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Rewiring the Nervous System with Art Therapy: Advocating for an Empirical, Interdisciplinary Neuroscience Approach to Art Therapy Treatment of Traumatized Children, A Literature Review

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Abstract

Devastatingly, children's exposure to trauma and stressful life events is pervasive and spans a range of human experiences. Advances in neuroscience demonstrate that such traumas experienced during childhood can deleteriously rewire a child's nervous system, in-turn altering their brain's organization, development, and function. Left unresolved, the impacts of trauma can compound across a child's lifetime manifesting in a host of negative psychological and health outcomes. Timely and neurosequentially-based interventions are key to helping traumatized children heal and achieve their full potential. This review of art therapy literature identifies current neurobiological-informed art therapy models for children who have experienced trauma. A substantial gap was revealed to exist between the integration of neuroscience concepts into art therapy practice and the availability of quantitative studies to empirically demonstrate art therapy's effect on a child's brain structure and function. This thesis proposes an empirical, interdisciplinary approach to art therapy, that sensitively aligns with the child's developmental stage as well as with their impaired nervous system.

Key Words: Art Therapy, Attachment, Childhood Trauma, Neuroscience, Nervous System, Neurosequential Development, Quantitative Studies

Introduction

"After trauma the world is experienced with a different nervous system"

(van der Kolk, 2015, p. 53)

This capstone thesis will explore the intersection between art therapy and the neuroscience of childhood trauma. The motivation for this inquiry is to promote the development of research that investigates neurobiological changes in response to art therapy interventions for traumatized children. I argue that art therapists need to accurately understand the direct neurobiological impacts of their practice to ensure the use of safe and effective treatments. Contemporary art therapists King, Kaimal, Konopka, Belkofer, and Strang (2019), champion this stance and write that by knowing which brain structures are "involved with cognitive and emotional processing can support intentional clinical choices…the more that is understood about brain structure and function, the greater the capacities to view a client holistically" (p.151). Since its inception in the 1940s, the field of art therapy has been supported predominantly by research in the form of case studies. These in-depth investigations of an individual or group can generate rich data, clinical substance, and provide qualitative evidence for the benefits of art therapy. However, because of the individualized design, case study results cannot be generalized. To expand the applicability of research to their identified target populations, a growing number of art therapists have begun to quantitatively research their arts-based methods (Chapman et al., 2001; Eaton et al., 2007; Westrhenen & Fritz, 2014). These efforts further art therapy's pluralistic body of evidence, as have the endeavors of art therapists, who have applied a neurobiological lens to their protocols and explanatory frameworks for the treatment of trauma, as shown in Table 1 (Chapman, 2014; Chapman et al., 2001; Gantt & Tinnin, 2009; Hass-Cohen

& Findlay, 2015; Homer, 2015; King, 2016; Klorer, 2005; Klorer, 2016; Klorer, 2017; McNamee, 2005; Talwar, 2007; Tripp, 2006).

Table 1.

Art Therapy Treatment Approaches with a Neurobiological Lens

Author(s)	Year	Art Therapy Treatment Approaches	Population
Chapman et al.	2001	Chapman Art Therapy Treatment Intervention	Children
Talwar	2003	Accessing Traumatic Memory Through Art Making: An Art Therapy Trauma Protocol (ATTP)	Adults
McNamee	2005	Bilateral Art: Integrating Art Therapy, Family Therapy, and Neuroscience	Adults
Klorer	2005	Expressive Therapy with Severely Maltreated Children: Neuroscience Contributions	Children
Tripp	2007	A Short-Term Therapy Approach to Processing Trauma: Art Therapy and Bilateral Stimulation	Adults
Gantt & Tinnin	2009	Graphic Narrative Processing	Adults
Chapman	2014	Neuro-development Model of Art Therapy	Children
Hass-Cohen & Findlay	2015	Art Therapy Relational Neuroscience Model	Adults
Homer	2015	Fabric Collage as A Neurodevelopmental Approach to Trauma Treatment	Adults
King	2016	Art therapy, Trauma, and Neuroscience	General
Klorer	2016	Neuroscience and art therapy with severely traumatized children: The art is the evidence	Children
Klorer	2017	Expressive Therapy with Traumatized Children	Children

An emerging example of this application entails the study of childhood trauma. Trauma studies have demonstrated how childhood trauma exposure can directly impact the brain's structures and functions during development, and have negative, compounding implications across the lifespan if left unresolved (Felitti et al., 1998; Perry & Szalavitz, 2017; Sapolosky, 2004; Siegel, 2015; van der Kolk, 2015). Two prominent art therapists, Gussie Klorer (2005, 2016, 2017) and Linda Chapman (Chapman, 2014; Chapman et al., 2001), have integrated neurobiological principles into their treatment frameworks for traumatized children. Klorer (2005, 2016, 2017) and

Chapman's (Chapman, 2014; Chapman et al., 2001) work infer how art therapy interventions may positively influence the brain's structure and function post-trauma to promote mind-body integration and healing. To-date, however, no direct quantitative study has focused on corroborating their neurobiological inferences in the context of art therapy treatments for children who have experienced trauma.

Therefore, this capstone thesis aims to lay the groundwork for studying how art therapy can promote ameliorative neurobiological changes. This thesis endeavors to broaden our understanding of the interconnectivity between art therapy and the neuroscience of childhood trauma by reviewing the treatment approaches of art therapists who are actively applying a neurobiological lens to their treatment models and practice. Throughout my thesis I will argue that art therapists need to back their neuroscience-informed trauma models and frameworks with scientific evidence.

The paper is organized into two sections, a critical review of the literature followed by a discussion. The literature review is further divided into five subsections. The first subsection introduces the extensive range of childhood traumas and the potential litany of trauma-related symptoms. The second subsection takes a more detailed look at the neurobiological impacts of childhood trauma and introduces the relevant neuroscience research. The third subsection reviews two art therapy treatment models for traumatized children that have actively applied the previously introduced neuroscientific concepts. The fourth subsection builds the case that art therapy can be empirically and quantitatively studied. The fifth, and final, subsection briefly introduces two studies which examine biological impacts of artmaking using noninvasive biomarkers and the implications for future studies. In the thesis' second section, the discussion, I leverage the aforementioned literature to build the case for a pluralistic approach to investigating

the neurobiological impacts of art therapy interventions for traumatized children. I recommend that art therapists systematically collect rich clinical data to identify relevant hypotheses. And then collaborate with neuroscientists to develop exploratory and randomized control trials based on the identified hypotheses and building off the inferences made in the work of Chapman (Chapman et al., 2001; Chapman, 2014) and Klorer (2005, 2016, 2017). Such research can inform the development of evidence-based art therapy interventions and individualized treatment plans for traumatized children, which assist children in rebalancing their nervous systems, promote opportunities for affect regulation, and foster healthy interpersonal relationships.

Literature Review

Introduction to Childhood Trauma

Scope & Range. Psychotherapist Monique Lang (2007) describes the trauma experience as one "over which we have no control and during which we typically feel fear and a sense of powerlessness to fix or get out of the situation" (p. 1). Devastatingly, children's exposure to trauma and stressful life events is pervasive and spans a range of human experiences including, but certainly not limited to, neglect, physical and emotional abuse, sexual assault, witnessing domestic violence, vehicular accidents, natural disasters, war, civil disruption, and cultural oppression (Courtois & Ford, 2016; Felitti et al., 1998; Hambrick, Brawner, & Perry, 2019; Siegel, 2017; van der Kolk, 2015).

Type I vs Type II Trauma. Some trauma events may happen only once (single-incident traumas) and have been categorized as Type I traumas. The literature suggests that it is easier for children to recover from single-incident traumas (Courtois & Ford, 2016, p.11). Other patterns of trauma can, and do, occur with greater frequency and/or for prolonged periods of time. And because of their cumulative impact can be harder to treat (Rankin & Taucher, 2003). This latter

category of trauma experience is categorized in the literature as Type II traumas (Herman, 1992; Courtois & Ford, 2016). Relational trauma is a form of Type II trauma that occurs when one person violates another person (Schore, 2010). Attachment theorists contest that in the context of child-caregiver relationships, these violations can include intentional acts of harm (e.g., physical, sexual, and/or emotional abuse) or the failure/inability to act (e.g., neglect, abandonment, and/or death) (Courtois & Ford, 2016). Over the past century, attachment theorists have investigated the central role that primary caregivers play in establishing a child's attachment security as well as programming the child's developing nervous system (Hass-Cohen & Findlay, 2015; Schore, 2010). From an attachment theory perspective, children are particularly vulnerable to relational trauma, because their basic survival and healthy social, emotional, biological, and cognitive development are reliant on the caregiver's responsiveness and accessibility (Perry et al. 1995, Schore, 2010; van der Kolk, 2015).

Protective and Risk Factors. Research demonstrates that two key factors significantly influence the trajectory of potential trauma symptoms: 1) the developmental stage of the child at the time of exposure, and 2) the nature of the trauma exposure (its frequency, severity, and pattern) (Perry et al., 1995; Schore, 2010). Trauma's impact is also dependent on a combination of risk and protective factors that are unique to that child (Felitti et al., 1998; Gil, 2006; Perry, 1995). Such contributing characteristics include attachment style, temperament, cognitive abilities, motivation, coping strategies, and previous stressors (Gil, 2006). Best case scenario, some children will experience no, minimal, and/or short-term negative effects. Conversely, other trajectories in response to trauma exposure are the manifestation of trauma- and stressor-related disorders (APA, 2013), or the more complex presentation of developmental trauma disorder (van der Kolk, 2015; Perry & Szalavitz, 2017).

Clinical Presentation. The *Diagnostic and Statistical Manual of Mental Disorders* (DSM-5) suggests that children exposed to trauma may develop alterations in arousal, reexperiencing, avoidance reactions, negative cognitions and mood, dissociation, and developmental delays (American Psychiatric Association, 2013). Although the DSM-5 is frequently cited as the clinical benchmark for determining trauma- and stressor-related disorder criteria, many clinical professionals challenge the DSM-5's utility in adequately capturing the breadth of children's reactions to trauma exposure (Courtois & Ford, 2016; Perry et al., 1995, Siegel, 2015 van der Kolk, 2015). Because of these limitations, Bessel van der Kolk has proposed an alternative diagnosis—developmental trauma disorder (Perry, 1995; van der Kolk, 2015). van der Kolk (2015) argues that developmental trauma disorder more adequately captures the varied scope of psychological outcomes that extend beyond DSM-5's criteria.

Psychological and Neurophysiological Effects. As van der Kolk points out, "traumatic experiences do leave traces, they leave traces on our minds and emotions, on our capacity for joy and intimacy, and even on our biology" (van der Kolk, 2015, p. 1). The concomitant neurophysiological and psychological outcomes of trauma can be profound (Courtois & Ford, 2013; Herman, 1992; Perry; 1995; van der Kolk, 2015). Traumatized children struggle with a range of issues, such as biological and affect regulation, safety, distrust, distress tolerance, anxiety, depression, incoherent personal identity, dissociation, somatization, impaired relationships, aggressive and self-injurious behaviors, as well as cognitive and developmental delays (Courtois & Ford, 2013; Herman, 1992; Perry; 1995; van der Kolk, 2015). The constellations of childhood trauma symptoms are extensive, uniquely impacting a child's biological, social, emotional, and developmental domains of functioning. Because childhood is such a sensitive period of neurodevelopment, it makes children particularly vulnerable to the

long-term impacts of their childhood traumatic life experiences (Siegel, 2015). The severity of trauma symptomology has the potential to compound across the lifespan (Felitti et al., 1998; Perry & Szalavitz, 2017; Siegel, 2015; van der Kolk, 2015).

At the most basic level, trauma compromises a child's sense of safety (Courtois & Ford, 2016). This can result in pervasive feelings of anxiety, fear, and/or terror. In such cases, the prevalent lack of control, fear and sense of powerlessness, which Lang (2007) so poignantly articulated, traps children in survival mode, which inhibits their ability to regulate their affective and interpersonal capacities (Courtois & Ford, 2013; Herman, 1992; Perry; 1995; van der Kolk, 2015). In order to best serve our child clients, clinical professionals need to understand that "after trauma the world is experienced with a different nervous system" (van der Kolk, 2015, p. 53). This recognition can help inform the development of evidence-based art therapy treatment models for traumatized children that assist clients in rebalancing their nervous systems and promoting opportunities for affect regulation and healthy interpersonal relationships.

Trauma's Impact on a Child's Brain

Advances in neuroscience over recent decades have significantly increased our understanding of how childhood experiences of trauma can impair the brain's organization, development, and function. (Perry, 1995; van der Kolk, 2015). This subsection first focuses on normal neurosequential development from the bottom-up (brainstem to cortex) in conjunction with right-to-left brain hemispheric development. The subsection goes on to explain how the brain's neurosequential development influences a child's autonomic survival response to perceived danger (fight, flight, and/or freeze), as well as the formation and storage of traumatic memories. While an in-depth review of the complex neurobiology of trauma is beyond the scope of this paper, the foundational neurobiological concepts presented below have informed the

design of trauma-sensitive art therapy treatment models for children (Chapman, 2014; Chapman et al., 2001; Klorer, 2005; Klorer, 2016; Klorer, 2017).

Experience-Dependent Neural Growth. The human brain grows rapidly during childhood. According to Hambrick, Brawner, and Perry (2019), "from birth to five, nearly 90% of brain development occurs" (p. 2). A complex interplay between a child's genetic makeup and environmental stimuli is responsible for the sequential organization of the brain's neural circuitry (Perry et al., 1995; Schore, 2010). While the basic architecture of the brain follows a genetically programmed sequence, research has demonstrated that the frequency, intensity and patterning of neural activity in response to environmental stimuli directly influences the brain's neural networks in an experience-dependent fashion (Perry et al., 1995; Schore, 2010). As Hass-Cohen and Findlay (2015) write, "the newborn's brain develops as a result of potentiated and pruned synaptic connections that respond to sensory inputs. Synaptic pruning eliminates weaker neuronal connections, and strengthening and potentiation of activated neural pathways shape the brain" (pp. 86-87). This means that the more frequently a neural circuit is activated by stimuli, the more likely the activated response will become the conditioned response in subsequent experiences under similar conditions, irrespective of whether the response is adaptive or maladaptive.

A pivotal experience in a child's neurodevelopment is the formation of the attachment relationship with a primary caregiver. Attachment theorists have shown that human infants are unable to care for themselves and therefore must rely on their caregivers for survival and to provide a secure base from which to explore the world (Schore, 2010). Because infant's language centers have yet to come online, the infant and primary caregiver communicate through nonverbal, sensorial cues, such as touch, smell, facial expressions, body gestures, eye contact,

mutual gaze, and vocalizations (Hass-Cohen & Findlay, 2015; Perry et al., 1995, Schore, 2010; Siegel 2015). Through these cues, the infant and caregiver establish a pattern of attunement. As Hass-Cohen and Findlay relate, "the caregiver's warm support and capacity for attunement are key to the developing nervous system and to resiliency. Many early brain linkages are dependent on the emotional and social attachment relationship with the caregiver" (2015, p. 86). When a caregiver is able to consistently respond to an infant's signals of negative arousal, e.g., crying, by meeting the child's needs, a secure attachment bond is formed. Successful sensory integration, with the co-regulatory support of an attuned primary caregiver, establishes the neural foundation necessary for optimal neurosequential development.

In the context of relational traumas, when the caregiver is not able to consistently attune to their child's needs, either through neglect or abuse, an insecure attachment bond is formed, with negative implications for the child's neural growth (Hambrick, Brawner & Perry, 2019). In cases of neglect (deprivation), the child's neural networks may not be sufficiently activated, and sensory integration may not be fully achieved. This suboptimal neural activation can result in a nervous system predisposed to hypoarousal. For children who experience abuse, the neural pathways for the autonomic survival responses may become overactivated, and thus the child may present behaviorally with heightened symptoms of hyperarousal and hypervigilance (Hass-Cohen & Findlay, 2015; Perry et al., 1995, Schore, 2010; Siegel 2015).

Neurosequential Development. From a neurological perspective, the bottom-up and right-to-left neurosequential development of the brain is important for understanding a child's trauma response (Hart, 2008; MacLean, 1988; Perry & Szalavitz, 2017; Siegel, 2015). Neuroscientists have determined that the human brain is organized from the bottom up into three integrated, yet evolutionarily distinct, cerebral regions. The lower, sensorimotor/survival regions

of the brain are activated earlier in life than the central emotional structures. Last to develop are the upper, complex cognitive regions (Hart, 2008; MacLean, 1988; Perry et al., 1995; Siegel, 2015). As Chapman (2014) writes "the development of the higher structures is dependent on the optimal development and organization of the lower structures" (p. 81). In effect, healthy development of the brain is contingent upon the successful development and integration of first the lower brain structures, followed by the central and then upper regions of the brain (Perry et al., 1995).

Lower Brain Structures. The lower region of the brain is often considered the most primitive layer, because these brainstem structures regulate the most basic and instinctual functions of survival, such as involuntary body functions, the respiratory and cardiovascular systems, states of arousal, and sensorimotor processing (Hart, 2008). When trauma exposure renders other regions of the brain incapacitated, the lower structures induce the body to "freeze" and wait for the danger to pass.

Mid-Brain Structures. The central region of the brain is demonstrated to modulate emotional regulation, attachment, memory formation and integration, and goal-driven behavior (Perry et al., 1995; Siegel, 2015). A major component of the central region is the limbic system, which is closely associated with autonomic survival responses (explained in greater depth below). Within the limbic system are two brain structures intimately involved in a child's trauma response: the amygdala and hippocampus. The amygdala are two almond-shaped structures that constantly scan the environment for danger and encode incoming sensory stimuli as implicit memories. When a threat is perceived, the amygdala sends a distress signal to other parts of the brain to activate the body for the "fight or flight" autonomic survival response (Hart, 2008). The

hippocampus encodes explicit memories, which provide spatial and temporal context to events (Hart, 2008).

Upper Brain Structures. The upper region of the brain consists of the cerebral cortex and is the last layer to differentiate and continues to develop into a person's mid-20s (Hambrick, Brawner, & Perry, 2019). The cerebral cortex is responsible for our complex executive functions: attention, working memory, planning/organizing, task monitoring, self-monitoring, regulation, inhibition, flexible thinking, emotional control, and initiation. In stressful situations, the cerebral cortex functions to make sense of the threat and generate a cognitive plan of action (Perry et al., 1995; Siegel, 2015).

The neurosequential development of the brain from the bottom-up has implications for the treatment of childhood trauma. According to Ogden and Minton (2000), "the activities of very young children are often dominated by sensorimotor and emotional systems, in other words by bottom-up processes. Tactile and kinesthetic sensations guide early attachment behavior as well as help regulate the infant's behavior and physiology" (p. 153). Trauma experienced during childhood impacts the still-developing subcortical structures (lower and central regions) of the brain. Consequently, these impaired areas in turn effect the subsequent development trajectory of the higher structures (central and upper regions). These disruptions in neurodevelopment can significantly compromise a child's behavioral, social, emotional, and cognitive functioning.

Right-to-Left Brain Hemisphere Lateralization. Just as the upper regions of the brain develop from the bottom-up, studies have shown that the brain also develops laterally from the right-to-left. The human brain is a bilateral organ divided into two hemispheres: the right and the left hemispheres. Research has demonstrated that the two hemispheres have distinct processing specializations (Schore, 2010). During the first two to three years of a person's life, the right

hemisphere functions as the dominant side of the brain and is responsible for affect and body state regulation, as well as for storing preverbal, sensory-based memories (King-West & Hass-Cohen, 2008; Schore, 2010). According to Kravits (2008), the right hemisphere, "limbic structures and the HPA axis [hypothalamic-pituitary-adrenal axis] predominate functionally after birth. These affectively biased structures facilitate the management of non-verbal information. Maturing motor and sensory capacities, especially smell, taste, and touch, provide primary access to sensory data from the environment" (p. 133). After age three, the corpus callosum—the extensive neural network between hemispheres—begins to myelinate, a process that shifts dominance to the left hemisphere—the side of the brain largely responsible for language and autobiographical narrative (Gantt & Tripp, 2016, Hass-Cohen & Findlay, 2015). It has been shown that trauma exposure can overwhelm the brain's cognitive capacities and effectively shut down the left hemisphere's language centers, hence the commonly used phrase "speechless terror" (van der Kolk, 2015). As will be discussed next, the brain encodes the trauma as fragmented, sensory-based implicit memories that lack a cohesive narrative.

Memory Formation, Storage, and Retrieval. As mentioned earlier, the hippocampus and amygdala—located in the mid-brain's limbic system—are the two brain structures responsible for the formation, storage, and retrieval of memories. The hippocampus encodes explicit, autobiographical memories. It is important to note that these memories provide temporal and spatial context, which allows individuals to construct a chronological autobiographical narrative. The amygdala, however, is responsible for the formation of implicit, sensorimotor memories (of threat and danger). Under normal conditions, the hippocampus and amygdala work in conjunction to provide experience-based context to the implicit memories, so the memories do not override the system (Hart, 2008). In contrast, during trauma exposure stress response

hormones (adrenaline and cortisol, respectively) increase the activation of the amygdala and greatly impair the hippocampus' ability to place trauma memories within a chronological timeframe. This results in intense and fragmented sensorimotor memories. A devastating effect of trauma is that these fragmented memories can manifest as intrusion symptoms, such as flashbacks, night terrors, dissociation, and trauma-specific reenactment (APA, 2013).

Autonomic Survival Strategies. The aforementioned bottom-up and right-to-left, neurosequential development influences the autonomic survival strategies utilized by children during stressful events and experiences. These autonomic survival strategies are generally short-term and dissipate after the stressor is no longer present. When faced with stressors, the upper regions of the brain—the cerebral cortex—first tries to make sense of the alarm bells being sent from the central brain's limbic system (e.g., identifying the stressor, appraising its consequences to self and others, and formulating a plan for action/escape). In this way, humans have evolved to apply logic and reason to navigate stressors, processing events top-down, first through the upper regions of the brain to the central and then lower regions of the brain. When our capacity to reason through situations becomes overwhelmed, our autonomic survival strategies dominate our response (fight, flight, or freeze). At this point of being overwhelmed, our central brain region overrides the cerebral cortex. This shift in regional and hemispheric dominance shuts down our language capacities while also accentuating our sensory memories. During such occurrences, the limbic system initiates a complex and involuntary chain of neuroendocrine reactions—known as the HPA axis which either energizes us to fight/flee or enervates us to freeze (Porges, 2009).

In instances of trauma exposure there is the potential for these autonomic responses to chronically persist—dramatically disrupting a child's neurodevelopment, physiological reactivity, and psychological functioning (van der Kolk, 2015). As Sapolsky (2004) writes, "with

sufficient activation…the stress-response can become more damaging than the stressor itself" (p. 13). Overly stimulated neural pathways can have crippling, life-long impacts for the child. Prolonged trauma exposure during childhood tends to condition the nervous system to persist in a state of fear, even if the threat is not immediately present and/or no longer exists. Furthermore, elevated, prolonged stress has been cited to cause chronic health problems, including but not limited to heart disease, autoimmune disorders, and digestive problems (Felitti et al., 1998; Hambrick, Brawner, & Perry, 2019; Siegel, 2015, van der Kolk, 2015).

However, the experience-dependent nature of the brain's wiring also presents a way forward for therapeutic treatment models. The fortunate news supported by neurobiology research, is that the brain's neural circuitry is not just shaped by adverse experiences. As was highlighted earlier in the paper, a secure attachment bond with an attentive and nurturing caregiver can establish brain linkages for an infant's optimal neurodevelopment. Moreover, a child with insecure attachment has the potential to later form an earned secure attachment within the context of a caring and supportive relationship, such as is fostered within a therapeutic relationship. These relationships, in effect, help to rewire the disrupted nervous system and enable the child to heal from their trauma.

Neurosequential Model of Therapeutics (NMT)

Leading the endeavor in designing therapeutic trauma treatment models for children based on the neurobiology principles outlined above is the prominent psychiatrist, Bruce Perry. Since the 1990s, Perry has been working with severely traumatized and maltreated children (Perry & Szalavitz, 2017). Over the years, Perry integrated his medical training with his clinical expertise to create and research the Neurosequential Model of Therapeutics (NMT) (Hambrick, Brawner, & Perry, 2019). The ultimate goal of the NMT is to sequentially rewire the neural

networks from the bottom-up to "facilitate intra-structure communication"—i.e., whole brain integration (Perry & Hambrick, 2008, p.39). Perry asserts that the NMT is not a formulaic prescription of interventions and techniques, but rather an approach to clinical practice that sensitively aligns interventions and modalities with the child's developmental stage and brain regions impaired by trauma (Perry & Hambrick, 2008). Perry and Hambrick (2008) describe how NMT interventions are applied based on the child's neurosequential development:

> The more the therapeutic process can replicate the normal sequential process of development, the more effective the interventions are. Simply stated, the idea is to start with the lowest (in the brain) undeveloped/abnormally functioning set of problems and move sequentially up the brain as improvements are seen… Once there is improvement in self-regulation, the therapeutic work can move to more relational-related problems (limbic) using more traditional play and arts therapies. (p.42)

As will be explored in the following subsection, Perry's pioneering model has laid the groundwork for art therapists looking to integrate neuroscience into their treatment models for traumatized children.

The Integration of Neuroscience and Art Therapy in Trauma Treatment Models

Although humanity has engaged in creative expression for thousands of years, art therapy did not emerge as a psychotherapeutic discipline until the turn of the 19th century (Vicks, 2003). Psychologists Margaret Naumburg and Edith Kramer are frequently credited with formalizing the field in the United States during the 1940s and 1950s. Both pioneers grounded their work in psychoanalytic theory—a form of talk therapy that focuses on the unconscious mind and childhood experiences; however, over time they developed disparate schools of thought. Naumburg focused particular attention on analyzing client's artwork for clinical impressions and

diagnostic criteria. In contrast, Kramer emphasized the healing properties intrinsic to the artmaking process. She advocated that the process of artistic expression, in relationship with an art therapist, was the underlying mechanism of psychological change (Vicks, 2003). Over the subsequent decades, many art therapists have reconciled the dichotomous thinking between product versus process in recognition of the strengths both viewpoints bring to the field. In alignment with the times, art therapists have gone on to expand the theoretical underpinnings of the field. Depending on the art therapist, they may identify as practicing psychodynamic, humanistic, attachment and relational, behavioral, cognitive behavioral, existential, biological, and/or evolutionary theories of psychotherapy (Vicks, 2003).

At its core, art therapy integrates art and psychotherapy, through the creative tools of drawing, painting, sculpture, textile art, collage, along with many other media. The multifaceted dimensions of the artmaking process (sensory, kinesthetic, affective, perceptual, symbolic, and cognitive) provide children and adults, alike, the opportunity to engage in nonverbal artistic self-expression within the context of a supportive therapeutic relationship. Art therapy is used with numerous populations to address a wide range of psychological vulnerabilities and to support client strengths (Malchiodi, 2007). One such population is children who have experienced trauma. Malchiodi (2012) explains that artmaking experiences "mobilize the expression of sensory memories in a way that verbal interviews and interventions cannot…The capacity of art making to tap sensory material (i.e., the limbic system's sensory memory of the event) makes it a potent tool in trauma intervention" (p.21). As evidenced by the neurobiological concepts explored in the previous subsection and the NMT, the dimensions of the art process and product naturally lend art therapy to the treatment of childhood trauma.

Today, during this exciting juncture in our field's history, art therapists are beginning to explore the intersections of creative self-expression, traumatology, and neurobiological theory. In response, they have designed neurobiological-informed art therapy protocols to help reduce trauma symptomology (Chapman, 2014; Chapman et al., 2001; Gantt & Tinnin, 2009; Hass-Cohen & Findlay, 2015; Homer, 2015; Klorer, 2005; Klorer, 2016; Klorer, 2017; King, 2016; McNamee, 2004; Talwar, 2007; Tripp, 2006). The aforementioned therapists hypothesize that art therapy's relational, nonverbal, and sensory qualities have the capacity to address dysregulation resulting from exposure to trauma by recalibrating our nervous system's response to stressors. Malchiodi writes, "in cases of emotional trauma, loss, or abuse, art making offers a way to reintegrate complex emotions that are expressed through the senses (2007, p. 14).

To-date, adults have been the primary target population for many of these models. However, this paper focuses on two art therapy treatment frameworks specifically designed for traumatized children (Chapman, 2014; Chapman et al., 2001; Klorer, 2005; Klorer, 2016; Klorer, 2017). They are based on the neurosequential hypothesis that once the child has recalibrated their nervous system and mastered the skills of self- and emotional regulation, they can start to cognitively process their traumatic experiences and thereby reduce the long-term negative health outcomes associated with childhood exposure to trauma (Hambrick, Brawner, & Perry, 2019). The implications of this shift for improved public health cannot be overemphasized (Felitti et al., 1998; Perry & Szalavitz, 2017; Sapolosky, 2004; Siegel, 2015; van der Kolk, 2015).

Art Therapy Treatment Frameworks for Traumatized Children

Gussie Klorer (2005, 2016, 2017) has contributed to the growing body of literature advocating for the application of a neurobiological lens to art therapy in the treatment of childhood trauma. Over 20 years, Klorer's work has focused on severely maltreated children,

who were abused and/or neglected at a young age by their primary attachment figure (Klorer, 2005; Klorer, 2016; Klorer, 2017). Klorer (2005) contends that art therapy's nonverbal and sensorimotor qualities are aligned with what is currently considered best-practice within attachment theory and neuroscience research. Klorer frames her rationale by discussing how maltreatment adversely affects experience-dependent neurodevelopment, and consequently, a child's ability to regulate their body and emotions. Klorer (2005) supports her assertions, in part, by Romanian orphan studies conducted in the 1980s. According to Klorer (2005), the Romanian orphan studies helped traumatologists confirm that early environments of severe neglect and deprivation significantly impact the normal maturation of the brain. Klorer (2005, 2016, 2017) also grounds her work in the seminal work of attachment theorists John Bowlby (1969) and Allan Schore (2001). Schore (2001) claims that early relational trauma particularly affects right cortical areas responsible for forming social relationships and developing affect-regulation. Klorer goes on to state that affected areas in the right hemisphere can lead to long-term "deficits in language processing, memory, and executive functioning" (Klorer, 2005, p. 214).

In response to this neurobiological framing of childhood trauma, Klorer suggests that art therapy has the capacity to "bypass the severely maltreated child's habitual or defensive modes" (2016, p. 141) within the context of a supportive therapeutic alliance and through the nonverbal and body-based interventions that parallel bottom-up and right-to-left hemisphere neurosequential development. The therapeutic relationship provides the maltreated child with psychological safety, thus affording opportunities to confidently practice and establish positive relational experiences (Klorer, 2016).

Additionally, Klorer (2005, 2016, 2017) advocates for long-term treatment activities that work towards whole brain integration, starting with body-based activities. In the context of

artmaking, Klorer (2017) describes scribbling as one of the first body-based activities observed in children, generally emerging around age two. According to Klorer (2017), the marks made during this stage of graphic development are random, as opposed to controlled and/or organized. The scribbles are created without cognitive or symbolic intention. Instead the experience is simply kinesthetic. As the child's sensorimotor skills develop, the child moves on to repeating movements and naming the scribbles, and then to creating shapes and humanoids (Klorer, 2017). Klorer goes on to state for traumatized children, "the artwork may point toward particular areas of stress, as evidence by such indicators as excessive scribbling, scribbling over, and other graphic indicators" (2017, p. 59). Klorer speculates that such sensorimotor art interventions activate the right hemisphere, thereby helping children integrate their nonverbal, somatic and sensory memories of trauma with explicit memory to create a coherent, chronological trauma narrative.

In agreement with NMT's approach to clinical practice versus a standardized protocol, Klorer writes, "a neuroscience approach to art therapy with traumatized children utilizes neurodevelopmentally appropriate therapy techniques, responding to the child's current level of emotional processing. This kind of approach requires individualization of treatment plans as opposed to a manual approach" (2017, p. 14). Klorer contends that therapists must take into consideration the client's unique strengths, needs, and trauma history when treatment planning, rather than implementing a one-size-fits-all protocol.

Linda Chapman lends a second voice to the dialogue on neurobiological-informed art therapy for traumatized children (Chapman, 2014; Chapman et al., 2001). Over the past decade, Chapman has concentrated on designing a mind-body, four-phased approach to trauma treatment called Neuro-developmental Art Therapy (NDAT). NDAT is a long-term treatment model that

addresses the effects of relational trauma, chronic abuse, neglect, and/or violence (Chapman, 2014). Similar to Klorer (2005, 2016, 2017), Chapman explains that the NDAT is grounded in theories of neurodevelopment and attachment, and that the protocol emphasizes activating the right hemisphere and lower brain structures shown to be impacted by relational trauma (Chapman, 2014; Klorer, 2005; Klorer, 2016; Klorer, 2017). The NDAT is comprised of four phases designed to activate specific brain structures and sequentially integrate the child's neural systems. The phases include: Self Phase (brainstem), Problem Phase (limbic system), Transformation Phase (cerebrum), and Integration Phase (prefrontal cortex). An example of a Self Phase intervention is what Chapman (2014) refers to as "sensory-motor art" (p.55). The intervention leads children through a scripted sequence of two-handed mark making, which range in size and tempo, across a 4' x 36" piece of white butcher paper. The sequence moves from vertical to horizontal lines, to arcs across the midline, to circles, and eventually ends with dots. Like Klorer (2017), Chapman (2014) hypothesizes that these movements parallel normal graphic development and thus activate the lower structures of the right brain. She also asserts that the bi-lateral crossing of the midline integrates the right and left hemispheres. As explanation, Chapman succinctly describes art therapy's putative role in this process:

> By engaging in the kinesthetic activity of art making, play, and other creative work involving the right hemisphere, the sensory nonverbal pathways are activated along with the left hemisphere neural pathways, thus utilizing the integrative capacity of the brain toward achieving maximum therapeutic potential. (Chapman, 2014, p. 50)

As this quote attests, Chapman's neurobiological justification for the efficacy of the NDAT is in alignment with Klorer's therapeutic suggestions and Perry's NMT (Chapman, 2014; Klorer, 2005; Klorer, 2016; Klorer, 2017; Perry & Hambrick, 2008). Klorer and Chapman's models

remind us that trauma symptoms originate in the body's reaction to overwhelming experiences and adverse life circumstances. Trauma's insidious impact is that it can disrupt the healthy functioning of a child's nervous system—through chronic over and/or under activation. The detrimentally altered nervous system, in turn, manifests in each child's unique constellation of trauma symptoms and tracks the individual into adulthood with impaired health outcomes (Felitti et al., 1998; Perry & Szalavitz, 2017; Sapolosky, 2004; Siegel, 2015; van der Kolk, 2015). The intent of Klorer and Chapman's art therapy trauma treatment models, therefore, is to first focus on recalibrating a child's nervous system, using relational, nonverbal, and sensorimotor interventions that stimulate and integrate the lower brain structures and right hemisphere with the central and upper regions of the brain. Following this neurosequential approach allows the child to establish safety and bodily control, before engaging in emotional and cognitive processing of their trauma narrative.

These two suggested models play an instrumental role in bridging the gap between art therapy and neuroscience. They provide art therapists with theoretical frameworks for conceptualizing the neurobiological implications for art therapy treatments designed for traumatized children. However, while grounded in neurobiological theory neither Klorer's work nor Chapman's NDAT have been empirically studied, but are backed by case studies and anecdotal information.

Future research is needed to demonstrate that these neurobiology-informed art therapy treatment models for children have impacts on the brain and nervous system. In this day and age, such studies are not out of reason. As will be addressed in the next subsection of this paper, there is an albeit small, but growing, body of literature to support the claim that art therapy models and protocols can be effectively studied using empirical designs. These initial studies focus on

researching the reduction of a child's trauma symptoms as measured by recognized trauma symptom indexes. The implication is that the reduction in symptoms may also be occurring at the neurobiological level.

Support for Quantitative Studies Designs

Historically thoughts and feelings were considered intangible and elusive variables, and therefore, unmeasurable (Slayton, D'Archer & Kaplan, 2010). However, art therapists have amassed qualitative evidence for their work in the form of case studies, which provide rich data and clinical substance (Eaton, Doherty & Widricks, 2007; Slayton, D'Archer & Kaplan, 2010; Uttley et al., 2015). This ever-growing collection of interviews and anecdotes supports art therapy's efficacy as an effective treatment modality for traumatized children (Slayton, D'Archer & Kaplan, 2010; Uttley et al., 2015). At the same time, quantitative art therapy research is only in its nascent phase. Art therapists are now beginning to attempt to merge the standardization necessary for randomized control trials (RCT) with the individualization of the client-centered approach imperative to the art therapy process. As the field of art therapy in-general grappled with this quandary, so are art therapists studying the implications for art therapy in treating childhood trauma (Eaton, Doherty & Widricks, 2007; Slayton, D'Archer & Kaplan, 2010; Uttley et al., 2015).

A meta-analysis conducted by Westrhenen and Fritz (2014) highlights the common disparity between case studies and quantitative research. Their analysis included a review of 28 articles focused on art therapy and the treatment of trauma symptomology experienced by children and adolescents. Twenty-two of those articles used case studies, while the remaining six implemented quasi-experimental and experimental designs. The only study from that meta-

analysis that quantitatively investigated the efficacy of a child- and art therapy-specific trauma treatment model was conducted by Linda Chapman (Chapman et al., 2001).

Before Linda Chapman developed the previously described NDAT, she designed an art therapy treatment protocol for single-incident, medical trauma pediatric patients—the Chapman Art Therapy Treatment Intervention (CATTI). The aim of the CATTI was to assist pediatric patients in creating a coherent trauma narrative, which was intended to help reduce their PTSD symptomology. In an attempt to quantify the CATTI results, an innovation in the field of art therapy, Chapman conducted a randomized cohort study comprised of 85 medical trauma patients between the ages of seven and 17 to test the CATTI's efficacy. While the experimental group underwent an hour-long, one-on-one CATTI session with an art therapist, the nonactive control group received regular hospital care.

The Children's Post Traumatic Stress Disorder Index (PTSD-I) was used to score pre- and post-test measures of symptomology. Post-tests were administered at one week, one month, and six months after treatment. The study results indicated no significant difference in PTSD-I scores between the study groups. However, Chapman et al. (2001) reported that their data indicated a reduction in avoidance symptoms at one-week post-treatment and continued for, at least, one month. The reduction in avoidance symptoms for the art therapy experimental group was not maintained over time. Rather, the severity of avoidance symptoms minimally increased after 6-months (Chapman, 2014). The study results could be perceived as disputing the effectiveness of art therapy interventions for treating childhood trauma. However, in later reflection, Chapman asserted that the study furthers art therapy's cause: "one conclusion that can be drawn from this project [CATTI] is that empirical art therapy research can be done" (2014, p.

203). As the seminal study to investigate art therapy's efficacy in reducing children's trauma symptoms, the CATTI provides a baseline for designing future empirical studies.

Biomarker Studies

In order to demonstrate that art therapy has a neurobiological impact, however, study designs need to incorporate methods that measure changes in the child's brain structure and/or function in response to art therapy trauma treatments. To-date, there are no scientific studies in the literature that directly address this claim. Several studies do exist, though, which demonstrate that artmaking sessions within nonclinical adult populations can reduce levels of the stress hormone cortisol (Kaimal, Ray, & Muniz, 2016) and increase the activation of alpha brain waves—shown to be associated with increased relaxation (Belkofer, van Hecke, & Konopka, 2014). These studies have implications for future experimental designs, as the findings identify biomarkers (cortisol and alpha waves) that can be used as potential indictors of neurophysiological changes.

Discussion

As was explored in the literature review, Gussie Klorer and Linda Chapman innovated art therapy frameworks grounded in neurobiological concepts of childhood trauma (Chapman, 2014; Chapman et al., 2001; Klorer, 2005; Klorer, 2016; Klorer, 2017). But as Belkofer (2012) poignantly articulates "absorbing neuroscience theory as a rationale is one thing, but claiming conclusive activation of identifiable systems of the brain is something entirely different" (p. 38). Well-intentioned, but uninformed therapeutic practices, may cause unintentional harm (Perry and Hambrick, 2008). Thus, we must bridge the gap between neurobiological rationale and scientific evidence. As art therapists, we have the ethical responsibility to do no harm, therefore we must ensure that the therapeutic tools we use in practice are safe and effective. And that means

scientifically exploring the efficacy and neurobiological impacts of art therapy treatments for traumatized children.

At the onset of this scientific endeavor, however, art therapists are faced with a paradox. How can we design experiments that quantitatively demonstrate art therapy's neurobiological effects on a child's nervous system post-trauma, while simultaneously acknowledging the necessity of standardized trials and the importance of individually tailored art therapy sessions? I propose that this paradox not be viewed as an impediment, but as a realistic starting point for future inquiry into the intersection between art therapy and neuroscience, as related to childhood trauma. In response, I suggest that art therapists cast a broad net of experimentation, using a pluralistic approach to inquiry. I recommend that art therapists utilize the rich clinical data from practice and case studies, in conjunction with the neuroscientific concepts of childhood trauma, to generate relevant hypotheses for scientific investigation. Through initial exploratory studies, art therapists would dig metaphorical test-pits to determine if there is justification to invest in rigorous experimental designs. If the initial findings indicate positive results, larger and more complex studies would follow. Theoretically, this approach would ultimately allow art therapists to hone their focus over time, as clinical observations build to exploratory pilot studies, which could be expanded into robust RCTs.

Klorer and Chapman's work suggest ways to approach the paradox from the two identified angles: gathering clinical observations of individual approaches and conducting RCTs. On the one hand, Klorer acknowledges the therapeutic necessity of designing treatments tailored to a child's individual needs and strengths, as well as their unique trauma history. This approach holds true to art therapy's foundational value of autonomy (American Art Therapy Association, 2013). It can be argued that RCTs cannot adequately demonstrate how the relational, client-

specific art therapy experience impacts trauma symptomology and/or the brain. Without standardizing interventions, however, the exact treatment process cannot be replicated across clients and hence is not generalizable. Because individualized sessions are not conducive to standardization, I suggest we harness the power of clinical practice and case studies to further scientific inquiries. By this, I mean that art therapists can use clinical observations to collect qualitative data regarding their therapeutic interventions that can be amassed to inform quantitative neurobiological-based study questions. Such data could include client demographics, trauma histories, therapeutic interventions and their observed, measurable outcomes. When correlated with neurosequential development phases, this information could point towards interventions that are showing results in the field, and therefore a potential basis for clinical trials. This rigorous data collection may best be streamlined under the direction of an organizing body, such as a grant funded project.

Another way to address the paradox is through direct scientific inquiry. Chapman's NDAT provides a valuable entry point for art therapists to engage in quantitative research and for investigating the neurobiological impacts. The interventions lend themselves to systematic and replicable testing, thereby assisting art therapists to more accurately isolate the mechanism of change—discrete interventions (or select components of the intervention) (Chapman, 2014). Studies would require interdisciplinary collaboration between art therapists and neuroscientists. Together, these professions could adapt Chapman's hypotheses to be potentially measured using biomarkers such as cortisol levels and alpha waves, similar to the work of Kaimal, Ray, and Muniz (2016) and Belkofer, van Hecke, and Konopka (2014). Instruments such as functional magnetic resonance images (FMRIs) and electroencephalogram scans (EEGs) could be used to measure changes in brain activity. Following neurosequential development, I recommend that

researchers initially focus their attention on studying the interventions that Chapman has claimed activate the lower brain structures and the right hemisphere, such as the "sensory-motor art" activity described in the literature review (Chapman, 2014).

When designing future research, the methodology needs to take into consideration the foundational parameters of RCTs in order to limit bias and promote the studies statistical power: randomly assigned experimental and control groups of similar sizes and representative of the target population, standardized treatment interventions, valid and reliable measurement of outcomes, and statistical analysis of the data. The limitations of Chapman's CATTI experiment provide a useful example of the importance of these parameters. First, the sample size of the CATTI was relatively small (N=85). A small number of participants is expected in an exploratory design like this, because the research is in the early stages of investigating whether there is justification for further study. However, it needs to be pointed out that a smaller sample size means the study results cannot be generalized due to its lack of statistical power. Another area for growth is Chapman et al.'s (2001) use of an inactive control group. The inactive control only allows us to conclude that doing art therapy is better than doing nothing. To better understand the art therapy-specific variables responsible for reducing PTSD symptomology, an active control must be included. This could entail control participants engaging in arts and crafts activities, while the experimental group participates in the art therapy intervention. Finally, a major weakness in this study design is that Chapman et al. (2001) did not present their method of statistical analysis. The omission of their statistical methods means the study results cannot be verified. Art therapists can take the lessons learned from Chapman and colleagues' study and apply them to the design of future studies.

In conclusion, this capstone thesis has provided recommendations for building on the inferences made in the work of Chapman (Chapman et al., 2001; Chapman, 2014) and Klorer (2005, 2016, 2017), in order to strengthen art therapy's quantitative research designs. Moreover, these recommendations lay the groundwork for art therapists to generate scientific studies that can systematically test art therapy's neurobiological impact on traumatized children. In this way, art therapists can practice trauma interventions that sensitively align with the child's developmental stage and impaired brain regions to help children rebalance their disrupted nervous systems.

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Thesis Advisor:_____Dr Tamar Hadar, MT-BC _____