Exploring Relationships Between Emotion and Art in Cognitive Science

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Abstract

This paper explores the intersection of design, creativity, and human-computer interaction and examines the impact of art on emotional processes and cognitive development. This domain was chosen because it has significant implications on everyday lives, both consciously and unconsciously. This paper adopts the literature review methodology to examine the current research in this space and relate it to the following study to discover and address potential limitations by finding something novel. Prior work has established the cognitive and emotional benefits to creating art; however, there is limited research on the relationship between specific cognitive science principles and aesthetic response, artistic design guidelines, and emotional expression and regulation via art. This paper furthers the literature by positioning these in the context of Thagard's CRUM framework, providing insight into how principles such as analogical and imagistic reasoning, connectionism, and rules and representations can help understand how people perceive, interpret, and benefit from art. It concludes by proposing potential ways for future studies to address its limitations.

Introduction

Emotion and art are fundamental aspects of human experience that have been studied across various disciplines, including cognitive science, psychology, and aesthetics. Although there is a breadth of work on the topic, the cognitive science community is not in agreement on how to interpret the aesthetic experience in terms of the mind and concrete neural processes. In this literature review, we explore three categories of inquiry to better understand the intersection of emotion, cognition, and both visual and musical art. First, we examine the basic cognitive and neural processes involved in emotional responses to art. Second, we investigate how insights from cognitive science can inform and enhance creativity and the design process. Lastly, we explore how engagement in art and music practices can impact emotional regulation and cognitive development.

Our review aims to provide a comprehensive overview of the current understanding of the complex interplay between emotion, cognition, art, and their implications for cognitive science and related fields. An interdisciplinary approach can enrich our understanding of the human experience and contribute to the advancement of theoretical frameworks, practical applications, and future research directions in these fields. In turn, this can inform the development of effective interventions, therapies, and educational approaches that can use the power of art and music for cognitive development and emotional well-being.

Through our research, we have found some gaps that may benefit from a cognitive science perspective. While there is plenty of evidence for the benefits of evaluating and practicing art for cognitive health and emotional well-being, there is a limited understanding of what exactly happens in the mind during such actions. Thus there is a need for further investigation into the physiological and neural mechanisms underlying emotional reactions to art

and how to interpret those in terms of cognitive techniques such as analogical reasoning or imagistic thinking. Further, the effects of such cognitive techniques on design thinking, decision-making, and creativity are not well-defined and could be improved with more empirical study. More research is needed to address these, but we aim to fill some of those gaps using the cognitive representational understanding of mind (CRUM) framework and other related cognitive science principles.

Methods and Design

Since the chosen field is broad with extensive applications, the literature review methodology was adopted as the method of study to examine the research questions. Once the field of study was identified, preliminary research was conducted to define the research questions. The purpose was to use the current research as a support for this study to examine something novel by relating it in the context of cognitive science and the existing literature.

Three primary subfields were identified, which formed the basis for the research questions. These were the emotional response and reaction to art, the application of cognitive science approaches to design thinking and creativity, and how practicing art affects cognitive development and emotional regulation. Once the research questions and relevant variables were defined, databases including GT Library, ProQuest, ERIC, etc. were used to investigate the existing studies. Thirteen sources of literature were identified and divided between the team for review and examination. The important findings and potential gaps were noted, after which the analyses were reviewed and discussed in the context of the relevance of each paper to this research. Using these learnings found while conducting the literature review, the scope of the research domain was narrowed as it focused on more specific research questions. A detailed

exploration and evaluation of the papers also led to a better understanding of the methodology that was used to conduct these studies, through which further direction was gained. This process thus provided a strong theoretical foundation that was built on in the study. Therefore, this was the most important step since it provided background into the subject, thus allowing for the discovery of key gaps in the existing material and the required modifications to be made to the research questions.

Finally, the results were integrated to organize the relevant findings. Important ideas, patterns, and relationships in the literature were identified and structured in terms of discussing approaches for this study. The results found as part of the exploration of the research questions through this literature review are discussed later in the paper.

Results

Emotional reactions to art involve numerous complex cognitive processes, including perception, attention, memory, emotion regulation, empathy, and aesthetic judgment. Mastandrea et al. (2019) found that viewing art can have a positive impact on psychological well-being by activating brain regions associated with positive emotions and reward processing. The authors discuss the concept of aesthetic emotion, or the emotional experience triggered by the perception of art, and summarize the neuroscientific research on the brain regions and neural networks involved in processing aesthetic stimuli. For example, Kawabata and Zeki (2004) found that 'beautiful' images elicit a higher reward activity in the brain (such as in the medial orbitofrontal cortex) than 'ugly' images as rated by participants.

Considering a broader definition of art, Krumhansl (2002) investigates the influence of music as a bridge between cognition and emotion. The research indicated how specific regions of the brain are activated with music, and how this leads to improvements in patients suffering brain

damage. It further suggests the impact of music in different spheres of life as a determinant of emotion. Research by Mitterschiffthaler et al. (2007) revealed that “the activation of an emotion processing network comprising the ventral and the dorsal striatum, the anterior cingulate and medial temporal areas has been associated with the transient mood changes in response to happy and sad classical music.”

A significant concept in this research space, which lends itself to better understanding emotion, is that of visualizing human emotion. Cheng (2021) discusses the importance of emotion in art and the limitations of traditional static art in conveying dynamic emotional experiences. The author argues that the system provides a new avenue for emotional expression and can help bridge the gap between traditional static art and dynamic digital media. J. Wang et al. (2022) explored how understanding the emotional response of viewers to visualizations is important for designing communicative and engaging visualizations. They identified several factors that influence the emotional response to visualizations, including the complexity of the visualization, the type of data being visualized, and the context in which the visualization is presented. Hagtvedt et al. (2008) designed a model for the perception and evaluation of visual art, which was interesting to explore since it provided insight into the complex field of visual art, thereby guiding our understanding of responses and reactions to it.

Findings from this space may help us learn how to think about design principles in a way that elicits emotional response. Y. Wang et al. (2019) focused on the emotional response to the value of visualization and how this can inform the design of effective visualizations. They found that there is a trade-off between the complexity of the visualization and the emotional response it elicits, and that understanding this trade-off is important for designing effective visualizations. They also suggest that cognitive science approaches, such as understanding how the brain

processes visual information and how emotions are regulated, can inform the design of effective visualizations and enhance creativity in the design process. Shao et al. (2019) provided a review on how culture shapes creativity, discussing the influence of cultural values, beliefs, and practices on the creative process and the outcomes of creativity. Goldschmidt (2001) explores the importance of visual analogy in problem solving and design-thinking. Thus, cognitive science concepts such as case-based reasoning and visual analogies have vast scope in understanding abstract material and shaping the design process and creative thinking.

Our third area research is most focused on how practicing art affects cognitive development and emotional regulation and how it can improve humans' wellbeing. Fancourt et al. (2016) conducted a systematic review of the effects of visual arts interventions on emotional regulation and found that engagement with visual arts can have positive effects, including reducing negative emotions such as anxiety, depression, and stress. They suggest that making art may provide a way for individuals to express and regulate emotions in a non-verbal way, and that this can lead to improvements in emotional regulation. The work of Mastandrea et al. on aesthetic emotions, referenced above, also discussed the potential benefits of engaging with art, such as reduced stress, increased positive emotions, and improved cognitive function. Baker (n.d.) investigated the impact of the integration of art in educational curriculum on cognitive development, particularly on children. Results indicated the significance of culture and context as key factors when examining this relationship. Farrington & Shewfelt (2020) explored how the integration of art in education has a significant impact on social and emotional development and growth. Through the incorporation of art in learning, students are engaged, participative, and are challenged to take informative risks, which enhances their socio-emotional development.

Literature Gaps

While existing research has provided insights into the cognitive processes involved in emotional reactions to art, there is a need for further investigation into the neural mechanisms underlying these responses. Advanced neuroimaging techniques could be employed to investigate the brain processes associated with emotional experiences during different types of engagement with art.

While cognitive science principles, such as analogical reasoning and imagistic thinking, have been proposed for enhancing artistic design and decision-making, there are not many empirical studies evaluating their effectiveness. The connection between the principles and outcomes are often presented in theoretical frameworks, so more research on the matter may help prove the value of these cognitive techniques and their impact on creativity, problem-solving, and decision-making.

The majority of research in this area has focused on general populations, and there is a need for more studies exploring the use of art and music for emotional regulation and expression in diverse populations and contexts. Although Pike et al. (2013) performed a study on how art therapy benefits cognition in "ethnically diverse older adults," limitations noted the participants were not very diverse (92% Caucasian or Hispanic/Latino). Many 'diverse' studies have similar limitations. Additionally, Shao et al. note the need for investigating the roles of culture, multicultural experiences, and cross-cultural neural differences.

Clearly there are many complex factors at play when discussing this topic, including the neurological basis for emotion and the diversity of human emotional behavior across age, culture, personality, and mental state, among others. Merely focusing on one of these factors ignores the nuance involved in each of the others, as each interacts with the others. Despite the

extensive work in the different fields surrounding this topic, there is very little available that discusses art's relation to emotional reaction and regulation, design principles, and creativity specifically in terms of Thagard's (1998) CRUM. As an element of our research, we take Thagard's approach to understanding the mind by viewing it analogously to a program. In particular, CRUM's theories of images, connections, and analogies help to position this topic within the framework. More so, however, we draw on Thagard's "extensions to cognitive science" that are not situated in CRUM: the brain, emotion, consciousness, and the body.

Discussion

The findings from these studies indicate that cognitive processes play a significant role in emotional reactions to art, both visual and musical, and can be explained in terms of the CRUM framework. Cognitive science principles, such as analogical reasoning, imagistic thinking, and rule-based processing, can be applied in artistic design and decision-making, with cultural factors influencing the approach to design thinking and creativity. Additionally, art and music can be used for emotional regulation and expression, an important application to be considered with respect to the role of art in cognitive development and well-being. The review of the existing literature showed that while there have been studies conducted in the chosen field, there has been limited focus on relating the concepts in terms of Thagard's CRUM theories and criticisms. Therefore, this study aimed to relate these factors and explore their interaction thoroughly.

Contextualizing this topic within CRUM is valuable for several reasons. A framework based on CRUM and its criticisms provides a structured, comprehensive, and integrated perspective to understanding the complex interaction between these concepts in the context of cognitive science. This structured approach, analogous to a computer, may make it easier to

understand the interplay between representations in the mind (data structures) and computational operations (algorithms) performed on them. Further, understanding the criticisms and boundaries of CRUM can lead to a more nuanced understanding of both the topic at hand as well as CRUM itself, and the documentation of these limitations and strengths may contribute to the development of the framework in future work. Lastly, CRUM can serve as a central framework for studying the mind in conjunction with other domains and theories, contributing to a more holistic and interdisciplinary approach to research in this area.

The first research question investigated the cognitive processes that are involved in the emotional reactions to art. The results found as part of this have important implications in fields including education, neuroscience, arts, psychology, etc. Knowledge of this underlying mechanism can lead to better comprehension of the process of interpretation of stimuli from the environment, thus allowing for an improved understanding of the nature and expression of human emotions. This has implications in psychological well-being and health (Mastandrea et al., 2019). These cognitive processes can also be related to CRUM theories - mental representations and computational processes generated by the brain in the form of beliefs and memories are elicited in the creation of art, giving internal representations an external form. Experiencing and perceiving art and music to feel socially connected in this way is an application of distributed cognition. Subjective emotional reactions in response to these mental representations of art can lead to better appreciation of art and even therapeutic applications. This ties into the criticisms of the CRUM approach in the form of consciousness and culture, which have limited research currently. This research thus studied how cognitive processes related to self-awareness can influence subjective experiences of art, including emotional states and

physical sensations, and how cultural background can influence the interpretation and emotional valence attributed to visual or musical elements in art.

This study also had significant implications with respect to the second research question. Stemming from the concept of mental representations and cognitive processes, the study explored how more engaging and intuitive designs can be created with this knowledge. Analogical and imagistic thinking play a key role here - these processes help improve the overall design process by generating new ideas by drawing parallels and making connections between domains such that unique and innovative design solutions are inspired. Mental imagery and visualizations allow designers to explore different design options, making it easier to understand information when focusing on artistic design principles and decision-making (Goldschmidt, 2001). Social and cultural influences connect these concepts as different cultures may have distinct aesthetic preferences, design principles, and decision-making styles that influence how design is approached and perceived. It is thus important to be mindful of different contexts and diverse audiences to ensure cultural relevance and resonance with the target users. This question can therefore be answered by relating CRUM principles and its criticisms and can have even broader applications in the field of humanity centered design.

The final area of research integrated ideas from the previous questions. An understanding of the cognitive processes involved in the emotional reactions to art in the context of design thinking and perception of art can be applied to study its impact on emotional expression. Past studies have proved the efficacy of visual arts in emotional regulation and the reduction of negative emotions (Fancourt et al., 2016). This can be explained by the concepts of imagistic reasoning, connectionism, and rules and representation. Imagistic thinking allows individuals to create and manipulate mental images that represent emotions, experiences, and desires, which

can help in processing and regulating emotions. This is especially important for nonverbal and symbolic expressions of emotions for people who have a hard time doing so verbally. The connectionist approach is significant because regulating emotions is analogous to changing the values of weighted connections within the brain that connect emotional experiences and responses. It thus provides a foundational scientific understanding of emotional regulation. Moreover, the connectionist approach can also be used to explain the dynamic nature of emotional regulation since the specific activation of neurons can change over time based on learning and experience. Since this is an adaptive and creative process, defining a set of rules can limit complete expressive potential; however, it might be beneficial in some cases to have some guiding principles to help achieve therapeutic goals.

Therefore, this study examined the existing literature in the context of the three research questions discussed above by relating it to cognitive science theories. It further delved into the interaction between these principles through the lens of Thagard's CRUM framework and its criticisms. While CRUM approaches successfully explained specific concepts individually, it was important to consider its criticisms and extensions to comprehensively relate them to the broader context of the research domain. The purpose of this study was to therefore utilize these concepts and explore the implications of how the complexity and richness of the human mind influences emotional experiences, decision-making, and expression.

Conclusion

Understanding the complex relationships between cognitive processes, emotional experiences, and artistic expression is a multifaceted field of study, drawing on findings from many different perspectives. There is extensive work confirming the cognitive and emotional

benefits to creating art, as it provides people the opportunity to reflect on, explore, and give form to their emotions. There is also a breadth of work on how visualization strategies and emotion have a mutually beneficial relationship that help both understand emotional response as well as improve visualization and design strategies. By understanding how emotions impact our perception and processing of visual information, we can design more effective visualizations that elicit the desired emotional response in our audiences. Conversely, by using visualization strategies to represent emotional data, we can gain a better understanding of how emotions impact our behavior and decision-making. However, we have found an absence of work on connecting specific cognitive science concepts to the process of aesthetic response, artistic design principles, and emotional expression and regulation via art. This study contributes to the literature by positioning these in terms of Thagard's CRUM framework, providing insight into how principles such as analogical and imagistic reasoning, connectionism, and rules and representations can help understand how people perceive, interpret, and benefit from art.

Limitations

The primary limitations of the method of this study included selection bias, publication bias, and subjectivity. While we aimed to maintain objectivity in the selection of current studies, the literature review method is prone to these biases, which could have led to a slight overestimation of the relationships that were found. Subjectivity was reduced by documenting the process and the findings, thus maintaining inter-rater reliability.

Since there was limited work on the connection of cognitive science concepts to design principles and emotional expression and regulation via art, this study provided a detailed analysis of these concepts in the context of Thagard's CRUM framework. Future studies can target more

specific research domains by examining the impact of individual design principles on emotional reactions to art, the impact of different types of art on emotional regulation and expression, and the variations in perception by different populations. These can be investigated by means of correlational, ecological, neuroimaging, and experimental studies.

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