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A Neuroscience Perspective on Creative Arts Therapies and Adolescent Groups

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During the Middle Ages, many religious paintings of Madonna and child depicted the child as a miniature adult. These paintings look odd, with head and body proportions bearing little relationship to actual youngsters. It appears that the artists didn't examine real children when creating their masterpieces, but instead drew upon idealized forms from imagination. This may be because the very concept of childhood didn't exist during the Middle Ages (Aries, 1962). With the infant and toddler mortality rate so high, and with no clear indication of who would live and who would die, it may have been too risky to pour attention onto young children. Not until the Renaissance, with the development of three-dimensional perspective, did artists start rendering children and babies in correct proportions.

As creative arts therapists already know, art communicates powerfully about broader social trends. An interesting parallel exists within the field of psychology. During the early twentieth century, when psychoanalysis arose, the concept of childhood definitely existed, yet an empirically based developmental perspective was part of neither theory nor practice. Instead, early analysts such as Sigmund Freud and Klein (1932/1975) hypothesized about development by abstracting backwards from work with adults. Because their theories were not based on direct observation, they misattributed cognitive processes and defensive operations to children whose prefrontal cortexes had not yet matured enough for such high levels of abstraction.

Mahler (Mahler, Pine, & Bergman, 1975) was among the first psychoanalysts to draw upon actual experience with children and their caretakers. Bowlby (1969) was another analyst highly influenced by empirical observation of mothers and their offspring, including those of other mammals. Bowlby introduced attachment theory as a developmental framework, and this perspective has proven unusually valuable. Whereas securely attached children are likely to have good self-esteem and lasting relationships, contributing to successful futures, insecurely attached children tend to encounter problems that last into adulthood, including with school, forming relationships, and developing emotional and even physical symptoms. Those with disorganized attachment are most vulnerable to future psychiatric and medical conditions (Puig, Englund, Simpson, & Collins, 2013; Zeanah, 2012). With Bowlby's development of attachment theory, all preconceptions and abstract ideas

had been set aside. The emotional needs of real children were placed front and center, including implications for ideal parenting and optimal therapeutic healing.

The 1990s are considered the 'decade of the brain,' bringing an understanding of stages of childhood to new levels. Neuropsychologist Schore (1994, 2012) extended Bowlby's findings, translating concepts into the language of brain and autonomic nervous system circuitry. Schore's modern attachment theory goes by the name *regulation theory*. Along with including neural aspects, he shifted Bowlby's emphasis from a behavioral focus to a central concern with emotion, which is mediated primarily by *subcortical* (beneath the cortex) and *cortical* (conscious thinking, reasoning, symbolizing, and self-awareness) structures of the *limbic* (emotional processing) *system* at the center of healthy development and relationships. Schore's regulation theory is both evolutionary and developmental, identifying neural underpinnings of healthy or unhealthy minds, brains, and bodies as they arise from attuned or misattuned early relationships.

This chapter aims to educate clinicians about the nature and distinct features of the adolescent brain, as well as to suggest ways that neuroscientific understanding can help to articulate the benefits of creative arts-based groups in working with teens. Adolescence is a time of great transition that prepares young people for adulthood, yet ushers in a period characterized by emotional dysregulation and unpredictability, particularly in social situations (Guyer, Silk, & Nelson, 2016; Victor & Hariri, 2017). A good understanding of any adolescent's early developmental history, plus genetic background, can be crucial in discerning whether symptoms are likely to be transient or part of a broader syndrome. By adding a conception of what is going on in the brain and autonomic nervous system, therapists are better equipped to sort out age- and stage-related factors from purely idiosyncratic ones.

Puberty Versus Adolescence

Puberty was once considered the end-point of brain maturation, but now we understand that the *prefrontal cortex* (forwardmost part of the brain, behind the eyes and forehead) doesn't finish developing until young adults reach their mid- to late 20s (Gogtay et al., 2004)—well past the end of puberty. The concepts of puberty and adolescence, though loosely connected, are often confused with one another. Puberty is a biological concept related to sexual maturation. During puberty, a tide of gonadal hormones sweeps through the body, changing the voice, initiating the growth of pubic and facial hair, and readying the sexual organs for procreation. All these changes are physical, linear, discrete, and time-limited, reaching their peak between 15 and 16 years of age (van Duijvenvoorde, Peters, Braams, & Corne, 2016).

By contrast, adolescence extends over a much longer period, representing the nonlinear transition between childhood and adulthood that may be best thought of as ending when the young person achieves self-sufficiency (Kilford, Garrett, & Blakemore, 2016). Adolescence is an emergent time of life characterized by many emotional, social, and behavioral changes, which are highly unique to each child and variable across culture. While hormones are important in affecting adolescent behavior, they don't determine it. In fact, there are no simple, one-to-one correlations between the flow of gonadal hormones and prototypical adolescent behavior (Spear, 2000).

The idea that adolescent development extends well into the 20s has tremendous implications across multiple domains. As an example, the courts in many American states frequently have responded to teenagers who commit murder as if they are identical to fully mature adults. When this has occurred, the fact that executive areas of teenage brains remain underdeveloped was not taken into account, either in determining punishment or in considering chances for rehabilitation or recidivism (Cohen, Bonnie, Taylor-Thompson, & Casey, 2015).

Psychotherapy is another realm in which an understanding of the adolescent brain can guide both clinicians and parents, especially in determining what is developmentally appropriate and normative versus problematic and pathological. Most people with mental health problems differ from those without by virtue of frequency and intensity of symptoms (Harvey, 2014). Indeed, in adolescence, the distinction between a 'normal' teen presentation and that which indicates mental health problems is often quite thin (Brennan, Murphy, & Flessner, 2017). This chapter brings both the evolutionary and developmental perspectives of interpersonal neurobiology to an examination of the adolescent brain. We begin with a description of adolescent behavior and concomitant brain processes, and conclude with implications for group psychotherapy, with a special emphasis on the importance of the creative arts.

The Animal Brain

Only recently, with the advent of fMRI technology, among other methods, have researchers been able to study the adolescent brain in context. Until then, animal studies of the juvenile period of rodents and other non-human primates had yielded a wealth of information about neurochemical and cellular changes that occur as a function of age. Given the absence of psychological stresses unique to humans, some people question the validity of animal models for studying adolescence. Yet, it turns out that a host of mammals, such as rodents and other non-human primates, exhibit behaviors very similar to human adolescents. Examples include increased attraction to peers and social interactions (Primus & Kellogg, 1989), as well as enhanced novelty seeking and risk-taking behaviors (Adriani, Chiatrotti, & Laviola, 1998). An important set of findings gleaned from rodent studies involves distinct changes within the limbic and *prefrontal* (executive functions, personality, social processing, moral reasoning) regions of the brain during adolescence.

Beginning with Darwin (1872) and continuing through Ekman (2003), interest in the neurobiology of emotion has led researchers to examine discrete emotional circuits in the brains of animals. Panksepp (2004; Davis & Panksepp, 2018; Panksepp & Biven, 2012), considered the 'father' of affective neuroscience, identified seven emotional/motivational circuits common to all mammals: SEEKING, FEAR, RAGE, LUST, CARE, PANIC/GRIEF, and PLAY (capitalized to emphasize their universality). Each has distinct neural architecture to link sensory, motivational, and behavioral areas of the brain. Yet overlap exists in the neurochemical cocktail of excitatory and inhibitory transmitters released into synaptic gaps between neighboring neurons. *Glutamate*, the most widespread excitatory neurotransmitter, works in tandem with *GABA*, its chemical precursor and most widespread inhibitory neurotransmitter.

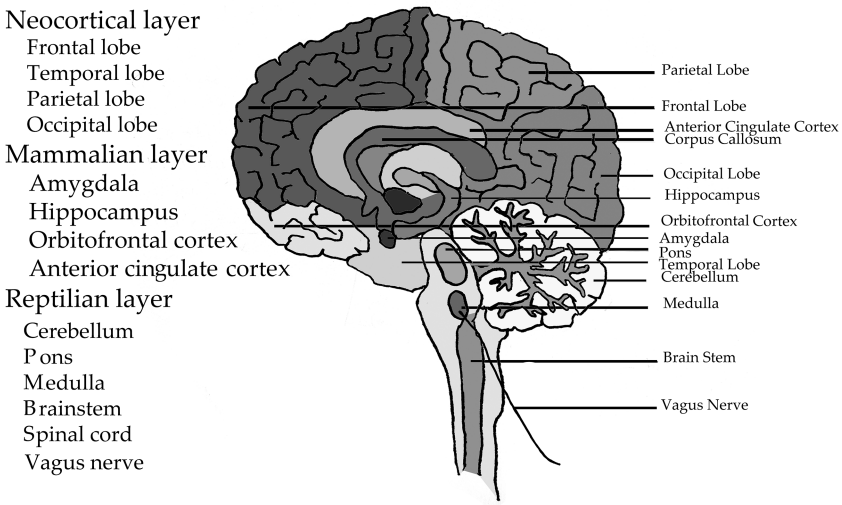
We humans love to pride ourselves on our differences from other animals, as the only species with multiple languages, books for our young, and computers that interconnect our social and political existences across the globe. It is easy to privilege the power of symbolic thinking. Yet the more we grasp about the centrality of emotion, the more we realize that to have a rational mind, we need a solid emotional foundation. It is the affective core we share with other mammals that lends us the capacity for compassion, the passion to play artfully, and the courage to help others. Meanwhile, the teenage brain is especially sensitized to emotion (Burnett, Sebastian, Cohen Kadosh, & Blakemore, 2011), so it is important for clinicians to put this into proper context.

Beginning in the 1960s, MacLean (1990) introduced his concept of the *triune brain*, the idea that the brain consists of three structures: the reptilian brain, the limbic brain, and the neocortex.

- The *reptilian brain* is the oldest of the three layers, serving as the foundation as relates to reflex and survival needs. The reptilian brain controls the body's vital functions, such as heart rate, breathing, temperature, and balance. Its main structures, the brain stem and cerebellum, lie deep within the subcortical part of the brain.
- Next is the *limbic brain*, which MacLean believed first emerged in mammals. By recording memories of behaviors that produce agreeable or disagreeable social experiences, the limbic layer introduces emotion and motivation connected to modulate basic needs. The main limbic structures include the *hypothalamus* (involved in sleep and emotional activity; coordinates the autonomic nervous system; regulates hormonal activity of the pituitary relevant to body temperature, thirst, hunger, and other homeostatic systems), the *amygdala* (processes emotional experiences; encodes memories for safety, danger, fear, and other strong emotions), and the *hippocampus* (encodes autobiographical and semantic memories).
- In humans, the reptilian and mammalian brains are both topped by the *neocortex*, which consists of two large cerebral hemispheres (right and left) permitting the more conscious experiences of self-reflection, planning, imagination, language, abstract thought, and symbolic representation. Whereas the subcortical layer of the human brain is the origin of impulse and emotion, the cortical layer helps Homo sapiens develop self-control, largely through cortical inhibition of subcortical impulses and feelings. By standing back and reflecting, the cortex allows us to slow everything down, to think about what is happening, to be mindful about what we are feeling, and to consciously decide what action to take in response. Our mature, cortical capacity to make decisions is what allows adults to override the natural impulses that drive children, adolescents, and animals.

MacLean's triune brain and Panksepp's emotional/motivational circuits go hand in hand. Contemporary neuroscience has revealed that the first four circuits previously listed—SEEKING, FEAR, RAGE, and LUST—also characterize the reptilian brain, while the last three circuits—CARE, PANIC/GRIEF, and PLAY—are unique to the social brain of mammals. The SEEKING circuit (also called the reward

Triune Brain



circuit) energizes humans, mammals, and reptiles to go out into the world and get their needs met. This circuit, enervated by the neurotransmitter *dopamine*, plays a large role in the emotional sensitivity of teenagers as well as in the underlying incentives that drive the adolescent brain.

Each circuit extends downward into lower subcortical centers in the brain stem as well as upward into higher, uniquely human cortical areas. In people, the neocortex is necessary for emotional experience to reach full awareness, yet this higher part of the brain cannot generate feeling states. Overlap also exists in how the circuits function, with blended emotions such as guilt or righteous indignation being a mixture of different emotional circuits blended with cognitive elements. Meanwhile, the subcortical origin of all feelings means that animals probably do experience emotion, but from a fully immersed vantage point, without reflective awareness.

The CARE circuit is considered part of the social brain because of its importance in attachment dynamics that drive mammalian parents to care for their young, strangers to empathize with one another, and members of one species at times to care for members of another. From a neural perspective, human empathy consists of two interrelated circuits (Decety & Ickes, 2009); one, online from birth, is purely emotional, consisting of affective resonance. Affective resonance is why babies so easily cry when they hear other babies crying, why joy, fear, and humor are so contagious, and why depression and trauma are difficult for loved ones to bear. While mammals share affective resonance, human empathy's other neural pathway is purely cognitive. It consists of two aspects: 1) *theory of mind*, the ability to put ourselves in the shoes of another and see the world through their eyes, and 2) the ability to differentiate self from other (even if we share the same feelings, we are not exactly in the same circumstances as others). Within all psychotherapists, the

affective dimension of empathy supplies great meaning in helping even strangers with their problems, while the cognitive dimension protects us from burnout and compassion fatigue (see Marks-Tarlow, 2012).

The Adolescent Brain

During adolescence, the brain undergoes a process that can be likened to a software upgrade on a computer, in which circuitry is consolidated, networks are reorganized, and processes are rendered more efficient and specialized (Giedd, 2015). Sercombe and Paus (2009) provided a helpful metaphor when they suggested thinking of the brain as an unchartered region like the Australian outback. The first people to arrive to this region forge their own pathways, and subsequent travelers follow those paths but then diverge in a number of directions. Over time, the most heavily used paths become easier to travel and eventually are paved to make efficient roads; the lesser-used ones grow over and their remnants fade with time. The child brain is represented by that set of multiple pathways, which are blazed by the millions of pieces of information that children take in, while the adult brain is represented by modern society, which has a reliable highway system that gets travelers to their destination more directly and efficiently. The adolescent brain serves as the transition between those two states.

During early puberty, an overproduction of axons and synapses occurs that is followed by a period of rapid *pruning* (or elimination of circuits) during later adolescence (Crews, He, & Hodge, 2007). Synaptic networks are reorganized, and their connections rendered stronger and more efficient through a process known as *myelination*, which involves an increase in white matter volume and a corresponding decrease in gray matter (Kilford et al., 2016). As different areas of the brain develop more quickly than others, there is a gap between the advancement of emotional responsiveness and motivation (subcortical processes) and the point when cognitive control mechanisms (cortical processes) come fully online. It is this gap, as will be discussed later, that is implicated in many of the risky and seemingly mind-boggling decisions that teenagers make.

Because the brain is in a state of development during adolescence, the common view is that teens are a 'work in progress' and that their inconsistency is attributable to their learning to use their new neural systems, a phenomenon that Abigail Baird aptly referred to as "neural gawkiness" (Dobbs, 2011, para. 19). During this period, the brain is particularly open to growth and change, a quality referred to as *neuroplasticity*. Steinberg (2016) defined plasticity as "the capacity of the brain to change in response to experience" (p. 345), and this openness to modification allows for important growth, as well as making adolescents particularly vulnerable to stress and the onset of mental illness (Tottenham & Galván, 2016).

Subcortical structures that mediate exaggerated emotional sensitivity and enhanced evaluation of incentives get reorganized during adolescence. So, it is no wonder this stage of life renders them so vulnerable to the onset of affective, eating, and addictive disorders. Fortunately, most teenagers successfully navigate the transition from depending upon caregivers for food, shelter, protection, and financial support to supplying these things for themselves by becoming self-sufficient,

contributing members of society. Unfortunately, some struggle to make this transition, and a small number never succeed. Amid so many physical and behavioral changes, the peak age of onset for many psychiatric disorders, including depression, anxiety, personality disorders, and psychoses, is adolescence (Giedd, 2015). Paus, Keshavan, and Giedd (2008) suggested that the pathophysiology of these disorders arises from aberrations of maturational changes that naturally occur within the adolescent brain.

As humans age, brain development is generally characterized by a shifting balance of decreased plasticity and increased stability (Fett, Gromann, Giampietro, Shergill, & Krabbendam, 2014). Preliminary evidence suggests that greater plasticity during adolescence is related to greater intelligence (Blakemore, 2018). The notion of experience as a catalyst highlights the importance of therapy processes rooted in the experiential domain, particularly during this window when the brain remains especially adaptable.

The Developmental Importance of Play and the Arts

Out of all mammals, the human's brain has the most open wiring. This circuitry allows for postnatal experience and learning to shape how each brain will become wired through culture and upbringing. For this reason, human babies are born with highly immature brains that require a more extended childhood than any other animal. As mentioned, two main sets of social instincts separate the open wiring of the mammalian brain from the closed wiring of the reptilian brain upon which it sits: care of the young and the tendency to play. PANIC/GRIEF is a third circuit of the mammalian brain that signals separation distress. When fear, panic, or grief is highly active, all play stops, while in the context of relational and emotional safety play can proceed.

Hand in hand with brain plasticity, another great development in the evolution of human knowing was curiosity. Instead of merely responding to the press of innate survival needs, as reptiles do, through play mammals became proactive, adventurous, and inquisitive. In most species, the urge to play occurs within a critical window during the juvenile period (Beatty, Dodge, Dodge, White, & Panksepp, 1982). Human play resembles that of other mammals in also having a critical window for normal development. As with many other mammalian species, rough-and-tumble play during the early childhood years appears especially related to cognitive capacities to settle down and focus attention. This led Panksepp (2018) to suggest that early education should begin each day on the playground. He saw running, romping, and grappling as preventative measures against increasing diagnoses of attention deficit/hyperactivity disorder amid a backdrop of decreasing interest in and funding for physical education.

Across all descriptive levels, neurobiological, psychological, sociological, and anthropological investigations have identified a host of affective, cognitive, social, and motor capacities that accompany children's play (for a summary, see Marks-Tarlow, 2010). These include:

- Brain growth.
- Self-regulation of behavior and emotions.

- Development of imagination and symbolic representation.
- Meaning making.
- Development of language and narrative.
- Meta-communication (communication about communication).
- Creativity and divergent thinking.
- Self-transformation.
- Social competence.
- Gender identification.
- Community membership.
- Cultural awareness and creation.

Humans differ from other species, which typically cease playing outside of their critical developmental window. People often continue playing right into adulthood, which includes our lifelong attraction to sports and the arts. Play is so important because it enhances positive feelings, provides passion for life and intrinsic motivation, and allows novel experiences (Marks-Tarlow, Solomon, & Siegel, 2018). Not just children, but also adolescents and even adults experiment with new ways to think, act, and be through play (Dissanayake, 2017). This is what makes the creative arts therapies and play therapy such vital modalities.

Along with its extension throughout the lifespan, human play differs from that of other species in another significant aspect. Beyond the rough-and-tumble variety common to other mammals, human play also diverges into symbolic realms and imaginative landscapes. As play becomes increasingly symbolic, social, and imaginative, it moves from implicit, preconscious, and nonverbal roots to include more explicit, conscious, and verbal elements. While still facilitated by safe attachment and primary caretaker involvement, children's play develops in opposite directions simultaneously: toward greater autonomy as well as toward fuller coordination with others.

Marks-Tarlow (2010, 2012) suggested that children learn how to operate intuitively in an internally grounded fashion, from the inside-out, through ample opportunities for free play during the early years. When mammals are meant to play but do not, whatever the reason, consequences can be severe. Brown, a psychiatrist at Stanford, stumbled into a professional focus on play after unearthing a chilling example (Brown & Eberle, 2018). As a psychiatric resident in 1969, Brown worked within prison settings, conducting clinical interviews on 26 young incarcerated murderers in hopes of finding common threads. At first, he was puzzled by the diverse backgrounds of these felons. They came from such different social classes, ethnicities, levels of trauma and deprivation, as well as varying opportunities in life. Then he came across a single factor these violent men appeared to have in common: the absence of play during childhood. Perhaps because of its necessity for normal development, play in psychotherapy is especially powerful at all ages.

Playing during psychotherapy is not engagement in frivolous activity (Marks-Tarlow, 2015a, 2015b); rather, it can provide safety in the context of what can be otherwise intolerable emotions. Playing helps to expand intersubjective space by relaxing defenses and allowing for safe exploration of even darker places when necessary (Haen, 2015). This potential is familiar to yoga teachers, who frequently guide students to approach the *asanas*, or poses, playfully as a means of creating more space

inside the mind, body, and spirit. The more present we are in our bodies, the more we lengthen out, relax in, and breathe through our movements, the more freedom we gain to create additional possibilities. Within the enterprise of psychotherapy, then, play grants more freedom of being, feeling, doing, moving, and relating in the context of a trusting bond.

The interpersonal neurobiology of attachment illustrates how the self grows, unfolds, and builds new structure through play. Freedom to play without inhibition or constriction is a key ingredient for joy, interest, passion, and vitality later in life. Within all juvenile animals, the mixing of pleasure and pain through play also expands emotional tolerance (Pellis & Pellis, 2010). For this reason, children often play in ways that serve to draw them toward the edges of their regulatory boundaries (Marks-Tarlow, 2012). Young children love to throw themselves into disequilibrium by spinning, jumping, climbing, and hurling their bodies right to the edges of what they can tolerate emotionally. Adolescents take these urges to play and explore new edges to unprecedented levels.

Impulsivity and Risk Taking

One hallmark of adolescence is a love of new experiences and especially risky ones. Teens feel driven in hot pursuit of novelty, often with a very present-centered state of mind that lacks consideration for future outcomes or negative consequences of their actions. Based on the 2005 National Youth Risk Behavior Survey, Casey, Jones, and Hare (2008) reported that adolescents engage in behaviors that increase the likelihood of their death or illness in multiple ways: by binge drinking, driving a vehicle while intoxicated, not wearing seat belts, carrying weapons, using illegal substances, and engaging in unprotected casual sex that results either in unintended pregnancies or sexually transmitted diseases.

Clearly, such risky behavior leaves them extremely vulnerable. In fact, the risk of injury or death is higher during adolescence than in childhood or adulthood, with suicide being the second leading cause of death among young people (Heron, 2017). To understand what is happening in the brain corresponding to such riskiness, it is first important to distinguish between two different concepts: *risk* and *impulse*. Casey and colleagues (2008) noted that adolescent behavior is often described as both impulsive and risky nearly synonymously, yet these behaviors rely on different cognitive as well as neural processes. This means that risk and impulse are distinct, with differing developmental trajectories.

The opposite of impulse is impulse control, which involves the capacity to suppress inappropriate thoughts and actions. Impulse control, or the ability to delay gratification in favor of goal-directed behavior, is a cornerstone of cognitive and behavioral development. Consider Mischel's classic "marshmallow experiments" (e.g., Mischel, Shoda, & Rodriguez, 1989; Mischel, 2014). A group of 4-year-old children were offered opportunities to either indulge in a smaller treat right away, such as one marshmallow, or resist immediate gratification to receive a bigger treat later in time, such as two marshmallows. This same group was tracked longitudinally. By the time they reached adolescence, subjects who could delay gratification at age 4 had developed greater social and emotional competence by adolescence.

Not only did they do better academically, but they also excelled at self-regulation. Experiments such as these suggest that goal-directed behavior requiring control of impulses to optimize outcomes matures steadily across childhood and adolescence.

A review of the literature suggests that impulsivity diminishes with age and is associated with protracted development of the prefrontal cortex (Casey, Galván, & Hare, 2005; Chein, Albert, O'Brien, Uckert, & Steinberg, 2010). It is important to know that brain development moves both from bottom to top (subcortical to cortical structures) and back to front (posterior to anterior). The highest, most frontal area of the brain—the prefrontal cortex—is the last to develop, only coming into full maturation between the ages of 26 and 28 years, and generally reaching full maturity for females more quickly than for males. The prefrontal cortex coordinates and adjusts complex behavior. It contains several subareas, each with distinct functions. Some relate to executive functioning, such as focusing and organizing attention, decision making, planning, prioritizing competing and simultaneous information, and task accomplishment. Others relate to personality and social processing of self and other, including theory of mind, empathy, and moral judgment.

A recently discovered area receiving a great deal of attention is the *default mode network*, which generally includes the medial prefrontal cortex, posterior cingulate cortex, inferior parietal lobule, lateral temporal cortex, hippocampal formation, and precuneus (Chan & Siegel, 2018). The default mode network is the most active part of the brain and uses the most metabolic energy. Although initially thought to represent internal resting states apart from external tasks, researchers now understand its significance to self-referential and social processing. This is the part of the brain we use for daydreaming, rumination, and associative acts of creativity. It is also an area highly affected by mindfulness practices. In general, the midline or *medial* areas of the prefrontal cortex are part of the cortical level of limbic circuitry that are emotionally toned for social and emotional information. The *lateral* areas of the prefrontal cortex farthest from the midline, such as the *dorsolateral cortex*, are non-limbic and more related to strictly cognitive processing and intellectual tasks.

In contrast to the gradual, linear increase in impulse control associated with age, there is a nonlinear increase in sensation seeking associated with late adolescence (Casey et al., 2005). What this means is that risk taking increases in late adolescence, peaking at around age 19, and because it is higher during adolescence than in either childhood or adulthood, when graphed it appears like an inverted U. Unlike impulsivity, which relates to slower prefrontal cortical development, differences in risk taking appear to relate more to subcortical limbic processing connected to affective information and evaluation of incentives. In a recent large-scale study of 5,000 participants across 11 countries, Steinberg and colleagues (2017) found that these trends appear across cultures, as does a steady increase in self-regulation skills from pre-adolescence to young adulthood. Of note, the findings also suggested that while adolescence is generally a time for greater propensity toward risk taking, how and to what degree these behaviors are expressed is influenced in part by one's culture.

fMRI studies (e.g., Ernst et al., 2005) reveal two important subcortical structures that become more highly activated in adolescents as they face risky choices or process emotional information: the *amygdala* and *nucleus accumbens*. Both structures, online at birth, undergo deep transformation during puberty, accompanying the influx of adrenal and gonadal hormones. The amygdala, which represents the first

line of emotional and social processing, is central in the neuroception of safety versus danger, including the experience of fear (Porges, 2011). The nucleus accumbens, which lies in the basal ganglia within the brain stem, represents the first line of processing incentives by the reward or SEEKING system. (Panksepp believed the term 'reward system' a misnomer, because this circuitry is not involved with actually enjoying the reward once we've found what we're looking for.)

As mentioned previously, the SEEKING system is energized by the dopamine neurotransmitter and is deeply connected with attachment dynamics. This includes the absolute joy of connection during infancy, beginning around 3 months, as part of interactive regulation of emotions and arousal. When all goes well with the attachment process, the SEEKING system makes a gradual and smooth transition between interactive regulation by caregivers and autoregulation through self-soothing and self-stimulating behaviors. If, for whatever reason, there are problematic early attachment dynamics, and especially in cases of relational trauma (see Schore, 2012) where the primary caregiver is abusive, neglectful, or otherwise not fully available, the infant may be forced into autoregulation too early in life. If this happens, the SEEKING system is in danger of getting co-opted by autoregulatory strategies such as addiction. All the same underlying mechanisms and subcortical structures come into play, whether the addiction involves food, drugs, sex, or alcohol (see Katehakis, 2016).

The subcortical part of the adolescent brain story also explains something else that would otherwise be puzzling. If the impulsivity, poor judgment, and risky behavior so characteristic of adolescents were purely a function of an immature prefrontal cortex (which suggests irrationality, a feeling of invulnerability, and an inability to perceive risks), then young children would also be high-risk takers. But this is not the case, for as mentioned, risk taking peaks during adolescence (Steinberg et al., 2017). What is more, research reveals that unlike small children, adolescents do have the cognitive ability to anticipate and understand the potential risks of behaviors in which they engage (Steinberg, 2015). These findings underscore the difference between intellectual understanding in a 'cold context' (decisions made in isolation or preemptively) and emotional response in the 'hot context' of embodied existence, such as in the presence of peers, in the moments of sexual engagement, or while under the influence of substances (Blakemore, 2018; Victor & Hariri, 2017). The latter necessitates both reflection and emotion regulation, involving different underlying brain systems, and often requires quick decision making (Zelazo & Doebel, 2015).

To understand what is happening in the brain, it is important to consider both cortical as well as subcortical levels. The brain is highly complex and rarely reduces down to a single thing. The combination of levels also reveals how the developmental mechanisms that underlie impulsivity are fundamentally different from those that underlie risk taking. The most prominent explanatory framework is the *dual systems model*, which attributes the increase in risk-taking behaviors in adolescence to a developmental mismatch between the rapidly developing reward system in the limbic and paralimbic regions and the more gradual neuromaturation of the cognitive control system localized in the lateral prefrontal and parietal cortices and synaptically connected parts of the anterior cingulate (Steinberg, 2015).

This asynchrony is thought to underlie teens' propensity for seeking sensation and novelty, their increased sensitivity to rewards, and their difficulty applying internal brakes to reflect on risky choices before acting on them.

While a useful heuristic, this model has been criticized (e.g., by Casey, Galván, & Somerville, 2016; Victor & Hariri, 2017) for oversimplifying neural processes and not sufficiently capturing how these two brain systems interact or how behavior is dependent on context (for example, with whom the teen is interacting). Likewise, Blakemore (2018) recently noted individual variability in these patterns, with some adolescents having both their amygdala and nucleus accumbens reach full maturity before their prefrontal cortex, while other teen brains showed acceleration in only one of these limbic regions, or neither. But as a parsimonious explanation, the dual systems model offers important ways for clinicians, parents, and teens to understand the often-confounding choices adolescents make from a non-pathologizing stance.

Given the incredible vulnerability to disease and even death that enhanced riskiness confers on adolescents, is there any evolutionary advantage to this state of affairs? Here is where an evolutionary perspective complements a developmental eye so well. Spear (2000) speculated that novelty seeking and willingness to take risks help the adolescent separate from their home territory. Given that this occurs exactly at the peak of puberty, the willingness to leave one's own village in search of adventure and sexual liaisons, in combination with increased emotional sensitivity supporting the neuroception of danger, appears to maximize successes of mating by mixing and spreading one's genes far and wide. This may be how the precise combination of novelty seeking, emotional reactivity, and elevated risk taking observed across so many different species of animals can confer evolutionary advantages.

It is now well established that adolescents are far more likely to take increased risks in the presence of peers, or even under conditions in which they believe peers are observing them. Less emphasized are findings that reflect the potentially positive influence peers can have, such as the ability to influence increased prosocial behavior, especially when that behavior is accompanied by positive peer feedback (Guyer et al., 2016). Likewise, Telzer and colleagues (Telzer, Fuligni, Lieberman, Miernicki, & Galván, 2015) found teen risk taking to be moderated by the amount and quality of existing peer support, with those adolescents who reported more peer conflict or exclusion also tending to take greater risks.

Significance of Emotional Dysregulation

Within all mammals, the detection, expression, and regulation of emotion is a specialty of the right hemisphere (McGilchrist, 2009; Schore, 1994), whose circuitry is lateralized to reach deep into the body's internal systems through the interface between limbic and autonomic nervous systems. Whereas the central nervous system consists of the brain and spinal cord, the peripheral nervous system consists of the *somatic nervous system*, which controls the striated muscles of the body, and the *autonomic nervous system* (ANS), which controls the smooth muscles of the internal organs. Along with the *enteric* division, which helps us to

digest food, the ANS includes two branches. The *sympathetic* division up-regulates emotional arousal to deal with fight-or-flight or intense joy. The *parasympathetic* division down-regulates arousal to bring the body back to rest and relaxation.

Within humans, whether in teenagers, younger children, or adults, most symptoms that cause concern and bring people to psychotherapy involve problems with emotional arousal. But adolescents are especially prone to emotional dysregulation, informed by their increased sensitivity to social threat and peer rejection. As the ability to *mentalize*, or to understand the mental and emotional states of others, is under development during this developmental period, there is a tendency for teens to misperceive threat, engaging in "faulty neuroception" (Flores, 2017, p. 212). As such, adolescents tend to show greater brain activity than adults in areas related to social cognition when engaging in self-reflection, suggesting that how they see themselves is highly informed by how they believe others see them (Guyer et al., 2016).

It is important for clinicians and parents to understand the neurobiology of emotion. Emotional experience carries two dimensions: *intensity* (high or low arousal) and *valence* (negative or positive emotional experience). Adolescents tend to experience greater extremes of both positive and negative emotions in response to social situations. Also, their joyful feelings tend not to last as long as they do in adults, which leads to heightened stress (Burnett et al., 2011; Tottenham & Galván, 2016). When dealing with the dark and dramatic turns of the teenage repertoire, it is helpful to remember that everyone, not just teenagers, needs the full range of emotional experience. What is more, even negative emotions pass relatively quickly when given full expression. Finally, most emotional problems involve difficulties tolerating the intensity and not the valence of felt emotions.

What Group Therapy Offers

The neurobiology of adolescence suggests targets for intervention that groups are uniquely suited to address. Namely, groups can capitalize on social influence and novel experiences while fostering self-regulatory skills. When working clinically with adolescents, it is important to redirect the SEEKING circuit by helping teens experience inherent rewards within the search for self-understanding and growth. Given that creativity is a sophisticated form of play, and play is inherently growth-promoting and intrinsically rewarding—not to mention the most complex sophisticated mammalian circuit—creative arts-based groups may be particularly potent in supporting teenagers through this emotional time period and developing the skills to ease their developmental transition to adulthood.

As adolescents experience a shift from the importance of caregivers as primary attachment figures to a broadening of the attachment network to include peers, they are often caught in a dance between wanting to retain the security of the parent relationship for support and seeing that relationship as a threat to their need to establish independence and social connections (Allen & Tan, 2016). The drive toward connection with peers, the power of peer influence, and the opportunity to have these connections facilitated by an adult render group therapy a developmentally responsive form of intervention for teens.

As numerous authors (Badenoch & Cox, 2015; Flores, 2017; Goldstein, 2018; Grossmark, 2017; Mark-Goldstein & Ogden, 2015) have asserted, a prime value of group therapy comes from how it evokes past relational experiences from one's family-of-origin or other important groups, and how these often-traumatic experiences can be held, understood, and repaired within the group itself. During group, when interactions mirror past interpersonal experiences as encoded in implicit as opposed to explicit memory, related emotions and behaviors tend to surface automatically (Livingston & Scott, 2017). By slowing down the process and bringing implicit reactions to conscious awareness and reflection, the group helps to regulate affect in real time, while habitual responses can be modified in the face of powerful new experiences. Leszcz (2017) succinctly wrote, "Group therapy can be viewed as a neural exercise in the co-construction of regulatory capacity" (p. 283). These regulatory moments have the possibility of fostering new neural connections within the brain, stimulating growth that accompanies the emergence of new behavior patterns (Kinley & Reyno, 2016).

As Schermer (2016) noted, knowledge of neuroscience cannot yet provide specific best practices, but can increase the therapist's attunement to underlying individual and group processes. Knowledge of neuroscience also underscores the importance of therapist intuition by providing "a conceptual map that can supplement the intuitive maps inwardly available to the therapist" (p. 181). This sort of 'bottom-up' understanding relates to the importance of emotions and novel experiences for adolescents when it comes to effecting learning and change. Yet, there remains a propensity of 'top-down' approaches to adolescent treatment that largely target cognition and fear extinction. Recent neuroscience literature notes that heightened emotional reactivity and diminished fear extinction characteristic of the teen years make these approaches less effective for adolescents (Fett et al., 2014; Guyer et al., 2016; Lee et al., 2014). Instead, modalities that provide prosocial forms of risk taking in the context of novel stimuli, regulatory activities, and opportunities for reflection may show the greatest promise (Suleiman & Dahl, 2017). In the following section, we highlight the value of creative arts-based groups through a neuroscience lens.

What Arts-Based Groups Offer

While the arts are ubiquitous among young people, they have not yet been given proper attention by developmental researchers. Goldstein, Lerner, and Winner (2017) asserted that the arts represent an important area for study. Embedded within their praxis are abilities important to development, including self-control, executive function, attention, engagement, motivation, emotion regulation, and understanding of others. Dissanayake (2017) also noted their developmental significance by locating the origin of the arts within the attachment relationship, emerging out of the patterned interactions of children and their caregivers.

Whereas the reptilian layer matures in the womb, the mammalian and cortical levels of the brain mature after birth through interaction with primary caregivers and other experiences in the environment. The first two years of a baby's life provide the emotional foundation upon which cognitive development occurs. Right-brain

to right-brain communication between parents and child enables primary caregivers to sense and respond to their infant's emotional needs (see Schore, 2003a, 2003b). Creative arts-based therapies can similarly serve as an important form of interactive regulation. Interactive regulation takes place through empathically based communication, occurring through nonverbal, subcortical channels that use paralinguistic features like facial expression, tone and rhythm of voice, posture, and movements. Precisely because the expressive arts employ body-based, nonverbal techniques, they quickly shoot under defenses to reach preverbal levels of development. In this way, creative arts therapies can help uncover and heal early relational wounds, as well as channel negative emotion, contain high arousal, and provide a safe way to take emotional risks.

For adolescents, whose regulatory systems are still maturing and who may therefore find it particularly difficult to remain present through the interpersonal friction that can come from interacting with others, groups also offer the opportunity to see another group member engaged in a rupture and repair sequence. These moments may register for teens more fully from the slightly more distanced but nevertheless emotionally resonant position of witness. Witnessing provides a sense of the others' emotional experience through what has been termed *embodied simulation*. Gallese (2017) described this process as such:

> When perceiving others expressing disgust, or experiencing touch or pain, some of the same brain areas are activated as when we subjectively experience the same emotion or sensation. We do not fully experience their qualitative content, which remains largely opaque to us, however, embodied simulation enables us to experience others as experiencing emotions or sensations we know from the inside.
>
> (p. 44)

Embodied simulation is closely linked to the discovery of *mirror neurons*, or the finding that when one watches another engaged in intentional action, the same areas of the brain activated in the person who is being observed are stimulated in the viewer (Gallese & Goldman, 1998).

In arts-based methods, in which group members observe others performing intentional actions, whether through the creation of a piece of art, engagement in a movement sequence, the taking on of a role, or the playing of a musical phrase, the firing of mirror neurons and the "jointly-evoked sensory and emotional reactions" (Gallese, 2017, p. 45) are facilitative of empathic connections. While it is not uncommon for teens to engage in criticism and judgmental behavior toward peers during the verbal process of psychotherapy groups, there is often a respect that emerges during the action sequences of arts-based approaches that helps to create connection through attunement (Haen, 2015). Linking the arts to the play that is so vital for human development, Brown eloquently observed, "Art is part of a deep, preverbal communication that binds people together. It is literally a communion" (Brown & Vaughan, 2009, p. 62).

Likewise, experiential approaches rooted in the arts and play allow for forms of mobilization of the body that, in contrast to typical manifestations related to aggression and defense, allow for a "neuroception of safety even with heightened

arousal" (Kestly, 2014, p. 35). This ability to create safety may be particularly apt for those young people who would otherwise find therapy groups—with their emphasis on being with and seeing others—especially threatening, such as teens with complex trauma (Haen, 2015). More generally, the arts lend themselves to embodiment in a way that teens sitting in a circle and talking during verbal group therapy simply does not. As such, it is possible to both observe and explicitly work with "the sensations, gestures, tensions, movement patterns" that underlie feelings, thoughts and behaviors as they are "happening live" (Mark-Goldstein & Ogden, 2015, p. 124).

Recently, researchers have established an intriguing correlation between levels of patient–therapist bodily synchrony during individual sessions and both ratings of the strength of the therapeutic relationship and treatment outcomes (Ramseyer & Tschacher, 2011; Tschacher & Pfammatter, 2016/2017). Likewise, depressed patients may have lower levels of nonverbal synchrony, perhaps reflecting their heightened focus on self or a loss of hope in the possibility of connection (Paulick et al., 2018). In societal groups, synchronized activities, such as moving or singing together, have been found to increase group cohesion and cooperation (Wiltermuth & Heath, 2009), as well as to enhance sense of belonging (Welch, Himonides, Suanders, Papageorgi, & Sarazin, 2014). Creative arts-based groups often use shared movement, communal singing, group mirroring, and other forms of synchronized action as a means of bringing members into shared affective space. As a complement to the sense of universality that operates as a therapeutic factor within verbal groups, these facilitated forms of connection likely help to establish an implicit sense of 'we' among adolescents—who often feel isolated or that their problems and feelings are unique.

This sense of 'we' might alter an adolescent's construction of self. As group members become engaged in arts-based work, they also begin to see themselves as artists, a role that can empower teens and help them develop agency. Likewise, adolescents frequently experience a shift in their sense of who they are in relationship to others, transcending differences in ways that have ramifications beyond the group room. For example, studies on the impact of group membership suggest that humans are neurologically primed to empathize with those they associate with their in-group, particularly regarding race and culture (Eres & Molenberghs, 2013). Likewise, children as young as 6 years old, regardless of their race, demonstrate implicit bias toward White individuals (Stevens & Abernethy, 2018).

However, preliminary data suggest that the affective, cognitive, and regulatory components of empathy can be modified, and racial and cultural bias reduced, through experiences in which one identifies, even temporarily, as the member of a group composed of diverse others (Van Bavel, Packer, & Cunningham, 2008). This is particularly true in the context of emotional experiences (Stevens & Abernethy, 2018). Evidence suggests that these findings reliably apply to relationships across gender as well (Martin et al., 2017). In other words, factors such as race and gender that often mark a division between 'us' and 'them' can be transformed through shared group experiences.

Conclusion

Despite all that is known about the adolescent brain and how that knowledge can inform what motivates and produces change for teenagers, there remain outdated

approaches to group therapy that privilege verbalization as the hallmark of adolescent treatment progress and that view action as connected to pathology (e.g., Sharp & Ahmed, 2016). Creative arts-based group therapy provides an alternative approach that redirects the SEEKING system using novel stimuli and attuned forms of interactive regulation. An arts approach allows for embodiment that fosters cohesion and connection. Creative arts-based groups also provide safe distance for witnessing and reflection. As one adolescent member, summarizing his group experience, so aptly stated: "We came (to group), we made (art), we bonded, and we grew."

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