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Arts Based Brain Research

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The Need for a Holistic Approach to Brain Based Art Research

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Art is believed to be "the expression or application of the human creative skill and imagination, producing works to be appreciated primarily for their aesthetic value or emotional power" (Buk, 2009, p. 61). While there are a myriad of ways to define and categorize art, such a definition as the one above is useful as it touches upon three key areas of arts based brain research; artistic cognition, artistic production and aesthetic experience. The study of arts based brain science, or the neuroscience of art, demands an understanding of the interplay between these three facets of the artistic experience. Most current research, however, looks at various aspects of art in isolation from the others. Studies examine how the brain engages in thinking and planning works of art or how the brain perceives beauty. While these studies are ground breaking and illuminating, they are simply parts to a larger whole. In order to understand one aspect of art making, it is critical that neurosciences working in art understand the whole of the artistic experience.

Neurosciences view creativity and artistic cognition as a multifaceted function that engages various regions of the brain. While previous thinking and unsubstantiated claims perpetuated the right brain, left brain myth; researchers who studied brain injuries, found that artistic ability remained intact even when the entire right hemisphere of the brain was impaired. (Pearce et al., 2016). Additionally, recent research that focused on renowned artists, George Braque and Oskar Kokoschka, both of whom suffered brain injuries during WWI, found that while both men suffered brain impairment in various regions of the brain (though the exact regions are unknown due to limited technology), neither's art work was impacted after their injuries. Pearce et al writes,

> unlike language, where neural control in the brain is highly localized (mainly in the left hemisphere), the advantage of art's communicative format is that humans have increased their ability to express their inner and external life's experiences through widely distributed systems in the brain. It explains why brain injury of the

> kind described here does not lead to significant alternatives in art expression (2016, p. 58)

This begs the question, what are these "widely distributed systems" and networks within the brain and how are they involved in each aspect of the creative process?

Creativity and Divergent Thinking

The term artistic cognition can be used as a term to describe the interpersonal reflection that happens throughout the artistic process. Artistic cognition occurs throughout the creation of a piece of art, including the brainstorming and planning phases, the creating phase, the critique, editing and revision phase and even in the appreciation stage. The most accepted way of deconstructing artistic cognition in the brain is by examining convergent and divergent thinking. (Zmigrod, Colzato, & Hommel, 2015)

Convergent thinking is related to the ability to find "a single solution to a problem in an analytical, deductive way" (Zmigrod et al., 2015, p. 353) and is primarily associated with the executive control network (EN) in the brain. (De Pisapia, Bacci, Parrott, & Melcher, 2016) The executive network is located in the lateral nodes of the dorsolateral prefrontal cortex and is believed to control goal oriented, evaluative, rule based thinking. It enables the brain to generate mental representations and is responsible for "cognitive control, abstract thinking, decision making and planning" (De Pisapia et al., 2016, p. 2).

Conversely, divergent thinking is linked to spontaneous thought and the ability to generate a wide range of possible solutions of ideas for a singular problem (Zmigrod et al., 2015). Divergent thinking is believed to be activated by the default-mode-network (DMN) within the "medial prefrontal cortex (anterior part of the medial frontal gyrus), the posterior cingulate cortex, the medial temporal lobes, the precuneus and the temporo-parietal junction."

(De Pisapia et al., 2016, p. 2). These regions of the brain regulate spontaneous and divergent thinking as well as mind wandering.

Convergent and divergent thinking are generally used in opposition of one another. It is consistently found that during stimulus-based tasks, such as following the steps of a math problem, activity within the executive network will increase, while the default-mode network activity will decrease. Researchers have defined these two network as have a "push-pull relationship" in most subjects, however, when engaged in creative or artistic thought, these networks are believed to work in tandem (De Pisapia et al., 2016).

De Pisapia et al hypothesized that due to the need for creativity to be both divergent (spontaneously creating new ideas) as well as convergent (regulated and focused) artistic cognition would involve both the executive control (EN) and the default-mode-networks (DMN) of the brain. To test this hypothesis, researchers created a study uses f (MRI) to scan the brains of participants, including professional artists and those without artistic skills, and monitored their cognition when daydreaming, visually imagining letters of the alphabet and visually planning out a work of art. During the planning of the artwork, both the executive control network and the default mode networks were strongly engaged as compared to the resting state. During the alphabet phase, there was a decrease in connection between the EN and the DMN as compared to the visual planning phase. Researchers noted that this is significant as "this suggests that ENs and DMNs are more strongly connected during the visually creative phase than when compared with an alphabet visualization task - a mental activity which is close to visualization efforts of the creative task, but without the creative component" (De Pisapia et al., 2016, p. 6).

Researchers also suggest that these findings are not limited to fine arts, but the performing arts as well. De Pisapia et al drew a comparison between their finding and similar

studies of creativity that compared piano and rap improvisation, showing a similar increase in these networks during improvisational periods as compared to repeated sequential music making (2016). The fact that these networks were more connected during artistic cognition is worth further examination and has potentially significant application to visual arts education and curriculum.

Grounded Cognition

One of the main limitations of this study, however, is that artistic cognition is happening in isolation. The artistic process involves a constant flow of cognition and creation. Artists are engaged in a constant stream of planning, doing and revision throughout the artistic process. This concept may be better illustrated through the understanding of grounded cognition. Grounded cognition, suggests that thinking is "grounded" in one's physical interactions with the world around them. Kantrowitz states:

> There are three main components of grounded cognition: modes of perception, movement, and introspection. We know the world through our modes of perception: vision, auditory, smell, taste, and touch. We also get information from the movement of our bodies in space, through direct action, and through proprioception—that is, the awareness of different parts of our bodies in relation to each other as we move. Our third source of knowledge comes from introspection, our inner awareness of bodily states and feelings. (2012a, p. 4)

Art, and in particular, drawing, according to Kantrowitz involves all three aspects of grounded cognition. The role of art making is a circular process that involves taking in information about what is both around the artist and within their drawing. Artists are constantly taking in critical information about the work they are creating; the connection of their lines to one another, the negative space within the paper, the angle and proportion of their marks. This information is impacted by their movement and motor skills, which are constantly at work changing the drawing/art and therefore changing their perception. Throughout this process

cognitive introspective is taking place to help generate the artist's understanding of their body, mood, expression and creation (Kantrowitz, 2012b).

Artists may be the best form of verification for these claims. In his 1985 interview, renowned painter, Francis Bacon, when asked if he had an idea of what he wants his art to look like before he starts stated, "I have an overall idea of what I want to do but it's in the working, in the working that it develops" (Bragg, 1985). Additionally, architect Marc Trieb, illustrates this point beautifully saying, "at some point—and this is one of the miracles of drawing—the image begins to tell us more than we have projected into it; new or unrecognized relationships or ideas emerge that stimulate further creativity" (Robert, 2009, p. 15). Research studies that isolate one or even two of the artistic processes aren't presenting a holistic picture of art making.

Artistic Parameters

A recent study conducted by Kaimal et al, applied the ideas of artistic cognition to various activities ranging from structured coloring to less structured doodling and unstructured free drawing. The study included a total of 26 participants of which 11 were self-identified artists and 15 were non-artists. Researchers operated under the hypothesis that the unstructured free drawing would provide participants with more reward activity within the brain, and that this reward would be greater for their artistic participants as compared to their non-artistic participants. (Kaimal et al., 2017)

The study found that reward activation levels increased during all three of the drawing conditions as compared to the control rest conditions, however, the findings were not statistically significant. What is worth noting, however, is that brain activation in the reward system, for all participants regardless of art skill, was higher during the less structured activities of doodling and free drawing as compared to coloring. The most activation occurred during the doodling

condition, and not the free draw phase as was hypothesized by the researchers (Kaimal et al., 2017). From an artistic perspective, this may be a result of the exceptionally similar relationship between doodling and free drawing. As an artist there seems to be less limitations and structure involved in doodling, as opposed to free drawing, which suggests the artists are following a more structured format and engaging in more compositional planning. The authors stated: "Doodling was defined as a personalized doodle style that the participant might have used in the past. Free drawing was defined as any drawing the participant chose to create" (Kaimal et al., 2017, p. 88). The term free draw may suggest to artists that they should follow compositional standards and form a "drawing" or "picture" whereas doodling generally lacks normal artistic parameters and can be more free formed and unstructured.

Similarly, a study by Kruk et al entitled "Comparing Brain Activity During Drawing and Clay Sculpting" used qEEG studies to examine brain activity during a drawing created in response to a directive and a clay sculpture created without a directive. The results of the study showed that both the directed and undirected activities engaged the medial frontal and parietal lobes within the right hemisphere of the brain. In addition, clay sculpting also showed a slight increase in theta waves, associated with imagination and meditative states. More significantly, the clay sculpting activity showed, higher gamma wave power within the parietal lobe. Gamma waves are associated with "synthesis, simulation processing and information rich task processing" (Kruk, Aravich, Deaver, & deBeus, 2014, p. 53). The fact that these gamma waves were higher during unstructured art making as opposed to directed art making suggests that artistic freedom plays significant cognitive part within the artistic process. These finding, however, could be colored by change in materials. Researchers noted their own limitation, especially when selecting two different materials for the experiment. The results would have

been more controlled had they conducted the test using only clay sculpting or drawing with their participants. Further research must be conducted before applying this study to art education and art therapy, however, it raises essential questions about how the purpose of the art work itself impacts one's neurological responses.

Conceptual Art and Cognition

Conceptual art, unlike more historical and traditional art, isn't linked to a time period or style but instead is seen as a piece of art that is focused on an idea. Kranjec, notes, "Conceptual art frequently interrogates traditional ideas of what art is by playfully challenging standards of beauty and medium to the point that much of what constitutes a work of conceptual art is the idea itself" (2015, p. 1). In his metaanalysis of neuroaesthetic research, Kranjec discusses the limitations of exploring aesthetics within research and postulates that looking at something for its beauty would illicit different regions of the brain than looking at something for its meaning and purpose. This hypothesis can be furthered by questioning the role of making something for the purpose of being aesthetically pleasing vs. making something to be meaningful and conceptual. (Kranjec, 2015)

Art and its Audience

Based on the definition of art in which states art is "producing works to be appreciated primarily for their aesthetic value or emotional power" (Buk, 2009), the role of the audience is ever present in the mind of an artist. In fact, it can be argued that conceptual art is created with a more conscious awareness of the audience, as its focus is to communicate an idea to someone. The field of neuroaesthetics examines the brain of the audience and often crosses over to the neuroscience of art. The overlap for these two fields is particularly poignant for the purpose of research into the creative process. While neuroscience of art examines the neurological and

evolutionary processes of interacting with art from a variety of entry points, neuroaesthetics looks at art from the lens of beauty and is founded in empirical aesthetics. In order to understand the viewers/audience response to art and the relationship between the artist and audience, it's critical to examine this from both a neuroart and neuroaesthetic viewpoint. (Pearce et al., 2016)

Conceptual artist Francis Bacon is an excellent example of artist created art with the audience in mind. Bacon's work is known for its visceral and grotesque style.
Critics describe his work as being filled with, "contorted figures and portraits, his screaming popes and apes, his flanks of beef and crime-scene gore, and his wrestling lovers bring to mind any number of video-melodramatists" (Smith, 2009, p. para. 3). The critic goes one to describe additional works by Bacon as "Sex, both violent and not, takes place; crimes are committed; guts are spilled. Colors become electrifying, textures enriched. The curved shelf of space that becomes the norm circles around, implicating us as intimates, voyeurs or unwilling witnesses" (Smith, 2009, p. para. 16). In 1985 on the Melvyn Bragg (1985) on the *South Bank* Show with Melvyn Bragg, Bacon stated that he doesn't want to tell a story and but instead wants to give a "shock. . . not a shock that you could get from the story [but] a visual shock" (Bragg, 1985).

Neuroaesthetic researchers, used Bacon's art as a model to examine how viewers actually experienced a visual shock when looking at Bacon's work. Researchers argue that through Bacon's use of distorted figures, and subverted messages of revulsion and horror, he was attempting to trigger a location in the brain of the viewers that would in turn project his pain onto the viewers. The use of figures allows the viewers to feel an ever more visceral shock and neuroscience suggests that stimulus such as bodies and faces are perceived in a different and more interpersonal way by the viewer than acquired stimuli such as houses and cars. By portraying distorted and violently drawn figures and faces, Bacon is presenting a person stimuli

to the viewers in a disruptive and trigger way. (Zeki & Ishizu, 2013) His art work attempts to simulate that same feeling of pain and anguish within his audience. Bacons desire to shock and evoke emotions within his viewers is actually founded in brain science.

Conclusion

The artistic process is widely accepted by art teachers as being a cycle of brainstorming, planning, creating, reflecting, editing and displaying art work. (Walker, 2001) While some stages such as planning and displaying may seem to happen in isolation, the majority of the artistic process is a constant progression, each happening simulations and thus informing the other. Kantrowitz writes, "unlike diagrams, drafting systems, and natural language, which differentiate phenomena into discrete categories, human thought is often continuous. Quick, gestural drawing—that is, sketching—unlike these other symbol systems, is also continuous" (2012a, p. 10). The role of drawing and sketching, according to Kantrowitz, and fellow neuroscientist Vinod Goel, mirrors the role of thinking within the brain. Kantrowitz states that sketching's "indeterminacies and gaps reflect the way we actually think through problems and provide openings for the new and unforeseen" (2012a, p. 10).

Brain based arts research has improved wildly over the past decade as new technology allows scientists to see and understanding the living brain. While this research is constantly evolving, it's critically to note the limitations within technology and research. Each individual study, including those discussed here, help to inform the general understanding of the neuroscience of art. The danger of these studies,

however, lies in looking at them in isolation and seeing them as a holistic understanding of the artistic process. The artistic process is vast and deeply connected. As technology advances and brain scans can be conducted to capture the entirety of artistic creation, these isolated studies will provide invaluable resources in understanding the interplay between artistic cognition, creation and appreciation.

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