Neuromarketing, AI and Art:
Further Developments in Testing The FaceReader Technology on Artistic Paintings

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ABSTRACT

This is an ongoing research whose scope is to test and validate the software FaceReader by Noldus for detecting emotions from facial expression in art painting. Arts is often used in marketing as it evokes strong emotions in consumers improving the effects of the ad. Given the emotionality of the art infusion effect in advertising ads, the ultimate goal is to expand the application of the FaceReader tool to the field of art, which shares strong connections with the marketing field. Emotional responses to art vary depending on various factors, such as the individual, the artwork itself, and the context. However, the motivations leading to specific emotional responses remain unclear. We aim to bridge this gap by focusing on the emotions depicted in painted characters. The study combines neuromarketing techniques based on facial expression detection with traditional surveys. Further, the study applies FaceReader's capabilities to AI-generated versions of classic paintings. It contributes to support the understanding of the motivations behind emotional responses to art, providing managerial implications for brands that incorporate art into their marketing and communication strategies. The study provides valuable guidance for art managers and educators on designing art courses and exhibitions that highlight the emotional resonance of artworks.

Introduction

Neuromarketing is a discipline that combines neuroscience with marketing, economics, and psychology, allowing for alternative explanations of marketing impact on consumer behavior (Butler, 2008; Garcia and Saad, 2008; Javor et al., 2013; Lee et al., 2007). For instance, neuroscientists in marketing can gather real-time emotional data from test subjects exposed to various stimuli by using face reading technology (Lim, 2018). Among the other tools, FaceReader by Noldus traces facial movements to detect emotional states using around 58 action units (AUs). This tool is able to classify facial expressions into seven primary emotions: happiness, anger, disgust, fear, sadness, surprise, and contempt (Yu and Ko, 2017).

Marketing literature has demonstrated the crucial role of emotions on consumer behavior (Bagozzi et al., 1998; Huang, 2001; Gaur et al., 2015; Manthiou et al., 2020). For instance,

emotions can stimulate contagion effects (Hatfield and Cacioppo, 1994), where the emotional characteristics of the source are transferred to the targeted object (Hasford, 2015). These effects can be positive, such as a smiling testimonial positively influences consumer attitudes towards a product (Howard and Gengler, 2001) or the use of art in luxury marketing (Hagtvedt and Patrick, 2008). Negative emotions, such as sadness in social cause ads, can also be contagious and influence donation behavior (Small and Verrochi, 2009).
Considering art, many brands, products, and services employ art in their packaging or advertising due to its positive contagious emotional effects (Estes et al., 2018). Moreover, emerging trends like digital art and AI-generated art open up expansive opportunities for innovative artistic brand campaigns, whose effects need to be understood. The motivations leading to specific emotional responses to art used in ad campaigns still remain unclear. As emotionality represents a fundamental aspect of the art infusion effect in advertising (Estes et al., 2018), we aim to bridge this gap by focusing on the emotions depicted in painted characters. To the best of our knowledge, no research has addressed emotions in art with neuromarketing technologies. Previous research demonstrates that art elicits emotions by fostering audience empathy with the emotions of depicted characters (Noy and Noy-Sharav, 2013) and by using form to directly evoke specific emotions through its messaging (Holbrook et al., 1986; Langer, 1942; Pratt, 1952). However, a lack of sufficient empirical evidence and integrated studies hinders a complete understanding of emotions related to painting (Miu et al., 2015). To overcome this lack of evidence, the current ongoing study empirically tests the capability of face reading technologies to identify emotions depicted in paintings.

Theoretical Background

Neuromarketing and Emotions

Neuromarketing, born from neuroscience and marketing, was initially termed by Ale Smidts in 2002 as "the study of cerebral mechanisms to understand consumer behavior to enhance marketing strategies" (Boricean, 2009, p.119). Neuroscientists observe real-time neural processes using three main methods: recording neural activity inside the brain, monitoring activity outside the brain, and manipulating neural activity (Lim, 2018). Neuromarketing techniques, widely applied in communication and advertising, aid in identifying elements that evoke positive emotions and those that may trigger consumer aversion (Senior and Lee, 2008).
Emotion is characterized as a distinct and transient response to either internal or external stimuli, typically experienced for a brief period, termed emotional arousal (Choi et al., 2016). Emotional arousal refers to the physiological and psychological state of heightened responsiveness to emotional stimuli (Rule and Nesdale, 1976). Physiologically visible changes which accompany people's experience of emotions include facial expressions, body language, skin responses, tears, and sweating (Kret, 2015). By using neuroscientific tools such as facial expression analysis, skin conductance measurements, and eye tracking,

neuromarketers can detect subtle emotional responses to various stimuli (Lim, 2018). Traditionally, self-report techniques gauge individuals' emotional responses through open-ended questions or Likert-type scales (Lewinski et al., 2014). However, these methods only tap into conscious emotions, neglecting unconscious reactions (Daugherty et al., 2016; Casado-Aranda et al., 2019). In contrast, neuromarketing measurements of neurophysiological parameters offer more accurate insights into emotions by bypassing cognitive mediation and social desirability bias (Poels and DeWitte, 2006; Missaglia et al., 2017; Russo et al., 2020).

Arts and Emotions

Emotions, linked more to the content and personal interpretation of artworks rather than their formal qualities, contribute to the complexity of emotional experiences in art appreciation (Silvia, 2011). Artists may elicit emotional responses from their audience according to three distinct pathways, each rooted in a different theoretical framework: the "narration-imagination-identification" theory, the theory of "isomorphism," and the theory of "ego mastery" (Noy and Noy-Sharav, 2013).

The first pathway, known as the narrative route, entices the audience to empathize with the experiences and emotions of the characters depicted in the narrative by stimulating their imagination. The second pathway, termed the direct route, employs messages that directly activate the desired emotions through their form. Langer (1942) and Pratt (1952) argue that each emotion has a unique "Gestalt," and a message mirroring that form can evoke the corresponding emotion. The third pathway, or indirect route, engages the receiver's ego to elicit the desired emotional response (Kohut and Levarie, 1950).

Prior literature shows that emotional responses to paintings result from a complex interplay of factors related to the artwork, the individual, and the context. However, gaps in empirical evidence and integrative studies limit a comprehensive understanding, especially regarding painting-related emotions and motivations (Miu et al., 2015).

FaceReader technology

In emotion measurement, two primary theoretical approaches are typically considered: the categorical and the dimensional approach. The dimensional approach, as proposed by Tomkins and McCarter (1964), and Johnson-Laird and Oatley (1992), categorizes emotions based on the dimensions of valence (positive or negative) and arousal (activation level). In contrast, the categorical approach, supported by Ekman (1970), Ekman and Friesen (1986), posits six basic emotions (happiness, surprise, anger, fear, disgust, sadness) alongside a neutral state, discernible through Facial Action Coding System (FACS) analysis of facial expressions (Ekman and Friesen, 1978).

Contemporary research often embraces a hybrid model (Russell, 2003), as seen in Noldus's FaceReader software, which combines categorical and dimensional approaches for better analysis. FaceReader employs facial feature tracking to identify and classify emotional states, with approximately 58 action units (AUs) representing various facial movements.

The software categorizes emotional states into seven primary categories, including happiness, anger, disgust, fear, and sadness, while surprise and contempt are context-dependent (Yu and Ko, 2017).
Additionally, FaceReader provides valence and arousal measurements, crucial for capturing the intensity and activation level of emotions, aiding in moment-to-moment analysis. Valence values range from -1 (purely negative) to 1 (purely positive), while arousal denotes the emotional activation, indicating calming or exciting states (Yang and Dorneich, 2015). FaceReader has been employed in many marketing research so far (for an extensive review see Landmann, 2023), and it is able to detect facial expressions amidst ages, gender, and culture. However, no applications of FaceReader have been performed on paintings. This study wants to validate this tool on facial paintings to enlarge its application.

Artificial Intelligence and Art

Digital and AI technologies are revolutionizing the world of art. Generative Adversarial Networks (GANs), developed by Ian Goodfellow in 2014, have been used to create photorealistic images that can mimic real-world appearances. GANs are a class of deep learning models consisting of two neural networks: a generator and a discriminator. The generator creates realistic images, while the discriminator evaluates their authenticity. Through competition, these networks improve, allowing GANs to produce highly realistic images from input data. When GANs are trained on datasets containing both paintings and real images, they learn to translate artistic styles into realistic human features. For instance, if a GAN is trained on the Mona Lisa and a dataset of human faces, the generator can produce a photorealistic version of the painting that resembles an actual person.

Methodology

The study uses the FaceReader technology to analyze facial expressions in selected artworks. The face-reading system provided by Noldus utilizes the Facial Action Coding System (FACS) to detect facial movements associated with Ekman's six fundamental emotions: joy, sadness, anger, fear, surprise, disgust, and contempt (Ekman, 1970).
First, a committee of experts selected 12 artworks from Google Arts and Culture, two per emotion, from Renaissance to Liberty periods, ensuring each depicted humans with clearly visible faces. They identified the predominant emotions for each artwork. Second, FaceReader software analyzed the facial expressions in the paintings. Third, the congruence between the committee's identified emotions and FaceReader's top-ranked emotions was assessed. Fourth, a survey of 103 respondents ranked the top three emotions perceived in each painting. Finally, the survey results were compared with FaceReader's findings to measure congruence, excluding cases where FaceReader detected emotional neutrality.
The next step applied FaceReader to 11 AI-generated realistic versions of the 11 classic paintings created using Generative Adversarial Networks (GANs). GANs allow to create realistic versions of human faces depicted in classic paintings. This analysis enabled us to

compare AI-recreated realistic artworks with the originals in terms of emotional expression. FaceReader analysis was conducted on both the original and AI-generated versions. Then, a congruence analysis was performed comparing the predominant emotions in the originals with their AI counterparts. The degree of congruence between the AI-generated and original paintings confirms FaceReader's ability to assess depicted emotions accurately.

Preliminary Results

We found a 100% match between the emotions ranked first or second in intensity by FaceReader and those ranked first or second by respondents. The same 100% congruence was observed when comparing FaceReader's findings with the Committee's results. Additionally, there was a 100% match between the emotions identified by FaceReader in the original paintings and their AI-generated versions.
When we conducted a more precise comparison focusing only on the emotions ranked first, the match between FaceReader and the respondents was 41.67%, while the match with the Committee of Experts was 83.33%. The congruence between the original paintings and their AI-generated counterparts was 59.09%.

Implications for Theory and Practice

In terms of theoretical-methodological contributions, this paper presents one of the first applications of FaceReader to facial paintings, aimed at expanding the instrument's field of application (Landmann, 2023). Additionally, by focusing on the emotions portrayed in paintings, this paper addresses an existing gap in the study of motivations behind painting-related emotions (Miu et al., 2015). The FaceReader application may also be extended to include artifacts of lesser artistic significance that serve as components of a marketing stimulus.
From a managerial perspective, this study offers several insights. First, FaceReader can effectively interpret emotions from realistic human faces in artworks. This capability can enhance marketing strategies by incorporating human faces in advertising, chatbots, and digital interactions to evoke desired emotions. Art experts may integrate FaceReader analysis into their critiques, while galleries and museums could use these insights to optimize the layout and display of artworks based on the emotions conveyed by depicted faces. Furthermore, art educators may design their courses basing their decisions on the FaceReader analysis results too.
Additionally, this approach could be extended to cartoons and realistic 3D representations, such as robots and sculptures.

Keywords: Neuromarketing, Emotions, Arts, FaceReader, Artificial Intelligence

References are available upon request