the art world - is classified. With the development of AI, the question of agency in the emphatic and emotional expectation and reception of art has been raised again and the discussion about it is even more vehement. Here, too, the comparison of the camera continues to be used, since again similar hopes, critique and concerns were debated, although the comparison no longer seems completely applicable. While cameras have been widely accepted as tools and are thus only another form of expression of an artist, there are different views on the question of authorship in AI art and therefor the essence of AI art. Also, there is a certain intent in choosing what and how to photograph- although without denial, there are also snapshots in photography. With new AI systems on the other hand, it is not clear if the intention of the artist is visible in the output, since there has not been the same degree of control over the outcome (Pepi, 2020). While some see AI as a tool (e.g. Hertzmann, 2018; Audry & Ippolito, 2019), others see it as a collaborator (e.g. Cohen, 2010; Pranam, 2019) and others again either strive for, or already see AI as an artist in its own rights (Christies, 2018; Colton, 2012). These three categories are fluid and clear lines are hard to draw.

On the one hand, the different points of view arise from the different types of computer and AI art, which entail different uses und are based on the degree of autonomy of a computer (e.g. as in Daniele & Song, 2019). On the other hand, however, they are also based on the categorization and understanding of computer art as a whole, rather than separating the different computer and AI art forms. Here we can identify three basic tendencies on a spectrum regarding agency: AI as tool, collaborator and independent artist.

The Spectrum of Agency in AI Art Creation

With different perspectives on AI agency and the degree of its autonomy, there are also different implications of the ability of AI artworks to convey emotions and intentions in a work of art.

AI as Tool

Most representatives of the group, which see AI for art creation, if anything, as a tool refer to their point of view by the lack of emotionality , creativity (Mersch, 2020), autonomy (Bishop, 2014) and intentionality of an AI system (McCormack & D'Inverno, 2013, Hertzmann, 2018). Furthermore, they postulate, that no AI can act alone (Epstein et al., 2020). Calling an AI an artist is misleading for society and can be the cause of false beliefs about emotions, intentions and moral projections on the AI (Epstein et al., 2020; Hertzmann, 2018). Thus, while there is an admittance of increasingly complex, autonomous algorithms, that make decisions themselves, the self-learning systems need training sets, which are curated by the artist or a human agent, and on which the outcome is based, thus AI just stays a tool (Hertzmann, 2018).

AI as Collaborator

A similar argument is made, although with a different conclusion, by a group of people that see AI as a collaborator. Because of the evolution of AI systems there has been an opening for new possibilities of working with AI as a collaborator not as tool. AI can serve as resonance and help artists to better understand their underlying creative process and how to collaborate best. AI can give feedback to the artist during the process and contribute new ideas (d'Inverno et al., 2015; Fiennes & Hayek, 2019) In contrast to conventional tools, AI systems can be formed and evolve with the artist (Pranam, 2019; Radovanović & Chung, 2020). The idea to erase a human compound is not the goal as understood by Chung (2020). Finnes (2019) believes that there is an "energy" in artwork by humans that can be sensed by other humans. This implies that there cannot be art made solely by a computer, the creativity originates from the collaboration between computer and human (Cohen, 2010).

AI as Artist in his own Rights

In contrast, some people see AI art as more than just tools and collaborators but as (becoming) artists. Somewhere between the AI as collaborator and AI as an artist in her own rights sees Meller his project AI-DA, an artwork and a visual and performance AI-artist-robot (Schlieckau, 2021). Colten describes his algorithm, the painting fool a

> *"fledgling artist that is being trained to act increasingly more creatively."* (Colton, 2012, p. 7).

Moura, (2018) states that the process and therefor the creator plays no role in today's art, and for him the acceptance in the artworld, more precise on the art market, is all that matters. Here, Colten has a different opinion, seeing the process of creation of art and also the possibility for the viewer to see this process an important component of art (Colton, 2012).

Examples of creative AI programs are AARON, DeepDream, the painting fool and GANs, the latter is the neural network that was used to create Edmond Belamy, the picture mentioned above. These programs are written to minimize human influence on the outcome, which leads to a higher autonomy of the program. AARON, the oldest, was written in the mid 1970s and has been continuously developed further (Cohen, 1995). The painting fool, written around 2005 and further developed since, DeepDream published 2015(Mordvintser et al., 2015), and GANs, published 2014 (Goodfellow et al., 2014), are younger. To better understand how creativity is referred to in these programs, one needs to better understand the different functioning of each of these programs.

The Technical Side of AI Art – An Example

We will have a closer look on the algorithm that created Edmund Belamy, the GAN and on its evolved version the Creative adversarial network (CAN). A GAN consists of two connected networks. The first network (also called the generator) tries to generate images that resemble a training set of images, to which it does not have access. The other network (also called the discriminator) has access to the training set and tries to discriminate between "real" images (from the training set) and the "fake" images from the generator. It provides feedback to the generator on how its image has been evaluated, so that, the generator evolves from creating images at random to creating images from the same distribution as the training set, which can no longer be distinguished by the discriminator. The idea of a CAN is, as the name already implies, to not only create art but explore a creative space with the outcoming artefact. Hereby three conditions for the achievement of a creative output have been defined. First, the work should be new and not a mere reproduction, second it should still be in the framework of art, therefore has to still have characteristics of the distribution and thirdly it should increase the arousal potential through stylistic ambiguity and should break with style norms. Like the GAN, the CAN consists of a generator and a discriminator, with the discriminator having access to a training set with classified art. But the discriminator in this case sends out two signals of opposing character. The first signal gives feedback if the picture belongs to one of the distributions from the training set, and can therefore be seen as art. The second signal gives feedback on the art style the picture belongs to. Goal of the generator is to produce a picture that is classified as art but cannot be classified as one specific art style (Elgammal et al., 2017).

If looking at the GAN code now, another point of criticism of the Edmund Belamy painting in the Christie's auction becomes clear: Especially by AI artists but also critics, the work was also criticized under professional artistic criteria - unproximate code, uncreative application (this is equivalent to painting-by-numbers in the analogue world) (Saltz, 2018; Schlieckau, 2021). For them a distortion of facts, including the claim by Christies the AI was the creator of the painting, has led to a hype around a picture produced by a group of people with no art background, that used a borrowed code to make money, instead of showing the momentary state of the art of AI art. The anger by artists and critics shows parallels to Weizenbaum's anger about the perception of ELIZA, here again the underlying functioning and algorithm is misunderstood by laypeople and results in an overvaluation in the eyes of experts.

Thus, opinions about AI as artist and about the categorization of the created artefacts differ, not only because AI has been used and seen so differently. The more autonomy these programs use, and the less influence is taken by the artist the more stays the question, “is this art?”. As (Cohen, 1995) puts it:

> *“If […] whoever, believes that art is something only human beings can make, then for them, obviously, what AARON makes cannot be art. […] If what AARON is making is not art, what is it exactly, and in what ways, other than its origin, does it differ from the "real thing?" If it is not thinking, what exactly is it doing?”* (Cohan, 1995, p.13)

This leads us back to one of the opening questions, which seeks answers and new insights on a behaviorale level: How do we respond to art, and what role plays assumed human or computers agency in empathic and emotional expectations and reception of art? The next section therefore addresses the reactions as well as the influences of art perception on a behaviorale level. Specifically, we look at how prevailing paradigms of labelling, apparent recognition of intention as well as emotional transmission are transferable to computer art.

Art Perception and Agency, on a Behaviorale Level

In art perception different aspects of influences are relevant, and have already been examined on the behavioural level. These are foremost labelling (Leder, 2001; Locher et al., 2015; Wolz & Carbon, 2014), intentionality, “feeling into” the artwork (Gerger et al., 2018) and emotion transmission through the artwork (Pelowski et al., 2020; Pelowski et al., 2018, submitted for publication) and the language used to describe the artist. The examination of the influence of labelling, the intentionality and emotion transmission are key aspects of this study.

Is it the Prime or the Art?

(Hawley-Dolan & Winner, 2011)found that that labelling of an Artwork as produced by elephants, monkeys or children, had no effect on the subjective evaluation (e.g. the liking of an artwork), but on the objective evaluation (e.g. “which is the better work of art”) (Hawley-Dolan and Winner, 2011, p.437). Furthermore, works by professional artists were detected independently of a given label (Hawley-Dolan & Winner, 2011). The capability of distinguishing children/animal pictures from artworks by professional artists, was replicated by Snapper et al., (2015), although they also found differences between the pictures, some being easier and some harder to distinguish. In a study with pictures produced by AI and human artist, human pictures were rated higher in “composition”, “degree of expression” and “aesthetic value” regardless of label, further supporting a basic underlying difference in human produced art (J. W. Hong & Curran, 2019). Also, it has been shown that pigeons can be trained to distinguish between artworks (Watanabe, 2001, 2010; Watanabe et al., 1995). In the context of children drawings, the pigeons were able to learn to distinguish between “good” and “bad” drawings as rated by human adults. This implies an underlying structure and rules in art that can be even taught to other animals, which most probably have not the same construct of art and beauty as we have (Watanabe, 2010). In a study comparing pictures produced by AI and human artist, human pictures were rated in “composition” “degree of expression” and “aesthetic value” regardless of label (Hong & Curran, 2019), but not emotional transmission which this study looks at.

Contrasting results showed that AI produced art could not be distinguished from art made by an artist, when not labelled as such (Elgammal et al., 2017). Elgammal et al. (2017), compared four sets of pictures: Deep Convolution GAN, CAN, Art Basel and Abstract Expressionists in four experiments showing the pictures to participants and asking for parameters such as liking, communication, intentionality and who they believed it was made by. Surprisingly, from the two used art-sets made by human artists, not only were the pictures of the CAN rated higher as both sets with artworks made by humans, but also the CAN artworks were rated more often as being made by an artist, than the artworks from Art Basel. In a follow up experiment CAN pictures were also rated on average as showing more intentionality, visual structure and were communicating more with the viewer than an Abstract Expressionists set of artworks (Elgammal et al., 2017).

These results, in turn, could suggest a perceived author. How are these results compatible and what factors play a role in the different evaluations and perceptions of computer art? Thus, are CAN-created artworks, with minimal human intervention, better at creating artworks than children and animals? Would a prime change the results? The present study attempts to gain further insights in this regard. It also builds on Hong and Currans' (2019) criticism that the small sample size raises doubts about the statistical power of Elgammal's findings.

Emotional Transmission in Art and the Perception of the Intended Emotions

As mentioned above, one of the main points of the art critiques has been the missing emotional component in AI art, which is understandable since communication through art is a main component of the art experience. Lipps, (2018) puts "Einfühlung" as base for enjoyment and pleasure in an object and in art, as part of the theoretical formation of the general idea of Einfühlung in the 19^{th} century. Also, more recently empathy has been highlighted as important aspect in the art experience (e.g. Gerger et al., 2018). The communicational aspect of art between the artist and the viewer has been highlighted to be characteristic as well as one origin of art's existence (D'Inverno & Mccormack, 2015; Hertzmann, 2018).) Art has the ability and the characteristic of giving insight in the creator's reality and to share, through the artwork, feelings and views. For this to be achieved empathy is an important trait and is said to be the base of emotion transmission in art. Croce (1930) talks about art as intuition and sharing this intuition between artist and viewer.

Intentionality has been identified as an important factor in art identification/labelling and appreciation of art (Barrett & Jucker, 2011). Snapper et al. (2015) found intentionality and visual structure to be the base of distinguishing animal/children's works of art from artworks by professional artists. Intentionality is also hypnotized to be a form of communication through the work of art (Jucker et al., 2014).

Research on this topic has been limited so far. On a behaviorale level, Takahashi (1995) found support for emotion transmission in drawings from art students, Dubal et al. (2014) on emotion detection (high vs. low emotional load) in Chinese calligraphy. Pelowski et al. (2020) investigated emotion transmission and perception of intentions of artists and viewers through three installation artworks of upcoming artists. They found that, in two out of three installation artworks the emotions intended by the artists were more likely to be felt by viewers than the ones not tried to be transmitted by the artists. Furthermore, in all three involved installation artworks, viewers could to a significant degree identify the intended emotions, or to an even greater degree, which were not intended. Interestingly there was also an emotion sharing of participants and the artists reported as the viewers felt the same emotions as the artists when creating the art, independent of the artists intended emotions. While Pelowski et al. (2020) found that intentions and emotions of the artist could be picked up significantly often in installation artworks by viewers, the perceived intentionality in computer artworks and artworks by artists that look highly similar to the computer artworks has not been examined. So here we expect to give new insights on the perception of intentionality in computer art.

To further investigate emotion transmission Pelowski et al. (2018, submitted for publication) used a similar setup with three installation artworks, although working with artworks of already established artists, at 2017 Venice Biennale. The team had access to the artists intentions through the curator of this specific Pavillion. Results supported their previous findings that emotions as intended by the artist could be identified and were also reported more often than those not intended. Could such emotion transmission also be felt in AI generated art? Or is there a certain "energy" or emotional transmission that can only be sensed in human created art?

Discrepancy in the Ascribed Agency

How ambiguous our perception of AI art can be is shown in a study by (J.-W. Hong, 2018), who explored how people perceive art made by AI through focus groups. In the focus group, participants explained how AI cannot be the creator of art because of missing emotional and intentional compounds as well as the ability to make mistakes. When shown an artwork of an AI and asked if it was art to them, the majority said yes, even though knowing it was made by an AI. So, it seems like there is ambiguity in the perception of AI art as well as in research investigating it on a behaviorale level. This implies, that more research is needed in this regard but also suggests, to look for more answers on another level, to better grasp the aspects of art and AI art perception- a (neuro-) physiological level.

(Neuro-)Physiological Approach

One aspect of this thesis that we theoretically discuss, but which we did not empirically do because of Corona, would have been the examination of brain activation in the empathy regions when viewing computer and human generated artworks. In the following paragraph we therefore look at the state-of-the-art of research on art perception on a brain level, to then theoretical discuss our deriving research questions.

Attribution and Expectation

Past research on AI art, as mentioned above, has certainly shown that people, if they know or think an artefact is made by AI, react differently, then when labelled as such, suggesting a bias against computer generated art (Chamberlain et al., 2018). This can not only be observed on a behaviorale level but also on a neurophysiological level. In a study by Kirk et al. (2009) the label "made by a computer" effected both liking evaluations of the pictures (professional artworks by actual artists), and importantly, showed that even before viewing individuals who thought they were going to look at art had higher activity in the reward (OFC) areas of their brain.

This may fit into an aspect of authenticity or rarity. For example, similar study of pictures by Rembrandt showed that when individuals thought what they were seeing was not a forgery, but a real Rembrandt, they had similar OFC activations. In cases where they thought it was a fake, they had higher activations in the Occipital visual regions of the brain. While Kirk et al. (2009) used only artworks by real artists with different labels, the following study uses pictures made by computer and humans to investigate not only the influence of the label but also the different effects of the two types of stimuli (computer vs. human) on a neuronal level. The ability to distinguish between children/animal art has been shown before and could be further supported when looking at different gaze fixations and pupil dilation when looking at children/animal pictures vs. pictures by professional artists further supported the earlier findings (Alvarez et al., 2015).

Emotion Transmission and its' Neural Resonance

It has been argued that emphasizing emotions, actions and bodily sensations are an important part of the aesthetic response evoked by art. Hereby the mirror neuron system plays an important role. The translation of an observed action in one's own action seems to help understand others (Keysers & Gazzola, 2006). This seems to be not only working for the observation of actions, but also the result of an action can activate the same neural network as the execution of the action itself. These embodied simulations help the viewer to understand emotions and intentions of the artwork (Freedberg & Gallese, 2007). There has been the proposition, that the movement of the artist while creating the artwork as visible in for example strokes of a painting evokes similar networks of motor neurons, further supporting empathy for the artist (Freedberg & Gallese, 2007). This idea was supported by findings of Umilta' et al. (2012) and Sbriscia-Fioretti et al. (2013). They were looking at the activation of motor neuron areas while showing participants either pictures by artists - with cuts in the canvas (Umilta et al, 2012) or brushstrokes (Sbriscia-Fioretti et al, 2013) and structurally similar pictures made on the computer. In both studies the pictures by artists showed a significant higher activation of the motor neuron areas. Furthermore, people reported works made by artists more often as art, perhaps linking again to the difference in perceived agency. How does this effect perception of AI generated art? Can there be activation in the motor neurons as response to goal-directed movement, as given through for example the imitation of brushstrokes of an artist, when in fact there was no artist involved in the direct creation process?

Bodily Triggers from a Non-Human Agent

The activation of mirror neuron system can also be observed if the actor is not human but robotic, although the effect was stronger for complex actions than for simple ones (Gazzola et al., 2007). Chamberlain et al. (2018) investigated how observing and interacting with a robotic artist influences aesthetic judgement and artistic value of the produced artwork. While observing the robot did not increase perceived creativity or authorship it did increase the perception of intelligence and intentional acting of the robot, although it did not increase humanity of lifelike perception. Furthermore, it positively increased the aesthetic evaluation of the artwork supporting the effect of embodiment in art perception (Chamberlain et al., 2018). So, it stays questionable if AI generated artworks would evoke similar mirror neurons when for example strokes are visible in the artwork or if there can be no embodiment of goal-directed movement since the movement is not similar to human movement. To investigate this question the prefrontal motor cortex is included in the regions of interest for this study and should be looked at when viewers are shown pictures made by CANs vs. made by human artists.

Original Conception of the Study – to Investigate the Transmission of Emotions also on a Neuronal Level

As mentioned above, this study is originally conceived to also include brain scanning to win new insights in emotion transmission not only from a behaviorale, but also from a neurophysiological level. Stimuli were planned to also include pictures created by a CAN as well as non-digital artworks made by artists. Thus, in a follow up study to the online study, following questions are to be investigated with near infrared spectroscopy:

How does priming OR actual art provenance, impact empathy and theory of mind regions of the brain?

- Following Kirk et al. (2009), which showed a higher activation in reward parts of brain before an individual started viewing, and during, when told they would see art, do we also find similar pre-activations (or “coming on line”) of empathy regions?
- Is there a correlation between empathy brain activation and art evaluation or reported emotion in general?

- Is it possible that, even if the main impacts of art and emotion evaluations at the behavioural level, are due to context/priming, there may still be subtle differences in brain activity when we engage art that does have aesthetic intentionality and emotion communication intentions from an artist (Does our brain "know" that it is looking at human communication—the handprints of the artist—that the brain can pick up, even if the eye can't)?

The method to be used, functional near infrared spectroscopy (fNIRS), is a non-invasive brain image technique that estimates brain activity through measurement of oxygenated and deoxygenated blood. For this, it uses the light absorbing characteristics of the haemoglobin. Near infrared light is send through emitters into the cortex and detectors are measuring the light reflected. fNIRS has a better temporal resolution than fMRI and a better special resolution than EEG. Furthermore, it is more cost efficient than fMRI, which allows also to test more participants, it has less restraints linked to it, is portable and less sensible to movement. Research with fNIRS has been proposed to be especially helpful for study of emotion and social cognition (Balconi & Molteni, 2016)

The regions of interest for this study, to investigating underlying neuronal response are the medial prefrontal cortex, the ventromedial and ventrolateral prefrontal cortex (mPFC), the bilateral temporoparietal junction (rTPJ and lTPJ) and the right inferior frontal gyrus (rIFG). The mPFC has been linked to theory of mind related processes, introspection, perspective taking and cognitive empathy/mentalizing (Krämer et al., 2010). The rTPJ is said to be responsible for analysing signals from self-produced actions and processing social cues which both play an important role in empathy (Blakemore et al., 2002),while the lTPJ is linked to connecting mental ideas and inferring others' beliefs and intentions. The vmPFC and vlPFC previously linked to emotion processing have also been linked to empathy (Krämer et al., 2010). The rIFG is connected to the affective empathy, so the feeling into emotions. In all the above-mentioned areas can activity be measured with the fNIRS. The prefrontal motor cortex is linked to mirror neurons (Jankowiak-Siuda et al., 2011).

Method

Participants

Data was collected between the 2nd of September 2020 and the 27th of January 2021. The final sample of 48 participant was no usual psychology student sample, with an average of *M*=36.42 (*SD*=14.42) and an age range from 22 to 80. Gender was almost balances with 43.75% (21) identified as female, 52.08% (25) as male and 4.17% (2) identified with another sex. The educational background of the participants was wide ranging with 26% (12) of participants having an upper secondary school degree, 20% (9) an apprenticeship, 22% (10) a bachelor's degree, 28% (13) master's degree, 4% (2) doctorate/PhD and 2 participants with non-response. Participants did not receive payment or renumeration for their participation. Participants were recruited through postings on social media and on SurveyCircle, an online research platform for recruiting participants (SurveyCircle, 2021). A total of 274 people were asked to take part in the online study, from which 221 participants took part and 48 finished the study completely, 3 participants did not agree to the disclaimer provided at the beginning of the study. The high drop-out rate was probably due to the length of the study (total of 144 Questions additional to disclaimer (1) and demographic questions (3)) as well as maybe because of the similarity of the stimuli. We suggest that, especially because of the high dropout rate, participants who finished the study, completed it to the best of their knowledge and belief, since dropping out was easy and they were given no incentives.

Stimuli

For the stimuli, we used a format that allowed for the creation of artistic images by either human artists or randomly generated by a computer algorithm, involving exactly the same formal parameters for their production and leading to highly similar final stimuli set. Inspired by artworks by for example by Georg Nees *Plastik1*, Gerhard Richter's colour charts and especially Gerhard Richter's *4900 Farben*, this involved a 32 x 32 grid of squares (14,17 x 14,17 pixel/ 0.5x0.5 cm ; total artwork dimensions = 453.5 x 453 pixel, 16x16 cm) which could be individually coloured as black or white. Examples can be seen in Figure 1.

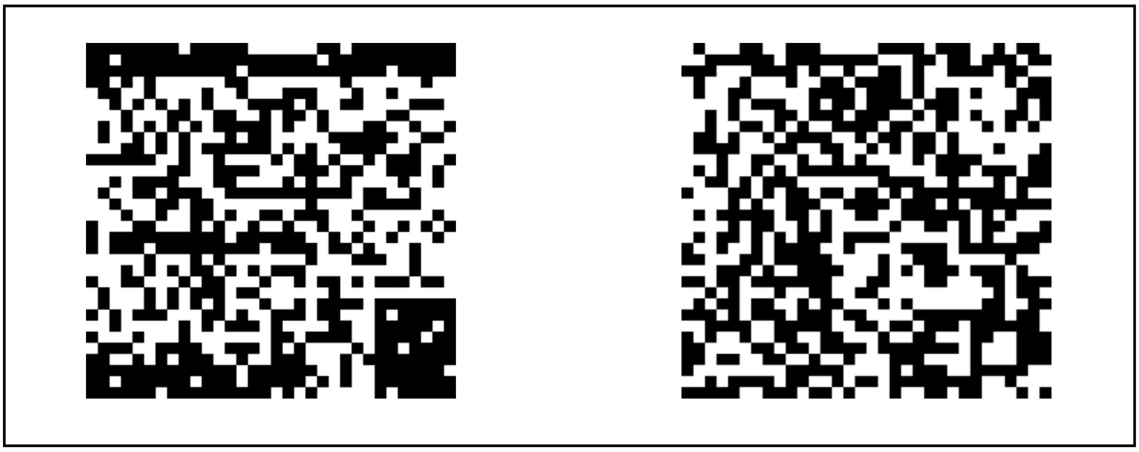


Figure 1. Human Picture 1 (left side) and Computer Picture 1 (right side)

For the computer generated images, we used an online Random Noise Generator (RNG) (PINETOOLS, n.d.) to randomly fill the cells, creating a random pattern. For the human derived images, we used a group of nine visual artists (6 female, 3 male), which either were currently or had studied art and/or were working as artists. They were given the 32x32 grid template described above, opened in Illustrator (Adobe Inc., 2019a, 2019b, 2019c), and were asked to use the template and ability to paint the individual cells black or white in order to make an abstract artwork. To further focus the making process and final artworks on the aspect of communication and emotion sharing, the artists were also instructed, as part of the making process, to actively choose one emotion they were feeling and that they should wish to transmit through the picture to a subsequent viewer.

In the human artist case, after creating the picture, the artists were also asked to fill out a questionnaire asking for their own spontaneous emotional experience while creating the art, regardless of the actual target emotion. The list was based on the previous study of Pelowski et al. (2020) and had the goal of potentially assessing the ability of the artist and an art viewer to both feel and/or cognitively recognize the target emotion (as specified by the artist), but also to potentially share the same felt emotional experience between art making and viewing. One picture by one artist was excluded because of a very high degree of structure.

The final stimuli set consisted of 24 stimuli, 10 RNG pictures and 14 pictures by artists, with 4 pictures made by artist one, 4 pictures made by artist two and the other six artists. After careful consideration it was decided not to balance the ratio of artist images and RNG images in order to avoid a further prolongation of the study, which would have been possible by adding four computer generated images. All artworks with accompanying target emotion (if any) are shown in Table 1.

Pilot Assessment and Division of Stimuli into Groups

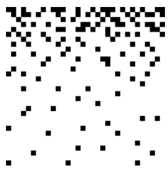
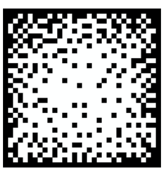
In order to provide a balanced set of images for our main analysis, primarily to avoid unwanted grouping/order effects, the 24-item stimuli set was rated in an online pre-study with Qualtrics (Qualtrics, Provo, UT). The images were shown individually on the screen, presented in random order to 37 participants, with 32.43% (12) identifying as female and 5.40% (2) identifying as another. The average age was 28.11 (SD = 3.603). The participants were told that the following pictures were either made by human or computer. They were asked to look at each image (no time limit) and to decide if the image was human or computer derived by checking a corresponding box (as well as no answer).

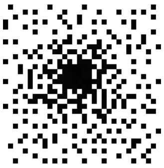
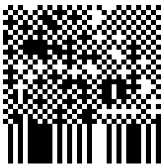
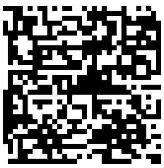
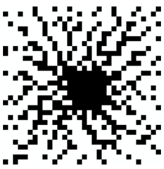
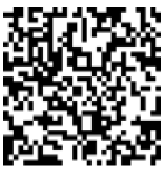
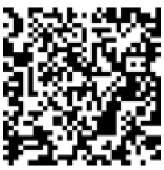
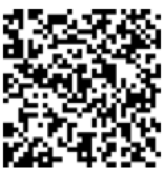
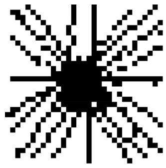
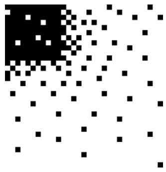
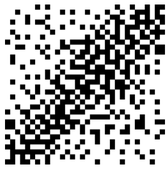
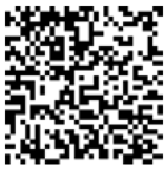
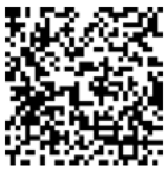
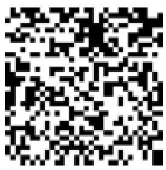
This resulted in a rating of each image as one or the other human/computer by an average of 26.71 participants (*SD* = 1,78), with the remaining answers being left blank. The average hit rate of for human pictures was 47.1 %, for computer 53.93%.

In order to split the stimuli in two groups, means and standard deviation were calculated in R for computer and human made art separately. Data was then visualized in two plots and outliners defined as all data outside the standard deviation. The images were ordered from smallest to largest mean value. To prevent one of the blocks from being skewed in one direction, the extreme values were grouped together, and the highest and lowest values assigned to one block, respectively the second highest and lowest to the other block. All other values were ranked within the standard deviation and equally assigned to Group A and B. Both groups were visualized in histograms to examine normal distribution and a Levine test was conducted to assess variance homogeneity. Since normal distribution were not detected in several cases, a Mann Whitney test was conducted to test for mean difference of Group A and B. This indicated no significant difference between both groups ($W = 73.5$, $p = .954$).

This resulted in two sets of 12 pictures (5 computer made, 7 human made) which were balanced for "guessability" across the relatively easier and more difficult extremes. Artworks split by set are seen in Table 1.

Table 1
Stimuli Set with Human and Computer Pictures split by Set

Set 1			Set 2		
Picture Name	*Picture*	*Intended Emotion*	*Picture Name*	*Picture*	*Intended Emotion*
Human Picture 1		Intentions Chills Confused	Human Picture 8		Distracted confused
Human Picture 2		Disappointed angry	Human Picture 9		sad
Human Picture 3		Happy Free Self aware	Human Picture 10		Stimulated Focused Free Harmony

Human Picture 4		
Human Picture 5		Over-whelmed
Human Picture 6		Fear/scared
Human Picture 7		
Computer Picture 1		
Computer Picture 2		
Computer Picture 3		
Computer Picture 4		
Computer Picture 5		
Human Picture 11		Angry Confused Anxiety Over-whelmed
Human Picture 12		Fear/scared
Human Picture 13		Happy Harmony
Human Picture 14		Stimulated Amused Distracted
Computer Picture 6		
Computer Picture 7		
Computer Picture 8		
Computer Picture 9		
Computer Picture 10		

Procedure of the Main Study

The main study consisted of three blocks. These were presented using the same online Qualtrics platform as the prestudy. Distribution was via an anonymous link. In the first two blocks, participants had to evaluate the art, report their emotions and report their general feelings towards the art. In the third block participants were asked to decide for each of the 24 artworks if they believed the artworks looked more human or more computer made.

The first screen of the study welcomed the participant, thanked them for taking part, and introduced the background of the study. Participants were told that in recent years, computers are making art that looks like artists' work, and vice versa, artists have been making art that looks like it is computer generated, but which does have careful aesthetic decisions and even desired emotions that they may have wanted to transmit. Participants were then informed that they would be shown a selected group of such artworks, which looked highly similar but were however made either by a computer or a human artist. Participants would then be asked to view the art and to report on their experience and understanding of the intentionality behind the artworks.

When participants clicked to continue a disclaimer was shown to them, asking if they agreed to participate and to have their data recorded as well as used for research purposes. This was followed by three demographic questions about age, gender and highest education. Hereafter, the first block of the main study started, with a second introduction explaining to participants again the origin of the pictures (human artist vs. computer made), the procedure of the study and following instruction: "*We would like you to take a look at the artwork for as long as you like. While looking, please pay special attention to how you feel.", "Please try to answer as truthfully as possible, there is no right or wrong."*. All text was provided in both English and German.

First and Second Block

The first two blocks of the main study used a 2x2 design. The artwork Sets 1 and 2 (as grouped in the prestudy above) were shown to participants in two blocks, preceded by a label that all of the following artworks were either made by a human or computer *("The following artworks were made by a computer/human."*). Upon viewing the images of one set and providing ratings (see below), participants then viewed the remaining artwork set, with the opposite label. To minimize order/grouping effects, the order of the groups and the labels was counterbalanced between participants, resulting in four conditions.

Within each block, following the descriptive making-provenance text, each image was shown individually, centred on the screen. In Qualtrics (2005) pictures were programmed to be pinned on top of the page, while below questions on the pictures were presented. The questions were similar to the questionnaire filled out by the artists from Pelowski et al. (2018).

Firstly, they were asked to evaluate the art (*"How would you evaluate the art?")* while viewing the art with 14 bipolar adjectives on a 7-likert-scales (e.g., "very beautiful" "neither" "very ugly"). Secondly, they were asked to report on a 7-likert-scale (1-7), with 1 symbolizing "not at all" 2-7 symbolizing increasing intensity ending with 7 "extremely", how much they felt 24 different emotions or no emotions at all when looking at the artwork above *("Please try to think about your general feeling(s) while looking at the art: How did you feel while viewing the art? Please mark them on the scale "Not at all - extremely")*. With the same list of 24 adjectives, they were asked whether and if yes, which of the 24 emotions the artist intended to transmit in this artwork *(„If there are any of the below feelings that you think the artist particularly wanted to make you feel, please mark them under "Artists Intention", by clicking the box."*). These instructions were given under both primes (*computer/human*), to ensure the coherence between both prime conditions and the neutrality within the question, since the relevant distinction was previously set through the prime. We wanted to leave the following evaluation of the artwork primarily to its effect and not to suggestively cause a further distinction here.

Choosing multiple emotions was possible. To make sure people did not forget to choose an intention rather than deciding for no intention, a small checkbox beneath the list of the 24 emotions stated – the artists had no intended emotions. Lastly, they were asked to report their general feelings ("*In general I felt...*") ((emotionally)aroused, positive emotion, negative emotions) on a 7-likert-scale (1-7) from 1 "not at all" to 7 "extremly" with 2-7 symbolizing an increasing extend of the feeling. Order of images in each block was randomized between participants.

Third Block

Finally, the third Block consisted of all 24 stimuli presented in random order. Participants were told that they would see a mixture of computer and human made artworks. They were asked to decide how much they thought the artworks were computer or human made. Each picture was presented with a bipolar slider beneath the picture from *human* to *computer* and participants were asked: "*On the scale below, how much do you think this artwork is human or computer made*?". After the third block participants were thanked for their time and information contact information was given for further questions or complaints.

In total all the study took between 1 h and 1.5 h, since participants were allowed to take breaks exact duration could not be determined.

Analysis of the Data

Data was analysed using Excel (Microsoft Corporation, 2018), SPSS (IBM Corp., 2015) and R-Studios (R-Studio Team, 2020). In cases where normal distribution requirements were violated non-parametric methods were used for correlations. For the calculation of ANOVA the assumptions of dependence of the data, an at least interval scaled independent variable, a normally scaled inner subject factor, the normal distribution of the dependent variable, no outliners in the groups and variance homogeneity were considered and tested for. Dependence of the data was given in all cases since data within participants was compared. The assumption for normally scaled inner subject factors was given through the categorical character of the factors. In some cases in Likert scale sums were used, which are argued to be interval scaled (e.g. Carifio & Perla, 2007). Additionally ANOVA has been suggested to be robust for ordinal data (Carifio & Perla, 2007; Norman, 2010) and was therefore treated as if interval scaled in cases were single item responses were analysed. Similar is true for the normal distribution assumption, where it has been argued that ANOVA is robust against violations of normal distribution. (Blanca et al., 2017; Carifio & Perla, 2007; Harwell et al., 1992; Norman, 2010). Nevertheless, normal distributions were reported, but data was treated as normal distributed for analysis with ANOVA. Data was tested for outliners and homogeneity of variances. For paired t-tests data was examined for assumptions – dependence of the data, interval scaled dependent variable, nominal scaled independent variable, outliners, normality of data. The significance level was set at 0.05 as a general guideline for reporting analyses. For analysis of the second question on reported feelings.

Results

The following results are split into pre- and main study. The results of the main study are further split into the viewers perspective and the viewer artist interaction. The viewers perspective concentrated on the reported art experience of the viewer to answer our first research question as well as explorative analysis of viewer based data: Do people report emotions when viewing artworks made or labelled as made by a computer? Do people perceive intentions when artworks were made or labelled as made by a computer? How do people evaluate artworks made by a computer versus made by human and how is this influenced by the prime? Can people detect human made art and does this influence their art evaluation and experience?

The viewer artist interaction focused solely on the human artworks and compared the viewers` with the artists` experience to investigate the second research question on emotion transmission through the artwork: Can people correctly identify emotions as intended by the artist? Does spontaneous emotion sharing occur while making and viewing artworks? Do people feel the emotions as intended by the artist more than those not intended?

Pre-Study

To investigate the guessability of the data set, we looked at the overall correctly identified pictures and found that 66.67% of participants identified over half of the pictures correctly as human respectively computer made. While only two human pictures (*Human Picture* 7 = 62.16% and *Human Picture* 12 = 59.46%) were identified above chance (58.34%) all computer pictures were identified above chance (41.67%).

A sensitivity index (*d'*), as used in the signal detection theory (e.g. Richards & Thornton, 1970; Stanislaw et al., 1999), was calculated for each participant over all artworks. The *d'* is calculated with the *z* transformed relative frequency of correct hits and false alarms (Richards & Thornton, 1970; Stanislaw et al., 1999). For the present study correctly identified human pictures were counted as hits (H), human pictures identified as computer pictures as misses (M), correctly identified computer pictures as correct rejections (CR) and computer pictures identified as human pictures as false alarms (F).

The log linear rule was used to correct values of 0 and 1 for H or F. The log linear rule is one of two widely used methods to control for extreme proportions (0 and 1), which is necessary since, when *z* transformed the extreme proportions take an infinite value (Hautus, 1995). The log linear method is less biased than the other widely used method - the 1/(2N) rule - and has a more consistent performance as well as it treats all data equal (Hautus, 1995). In order to perform the log linear correction 0.5 is added to every value of the performance data, leading to an increase by one of total column and row value. (Hautus,1995). A *d'* value greater one indicates a systematic detection, a *d'* value around zero indicated a random answer scheme, a *d'* smaller minus one indicates a systematic detection in the wrong direction (Stanislaw et al., 1999). A one sample t-test against chance (0) was conducted and showed a significant pattern detection for most people ($t(30) = 2.538$, $p = 0.017$, 95% CI[0.12,1.15] $M_{difference} = .63$, $SD = 1.37$). In total, 53.33% of participants showed systematic detection, with a *d'* greater one.

Main Study

Did People report Emotions for Computer Pictures and is this Dependent on the Prime?

To investigate our first research question: *if someone believes or is told that an art-work is human generated (even though it is computer generated), do they report emotions or perceive intentions during their experience?,* we looked at the reported feelings for each prime and picture over both groups and for each group separately.

Figure 2 shows the average feelings over all participants for *Human Picture/Human Prime* (*M* = 2.16, *SD* = 1.62) *Human Picture/Computer Prime* (*M* = 2.13, *SD* = 1.53) *Computer Picture/Human Prime* (*M* = 1.97, *SD* = 1.5) and *Computer Picture/Computer Prime* (*M* = 1.91, *SD* = 1.31). The dots represent the mean reported feelings for each picture, bars the mean feelings over all participants and pictures. Error bars represent the standard deviation. In all four conditions emotions were reported. Reported mean emotions were higher in human than in computer pictures. When looking at both groups separately, as seen in Figure 2 on the right side, Group B had slightly higher reported feelings in all four conditions. In Group A mean reported feelings in the *Computer Picture/Human Prime* condition were higher than in the *Computer Picture/Computer Prime* condition, while this was the other way around in Group B with marginally higher reported felt emotions in the *Computer Picture/Computer Prime* than in the *Computer Pictures/Human Prime* condition.

Mean reported feelings split by Human and Computer Pictures under both Primes

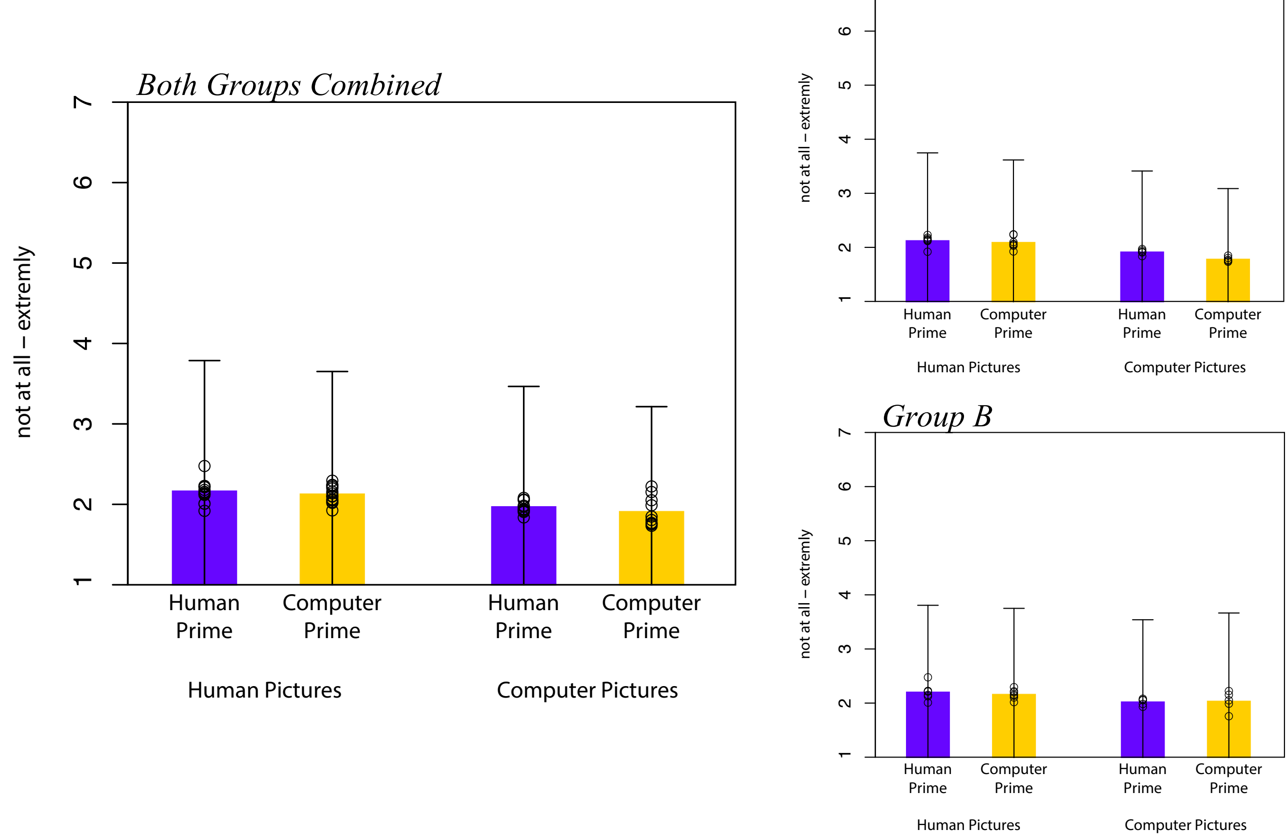


Figure 2. Left: Mean reported feeling for both groups combined split by picture type and prime. Top right: Mean reported feeling for Group A split by picture type and prime. Bottom right: Mean reported feeling for Group B split by picture type and prime

We compared mean values over both groups (A and B) and tested for a main effect for feelings of prime and picture within subjects between all conditions *Human Picture/Human Prime*, *Human Picture/Computer Prime*, *Computer Picture/Human Prime* and *Computer Picture/Computer Prime* with a two-way repeated measures ANOVA. One participant had to be excluded from the calculation due to missing values as result of a problem from data retraction from Qualtrics. Data for in both groups was not normal distributed. We found a main effect for picture (F (1,46) = 19.662, p < .001, $p\eta^2$= .299), with picture explaining 29.90% of the variance, but not for prime (F (1,46) = 1.159, p > .001, $p\eta^2$= .025) or prime-picture interaction (F (1,46) = .271, p > .001, $p\eta^2$= .006). To further support these findings a log-linear model was conducted. Type of picture (human/computer) significantly predicted the average reported feelings, b = 0.31, t(262) = 5.75, p < .001, while prime did not significantly, b = -3.19, t(262) = -1.46, p = .15. This was in line with the findings of the ANOVA.

Do People Perceive Intended Emotions in Computer Artworks?

A total of 408 intentions were reported in computer pictures, 1064 intentions in human pictures (Group A: 707; Group B: 357). Since the number of computer and human made pictures varied, the sum of all intentions for each picture type was formed and divided by the respective number of pictures of the picture type to obtain a normalized and thus comparable value. Results can be seen in Figure 3. The results showed more reported intentions in human pictures (human prime: $M = 45.071$; computer prime: $M = 30.929$; total human pictures $M = 76$) than in computer pictures (human prime: $M = 26.3$; computer prime: $M = 14.5$; total computer pictures: $M = 40{,}8$). For picture types (human/computer) we found a higher number of reported intentions for the human prime compared to the computer prime.

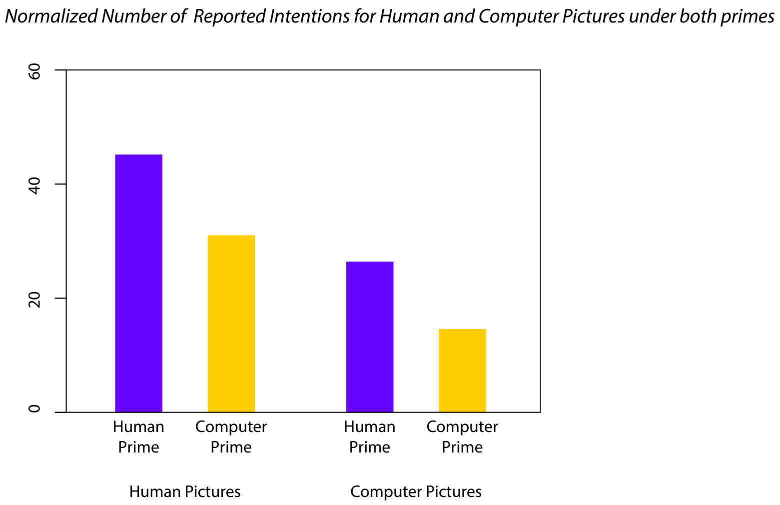


Figure 3. Normalised number of total reported intentions split by human and computer pictures under both primes.

Differences in Reported Emotions

To evaluate the degree of interpersonal differences, we looked at reported emotions for each picture average over all participants for each of the 4 conditions of *Human Picture/Human Prime*, *Human Picture/Computer Prime*, *Computer Picture/Human Prime* and *Computer Picture/Computer Prime*. Results can be seen in Figure 4. The graph highlights the interpersonal difference in emotion reporting between participants, showing that some participants in general reported more feelings than others regardless of picture type and prime. For the analysis of felt emotions the list of 24 emotions was used, while the last answer option "no emotions" was treated separately.

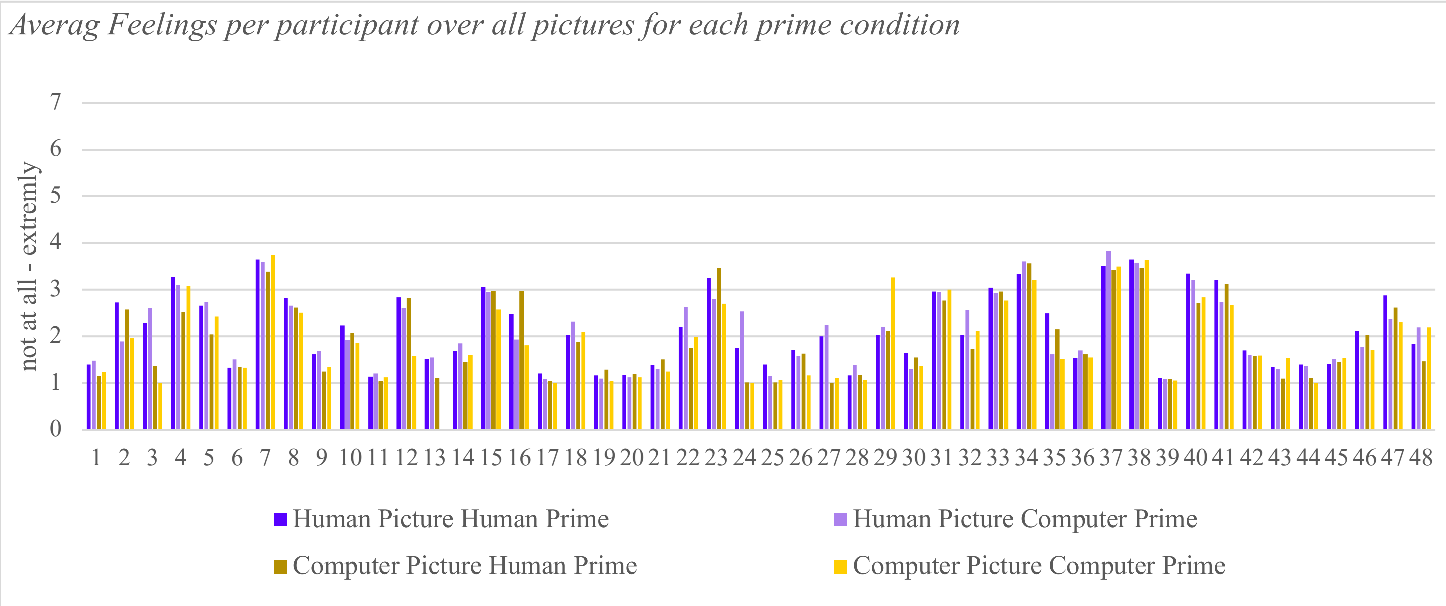


Figure 4. Average feelings for each participant separately over all pictures split by prime and picture type.

Explorative Analysis of Mean Feeling and Emotional Arousal Relation

A correlation between mean emotional feelings and the mean general emotions (emotional arousal, positive and negative emotions) was calculated to check if they correlated positively and if so, to use emotional arousal as indicator for reported feelings. Due to the variety of possible emotions to choose from (24 different emotions), and additional counteracting emotions among the list of emotions, small values for the mean of the reported emotions were to be expected. This also led to a left skewed distribution of reported feelings. A Kendall tau correlation was conducted and showed a significant positive correlation for mean emotional arousal and mean reported feelings over all pictures and primes ($r = .506$, $n = 48$, $p = .000$). This was also true, albeit with a smaller effect size, for mean positive ($r = .462$, $n = 48$, $p = .000$) and mean negative emotions ($r = .295$, $n = 48$, $p = .003$), supporting the use of all general emotions as indicator for mean feelings (Table 2). Thus, for further analysis emotional arousal was used as indicator for mean feelings.[1] To investigate if the answer "no emotions" was a valid indictor for no felt emotions by the participants we correlated no emotions with mean feelings overall conditions and for each condition separately but found no correlation. Therefore, we did not use the answers for "no emotion" for further analysis.

[1] Correlations of feeling and all general emotions split for the four conditions: human picture human prime, human picture computer prime, computer picture human prime and computer picture computer prime are attached to the annex (Table 8.Table 11) Since the four groups are compared in the following, the calculation was conducted to ensure that the results are also valid in all 4 conditions separately.

Table 2

Correlation Between Mean Feelings and General Emotion Overall Prime and Pictures

	Overall mean feelings	Overall mean emotional arousal	Overall positive emotions	Overall negative emotion
Overall mean feelings	-			
Overall mean emotional arousal	.506**	-		
Overall positive emotions	.462**	.722**	-	
Overall negative emotion	.295**	.340**	.256*	-

**$p < .01$.
*$p < .05$

Reported Emotional Arousal

Figure 5 shows mean emotional arousal for each prime and picture over both groups: *Human Picture Human Prime* (M = 3.182, SD = 1.773) *Human Picture/Computer Prime* (M = 3.131, SD = 1.684) *Computer Pictures/Human Prime* (M = 2.446, SD = 1.616) and *Computer Pictures Computer Prime* (M = 3.329, SD = 1.631). Dots represent the mean reported emotional arousal for each picture, bars the mean over all participants and pictures. The error bars represent the standard deviation. In all conditions emotional arousal was reported with higher means for human pictures than for computer pictures. When looking at both groups separately, results were similar for Group A and B.

Mean reported emotional arousal split by Human and Computer Pictures under both Primes

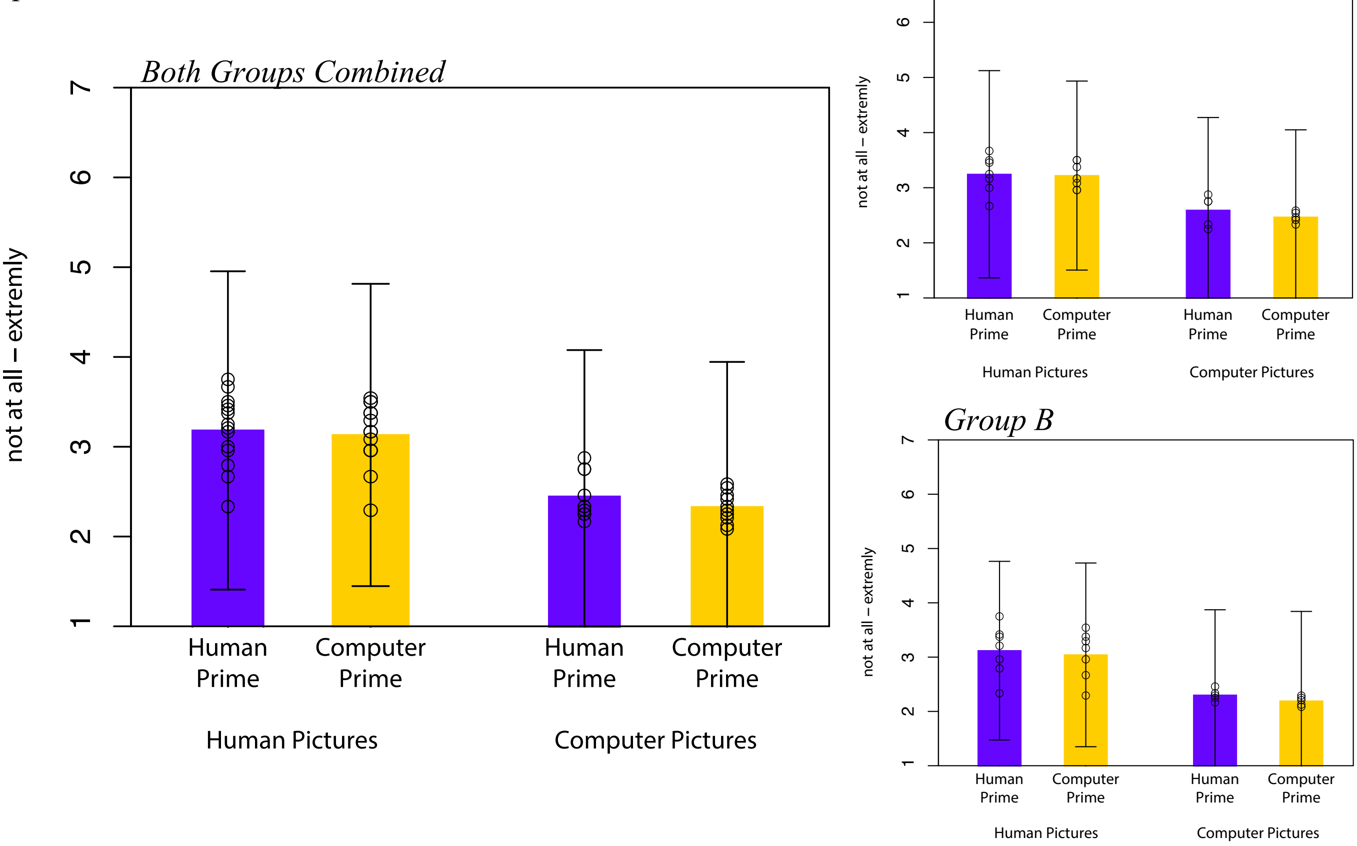


Figure 5. Left: Mean reported emotional arousal for both groups combined split by picture type and prime. Top right: Mean reported emotional arousal for Group A split by picture type and prime. Bottom right: Mean reported emotional arousal for Group B split by picture type and prime

Again, we compared means and tested for a main effect on emotional arousal of prime and picture within subjects between all conditions *(Human Picture/Human Prime*, *Human Picture/Computer Prime*, *Computer Picture/Human Prime* and *Computer Picture/Computer Prime).* In order to achieve this, we conducted a two-way repeated measures ANOVA. Data was not normal distributed for either group. We found, similar to the results of *Feeling*, a main effect for picture (F (1,47) = 38.712, p < .001, $p\eta^2$= .452), with picture explaining 40.80% of the variance, but not for prime (F (1,47) = 1.136, p > .001, $p\eta^2$= .024) or prime picture interaction (F (1,47) = .273, p > .001, $p\eta^2$= .006). Thus, regardless of the prime participants reported higher emotional arousal when pictures were made compared to computer-generated pictures.

Evaluation of the Artworks

Figure 6 shows mean evaluation for each prime and picture over both groups: *Human Picture/Human Prime* (*M* = 3.71, *SD* = 1.38) *Human Picture/Computer Prime* (*M* = 3.73, *SD* = 1.36) *Computer Pictures/Human Prime* (*M* = 4.28, *SD* = 1.36) and *Computer Pictures/Computer Prime* (*M* = 4.37, *SD* = 1.33). Over all participants, computer pictures were evaluated higher than human pictures in both Groups A and B. The response type of the question was bipolar with opposing emotions on both sides of the scale (e.g. 1=good, 7=bad). Therefore, a mean close to four implies a less emotional evaluation of the picture, a mean greater than four implies negative evaluation and a mean smaller four a positive evaluation. When looking at both Groups separately findings were similar in both Groups.

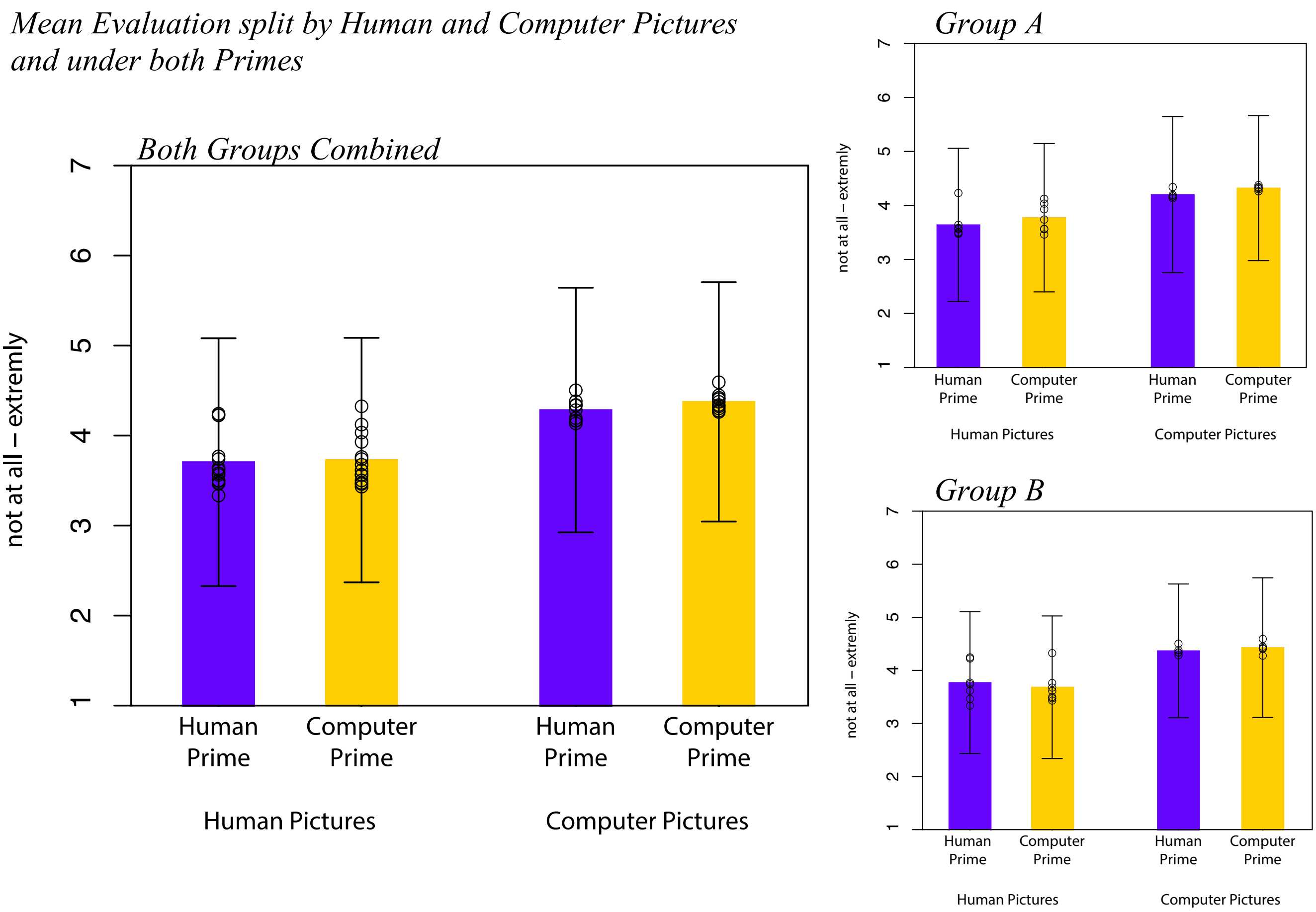


Figure 6. Left: Mean evaluations for both groups combined split by picture type and prime. Top right: Mean evaluations for Group A split by picture type and prime. Bottom right: Mean evaluations for Group B split by picture type and prime.

To investigate if prime, picture or prime*picture interaction were critical factors for the magnitude of evaluation, we tested for a main effect within subjects on the evaluation of the artwork of prime and picture with a two-way repeated measures ANOVA. The within subject factor was average evaluation for *Human Picture/Human Prime*, *Human Picture/Computer Prime*, *Computer Picture/Human Prime* and *Computer Picture/Computer Prime*. Data was not normal distributed for either group. We did not find any effect for prime (F (1,46) = 1.352, p > .001, $p\eta^2$= .029) and prime picture interaction (F (1,46) = 1.271, p > .001, $p\eta^2$= .027) but for picture (F (1,46) = 40.859, p < .001, $p\eta^2$= .470), with 47% of the variance explained by the factor *picture*. There was a higher mean for computer pictures (M = 4.303; SD = .101, CI 95% [4.099-4.506]), than for human pictures (M = 3.714; SD =.075, CI 95% [3.563-3.864]), which describes a more positive evaluation for human than computer pictures.

For further analysis the evaluation of the picture as good was used as an indicator of liking and was looked at separately for each condition. While the concept of liking cannot always be equated with evaluating art as good, the terms *evaluating something as good and liking* are also used as synonyms (in German "etwas gut finden", "etwas mögen") (Woxikon.de, 2021; korrekturen.de, 2021; thesaurus.yourdictionary.com, 2020). So, in the following we refer to liking when talking about the answer good of the first question *("How would you evaluate the art"*).

Distinguishing Human and Computer Pictures

We compared how often participants reported pictures to be human made under human, computer and no prime condition. The percentage of pictures that were reported to be human made was calculated for both primes and the prestudy (no prime) for both picture sets. the Results can be seen in Figure 7 and Figure 8. Overall, more participants reported a given picture to be human made in the actual human pictures than in the computer pictures. When looking at the prime we can see that in all seven human pictures of Set 1 a higher percentage of participants indeed reported these pictures to be human made under a human prime condition (Group B) compared to the computer prime condition (Group A). In the no prime condition, three of the seven pictures were categorized as human made less frequently than in the human prime and more frequently than in the computer prime in percentage terms. Two of the remaining four pictures, were categorized as human made in percentage terms more frequently than both prime conditions and the other two less frequently. The highest percentage of human made reports were found in *Humen Picture* 2 (95.83%) for the human prime condition. *Human Picture* 1 (62.5%) and *Human Picture* 5 (62.5%) showed the highest percentage for the computer prime condition. In Set 2, in six out of seven pictures a higher percentage of participants said the pictures were human made under a human prime condition than under the computer prime condition. The highest percentage of human guesses in the human prime condition (Group A) was found for *Human Picture 12* (87.5%) and in the computer prime condition for *Computer Picture 6* (62.5%). In the no prime condition percentage of participants reporting pictures as human made was for six out of seven human pictures higher compared to the computer condition. In two of the seven pictures a higher percentage of participants in the prestudy reported pictures to be human made compared to the human prime condition.

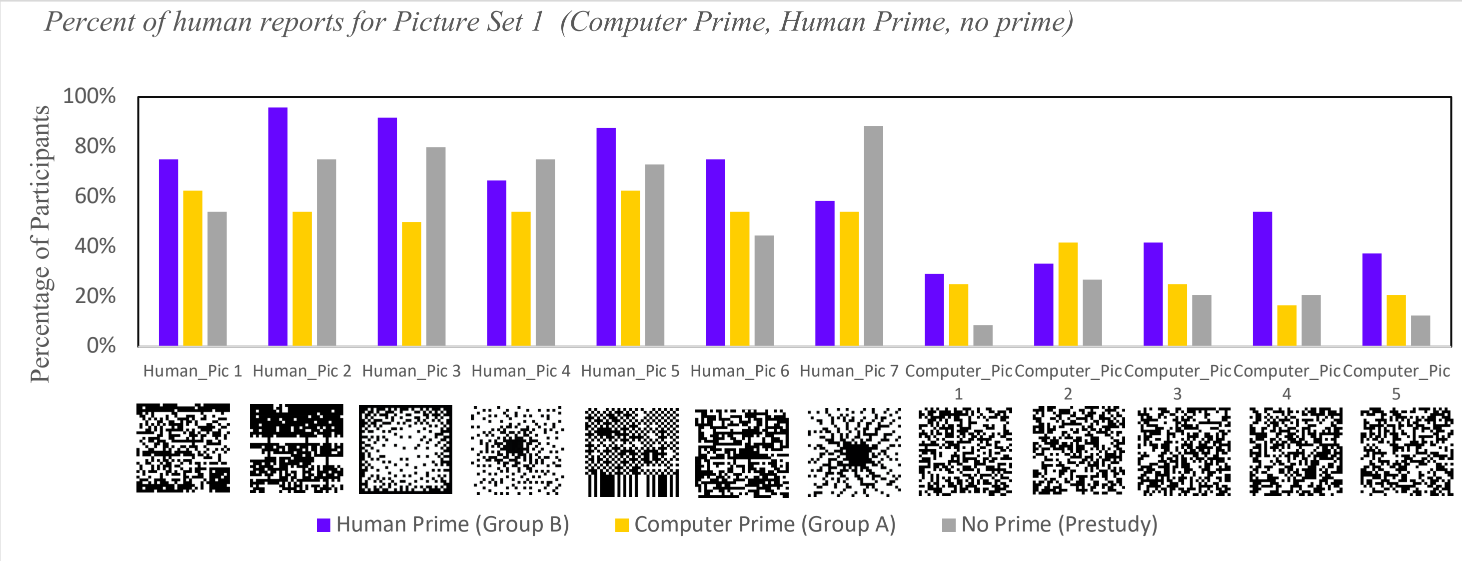


Figure 7. Percentage of participants that reported the pictures to be human made for each picture of picture Set 2 separately for human prime, computer prime and no prime conditions

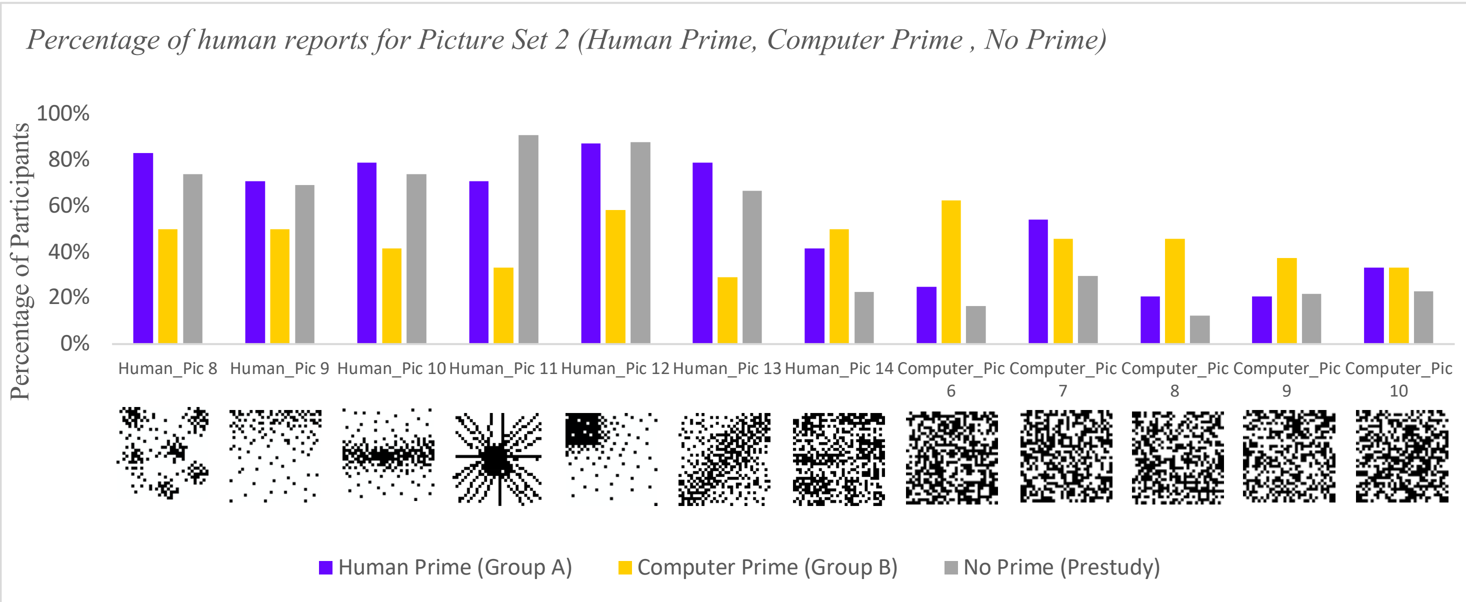


Figure 8. Percentage of participants that reported the pictures to be human made for each picture of picture Set 2 separately for human prime, computer prime and no prime conditions

How Good were Participants at Guessing the Correct Picture Type?

Figure 9 shows the total number of correct hits per participant with the red line representing chance. Over half of the participants (68.75%) were better than chance in guessing the right picture type (human made/computer made).

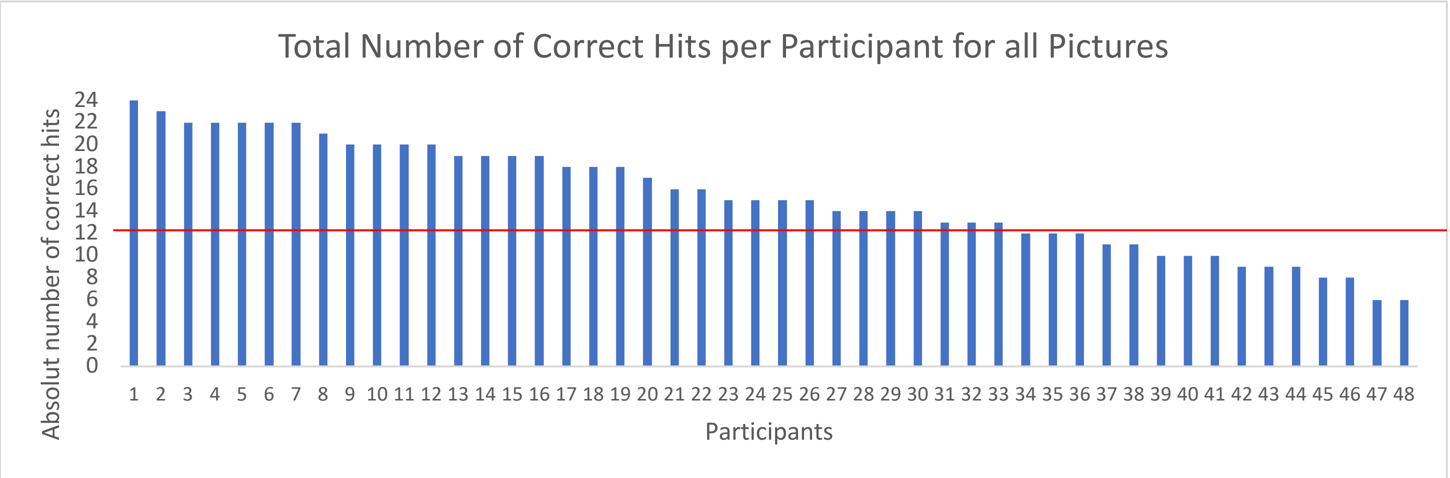


Figure 9: Total number of correct hits per participant over all pictures. The bars represent the absolut number of correct hits per participants, while the red line symbolizes the threshold of correctly guessed by chance.

In order determine if there was a difference between the two groups and picture types in participants' ability to identify the correct picture type, we looked at both groups and primes separately. Participants in Group A were better at guessing both picture types correctly, with 62% of the human pictures correctly and 49.14% of the computer pictures, while in Group B, 56.61% of human pictures and 37.04% of the computer pictures were guessed correctly (Figure 10).

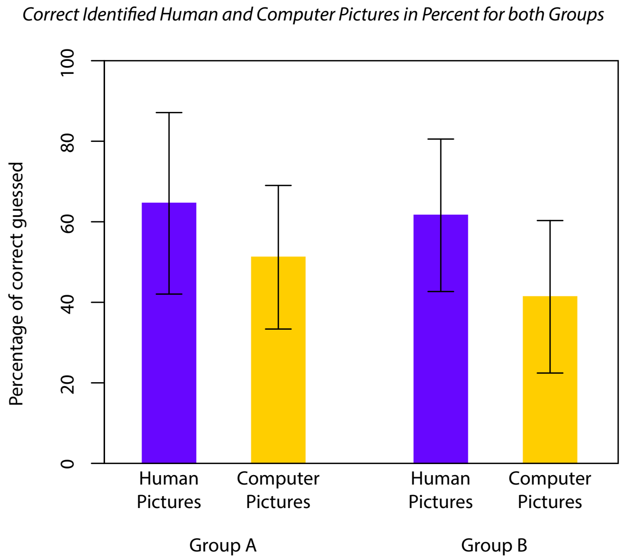


Figure 10. *Percentage of correct identified Human and computer pictures split by Group A and Group B. Error bars represent the standard deviation.*

To investigate whether the differences between prime and groups were significant, a repeated measures ANOVA was conducted. Picture type was the within-subject factor and group was the between-subject factor. We found a significant effect for picture (F (1, 46) =37.09, p = .000) but not for group (F (1, 46) = 1.614, p = .221). There was a significant difference between the human and computer pictures within each group but no difference between the groups. As in the pre-study, the *d'* sensitivity index (Richards & Thornton, 1970) was calculated as an indicator of people's ability to distinguish between both picture types. Hereby correctly identified human pictures were understood as correct hits, human pictures identified as computer pictures as misses, computer pictures identified as human pictures as false alarms and computer pictures correctly identified as correct rejection. A *d'* value greater one indicates a systematic detection, a *d'* value around zero indicated a random answer scheme, a *d'* smaller minus one indicates a systematic detection in the wrong direction (Stanislaw et al., 1999). Figure 11 shows participants' *d'*, with 39.58% (19) participants showing a systematic detection (*d'* > 1).

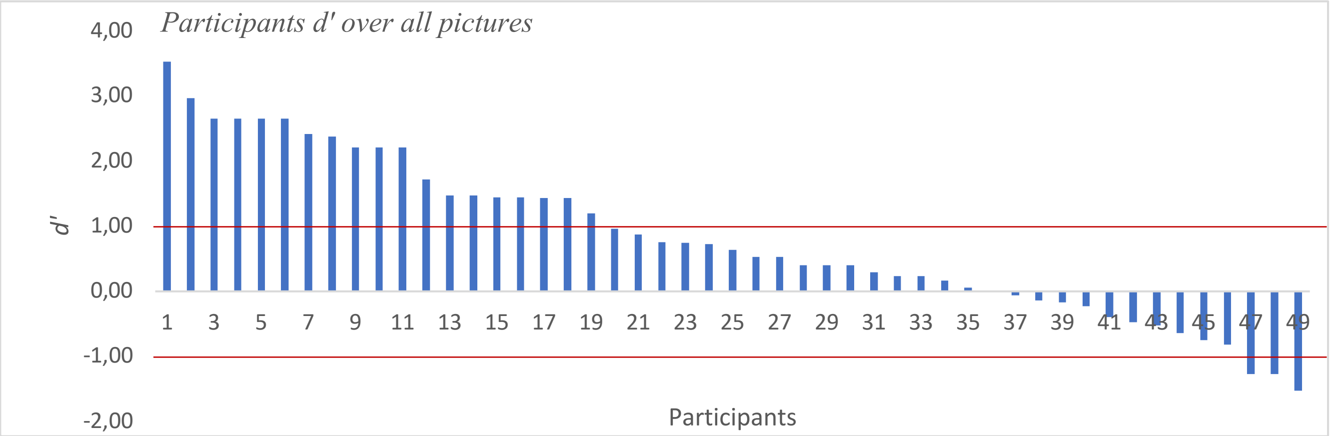


Figure 11: d' sensitivity score in descending order. The bars represent the d' for each participant descending order. A d' > 1 indicates a systematic detection, represented by the upper read line (x=1). A d'< 1 indicates a systematic detection in the wrong direction, represented by the lower red line (x=-1). A d' = 0 indicates no systematic detection (y-axis).

The median of *d'* was at 0 with a mean of *M* =.812. We conducted a one sample t-test again 0 to examine if the d' sensitivity scores are at chance level. The t-test was significant (t (48) = 4.60, p = 0.000, 95% *CI*[0.458,1.168] $M_{difference}$ = .813, *SD* = 0.355))

To assess whether people reported more emotions in the first two blocks for human pictures, if they were also better at guessing human pictures in the third block a Kendall tau-b correlation between the d' sensitivity index and all general emotions (emotional arousal, positive emotions, negative emotions) was conducted. In a first step, values for both picture types and primes were combined . In a second step picture types and primes were looked at separately. There were no significant correlations between emotional arousal, positive emotions, negative emotions and peoples *d'* sensitivity index over all pictures and primes combined (see Table 3). However, when looking at the conditions separately correlations were found for both human pictures conditions. In the *Human Picture/Human Prime* condition, a positive correlation was found for *d'* and positive mean positive emotions (r = .283, n = 48, p = .005), as well as a negative correlation between mean negative emotions and *d'* (r = -.217, n = 48, p = .034). In the *Human Picture/Human Prime* condition a positive correlation was found for positive emotions and *d'* (r = 223, n = 48, p = .028). Results can be seen in Table 4 - Table 7.

Is There a Connection Between General Emotions and Liking of an picture?

To investigate this question, we calculated Kendall tau correlation coefficient for all conditions and each condition separately between all general emotions and liking over all participants. Results are shown in Table 3 - Table 7 for Kendall tau correlations for all general emotions, liking of the picture and the *d'* sensitivity score over all four conditions. The *d'* sensitivity score is discussed later in the text (see Block 3). Over all conditions, we found a significant negative correlation for mean liking and overall mean emotional arousal (*r* = -.243, *n* = 48, *p* = .015) as well as overall mean positive emotions (*r* = -.297, *n* = 48, *p* = .003). A negative correlation indicates that the higher mean liking the higher the emotional arousal respectively the positive emotions, since the liking scale was bipolar (with "*how would you evaluate the art*" 1 = good and 7 = bad). In the next paragraph we look at each condition separately.

Table 3

Correlation of General Emotions, Liking, and d' Overall Prime and Pictures

	Overall emotional arousal	Overall positive emotions	Overall negative emotions	Overall liking	Overall d' sensitivity score
Overall emotional arousal	-				
Overall positive emotions	.722**	-			
Overall negative emotions	.340**	.256*	-		
Overall liking	-.243*	-.297**	.188	-	
Overall d' sensitivity score	.081	.146	-.190	-.203*	-

**$p < .01$.
*$p < .05$

For the *Human Picture/Human Prime* condition, there was a significant correlation between liking and all three general emotions. While mean emotional arousal (*r* = -.309, *n* = 48, *p* = .003) and mean positive emotions (*r* = -.389, *n* = 48, *p* = .000) had a negative correlation with liking, mean negative emotions was positively correlated with liking (*r* = .235, *n* = 48, *p* = .023) (Table 4). Thus, the higher mean emotional arousal respectively positive emotions were, the more they liked the picture, and the higher reported mean negative emotions were, the less they liked the picture. The effect was highest for positive emotions.

Table 4.

Correlation of General Emotions, Liking, and d' Human Picture/Human Prime

	Emotional arousal for human picture human prime	Positive emotions for human picture human prime	Negative emotions for human picture human prime	Liking for human picture human prime	d' for human picture human prime
Emotional arousal for human picture human prime	-				
Positive emotions for human picture human prime	.682**	-			
Negative emotions for human picture human prime	.217*	.092	-		
Liking for human picture human prime	-.309**	-.389**	.235*	-	
d' for human picture human prime	.176	.283**	-.217*	-.183	-

$^{**}p < .01.$
$^{*}p < .05$

For the *Human Picture/Computer Prime* condition, a significant correlation between liking and emotional arousal, as well as positive emotions but not for negative emotions was found. Both, mean emotional arousal (r = -.337, n = 48, p = .001) and mean positive emotions (r = -.369, n = 48, p = .000) had a negative correlation with liking. Mean negative emotions was not significantly positively correlated with liking (Table 5). So, the higher mean emotional arousal respectively positive emotions were the more they liked the picture and the higher reported mean negative emotions were the less they liked the picture.

Table 5.

Correlation of General Emotions, Liking, and d' for Human Picture/Computer Prime

	Emotional arousal for human picture computer prime	Positive emotions for human picture computer prime	Negative emotions for human picture computer prime	Liking for human picture computer prime	d' for human picture computer prime
Emotional arousal for human picture computer prime	-				
Positive emotions for human picture computer prime	.670**	-			
Negative emotions for human picture computer prime	.280**	.191	-		
Liking for human picture computer prime	-.337**	-.369**	.131	-	
d' for human picture computer prime	.180	.223*	-.083	-.292**	-

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

For the *Computer Picture/Human Prime* condition, a significant correlation between liking and emotional arousal, as well as positive emotions but not for negative emotions was found. Both, mean emotional arousal (r = -.265, n = 48, p = .016) and mean positive emotions (r = -.376, n = 48, p = .001), had a negative correlation with mean liking (Table 6). Thus, the higher emotional arousal respectively positive emotions were, the higher was the reported liking. The effect was greater for positive emotions than for emotional arousal.

Table 6.

Correlation of General Emotions, Liking, and d' for Computer Picture/Human Prime

	Emotional arousal for computer picture human prime	Positive emotions for computer picture human prime	Negative emotions for computer picture human prime	Liking for computer picture human prime	d' for computer picture human prime
Emotional arousal for computer picture human prime	-				
Positive emotions for computer picture human prime	.714**	-			
Negative emotions for computer picture human prime	.423**	.288**	-		
Liking for computer picture human prime	-.265*	-.376**	.122	-	
d' for computer picture human prime	-.036	-.012	-.177	.033	-

**$p < .01$.
*$p < .05$

For the *Computer Picture/Computer Prime* condition, a significant correlation for liking and negative emotions (r = .258, n = 48, p = .019), but not for emotional arousal or positive emotions was found. The found significant correlation was positive, thus, the higher participants mean negative emotions were the less participants liked the pictures (Table 7).

Table 7.

Correlation of General Emotions, Liking, and d' for Computer Picture/Computer Prime

	Emotional arousal for computer picture computer prime	Positive emotions for computer picture computer prime	Negative emotions for computer picture computer prime	Liking for computer picture computer prime	d' for computer picture computer prime
Emotional arousal for computer picture computer prime	-				
Positive emotions for computer picture computer prime	.772**	-			
Negative emotions for computer picture computer prime	.471**	.313**	-		
Liking for computer picture computer prime	-.040	-.193	.258*	-	
d' for computer picture computer prime	-.061	.011	-.116	-.067	-

**$p < .01$.
*$p < .05$

In an exploratory manner we examined the relation between participants ability to guess the right picture type and their mean liking of the picture over all conditions and for each condition separately. There was a significant negative correlation between overall mean liking and peoples d' sensitivity score (r = -.203, n = 48, p = .0.43). When looking at the conditions separately we found a negative correlation in the *Human Picture Computer Prime* condition, between liking the pictures and d' sensitivity score (r = -.292, n = 48, p = .004) but for none of the other conditions (in Table 4 - Table 7).

Interaction Between Artist and Viewer – Emotion Transmission in the Artworks

In the following section the second research question is approached, which addresses a possible emotional connection between artist and viewer. Therefore, emotional sharing between viewer and artist, and the understanding as well as the feeling of emotions as intended by the artist was assessed.

Was there a shared emotional experience between participants while viewing the art and the artist while making the art? Figure 19 - Figure 22 in the appendix show the 25 emotions averaged over all participants split by prime and the emotions felt by the artist for all pictures of Set 1 respective Set 2. (Since the last 5 pictures of each set are computer made, there are only two lines). Emotions intended by the artist are underlined. There was no systematic difference in mean emotions visible between the two prime conditions.

To test for statistical significance a Kendall tau correlation was conducted between the mean reported emotions over all participants while viewing the art and reported emotions by the artist while making the art, for each picture. Results can be seen in Figure 12. (see also Figure 12 and Table 13 in the appendix for full report of correlations). In picture Set 1, a significant positive correlation was found between artists reported emotion while making the art and participants reported emotion while viewing the art for *Human Picture* 3, 4 and 7. Highest significant correlation was found for *Human Picture* 7 (r = .507, n = 23, p = .003) followed by *Human Picture* 3 (r = .448, n = 24, p = .005) and *Human Picture* 4 (r = .397, n = 24, p = .012) with the lowest significant correlation.

In picture Set 2, a significant positive correlation was found for *Human Picture* 8, 9, 11 and 14. Here the greatest correlation was found for *Human Picture* 14 (r = .584, n = 24, p = .000), followed by *Human Picture* 9 (r = .497, n = 24, p = .004), *Human Picture* 11 (r = .376, n = 24, p = .015) and *Human Picture* 8 (r = .343, n = 24, p = .029).

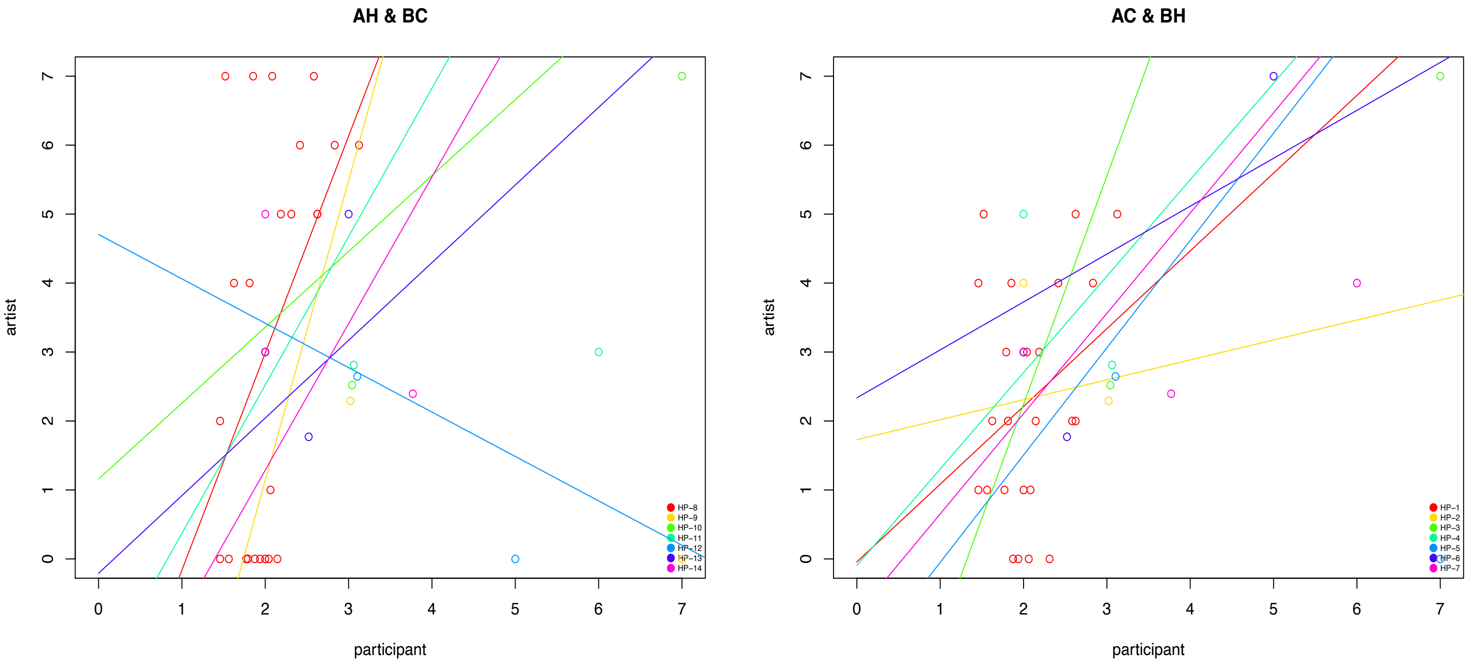


Figure 12. Left: Correlation between the mean reported emotions over all participants while viewing the art and reported emotions by the artist while making the art for pictures in Set 1. Right: Correlation between the mean reported emotions over all participants while viewing the art and reported emotions by the artist while making the art for pictures in Set 2.

We then considered the shared emotions for computer prime and human prime separately. We found significant correlations in five pictures that overlapped for both primes. However, under the human prime, two additional pictures were found with significant positive correlation for shared emotions of the viewer and the artist. For the pictures shown under human prime significant correlations were found in *Human Picture 3* (r = .448, n = 24, p = .005), *Human Picture* 4 (r = .394, n = 24 , p = .012), *Human Picture* 7 (r = .474, n = 23 , p = .005), *Human Picture* 9 (r = .450, n = 24, p = .008), *Human Picture* 11 (r = .319, n = 24, p = .041) *Human Picture* 13 (r = .607, n = 24, p = .000) and *Human Picture* 14 (r = .354, n = 24, p = .025). In the computer prime condition, *Human Picture* 3 (r = .444, n = 24, p = .005), *Human Picture* 4 (r = .436, n = 24, p = .006), *Human Picture* 7 (r = .470, n = 23, p = .006), *Human Picture* 9 (r = .431, n = 24, p = .010) and *Human Picture* 13 (r = .643, n = 24, p = .000) showed significant positive correlations between viewers' and artists' emotional profile (for full report of correlations see appendix Table 8 - Table 17).

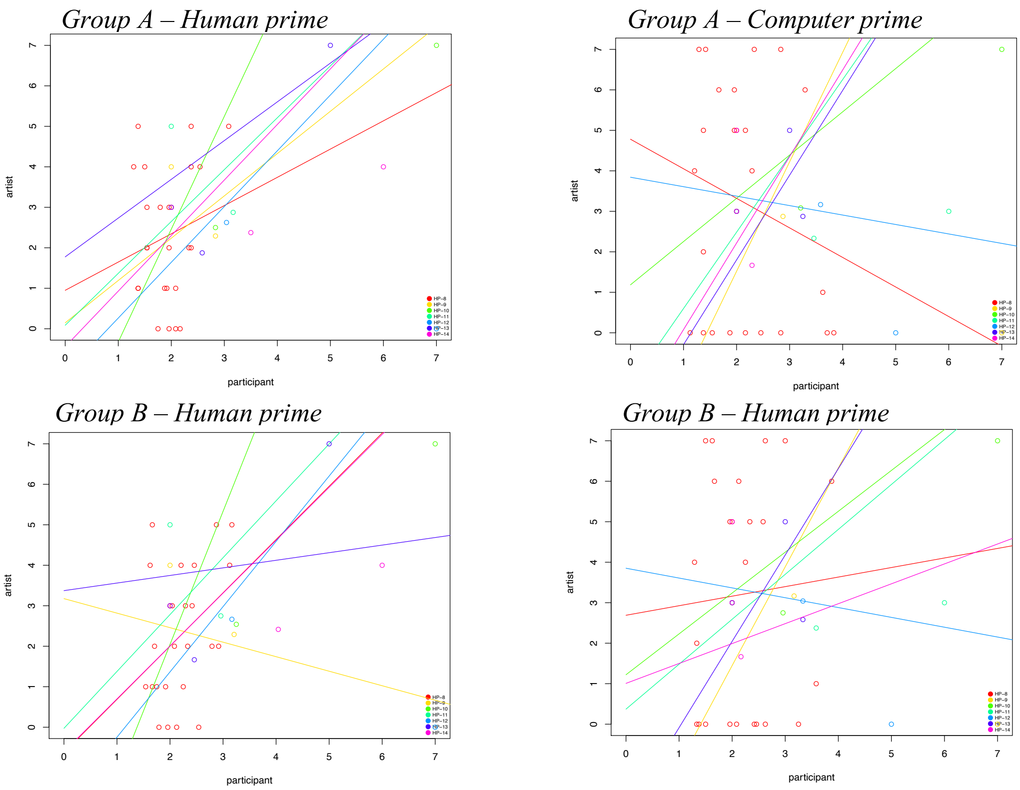


Figure 13. Top left: Correlation between the mean reported emotions over all participants while viewing the art and reported emotions by the artist while making the art for Group A/*Human Prime.*Top right: Correlation between the mean reported emotions over all participants while viewing the art and reported emotions by the artist while making the art for Group A/*Computer Prime.* Bottom left: Correlation between the mean reported emotions over all participants while viewing the art and reported emotions by the artist while making the art for Group B/*Computer Prime.*

Could Participants Pick up the Emotions Intended by the Artist? 12 of the 14 human made pictures had intended emotions reported by artists. Picture Set 1 had a total of 9 reported intentions, while picture Set 2 had a total of 16 intentions reported by the artists, leading to a total of 25 intentions for all 14 human pictures. Table 1 shows all pictures made by artists with corresponding intentions.

Figure 14 shows the distribution of the number of intentions for each picture under the four conditions (*Human Picture/Human Prime (HH) , Human Picture/Compute Prime (HC), Computer Picture/Human Prime (HC), Computer Picture/Computer Prime (CC)*) split by each set for the human pictures for better visibility. Emotions as intended by the artist are marked by the lines in the respective colour for the picture. For all 4 conditions “stimulated” had the highest number of reported intended emotions by participants. Pictures in picture Set

2 had for a greater number of emotions at least one intention reported, than pictures in picture Set 2.

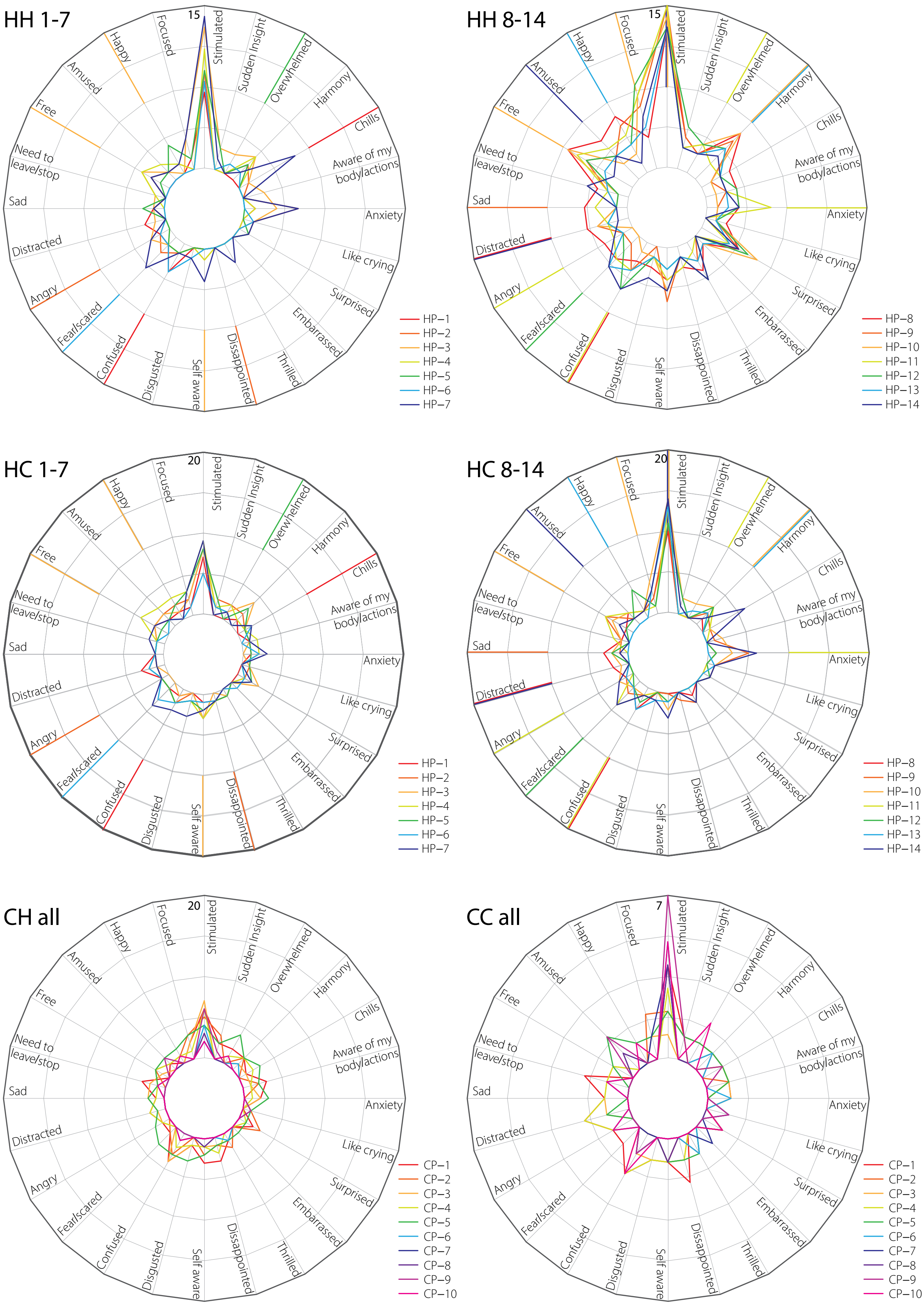


Figure 14. Distribution of the number of intentions for each picture over all participants under the four conditions: Top row: *Human Picture/Human Prime (HH).* Middle row: *Human Picture/Compute Prime (HC),* Bottom left: *Computer Picture/Human Prime (HC).* Bottom right: *Computer Picture/Computer Prime (CC* Underlined emotions were intended by the artist. Emotions as intended by the artist are marked by the lines in the respective colour.

The total number of correct identified intentions compared between both groups is seen in Figure 15 with Group A (Human Prime: total = 81, % of reported = 16.80%, Computer Prime: total = 29, % of reported =12.89) and Group B (Human Prime: total = 24, % of reported =19.23 %, Computer Prime: total = 40, % of reported = 16.11%). Thus, regardless of the prime, intentions were correctly reported, with the highest hit rate in Group A for pictures shown under computer prime.

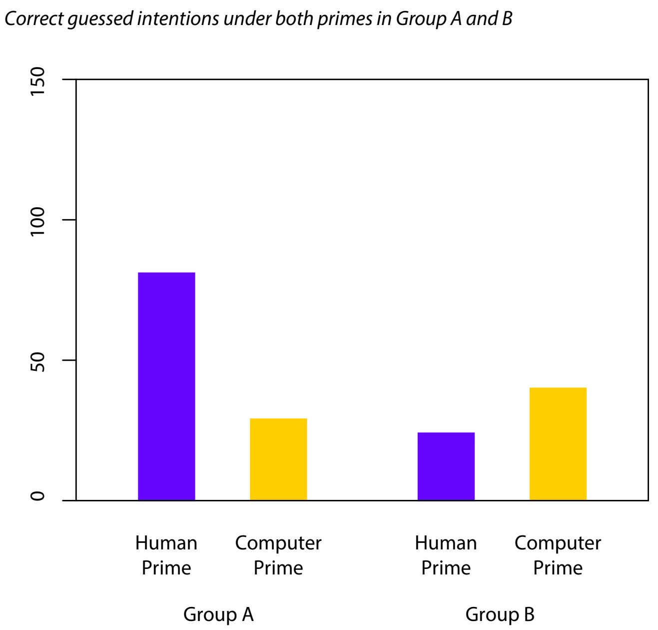


Figure 15. Total number of correct guessed intentions split human and computer prime for Group A and B.

To test if there was a significant effect for group or prime, we conducted a repeated measures ANOVA with picture type as within-subject factor and group as between-subject factor. We found no significant effect for picture (F (1,46) = 3.387, p = .072, $p\eta^2$ = .069) or Group (F (1,46) = 2.063, p = .153, $p\eta^2$ = .043) but a significant effect for group*prime interaction (F (1,46) = 12.085, p = .001, $p\eta^2$ = .208). Thus, there was no significant difference between the human and computer prime and no significant difference between the groups.

Did participants feel more what the artist intended? We split the mean emotions for each participant by emotions intended by the artists versus not intended. As shown in *Human Picture* 3, 10, 12 and 13 have the greatest difference between mean emotions as intended and not intended by the artist. While *Human Picture* 3,10 and 13 had higher mean reported emotions in the emotions intended by the artist than emotions not intended, *Human Picture* 12 showed higher mean emotions in not intended emotions than in intended emotions.

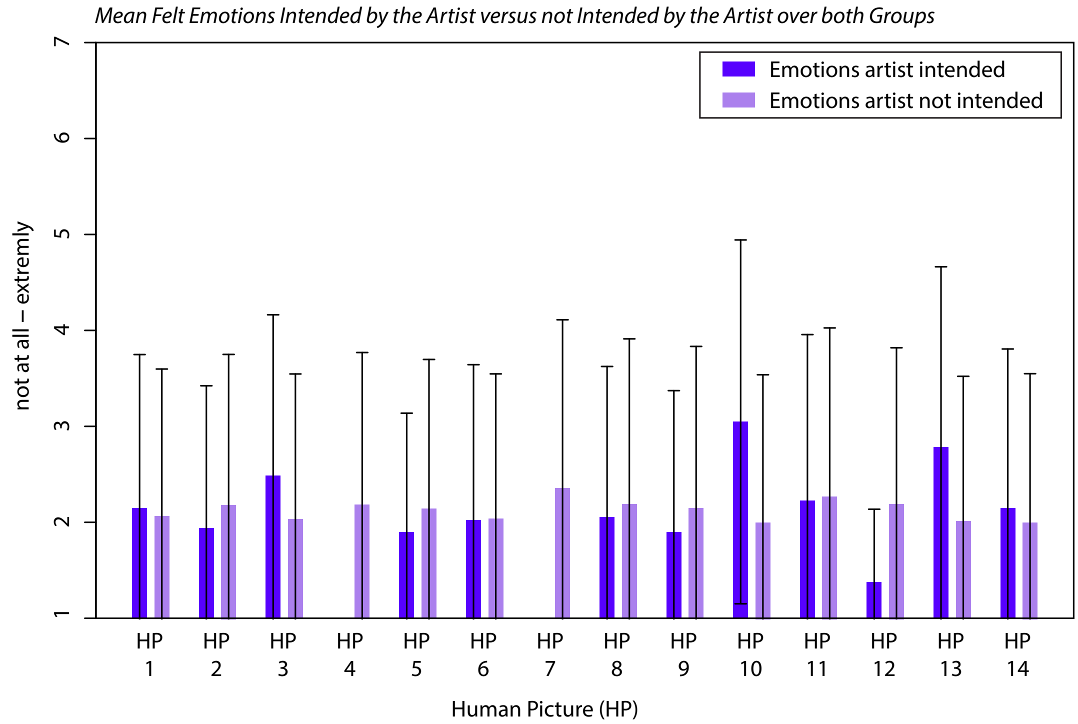


Figure 16. Mean felt emotions intended by the artist compared to mean felt emotions not intended by the artist per picture for both groups under both primes.

To test whether reported emotions as intended by the artist were significantly different from reported emotions not intended by the artist, we averaged the emotions reported for terms intended by the artist and for terms not intended by the artist for each participant and each picture. With the resulting dataset we conducted a two-tailed repeated measures t-test for all 14 pictures. Assumption of normal distribution of mean differences was violated for *Human Picture* 6 (W (47) = .868, p = .000), *Human Picture* 8 (W (48) = .874, p = .000), *Human Picture* 9 (W (48) = .921, p = .003), *Human Picture* 13 (W (48) = .946, p =.028), *Human Picture* 14 (W (48) = .934, p = .009), as well as the assumption of the absence of outliers. The t-test is robust against violation of normal distribution, especially with N>30, which was given in our case. The t-test was conducted without the assumptions of missing outliers. A significant difference between emotions felt as intended by the artist and not intended by the artists was found for *Human Picture* 3,10, 12 and 13. For *Human Picture* 3, 10 and 13 mean emotions as intended by the artist (*Human Picture* 3: M = 2.49, SD = 1.41; *Human Picture* 8:

M = 3.05, *SD* = 1.60; *Human Picture* 11: *M* = 2.78, *SD* = 1.77) were significantly higher (*Human Picture* 3: *t* (47) = 2.57, *p* = .014, *d* = .37 ; *Human Picture* 10: *t* (47) = 4.93, *p* = .000, *d* = .71; *Human Picture* 13: *t* (47) = 3.54, *p* = .001, *d* = .51) than mean emotions not intended by the artist (*Human Picture* 3: *M* = 2.03, *SD* = 0.84; *Human Picture* 8: *M* = 2.00, *SD* = 0.86; *Human Picture* 11: *M* = 2.01, *SD* = 0.81). For *Human Picture* 12, mean emotions were significantly higher (*t* (47) = -5.72, *p* = .000, *d* = -.83) for not intended emotions (*M* = 2.19, *SD* = 0.87) than for intended emotions (*M* = 1.38, *SD* = 0.761).

In a final step we looked at the mean felt emotions as intended by the artist compared to mean felt emotions not intended by the artist for each of the conditions separately. Results can be seen in Figure 17 and Figure 18.

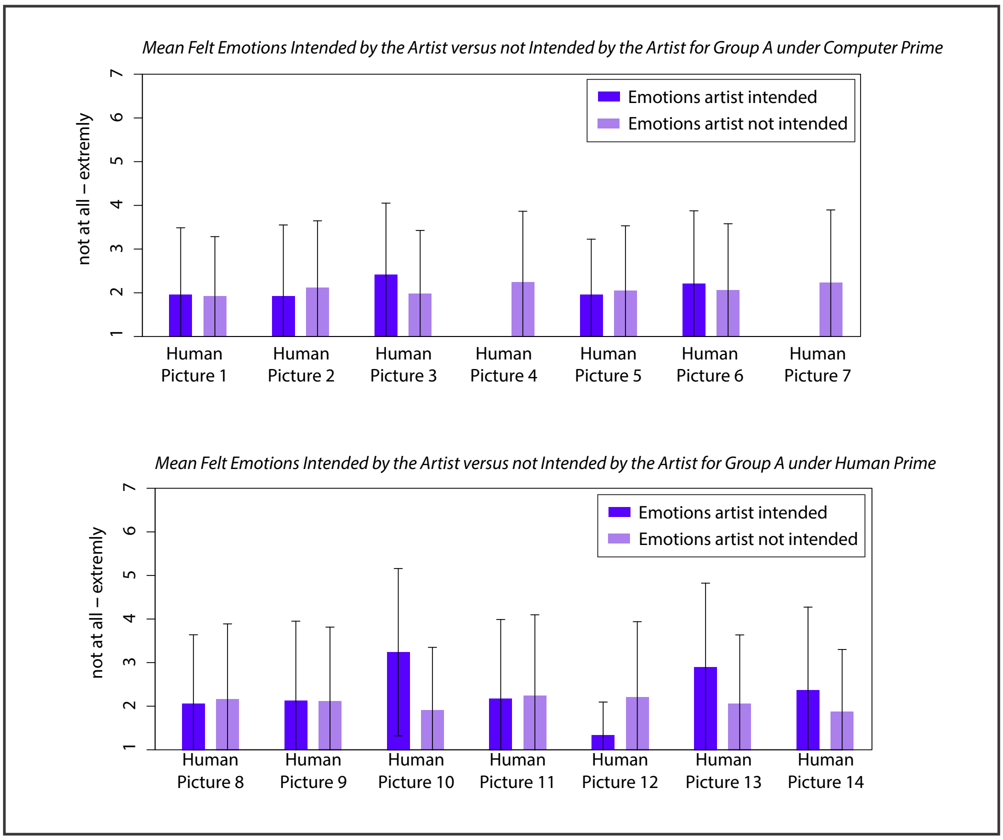


Figure 17. Mean felt emotions intended by the artist compared to mean felt emotions not intended by the artist per picture for Group A under human prime condition. Mean felt emotions intended by the artist compared to mean felt emotions not intended by the artist per picture for Group A under computer prime condition.

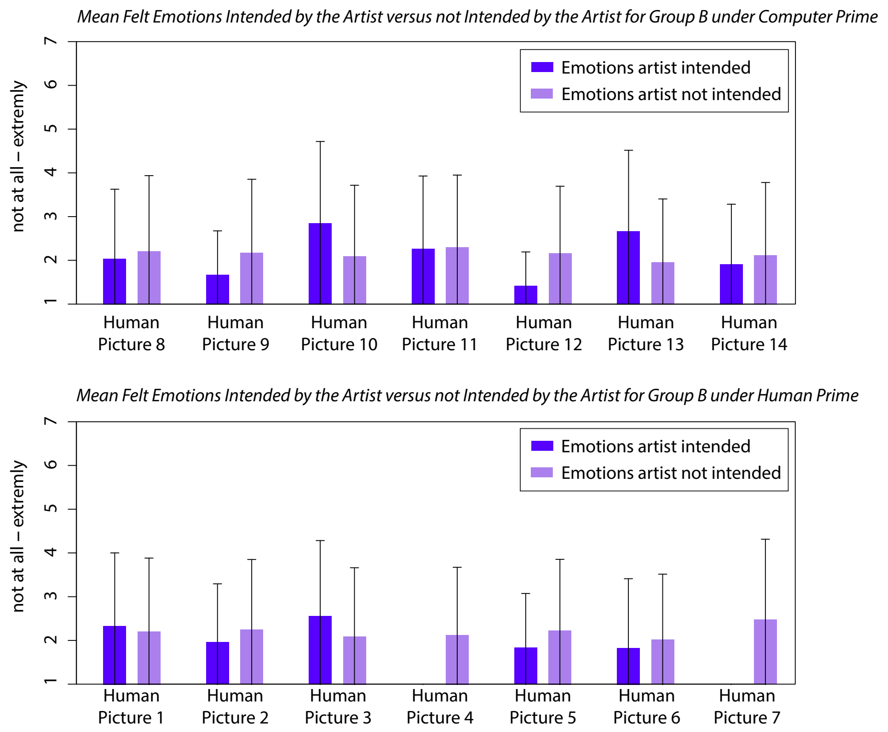


Figure 18. Top: Mean felt emotions intended by the artist compared to mean felt emotions not intended by the artist per picture for Group B under computer prime condition. Bottom: Mean felt emotions intended by the artist compared to mean felt emotions not intended by the artist per picture for Group B under human prime condition.

Before conducting a t-test to investigate the significance of the observed differences for each picture, group and condition separately we tested for violations of the t-test assumptions. In Group A in the computer prime condition, differences for *Human Picture* 7 (W (23) = 0.894, p = .016) was not normally distributed. The data showed 3 extreme outliers, all in *Human Picture* 5. In Group A human prime condition differences for *Human Picture* 8 (W (23) = 0.867, p = .005), *Human Picture* 9 (W (23) = 0.888, p = .012) and *Human Picture* 14 (W (23) = 0.915, p =.046) showed not normal distribution. There were no extreme outliers in the data. In Group B for the computer prime condition the normal distribution of the differences was not given for *Human Picture* 8 (W (23) = .887, p = .012) and *Human Picture* 13 (W (23) = 0.889, p = .013). There were 2 extreme outliers in one picture. The t-test was in this case calculated with the violation of the outlier assumption. In the human prime condition of Group B, the differences of *Human Picture* 5 (W (23) = .872, p = .007) and *Human Picture* 6 (W (23) = .736, p = .000). There were 4 extreme outliers, 2 in *Human Picture* 5 and 2 in *Human Picture* 6. The t-test was calculated with violation of the assumption of missing outliers.

In Group A we found no significant difference between the reported mean emotions intended by the artist and not intended by the artist in the computer prime condition but in the human prime condition. In the human prime condition reported mean emotions intended by the artist were significantly higher for *Human Picture* 10 (t (23) = 3.822, p = .001, d = .78) and *Human Picture* 13 (t (23) = 2.337, p = 0.29, d = .48). *Human Picture* 12 (t (23) = -3.710, p = .001, d = -.76) showed significantly lower reported emotions in the emotions not intended by the artist compared to the emotions the artist intended.

In Group B in the computer prime condition, the results of the t-test showed significant higher emotions reported for emotions intended by the artist compared to emotions not intended by the artist for *Human Picture* 10 (t (23) = 3.217, p = .004, d = .66) and *Human Picture* 13 (t (23) = 2.735, p = .012, d = .56). However, *Human Picture* 9 (t (23) = - 2.329, p = .029, d =.48) and *Human Picture* 12 (t (23) = -4.622, p=.000, d = -.94) had significantly higher emotions reported in the emotions not intended by the artists. For the human condition in Group B, we found no significant difference between the reported emotions as intended by the artist and not intended, in any of the pictures.

Discussion and Conclusion

In this study we added new insights to existing research on computer art by examining the emotional response to art generated by a computer versus human artists. Moreover, it was analysed whether and to what extend the concept of experiencing art can be transferred to art made by a computer. In order to achieve this, we used an arrangement of highly similar looking black and white grid pictures, which were either made by a computer or by human artists. We found evidence that art generated by a computer had indeed the potential to evoke emotions and perceived intentionality in the viewer. The results revealed an emotional connection between artist and viewer through art which looks highly similar to computer art.

In the following section we will discuss the results in more detail and link them to previous research. We first focus solely on the viewers emotional response and perception of the artworks, in order to investigate the first main research question: *Following art critics, if someone believes or is told that an artwork is human generated (even though it is computer generated), do they report emotions and perceive intended emotions during their experience? (Critics would say, no, they should not).* In other words, is there a difference in feeling emotions and perceiving intentions between computer and human made art and is this dependent on the prime? In an explorative manner we investigated if there might be a relation between the participants emotional arousal, perceived intentions, their ability to guess the creator of the artwork, and liking the artworks. We also investigated how these relationships are influenced by the type of the artwork and respectively the prime.

Interestingly, we found evidence that people indeed perceive the artworks generated by a computer as "emotional" as well as experience them as being intentionally created to evoke a state emotional arousal. This not only contradicts the opinion of art critics, but also contributes to new insight in how we experience computer generated art.

We now turn our attention to the second research question: *If we use an artwork that actually looks computer generated (grid of squares), but is made by an artist and does have specific emotions that the artist felt while making and also wished to communicate, can people pick these up, or is it all determined by priming/context?*

Here, we investigated a possible emotional connection between viewer and artist through the artworks. We solely looked at the human artworks including the artists emotions and intentions while making the art. Similar to Pelowski et al. (2018), we compared the reported emotions during the process of making the art and while experiencing the art. Consequently, we looked at the intended emotions as reported by the artist and if participants were able to pick them up as well as if they felt the intended emotions. We found evidence for all three hypotheses: emotion sharing while making and viewing the artwork, understanding the artists intention, and feeling emotions as intended by the artist.

The Viewers Perspective and Reactions

Do People Feel Emotions when Viewing Computer Generated Art and does this Relate to the Prime?

In regard to our first main research question, we found that emotions were reported in all four conditions (*Human Picture Human Prime, Human Picture Computer Prime, Computer Pictures Human Prime and Computer Pictures Computer Prime)*. As previously outlined, participants reported higher emotions in human pictures compared to computer pictures for both prime conditions (computer/human). This could also be shown in a two-way repeated measures ANOVA, which showed a main effect for the type of picture but not for the prime. These results suggest that emotions can be evoked by randomly generated computer pictures, even if these are much less pronounced in comparison to the emotions reported for human made pictures. Thus, even when there has not been a careful artistic process of using a computer as a tool or collaborator for creating a computer artwork but a random noise generator, emotion seemed to be felt by the participants when viewing these pictures. These findings add new insight to our understanding of art perception of computer generated art and calls into question the art critics' argument of a missing emotional component. We can therefore summarise that, on the one hand, computer generated art can also evoke emotions, but on the other hand, the reported emotions when viewing human made artworks were significantly higher. This further highlights that there might be a special component in human made artworks that can be sensed by the viewer, which would be consistent with previous findings on art perception (Hawley-Dolan & Winner, 2011; Snapper et al., 2015; Watanabe, 2010; Hong & Curran, 2019) and seems to be also applicable for simple grid black and white pictures made by artists.

Interestingly, the prime was not the critical factor for reporting emotions, but the provenance of the picture was. To the best of our knowledge, this is the first study to investigating the influence of labelling an artwork on the nuanced emotional response of the viewer. However, contrary to our results Wolz & Carbon (2014) found an influence of labelling Rembrandts as "copy" versus "original" on emotional value, amongst other aspects of art experience.

In regard to our first main research question, the results of this study show, that if someone believes or is told that an artwork is human generated (even though it is computer generated) they report emotions during their experience. However, the prime does not seem to be the crucial aspect, since regardless of the prime emotions were reported in computer pictures with no significant difference between both primes.

Do People Perceive Intended Emotions in Computer Generated Art and does this Relate to the Prime?

While participants reported more intentions in human than in computer made pictures, a certain amount of intention were still reported for the computer made pictures. The normalized number of intentions were higher for both picture types (computer/human) in the human prime condition compared with the computer prime condition. In the *Computer Picture/Human Prime* condition they were almost twice as high. This suggests an effect of the prime on the intention perception. These results further suggest that we might perceive an artist not only in the human pictures but also in the computer-generated pictures, which could be explained by the human tendency to ascribe agency to objects and machines (Aggarwal & McGill, 2007; Müller et al., 2018; Turkle, 2005). Furthermore, it could indicate that, as Foucault (2019) already hypothesized, a perceived author is more critical for experiencing art than the actual creator. Nevertheless, the results also show that we describe less intentionality to a computer, since this study finds there to be an influence of the prime on the perceived intended emotions.

Do People Feel Emotionally Aroused when Viewing Computer Generated Art and was this Related to the Prime?

In all conditions higher means of emotional arousal were reported for human pictures than for computer pictures. Indicating that, similar to the reported feelings, emotional arousal was influenced by the type of artwork rather than by the prime. This was also found to be significant by a two-way repeated measures ANOVA.

There was a positive correlation between the mean reported feelings and the mean general emotions (emotional arousal, positive and negative emotions), this allowed us to use emotional arousal as an indicator for the mean reported feelings. Furthermore, the results indicate an inner consistency of the participants' reported emotions.

Could Participants Categorize the Artworks, also Regardless of the Prime Given to them in the Previous Blocks?

In general, participants were better than chance in categorizing the artworks and better at correctly identifying human pictures than computer pictures. Interestingly, pictures were more often categorized as human made when participants had a human prime for these pictures in the previous block of the study. So, while there seems to be no effect of the prime on the emotions participants felt while viewing the art, the report of intended emotions, and the emotional arousal, the subsequent categorization of the artwork seemed to be affected by the prime. These results raise the question of whether participants were better at ignoring the prime when it came to their subjective perception, but not when it came to the classification of the images. Categorizing an image is a more cognitive task and in contrast to a subjective opinion of an artwork, this may have led participants to think that there is indeed a right or wrong reply. This switch into a more cognitive mode of processing the artwork may in turn lead the participants to fall back on the information provided to them by the prime.

We will further discuss this influence of the prime in connection to the effect of labeling on the liking of the pictures and reported intentions at the end of this section.

Did Participants Ability to Categorize the Pictures Regardless of the Prime Correlate with their Reported Emotions?

While we did not find a significant correlation between overall emotional arousal and the participants' ability to correctly distinguish human from computer pictures, we did find a significant positive correlation for positive emotions in human pictures and participants' ability to distinguish them, regardless of the prime. In other words, the higher participants' ability to correctly identify human pictures the higher the positive emotions reported. A possible explanation for this effect might be that the better participants are at distinguishing between human and computer pictures, the less they are distracted by the prime and can freely engage with the picture presented to them. This possibly enables them to overcome a bias against art computer generated art (J.-W. Hong, 2018; J. W. Hong & Curran, 2019; Kirk et al., 2009) which in turn results in higher positive emotions on the part of the participants. However, the emotional component of an artwork is argued to be an important aspect of aesthetic experience (Leder et al., 2004; Pelowski et al., 2017). If the viewer experiences more positive emotions towards a picture and has a greater feeling of connectivity this might lead to the familiar pleasure one associates with art viewing (Leder et al., 2004). This emotional response to the artwork could in consequence make it easier to distinguish between human and computer generated art.

Did Participants Evaluate the Computer Generated Artworks Similar to the Human Generated Artworks?

In this study, participants evaluated human pictures significantly more positively than computer pictures, regardless of the prime. These results stand in contrast to findings by Kirk et al. (2009) which showed that the label of an artwork had a strong effect on the liking of the art. How do these differences come about? One possible explanation might be due to the used stimuli. In Kirk et al. (2009) all pictures were made by human artists while the prime (human/computer) differed. In our study, we used a more advanced 2x2 design with computer and human stimuli as well as primes. This further highlights the importance of this study since, the use of both human and computer pictures reveals that the predicting factor for evaluating the artwork is indeed the picture itself.

The Relation Between General Emotions and Liking the Picture

When looking at all four conditions combined, we found significant correlations between emotional arousal as well as positive emotions with liking the artwork. This is in line with previous studies which suggested emotion as a strong predictor for liking (e.g. Leder et al., 2012).

Interestingly, when looking at the four conditions separately this finding only holds true for the *Human Picture/Human Prime, Human Picture/Computer Prime* and *Computer Picture/Human Prime* conditions. The correlation was even greater for positive emotions and liking in these three conditions. In contrast, in the fourth condition *Computer Picture/Computer Prime*, we found a significant correlation with negative emotions. This showed a reversed relation: The higher the negative emotions, the less the picture was liked. These findings can be linked to previous studies, which suggest that pictures evoking positive emotions are liked more (Mohammad & Kiritchenko, 2019) and pictures that evoke negative emotions are liked less (Silvia & Brown, 2007). Alternatively, this could also be explained by the previously mentioned bias against computer art which has been shown by Kirk et al., (2009) amongst others. We suggest that when the picture is thought to be computer generated participants like it less due to bias and will therefore feel more negative emotions. One might hypothesise that this dislike might, at least in part, be due to a perceived violated sender receiver connection.

Is there a Relation Between Liking the Picture and Participants' Ability to Categorize the Art?

Here we would like to focus on the interesting finding that in the *human picture/computer prime* condition the participants' ability to distinguish between human and computer made art was more strongly correlated to the liking of the picture than in the *human picture/human prime* condition. One possible explanation for this finding could be that in the *human picture/human prime* condition, liking was generally high. This leads to the observation that even participants' who were less able to ignore the prime reported high liking. However, in the *Human Picture/Computer Prime* condition, where the prime was not given according to the real provenance of the art, no prime induced liking was observed. This leads to the high correlation as previously outlined. The fact that this effect could not be found for computer images might again be due to a bias against computer art which lead to general low liking, as shown in previous studies (Kirk et al., 2009).

To summarise, some of our results are in line with previous research suggesting a difference in viewers reaction to computer and human made art (J. W. Hong & Curran, 2019). Contrary to some art critics believe that computer generated art is missing an emotional component, we found evidence that even randomly generated black and white grids made by a computer can evoke emotions, regardless of any prime given to the participants. This was also true for perceived intentions and emotional arousal of the participants, independent of the prime. To our knowledge, this is the first study to investigate the nuanced emotional experience of participants when viewing computer-generated art. Our results could suggest that at least one part of our art and aesthetical experience is decoupled from a sender and might be more connected to a perceived author in the sense of Foucault (2019).

While the finding that the prime had no significant influence on emotional responses is in contrast to findings by Wolz & Carbon (2014), it does point in a similar direction as other previous studies (Leder, 2001; Locher et al., 2015). These works have found that the provenance of the artwork has a greater influence on objective aspects (value of the picture) (e.g. Locher et al., 2015) than on subjective aspects (liking) (Leder, 2001) of experiencing an artwork. The emotional response to an artwork is a more subjective aspect of viewing art and therefore should be less influenced by the prime, which was also revealed by our data.

However, we did find an influence of the prime on the perceived intentionality. While artefacts which are not made by humans can evoke liking (Hawley-Dolan & Winner, 2011) and may even evoke emotions, we do not describe the same degree of intentionality to them (Chamberlain et al., 2018). Especially since participants did not see the process of the making, which has been suggested to improve perceived intentionality (Chamberlain et al., 2018; Colton, 2012). We hypothesize that this was also true for the computer prime conditions of this study. Reported emotions, emotional arousal and evaluation were less influenced by the provenance of the picture, and perhaps more by a subtle feeling of *intuition* as (Croce, 1930) referred to it. Intentionality however is explicitly referring to the maker of the artwork and can therefore hardly be separated from the provenance of the artwork. This leads to the information of the prime (computer/human) to have a more pronounced influence.

It has to be noted, that we found interindividual differences between the reported emotions. These can be explained by the individuality of art experience and a general difference in the intensity of feeling emotions (e.g. Gerger et al. 2018).

Interaction Between Artist and Viewer

We now turn our attention to the second research question: *If we use an artwork that actually looks computer generated (grid of squares), but is made by an artist and does have specific emotions that the artist felt while making and also wished to communicate, can people pick this up, or is it all determined by priming/context?*

To answer this question, we looked at the human artworks separately and investigated a possible shared emotional connection between viewer and artist through the artwork. As previously outlined, we used a similar paradigm to Pelowski et al. (2018) when comparing the data on the emotions while making and viewing the art and the intended. We also evaluated if participants could intuit the intentions of the artist as well as if they felt what was intended by the artist when viewing the artwork.

Was there a Shared Emotional Experience Between Participants while Viewing the Art and the Artist while Making the Art?

We found evidence for a shared emotional connection between the artist and the viewers for seven of the 14 human pictures. Therefore, to answer the first part of our second research question: If we use an artwork that actually looks computer generated, namely a grid of squares, but is in actuality made by an artist who felt a given set of emotions while making the art, people indeed show a similar emotional profile when viewing the art. Our results are in line with previous findings by Pelowski et al. (2018) and Pelowski et al. (submitted for publication) who found evidence for emotion sharing between the artist while making the art and the viewer. This also supports the general idea that mirroring emotions is a crucial aspect of our perception of our environment as well as our aesthetic experience (Freedberg & Gallese, 2007). These concepts seem to be also applicable for simple black and white grids. Peoples ability to have shared emotions with the artist seemed to be influenced by the prime with two more pictures showing significant correlations in the human prime condition compared with the computer prime condition.

Could Participants Pick up the Emotions Intended by the Artist?

To investigate the second part of the second research question *If we use an artwork that actually looks computer generated (grid of squares), but is made by an artist and does have specific emotions that the artist felt while making and also wished to communicate, can people pick this up, or is it all determined by priming/context?* we examined emotions intended by the artists.

The total number of correct guesses compared between both groups showed that, regardless of the prime, the artists' intentions could be intuited by viewers, with the highest hit rate in Group B for pictures with a human prime.

In Group A more correct intentions were correctly identified, with a general higher absolute number of reported intentions. In the human condition pictures (Set 2) of Group A more intentions were reported than under the computer prime condition. This could also be due to general more intentions reported by the artist additionally to an influence by the human prime. Reversed results were found for Group B, where participants had a higher hit rate for intentions in the computer prime condition (Set 2) than in the human prime condition (Set 1), although the difference in number of reported intentions between both primes was smaller in Group B. This could indicate that the results are partly influenced by the unbalanced number of intentions for both picture sets and could explain the high number of intentions when a matching prime was given.

In general, these results show that in some cases people can pick up artists intentions as suggested in previous studies (Pelowski et al., 2018; Pelowski et al. in Press). These results also relate to the general concept of emotion sharing in art which seems to be not limited to more classical artforms.

Did Participants Report more Emotions as Intended by the Artist Compared to not Intended Emotions?

Of the twelve pictures, which had associated information on the emotions the artists intended to transmit, three showed significant higher reported emotions by the participants for the intended emotions for both primes combined. When looking at the prime conditons separately, the results showed an effect of prime with two more pictures showing significant correlation in the human prime condition compared to the computer prime condition.

In summary, these results show that in some cases the artis was in fact able to send a message through the art by evoking specific emotions in the viewer. This is in line with previous findings (Pelowski et al., 2018; in submission). Even more importantly, this finding also holds true for black and white grids made on a computer by artists. The most profound evidence for an emotional connection between viewer and artist was found in their spontaneous emotion sharing. In this, evidence indicating an influence of priming was also found.

More generally, the fact that the second part of the study showed evidence that people can pick up the intentions by artists in art that looks highly similar to computer art hints at an interesting phenomenon. Even when the artworks were missing physical traces of the artist (e.g. brush strokes, paint drippings), which have been argued to be relevant for building an emphatical relation between artist and viewer through embodiment and therefor help understand the intentions and emotions of the artist (Freedberg & Gallese, 2007), a genuine connection between the artist and the viewer can be formed. We could therefore show that even without a visible artists' hand, emotion sharing, understanding of emotions, as well as feeling the intended emotions occurred. This raises new fascinating questions about the human ability to transmit emotions and the aspects that enable us to do so. Our results also suggest that when AI is used as a collaborator or a tool in an artistic process where a message and emotions are carefully chosen and an honest attempt at their transmission is made, these emotions can indeed be shared through the artworks. In this ability and intensity of creating an emotional connection the degree of autonomy of the AI will play a crucial role.

The present study showed evidence for emotion evoking and perceiving intentions in computer generated art. This opens exciting new perspectives and possibilities for computer generated art and art perception. Furthermore, we found that an emotional connection can be built between viewer and artist even in non-representational art like black and white grid, which further highlights the human ability to send and receive emotions through art.

However, we did also find a bias against computer generated art. Nori's (2018) question remains whether there will be an increasing adaptation effect, especially from younger generations who are growing up with AI. Art mirrors our time and society so we might have to find new ways and keep an open mind to how we define art in a constantly evolving world.

Limitations to the Present Study

One of the main issues for data analysis was the unbalanced number of computer and human stimuli in the study. For better data analysis and more comparability, picture types should be balanced in both sets. Furthermore, should the ratio of black and white squares in computer pictures be further varied. The present computer stimuli all had a 50/50 ratio of black and white squares while artists' ratio varied. This can be explained by the limited possibilities of expressing and transmitting emotions through black and white squares in a grid, which was supposed to still be unstructured. However, this also might have lead to a distorted guessability of the stimuli.

Additionally, for future studies, in addition to the degree of guessability of the images into human and computer, we recommend considering the number of intentions reported by the artists for dividing the images equally into 2 sets. This could lead to more balanced and therefore even more comparable data on intentions when using a two-by-two design, as used in this study.

Future Research

The ambiguity in existing findings toward the effect of labelling highlights the importance of further investigations, especially into the field of emotional responses to art. The emotional response towards art has been identified as a key aspect of art experience and yet there have been, to our knowledge, no studies focusing on a more nuanced emotional response to art in regard to the labelling.

Future studies should also broaden research toward the emotional response as well as the emotional connection between artist and viewer. Here we suggest to include a neural level and look at possible activation of the motor neuron and empathy regions, as was initially intended for this study.

In respect to AI art, this study laid the foundation for future research to investigate not only the objective and subjective appraisal (Elgammal et al., 2017; J. W. Hong & Curran, 2019) but also the emotional aspect of art perception in art generated by AI. We suggest the inclusion of different types of AI generated art such as artworks by CANs, the painting fool or AI-DA, artworks on a more collaborative base for example by Sougwen Chung and artworks either made by hand or using the computer solely as a tool. We believe that this could lead to even further reaching insights on the possibilities of AI generated art to evoke aesthetic emotions and a feeling of empathy.

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Appendix

Abstract English

After Christies put a painting made by artificial intelligence up for auction in October 2018, it sold for just under $450,000, and sent a wave of outrage through the art world. It was claimed that the picture could not possibly be art, because it did not transmit emotions. The evoking of emotions as well as empathy is seen as an essential part of the aesthetic experience, and recent studies have empirically demonstrated the ability of artist and viewer to share an emotional connection through an artwork. This raises important questions regarding AI art: Can emotions and intentions be perceived in AI art even if there is no sender, and does this depend on whether people believe there to be a sender? In order to assess this question, we used a stimuli set of highly similar black and white grids which were either made by a computer or by an artist. Additionally, we investigated a possible emotional connection between viewers and artists. We found that emotions and intentions were indeed reported for both picture types, independent of the label, although the reported emotions were higher for pictures made by human artists. Furthermore, we found evidence for emotion sharing, understanding and feeling of emotions as intended by the artist. These findings bring new implications for our understanding of art and art experience and highlight the importance of further research on emotions transmission in art, especially in surging digital art.

Abstract German

Nachdem das Auktionshaus Christies im Oktober 2018 ein von künstlicher Intelligenz gefertigtes Gemälde zum Verkauf stellte, wurde es für knapp 450.000 Dollar versteigert und trat eine Welle der Empörung in der Kunstwelt los. Viele Kritiker sprachen dem Werk ab, Kunst zu sein, da ein computergeneriertes Bild keine Emotionen übertragen könne. Das Hervorrufen von Emotionen und Empathie wird als wesentlicher Teil des ästhetischen Erlebens gesehen. Neuere Studien haben empirisch die Fähigkeit von Kunstschaffenden nachgewiesen, durch ein Kunstwerk eine emotionale Verbindung mit den Betrachtenden herzustellen. Dies wirft relevante Fragen in Bezug auf digitale und damit auch KI-Kunst auf: Können Emotionen und Intentionen auch dann wahrgenommen werden, wenn es keinen menschlichen Absender gibt, und hängt dies davon ab, ob Menschen glauben, dass es einen solchen Absender gibt? Um diese Fragen zu untersuchen, verwendeten wir ein Stimuli-Set aus sich ähnelnden Schwarz-Weiß-Grids, die entweder von einem Computer oder von einem menschlichen Künstler erstellt wurden. Zusätzlich untersuchten wir eine mögliche Übertragung von Emotionen von Kunstschaffenden hin zu Betrachtenden. Wir fanden heraus, dass Emotionen und Intentionen tatsächlich, unabhängig vom Labelling, in beiden Bildtypen empfunden und wahrgenommen wurden. Nichtsdestotrotz waren die empfundenen Emotionen bei Bildern von menschlichen Kunstschaffenden intensiver. Darüber hinaus fanden wir Hinweise auf das Teilen von Emotionen zwischen Kunstschaffenden und Betrachtenden, sowie das Erkennen und Fühlen der intendierten Emotionen der Kunstschaffenden. Diese Ergebnisse bringen neue Implikationen für unser Verständnis von Kunst und Kunsterleben mit sich und unterstreichen die Bedeutung weiterer Forschung zur Emotionsübertragung in der Kunst, insbesondere in der aufstrebenden digitalen Kunst.

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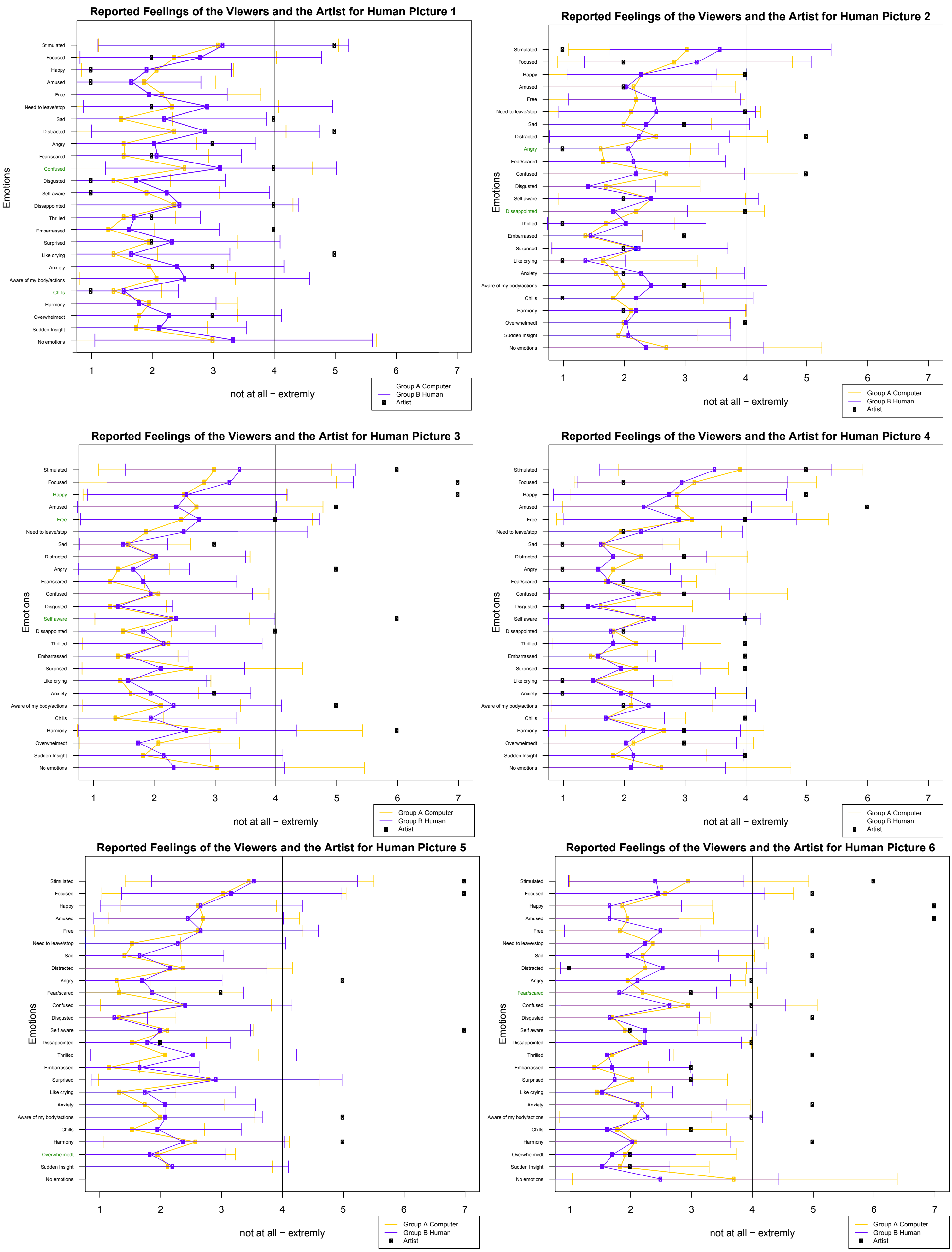

Figure 19. Reported Feelings over all participants split by prime for *Human Picture 1-6* (Set 1)

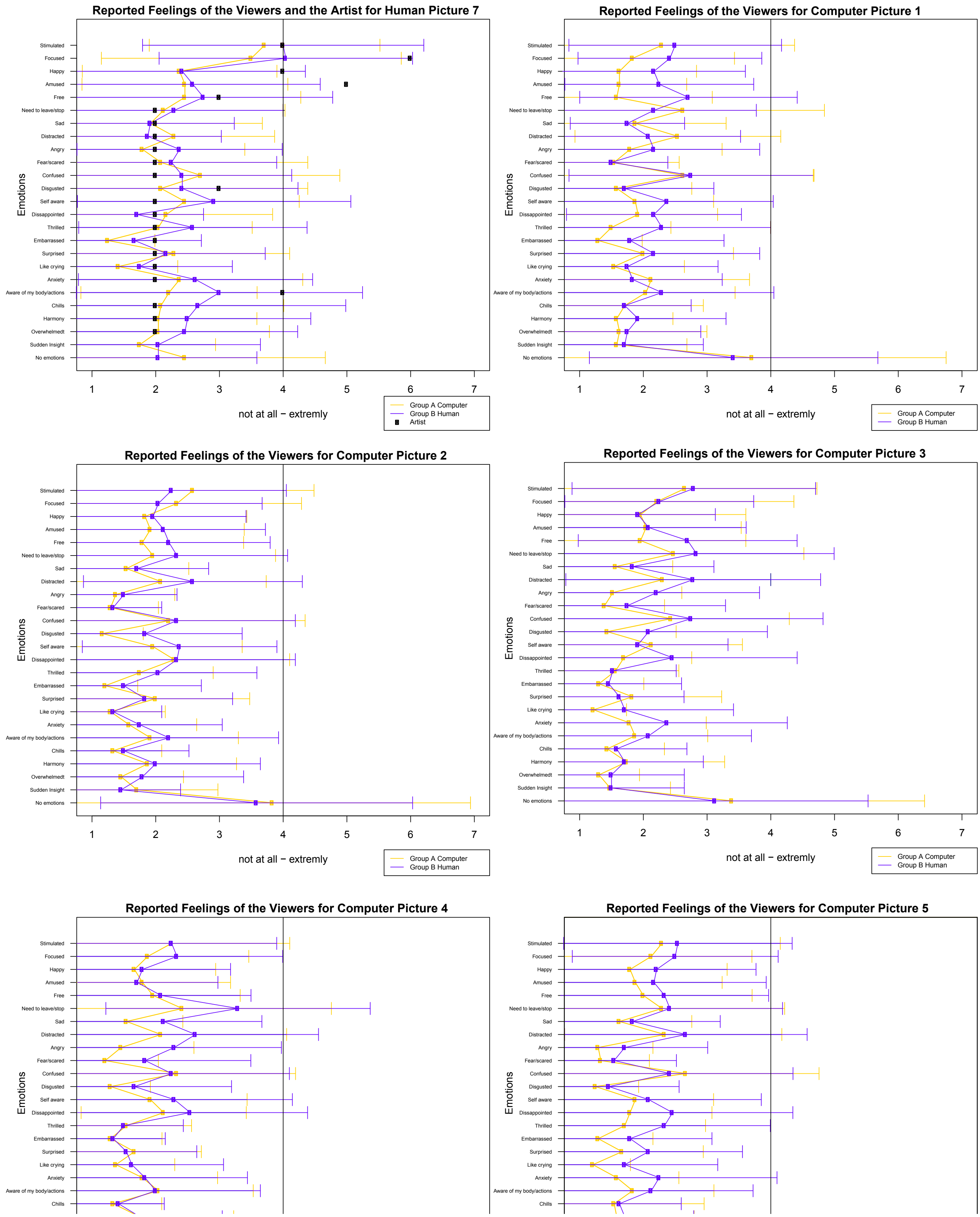

Figure 20. Reported Feelings over all participants split by prime for *Human Picture 7* and *Computer Picture 1-5 (*Set 1)

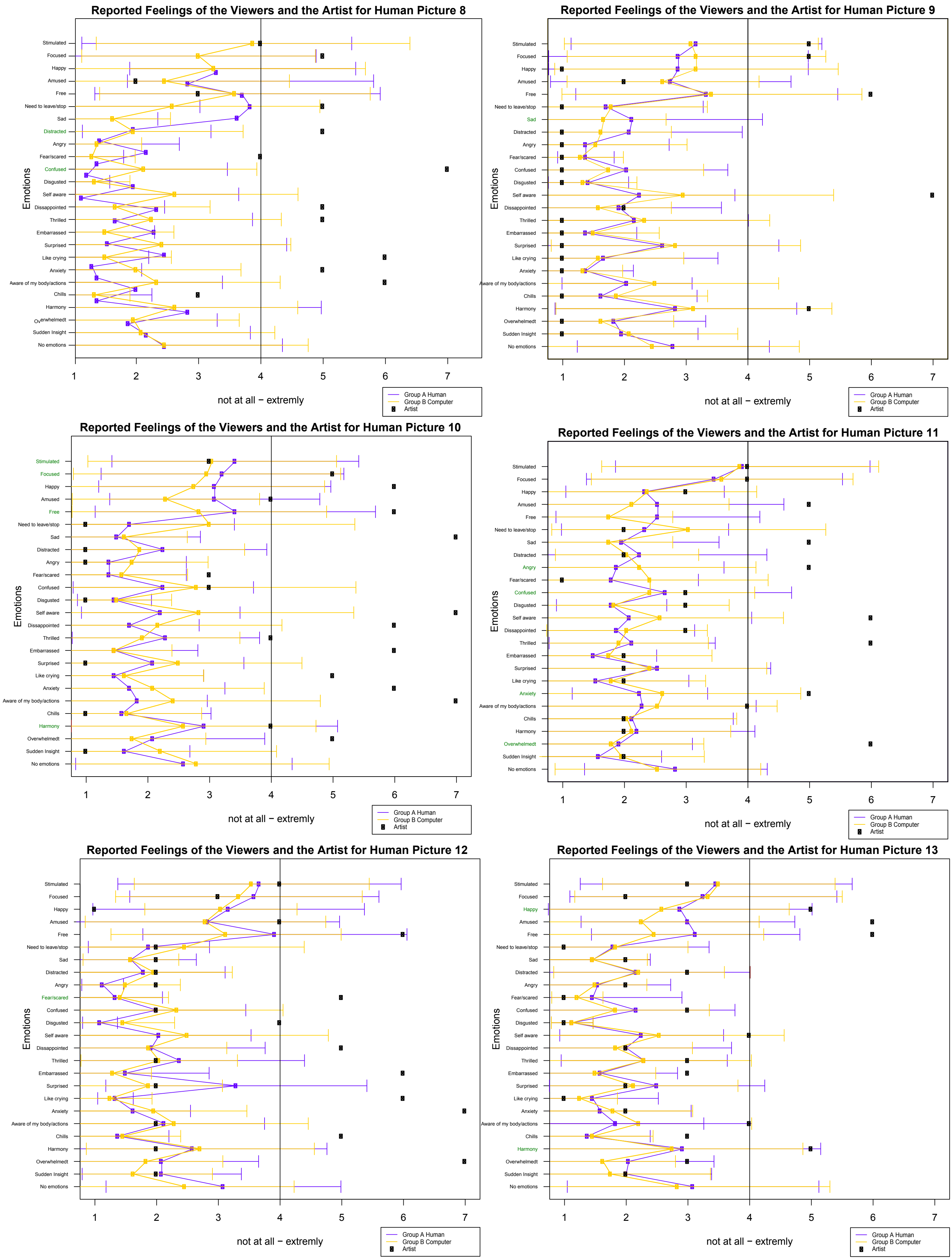

Figure 21. Reported Feelings over all participants split by prime for *Human Picture 8-13* (Set 2)

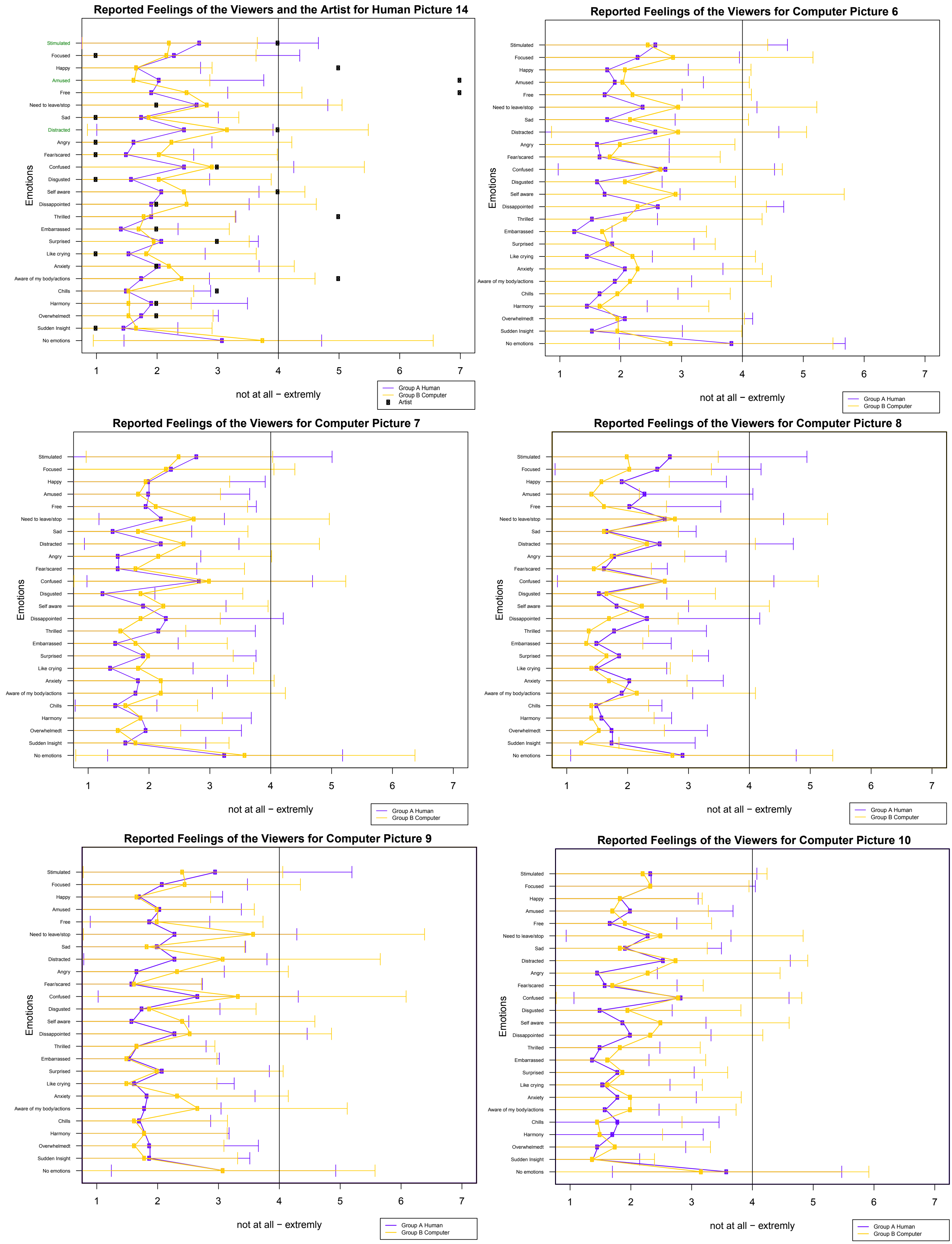

Figure 22. Reported Feelings over all participants split by prime for *Human Picture 14* and *Computer Picture 6-10* (Set 2)

Table 8.

Correlation for general emotions and mean feelings in the Human Picture/Human Prime condition

	Mean feelings for human picture and human prime	Mean emotional arousal for human picture and human prime	Positive emotions for human pictures and human prime	Negative emotion for human picture and human prime
Mean feelings for human picture and human prime	-			
Mean emotional arousal for human picture and human prime	.393**	-		
Positive emotions for human pictures and human prime	.301**	.682**	-	
Negative emotion for human picture and human prime	.325**	.217*	.092	-

**$p < .01$.
*$p < .05$

Tables

Table 9. Correlation for general emotions and mean feelings in the *Human Picture/Computer Prime condition*

	Mean feelings for human picture and computer prime	Mean emotional arousal for human picture and computer prime	Positive emotions for human pictures and computer prime	Negative emotion for human picture computer prime
Mean feelings for human picture and computer prime	-			
Mean emotional arousal for human picture and computer prime	.545**	-		
Positive emotions for human pictures and computer prime	.446**	.670**	-	
Negative emotion for human picture and computer prime	.305**	.280**	.191	-

$^{**}p < .01$.
$^{*}p < .05$

Table 10. Correlation for general emotions and mean feelings in the *Computer Picture/Human Prime condition*

	Mean feelings for human picture and human prime	Mean emotional arousal for human picture and human prime	Positive emotions for human pictures and human prime	Negative emotion for human picture and human prime
Mean feelings for human picture and human prime	-			
Mean emotional arousal for human picture and human prime	.509**	-		
Positive emotions for human pictures and human prime	.503**	.714**	-	
Negative emotion for human picture and human prime	.288**	.423**	.288**	-

**$p < .01$.
*$p < .05$

Table 11. Correlation for general emotions and mean feelings in the Computer Picture/Computer Prime condition

	Mean feelings for human picture and human prime	Mean emotional arousal for human picture and human prime	Positive emotions for human pictures and human prime	Negative emotion for human picture and human prime
Mean feelings for computer picture and human prime	-			
Mean emotional arousal for computer picture and human prime	.553**	-		
Positive emotions for human pictures and human prime	.535**	.772**	-	
Negative emotion for human picture and human prime	.358**	.471**	.313**	-

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

Table 12

Correlations between the artists emotions and the viewers emotions for Human Picture 1-7

	HP_1	H1_A	H2_P	H2_A	H3_P	H3_A	H4_P	H4_A	H5_P	H5_A	H6_P	H6_A	H7_P	H7_A
H1_P	-													
H1_A	.164	-												
H2_P	.657**	-.035	-											
H2_A	.364*	.203	.224	-										
H3_P	.355*	-.302	.577**	-.062	-									
H3_A	.217	-.183	.390*	-.070	.448**	-								
H4_P	.457**	-.239	.658**	.047	.828**	.482**	-							
H4_A	.028	-.219	.221	-.031	.469**	.117	.397*	-						
H5_P	.399**	-.184	.581**	-.019	.828**	.342*	.762**	.505**	-					
H5_A	.247	-.064	.238	-.210	.267	.616**	.267	-.076	.128	-				
H6_P	.755**	.165	.637**	.266	.297*	.282	.400**	-.088	.290*	.371*	-			
H6_A	-.012	-.155	.146	-.141	.263	.503**	.294	.159	.271	.132	.098	-		
H7_P	.318*	-.290	.537**	-.118	.579**	.448**	.623**	.285	.505**	.316	.327*	.373*	-	
H7_A	.128	-.304	.280	-.090	.418*	.525**	.457**	.261	.379*	.214	.139	.556**	.507**	-

**$p < .01$.

*$p < .05$

Table 13

Correlations between the artists emotions and the viewers emotions for Human Picture 8-14

	H8_P	H8_A	H9_P	H9_A	H10_P	H10_A	H11_P	H11_A	H12_P	H12_A	H13_P	H13_A	H14_P	H14_A
H8_P	-													
H8_A	.343*	-												
H9_P	.657**	.345*	-											
H9_A	.278	.388*	.479**	-										
H10_P	.355*	.020	.577**	.409*	-									
H10_A	.166	.405*	.151	.430*	.134	-								
H11_P	.457**	.089	.658**	.388*	.828**	.186	-							
H11_A	.213	.188	.290	.419*	.309*	.350*	.376*	-						
H12_P	.399**	.004	.581**	.278	.828**	.083	.762**	.257	-					
H12_A	-.082	.280	-.123	.059	-.131	.300	-.090	.119	-.155	-				
H13_P	.755**	.417**	.637**	.405*	.297*	.138	.400**	.230	.290*	-.020	-			
H13_A	.123	-.079	.423**	.433*	.632**	.218	.632**	.395*	.548**	-.120	.143	-		
H14_P	.318*	.154	.537**	.441**	.579**	.209	.623**	.495**	.505**	.086	.327*	.513**	-	
H14_A	.240	.009	.476**	.277	.628**	.102	.600**	.367*	.600**	-.128	.206	.724**	.584**	-

**$p < .01$.

*$p < .05$

Table 14

Correlations between the artists emotions and the viewers emotions for Human Prime/Human Picture 1-7

	HP1	H1_A	H2_P	H2_A	H3_P	H3_A	H4_P	H4_A	H5_P	H5_A	H6_P	H6_A	H7_P	H7_A
H1_P	-													
H1_A	.246	-												
H2_P	.440**	-.127	-											
H2_A	.340*	.203	.000	-										
H3_P	.225	-.344*	.566**	-.072	-									
H3_A	.119	-.183	.398*	-.070	.448**	-								
H4_P	.311*	-.291	.573**	.043	.793**	.488**	-							
H4_A	-.108	-.219	.110	-.031	.453**	.117	.394*	-						
H5_P	.270	-.188	.442**	-.062	.758**	.265	.642**	.485**	-					
H5_A	.266	-.064	.300	-.210	.284	.616**	.297	-.076	.094	-				
H6_P	.603**	.167	.474**	.201	.255	.294	.327*	-.085	.219	.390*	-			
H6_A	-.106	-.155	.143	-.141	.222	.503**	.236	.159	.247	.132	.060	-		
H7_P	.077	-.350*	.413**	-.251	.459**	.419**	.500**	.193	.378*	.347*	.204	.346*	-	
H7_A	.044	-.304	.276	-.090	.410*	.525**	.435*	.261	.362*	.214	.101	.556**	.474**	-

**$p < .01$.

*$p < .05$

Table 15

Correlations between the artists emotions and the viewers emotions for Human Prime/Human Picture 8-14

	H8_P	**H8_A**	**H9_P**	**H9_A**	**H10_P**	**H10_A**	**H11_P**	**H11_A**	**H12_P**	**H12_A**	**H13_P**	**H13_A**	**H14_P**	**H14_A**
H8_P	-													
H8_A	-.089	-												
H9_P	.762**	.094	-											
H9_A	.296	.388*	.450**	-										
H10_P	.744**	.045	.765**	.330	-									
H10_A	.115	.405*	.207	.430*	.188	-								
H11_P	.506**	.147	.522**	.302	.642**	.052	-							
H11_A	.282	.188	.367*	.419*	.430**	.350*	.319*	-						
H12_P	.779**	-.028	.731**	.351*	.768**	.193	.568**	.379*	-					
H12_A	-.234	.280	-.202	.059	-.112	.300	-.169	.119	-.139	-				
H13_P	.822**	.004	.740**	.322	.808**	.167	.558**	.350*	.783**	-.086	-			
H13_A	.659**	-.079	.606**	.433*	.657**	.218	.465**	.395*	.591**	-.120	.607**	-		
H14_P	.357*	.317*	.373*	.246	.473**	.008	.644**	.302	.346*	-.054	.435**	.198	-	
H14_A	.615**	.009	.554**	.277	.701**	.102	.594**	.367*	.599**	-.128	.603**	.724**	.354*	-

$^{**}p < .01.$

$^{*}p < .05$

Table 16

Correlations between the artists emotions and the viewers emotions for Computer Prime/Human Picture 1-7

	HP1	**H1_A**	**H2_P**	**H2_A**	**H3_P**	**H3_A**	**H4_P**	**H4_A**	**H5_P**	**H5_A**	**H6_P**	**H6_A**	**H7_P**	**H7_A**
H1_P	-													
H1_A	.052	-												
H2_P	.709**	.012	-											
H2_A	.323	.203	.288	-										
H3_P	.440**	-.184	.533**	.024	-									
H3_A	.331*	-.183	.384*	-.070	.444**	-								
H4_P	.602**	-.170	.642**	.010	.745**	.464**	-							
H4_A	.135	-.219	.284	-.031	.449**	.117	.436**	-						
H5_P	.520**	-.182	.673**	.024	.776**	.366*	.816**	.506**	-					
H5_A	.257	-.064	.200	-.210	.198	.616**	.244	-.076	.125	-				
H6_P	.604**	.242	.476**	.249	.237	.168	.291	-.150	.265	.295	-			
H6_A	.128	-.155	.167	-.141	.318*	.503**	.348*	.159	.305	.132	.087	-		
H7_P	.572**	-.060	.684**	.043	.457**	.386*	.663**	.256	.593**	.211	.406**	.307	-	
H7_A	.244	-.304	.316	-.090	.390*	.525**	.419*	.261	.438*	.214	.062	.556**	.470**	-

**$p < .01$.

*$p < .05$

Table 17

Correlations between the artists emotions and the viewers emotions for Computer Prime/Human Picture 8-14

	H8_P	H8_A	H9_P	H9_A	H10_P	H10_A	H11_P	H11_A	H12_P	H12_A	H13_P	H13_A	H14_P	H14_A
H8_P	-													
H8_A	.057	-												
H9_P	.754**	.000	-											
H9_A	.421*	.388*	.431*	-										
H10_P	.760**	.190	.613**	.383*	-									
H10_A	.221	.405*	.150	.430*	.138	-								
H11_P	.331*	.246	.197	.197	.528**	.040	-							
H11_A	.384*	.188	.293	.419*	.297	.350*	.120	-						
H12_P	.807**	.129	.635**	.415*	.740**	.193	.402**	.431**	-					
H12_A	-.135	.280	-.234	.059	-.139	.300	-.008	.119	-.139	-				
H13_P	.775**	.077	.657**	.427*	.674**	.250	.333*	.378*	.785**	-.127	-			
H13_A	.593**	-.079	.645**	.433*	.425**	.218	.121	.395*	.608**	-.120	.643**	-		
H14_P	.085	.379*	-.048	.100	.221	.040	.400	.104	.170	.033	.085	-,132	-	
H14_A	.589**	.009	.570**	.277	.446**	.102	.204	.367*	.608**	-.128	.631**	.724**	,072	-

$^{**}p < .01.$

$^{*}p < .05$