Playing with Ideas
The Affective Dynamics of Creative Play

Pat Power

Through an integrated investigation of emotion, play, and creativity, this interdisciplinary study analyzes the affective nature of playfulness, explores it as feeling or attitude in an adult context, and maps its relationship to the creative process. Combining phenomenological and empirical perspectives, the author builds on ideas and findings from research in neuroscience, emotion studies, psychology, anthropology, systems and evolution theory, and aesthetics and the arts. He considers the embodied mind environmentally interactive; biologically, experientially, and culturally influenced; and intrinsically dynamic and creative. Finally, he defines a model of playfulness consisting of eight qualities and makes connections between these and ideational phases of creativity.

Introduction

The study of play has long centered on children's early years and development, while play among adults remains poorly documented (Guitard, Ferland, and Dutil 2005). Many specialists see play as a primarily juvenile activity with little relevance to adulthood (Lieberman 1977), and serious scholars typically ignore the subject, while those who do not are themselves ignored (Burghardt 2006).

Like the study of play, the study of emotion and creativity has proved historically problematic. The passions seem the province of the irrational, the antithesis of rational thought. And creativity often gets ascribed to divine inspiration, personal idiosyncrasy, even individual dementia. Prior to the recent upsurge of research on positive emotions and well-being, emotion research focused mainly on emotional disorders, as have the links between emotion and creativity from Freud onwards. Creativity only became salient in psychological research in the 1950s when divergent thinking, or the idea-generating phase of the creativity process, came into focus (Cropley 2004; Mumford 2003), but it is still a relatively neglected research topic even within psychology, one that belongs everywhere and nowhere at once (Sternberg 2002).

These concepts—play, emotion, and creativity—are, in fact, multifarious and culturally challenging, and they thus affect a number of disciplines. So I am not arguing here that play is the sole route to creativity; there are many, such as cultivation of natural talent, integration of cross-domain experience, or the development of mindfulness. Nor am I suggesting that being playful invariably results in tangible creative output (it patently does not), nor indeed, that being playful is useful at every phase of the creative process (it is not). In other words, playfulness is neither necessary nor sufficient for creativity. What I do suggest, on the other hand, is that the cognitive qualities of playfulness (such as fantasy, spontaneity, and ingenuity) are congruent with divergent thinking or ideation (the generation of new ideas or concepts or of novel associations between existing ideas or concepts), which are widely accepted phases of the creative process. The complex correlation between cognition in playful moods and divergent or ideational thinking is underpinned by recent cognitive and neurological research and has practical implications for individuals with creative aspirations, for players in the creative industries, and for those teaching in creative fields.

Although playfulness and creativity can be studied in many contexts, and across a wide range of ages, personality types, and environments, the focus here is on adults, a neglected demographic in terms of play. This article considers adults with some need to be creatively active, such as students in the arts. That said, however, the analysis should have relevance for a much wider audience.

It is important to make a distinction here between playfulness as affect—that is, as playful cognition—and play as behavior. Neuroscientist Jaak Panksepp claims that "affect and cognition are completely blended in mature psychological experience" (2008a, 47). They can be difficult to distinguish as they tend to occur simultaneously. Their complex cause and effect is context dependent, but, generally, the interplay of affect and cognition motivates the behavior. Although playful cognition and play as behavior are critical to this analysis, its central focus is playfulness as an emotion-driven, dynamic process.

Let me expand on this point. Play as behavior has disparate guises, as detailed in Brian Sutton-Smith's *The Ambiguity of Play* (1997). Play can refer to a plethora of individual actions or cultural activities. It can include game play, festivals, artistic play, gambling, and sports. It can be organized, structured, or rule bound (as in games). Or it can be spontaneous, unstructured, and playful (as in imaginary or free play). Not all play is playful, and much depends on the attitude and motivation of those involved. Stuart Brown gives an example of a

game of golf that might be "part of a calculated, controlled effort to close a big sale" (2009, 59), instead of being the epitome of play. Banter with a colleague might comprise furtive power play, a probing for weaknesses in an attempt to undermine, rather than a genuinely playful collegial encounter. Or a football game might be motivated by competitiveness, team spirit, or even aggression, in contrast to a spontaneous knock-about with a ball that might feel simply playful. This latter sense of play, playful behavior engendered by playful emotion, serves as the prime focus of my analysis.

In keeping with the enigmatic nature of the subject, I have taken a dual approach in this exploration based both on phenomenological, felt experience and on an analysis of interdisciplinary analytical and empirical studies. This is what Arnold Modell, a Harvard professor of psychiatry (2006), calls an *epistemic pluralism*, integrating phenomenological introspection (first-person), intersubjective (interpersonal), and empirical (third-person) perspectives. This involves, for Michael Apter, "a rejection of any approach which attempts to explain human behavior without any reference to experience" (1989, 2), because, as Brown puts it in a play context, "there is no way to really understand play without also remembering the feeling of play" (2009, 20).

First of all, I will outline the relevance of dynamic-systems theory (also known as complex-systems theory or complexity) in this context and then examine the dynamics of emotion and feeling before homing in on that most dynamic of affective phenomena—playfulness.

A Dynamic-Systems Approach

Complex-dynamic systems such as society and the mind or the brain are neither wholly chaotic nor orderly but fluctuate constantly from fluidity to semi-stability, with self-organization (increasing pattern and complexity) emerging from this process. As an open (or interactive) system, the brain does not function in isolation, and intelligent behavior emerges out of the interplay among brain, body, and world. The nonlinear (or erratic), self-organizing dynamic feedback integral to such systems is, Frijda says, "best conceived of in terms of dynamic systems theory" (2007, 20). At the level of the brain, dynamic-systems theory offers a conceptual framework (neurodynamics) through which interrelationships of components and processes can be understood, while at the level of the mind, it frees us from chicken-or-egg arguments about what

causes what and in what order. The theory helps us sidestep those old philosophical diversions of cognition-versus-emotion and the primacy of reason vis-à-vis emotion.

In fields such as neuroscience and cognitive psychology, valuable research continues to isolate, classify, and label diverse aspects of cognition and emotion. However, phenomena such as emotion, perception, cognition (and their immediate environment) are sometimes more usefully envisaged as holistically integrated and interrelated processes, and dynamic-systems theory gives powerful insights into how such interconnected systems interact and function. In a dynamic system such as that comprising the brain and the nervous system, multiple subsystems influence each other continually through dynamic feedback, so that the experience of watching a dramatic scene in play, for example, might invoke powerful emotions linked to memories of childhood experiences that, in turn, might be modulated by beliefs about art or by feelings related to play.

Rather than focusing how the world is represented in the mind, dynamic-systems theory focuses attempts to model "how the body's continuous interactions with the world provide for coordinated patterns of adaptive behaviour" (Gibbs 2005, 10). The brain responds to stimuli through associative resonance in its neural networks, activating multimodal attractors—semistable patterns toward which systems gravitate—that affect and are affected by the interplay of phenomena such as emotion, attention, cognition, and memory (Power 2009). The resulting patterns of real-time entrainment (or synchronization) between emotions and cognitive ensembles can become stronger with repetition, which results in predictable alliances of emotion and modes of cognition in particular situations or environments. This process is known as Hebbian resonance, which occurs when the systems of cells become associated with each other because they tend to be simultaneously active over and over again—as one aphorism has it, cells that fire together, wire together. Thus, playful attitudes fostered at home, in study, or at work can prompt flexible modes of cognition and in time promote a culture conducive to creative behavior. As one well-known contemporary example of a creatively successful corporate playground, the animation company Pixar encourages playful approaches to creativity (Capodagli and Jackson 2010).

Dynamic-systems theory can also help us understand phenomena at several different levels. Neurologist Antonio Damasio argues that an understanding of the complexities of brain, cognition, emotion, and behavior requires approaches

relating to "all the levels of organization of the nervous system, from molecules, and cells and circuits, to large-scale systems and physical and social environments" (Liston 2001, 2). A playful episode at a carnival can be understood (from the bottom up) as chemical reactions at the molecular level, neurodynamic flexibility in the brain, playful impulses and emotions, conscious feelings of playfulness, playful behavior in a particular individual, and cultural and communal festive play. Each and all of these levels can be addressed using systems theory, with each level understood as emerging from the one below as a self-organizing higher level of complexity. Inquiry at the appropriate level is crucial. It means nothing to ask if your neurons feel playful because feelings emerge at a higher level. Theorizing in terms of dynamic systems seems particularly apposite in a play and creativity context because both phenomena are intrinsically dynamic not only in process but also in spirit.

macro levels and properties			organization affordance constrains
society	arts science economy, etc	politics culture enviroment	⇩
behavior	play creative activity communication, etc.	creativity socialization learning	abstraction
mind	conciousness cognition emotions	experience learning development	
brain	neural networks autonomous nervous system	development evolution	+ complexity -
life	organisms genes cells	evolution	emergence ⇧
matter	molecules atoms subatomic particles	chemistry physics quantum mechanics	organization affordance constrains
micro levels and properties			

Table 1. Levels, expression, and means of complex-systems organization

The Dynamics of Emotion and Cognition

Playfulness in everyday experience is an emotional disposition—an attitude, a feeling, or a mood—enabling playful action. *Emotion* is a short and often problematic label for a very broad range of biological, experiential, behavioral, and sociocultural phenomena. Different classes of emotion have distinct neural systems that have evolved for different reasons, and LeDoux (1998) subscribes not to emotion but to emotions—processes that have a family resemblance, often referred to collectively as affect. Emotions ensure that action is taken to fulfill needs, wants, wishes, and desires. Emotions are "all about transition and commotion" (Damasio 2003, 63), and both the Latin root of the term *emotion* (to move out) and the concept of *being moved* attest to the active nature of feelings (Gibbs 2005). Emotions are fitness-enhancing, multifunctional adaptations—evolutionary, developmental, and immediate—to the environment. We have evolved to perceive and respond to biological, social, and physical stimuli through emotions.

Emotions emerge from a synthesizing of more fundamental processes, Damasio says, with each level of reaction consisting of "tinkered rearrangements of bits and parts of the simpler processes below" (2003, 38). These processes include, at increasingly higher levels of complexity: (1) metabolism, immune response, and basic reflexes; (2) actions associated with pleasure and pain, such as approach and withdrawal; (3) drives and motivations such as hunger, thirst, lust, exploration, and play; (4) emotions proper (background, primary, and social emotions); and, at the top of this tree, (5) feelings. The complex mental perception of these nested emotions occurs in the brain's somatosensory areas as patterns of neural activity, or neural maps (Damasio 2003). Though many researchers use the terms *emotion* and *feeling* interchangeably, we say feelings are a qualitative awareness of our emotions. They appear after emotions, both in the moment and in terms of evolution, though granted, it is hard to keep them apart. Even Damasio admits that having been teased apart, they can be put together again as affects. In any case, feelings are accessible to consciousness, although we may not attend to them, and they are always in process. They may be intense, subliminal, or phenomenally complex. Some of them may be accessible; others, a faint whisper. As Damasio summarizes, whereas emotions play out in the theater of the body, feelings play out in the theater of the mind (2003). Feelings are perceptions not of the external environment but of our internal milieu.

Panksepp views emotions much as Damasio does, although Panksepp's research has convinced him that the process starts in the brain's emotion centers (the limbic system, common to all mammals) rather than in the body or the cerebral cortex. Panksepp uses the term *dual-aspect monism* to denote feelings that emerge from the brain. The dual aspect suggests that "certain emotional arousals concurrently generate instinctual emotional urges as well as complementary emotional feelings." The monism (as distinct from the dualistic Cartesian notion that mental phenomena are somehow immaterial) suggests that both behavior and feelings are manifestations of the physically embodied brain (Panksepp 2008a).

Moods are temporary, diffuse, and generalized (Siemer 2005), and they involve patterns of emotion and cognition. Sometimes a more general trait (e.g. a playful temperament) implies a predisposition to certain moods. If someone describes a person we are about to meet as dour, easygoing, or temperamental, we understand what to expect when we met the individual in question. If someone is described as playful, for example, we might expect him or her to be lighthearted, buoyant, or humorus. Philosopher and educator John Dewey saw playfulness as primarily an "attitude of mind" (1913, 727), and attitude can either be general or it can be context specific. Someone might be said to have a phlegmatic temperament, for instance, while having a nervous attitude towards asteroids or academics.

In terms of dynamic-systems theory, Panksepp says "affective experience is an emergent function of complex network-level neurodynamics, intimately connected to body and world" (2008a, 58). In this paradigm, moods can be understood as attractors, as semistable, self-organizing patterns towards which systems can rapidly evolve or gravitate. Such states can be initiated or amplified by positive feedback, and they can be stabilized by negative feedback. Hence, they are nonlinear. Slight perturbations can cause the system to destabilize and swing dynamically between states, as in the so-called butterfly effect. "Psychological systems," says Lewis, "like well trained neural networks, generally remain in an unstable phase only briefly, then settle to a particular region of the state space" (2005, 176). A playful bout of banter with a friend might briefly turn to anger after an edgy remark. Playfulness may resume, or resentment or caution may take over, but one mood or another will quickly dominate.

Dispositions, temperaments, attitudes, and moods are recurring dynamic patterns of affective response. They are strengthened by increased activation and resonate widely throughout the system, affecting processes including perception and sensation, memory, imagination, and decision making. Whether we see emotions primarily as attracting or repulsing, appraisal, decision mak-

ing, motivational, or attention focusing (and they are all of these), they have evolved as multifunctional dynamic systems that underpin—amongst other things—motivation and value in our lives.

Recent experiments offer considerable evidence for mixed emotional responses (Hunter, Schellenberg, and Schimmack 2008; Carrera and Oceja 2007; Frijda 2007; Hunter, Schellenberg, and Schimmack 2010), and mixed emotions are important in the context of playfulness. Mixed emotional responses may involve reciprocal activation (i.e. as one gets stronger, the other grows weaker) with emotions that tend to be incompatible (e.g. approach or avoidance), or they may involve coactivation, usually at lower levels with perceived opposites such as pleasure and pain. Mixed emotions are experienced simultaneously (Carrera and Oceja 2007; Hemenover and Schimmack 2007), so one feels disgusted and amused in response to a joke in dubious taste or bittersweetly nostalgic while watching an old movie. This has important implications for playfulness because play is underscored by secure and lighthearted feelings but may also involve other emotions. One can feel a touch of outrage at a friend's teasing, a tinge of fear when engaging in a playful dare, or hints of horror, angst, and exasperation when acting out a fantasy.

Positive Emotions and Playfulness

We should keep in mind that, though the use of positive and negative to describe emotions is widespread, they can be misleading. So-called negative emotions, in fact, can be positive for an organism (e.g. the fear of danger), which is why the emotions evolved in the first place. For my purposes here, positive emotions, including playfulness, evoke pleasure and motivate us to approach others or allow them to approach us in seeking novelty and engaging us in some activity. Panksepp, interviewed by Campbell (2010), says the seeking system—or wanting system (Panksepp calls it seeking; Berridge, wanting)—is "the granddaddy of the positive systems." In the interview, Panksepp contends that "all the other positive systems in the brain, such as care, nurturance, lust, sexuality, and play, use this system as a common substrate. . . . You don't build many different systems for different resources, you build one system for looking for resources" that can be requisitioned by other systems (such as the play system) using different rewards for different ends. Panksepp insists that "pleasure is nature's way of telling the brain that it is experiencing stimuli that are useful" (1998, 182). Nevertheless, in an evolutionary context and in contrast to negative emotions, the functional

advantages of positive emotions are not immediately obvious, and their functionality had remained poorly understood until recent advances in the study of positive emotions and well-being.

One such advance is Barbara Fredrickson's influential broaden-and-build theory of positive emotion, which has extensive empirical support (Fredrickson and Branigan 2005). It suggests that, unlike negative emotions that are narrowly focused on immediate survival (e.g. fright or flight), positive emotions confer a longer-term, if less-obvious, evolutionary advantage. By increasing flexibility for potential cognitive and behavioral response, they broaden response repertoires, thus helping build a variety of personal resources over a longer term. These resources are durable because "they outlast the transient emotional states that led to their acquisition" and include physical resources (skills, health), intellectual resources (knowledge, theory of mind) and psychological resources (resilience, optimism, creativity) (2005, 315).

This broadening of responses and buildup of resources motivates playful behavior. This behavior, in turn, confers multiple benefits (cognitive flexibility, skill refinement, and the fine tuning of emotional responses). Thus playfulness, as a positive, affective process, is adaptive. Behavioral neuroscientists Sergio and Vivien Pellis argue that "some motor, cognitive and social skills are improved, directly, by the experience of play," but they have found that "the primary avenue for the improvement of all skills is via emotional calibration" (2009, 162). In their view, optimal fine tuning of emotional responses to events is the primary function of play, and other benefits, however useful, are secondary. In any case, playfulness, both directly and through playful behavior, can positively affect other emotional (as well as physical and cognitive) processes. This fits a broaden-and-build approach. Playfulness is one of the positive affects Fredrickson (2003) cites explicitly, and the broaden-and-build theory has far-reaching implications for understanding it. If positive emotions generally encourage more flexible repertoires of response, then playfulness is a broaden-and-build process par excellence—the embodiment of flexibility and resourcefulness.

The Evolutionary and Developmental Dynamics of Playfulness

Playfulness is the essence of adaptability, and Panksepp sees the impulse to play as one of our "basic instinctual emotional urges" (2008a, 50) arising from "pri-

mary-process emotional systems of the mammalian brain" (2008a, 56). Playful affect and behavior are adaptive at several different levels of magnification—historically in terms of evolution, developmentally in terms of growing up, and immediately in terms of flexible interaction with our environment. Systems theory sees these self-organizing processes as "embedded interacting time scales" (Lewis and Granic 1999, 695). Playfulness, as a neurodynamic attractor, influences other attractors when activated, increasing flexibility and fluidity in the system, and enabling the characteristic behaviors associated with playfulness such as spontaneity and improvisation. In other words, playfulness can affect or even override other impulses, as when a ridiculous confrontation collapses into laughter after the participants realize the absurdity of their situation.

Playfulness evolved because of its functionality—it enables us to increase our options for cognitive selection and variable behavior. Being beneficial, it also feels good, and, in turn, can confer diverse systemic benefits, like stress control, improved social bonding, and greater optimism (Fredrickson and Branigan 2005). Both playfulness and creativity are meta-adaptive: they evolved because they enable developmental, psychological, behavioral, and cultural flexibility.

Sutton-Smith suggests that play may have evolved for internal as well as external conflict reduction in order to reconcile "the combative interactions between the ancient amygdala region of the hypothalamus and the more modern prefrontal cortex of the brain" (2008, 116). In other words, play evolved as a form of expressive-regulative mediation between older, emotion-driven or reflexive reactions and the more recent capacity for cognitive deliberation or reflection. In this view, play is an imitative mediation between reflexive and reflective reaction (or between instinct and guile), which evolved to optimize responses. This opposition is reflected in the range of play behavior and in the contrast between free or expressive play (more affectively reflexive) and rule-bound or ritualized forms of play (more cognitively reflective). The latter are more common in complex societies, and although most forms of play help fine tune emotions, structured play is often focused on rule-related social emotions such as cooperation or tactical aggression in paintballing or the camouflage of emotions in poker. Sutton-Smith (2008) encapsulates this evolved aspect of play as dialudic (his play on dialectic) in its synthesis of contending reflexive and reflective forces.

Because play affects maturation, it has evolved differently in humans than in other species. For most mammals, playful impulses subside, and they play less as they grow into adulthood. This makes sense both from evolutionary and

developmental viewpoints, as "most mammals grow new nerve connections extensively only during the juvenile period" (Brown 2009, 48). Mature adults generally exhibit "more compulsive, rigid and purpose-driven behaviour" (2009, 55), needing to attend more to breeding and survival, including being vigilant while juveniles play. Neoteny (the retention of juvenile traits into adulthood) is "a boon to humans" however, and is manifest in adult neuroplasticity (structural adaptability) and neurogenesis (the generation of new brain cells), both now regarded as lifelong phenomena in humans. Adult playfulness is the most salient sign of human neoteny, and it can, in turn, help optimize both neurogenesis and brain plasticity (2009). "All mammals engage in play as juveniles," says Rod Martin "but, unlike most other animals, humans continue to play throughout their lives" (2007, 6), although the propensity for play may diminish as a child matures into adulthood and the nature of playful expression changes.

The Neurochemical Dynamics of Playfulness

Unweaving the dynamics of playfulness in the brain as it has evolved is a complex task. Not even including neuronal connections, it involves considering input from glial and other cells, the influence of synchronization (temporal coordination) on excitation and inhibition patterns, and multiple neurochemical influences, in particular from neurotransmitters. "Almost all computational models of the mind and brain ignore molecular details," says Paul Thagard (2002, 429), despite the fact that neurotransmitters, hormones, and many other chemical neuromodulators have a profound influence on cognition. There have been recent advances, however, in determining which neuromodulators in different areas of the brain give rise to particular motivational effects.

Research summarized by Alice Isen (1999) has revealed that increased levels of the neurotransmitter dopamine in the brain correlate to cognitive flexibility while, conversely, cerebral dopamine depletion (a hallmark of Parkinson's disease) reduces such flexibility. Dreisbach's empirical studies (2005) also confirm that an increase in central dopaminergic activity leads to more cognitive flexibility, while Bianca C. Wittmann and colleagues (2007) associate it not only with exploration and curiosity but also with an appetite for novelty. Cognitive flexibility, curiosity, exploration, and a hunger for novelty are all characteristic of play.

Recent research shows, however, that although "both the mesolimbic dopamine system and opioids play a functional role in the generation of positive

affective states" (Burgdorf et al. 2010), "dopamine is probably not a pleasure neuro-transmitter even if it causes some other component of reward" (Berridge et al. 2009, 43). Berridge distinguishes wanting from liking. So dopamine is a motivator, driving us on to seek novelty in the anticipation of reward (wanting), whereas stimulation of the opioid system is the payoff and creates the feeling of pleasure (liking). Serotonin, on the other hand, opposes the activating neuromodulators (particularly noradrenaline and dopamine) and activates withdrawal rather than stimulation (Tops et al. 2009). It is significant then, that play activity is linked with increases in dopamine and opioids and a reduction of serotonin (Panksepp 1998).

Playfulness may be neurochemically dualistic. In other words, perhaps it is both dopamine driven as an emotional impulse—a wanting to play—and opioid rewarded as a pleasurable feeling. This supposition would agree with Damasio's teased-apart concepts of emotion and feeling and with Panksepp's dual-aspect analysis of the concurrent generation of instinctual emotional urges and complementary emotional feelings (2008a, 60). Since dopamine energizes curiosity, novelty, and flexible response patterns, and since opioids are powerful modulators of positive mood, their effect on the neuronal landscape seems to coincide sonorously with aspects of playfulness. Apparently playfully networking neurons, tippling dopamine or opioid-based cocktails, connect and communicate more freely and pleasurably, like they were frolicking at some neurofestival.

Qualities of Playfulness

Psychologist Nina Lieberman sees playfulness as a behavioral disposition in children and thus the "quintessence" of play (1977). Sutton-Smith (1997) suggests that playful activity is metaplay, in that it is playfully disruptive of more structured or mundane forms of play that model, ritualize, or stylize routine experience. These latter forms of play, sports for example, are often more serious than playful and are disconnected from the quintessence of play, i.e. playfulness. So to be understood fully, playfulness requires analysis both from phenomenal and behavioral perspectives—playfulness as affective experience and the playful activity it engenders.

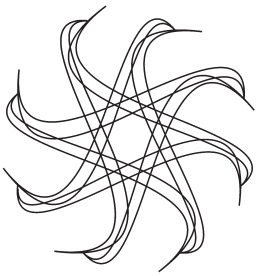
There are multifarious qualities attributable to playfulness, and just a few of these are "humor, manifest joy, and spontaneity" (Lieberman 1977, xi), "creativity, curiosity, pleasure, sense of humor, and spontaneity" (Guitard, Ferland, and

lighthearted
background feeling of well-being, euthymia, confidence, spirit, cheerfulness, good humor, brio, frolicsomeness, buoyancy, pleasure, animation enjoyment, exuberance

dynamic
spontaneity, diversity, flexibility, fluidity, unpredictability, plasticity, lability, improvization, fluency, flow, energy, perspective shift, process orientation, versatility, agility, flux, multistability

humorous
impishness, wit, amusement, ingenuity, mischief, funniness, cheerfulness, good humor, mirth, ribaldry, absurdity, laughter, sense of ludicrous, farce

interactive
engagement, socialization, aroused attentiveness, flow, curiosity, appetite, proactivity, connectivity, flirtation, serendipity, communication, competition



imaginative
vision, pretense, fiction, virtuality, fantasy, novelty what-if attitude, creativity, experimentation, make-beleive, possible worlds

enigmatic
ambiguity, contingency, becoming, edge of chaos, dualism, subversion, dimorphism, incongruity, synaesthesia, anomaly, irony, metaphor, paradox, liminality, shape shifting, randomness, probability, chance, dissonance

transformative
movement, transition, becoming, metamorphosis, change, evolution, development, adaptation, shift, progress, maturation, transcendence

open-minded
integration, permissiveness, holism, synthesis, synergism, accessibility, freedom, pattern or gestalt orientation, unity

Table 2. Characteristic qualities of playfulness

Dutil 2005, 9), and "frolicsomeness, lightheartedness, and wit" (Sutton-Smith 1997, 147). These qualities of playfulness make sense either from phenomenal experience or observed behavior, and many do so from both perspectives, often sharing the same root linguistically. For example, it makes perfect sense to feel frolicsome and to frolic simultaneously because the affect is a motivator for the behavior.

Table 2 presents a schematic model of playfulness. In keeping with the dual phenomenological and empirical nature of this article (and the dualistic nature of play itself), table 2 aims to articulate both experiential and behavioral qualities of playfulness simultaneously. In this model, playfulness is envisaged as having eight qualities. It is dynamic, interactive, enigmatic, lighthearted, humorous, imaginative, open-minded, and transformative.

Dynamic

Playfulness is a feeling of energized freedom, of spontaneous mental or physical agility and flexibility, or both. The dynamics of playfulness are exemplified by cognitive spontaneity and what Liebermann calls "ease of movement" (1977, 20).

Whereas ease of movement in physical space may be intrinsic to most children's play, it is by no means integral to playfulness in adults. In exploratory play, children investigate the world both conceptually and physically. They experiment by mixing substances or breaking things, swinging exuberantly on branches, testing the elasticity of the bounce house, or stretching the boundaries of their parents' patience.

This dynamic playfulness found in children manifests itself in adults as imagination and creativity (Lieberman 1977). Adults are capable of thinking "more flexibly, dynamically, and contextually than children" (Fischer, Yan, and Stewart 2003, 493). When adults are in a playful mood, they internalize the high jinks kids enjoy. Adults play with the boundaries of their own thoughts and perceptions and with those of others—dynamically exploring possible worlds in fantasies or creative writing; mixing and blending conceptual spaces through satirical imitation or playful design; stretching and breaking established schemas by engaging with art or being absurd; and bouncing round otherwise solid and well-defended psychic structures using self-deprecating humor or teasing others.

The very nature of our systemic equilibrium can be affected by playfulness. Dynamic iterative (repetitive or cyclical) feedback plays an important part in the brain's complex regulatory systems, and the generally acknowledged goal is homeostasis. When a more dynamic balance is sought, however, as in playful states, it can be described as heterostasis (or multistability). Abraham Maslow's (1987) basic-level deficit needs (like hunger, tiredness) seek homeostasis, whereas higher-level needs for self-actualization (like play, creativity, and peak experiences) seek a more dynamic heterostasis.

Reversal Theory in psychology, also based on system dynamics, sees the system moving between pairs of stable but polarized metamotivational states such as telic (serious) and paratelic (playful) states (Apter 2003). The former is results oriented and serious, and the latter is process oriented and playful with a "protective frame" enabling enjoyment of phenomena normally avoided and with a tolerance for paradox and dissonance. The system swings dynamically between these two equally stable states enabling contrasting attitudes and serious or playful reactions to a given situation.

The fact that stable and flexible global outcomes can emerge from local unpredictability constitutes an example of two intertwined core concepts within dynamic-systems theory. Fredrickson and Losada cite neurological (and cardiac) systems as functional examples. They argue that such flexibility allows systems to cope with the exigencies of an unpredictable and changing environment, and that "chaos underlies

the ability of the brain to respond flexibly to the outside world and to generate novel activity patterns, including those that are experienced as fresh ideas" (2005, 680).

As Postrel (1999) observes, playfulness is not just a product but also a source of dynamism. The brain's protean dynamics are optimized in playful moods, creating diverse and eclectic connections that facilitate fluency, flexibility, and originality and enable novel perspectives in the generation of new ideas. Albert Einstein's quirky switch of perspective to that of a light beam, for example, resulted in $E=MC^2$.

Interactive

Playfulness feels engaged and interactive both internally and externally, and this dynamic interplay forms the essence of an open system such as the embodied brain. Internally it plays reflexively, transforming thoughts and other emotions while externally it engages socially with people or other organisms or with inanimate objects in the environment through object play.

While Sutton-Smith (1997) says that solitary playfulness is typified by the rhetorics of the imaginary and of the self, according to Panksepp, playfulness as a "joyful social exchange" is central to all socialization (1998, 284). It is, he claims, the "fundamental play systems of the brain from which the urge for joyous social engagements emerges" (2008b, 65). Panksepp also says: "The neurobiology of playfulness suggests that this important gift of nature is a primary-process tool for helping construct social brains" (2008b, 75) and for helping to "stitch individuals into the social fabric" (1998, 280). Playfulness is socially contagious (1998b), and through positive affective feedback it can trigger playful and creative interaction with others. As psychiatrist Allan Schore puts it, those engaged in "play episodes of affective synchrony . . . experience a condition of resonance, and in such, an amplification of vitality affects and a positive state occurs" (2009, 117).

Emotions are not just private feelings. They are the mainspring of interaction. Both subjective and objective, they are "both in us and in the world at the same time. They are, in fact, one of the most pervasive ways that we are continually in touch with our environment" (Johnson 2007, 67). As Gerd Gigerenzer puts it, "to understand what goes on inside our minds, we must look outside of them, and to understand what goes on outside, we should look inside" (2008, 92). Moment-to-moment changes in our environment can signify danger or imminent opportunity. We find this uncertainty arousing and interesting, though stressful and anxiety ridden, and the embodied brain reacts as flexibly as possible

in response. Playfulness helps enhance our flexibility in the face of uncertainty, and through ball play or banter, through role play or rough-and-tumble, we can hone our reactions safely in pursuits we find pleasurable and engaging.

The play system is generally engaged and interactive and motivates approach rather than avoidance. To this end it routinely co-opts the seeking (or wanting) system, a generalized motivator for energized, active, and curious engagement. Although seeking and play are separate systems, they can work synergistically (Panksepp 1998), and the seeking system, an evolutionarily early "general-purpose find-it system," is a common substrate routinely requisitioned in exploratory circumstances by more evolutionarily modern systems, including play (Campbell 2010). Stimulated by the anticipation of reward (rather than any specific reward), and likely orchestrated through dopamine release, seeking can be activated in exploratory and engaged play, in serendipitous scientific exploration or a treasure hunt, for example, or a playful exploration of novel uses for a play theorist. In playing hide-and-seek incidentally, the seeking system will be engaged in all players, as hiding is seeking too—a quest for refuge.

One of the main differences between juvenile and adult play may involve the balance between the play and seeking systems. Lieberman (1977) suggests differences between play and exploratory behavior in children, and this may be most obvious in object play. Pankseep suggests that exploration may be "a source process" for "object or manipulative play" (1998b, 296). And in a study of octopus play, Michael Kuba and his colleagues support the hypothesis suggested by several authors that juvenile object play in both animals and humans follows from object exploration and that there is a transition from exploration to play. They found that behaviors focused on learning to manipulate an object were succeeded "by more diverse exploration and/or habituation and culminating with play" (2006, 184). It seems reasonable that an unfamiliar object should be approached carefully at first before an eventual shift to a more carefree, playful exploration.

Whereas this shift between seeking and play can happen with children as they become familiar with objects in the environment, adults are usually accustomed to both their external environment and their internal milieu, so exploration is likely to have a different profile. Generally, adult exploration is voluntary, without the earnestness it can entail for children, and it usually involves the deliberate perturbation of clichéd cognitive habits. As adults, we choose, when in the mood, to defamiliarize the mundane, to adopt playful perspectives, and to engage in serendipitous peregrination. This might involve cooking novel concoctions for dinner, caricaturing friends for fun, or deciding—like Spike Milligan

in the 1956 song he wrote for BBC radio's the *Goon Show*—that "I'm Walking Backwards for Christmas." Neuroscientist Gerald Edelman suggests that "the mature brain speaks mainly to itself" (2007, 100), and playful manipulation of the internal mental milieu may be a hallmark of playfulness in adults. Such play can be ironic, involving a pretend exploration of the familiar, a playful switch of perspectives, or a reflexive investigation of mindset as much as environment. This synergy of play and seeking circuits in playful mental exploration has resonance, too, in creative science and arts practice, and it may well be one of the salient differences between developmental and adult play.

Enigmatic

To feel playful is to feel physically or mentally in flux, to feel the frisson of being enigmatically betwixt and between, in a pleasant but paradoxical dance of dualistic becoming. Playfulness is impossible to pin down—and not merely theoretically. Playfulness inhabits no man's land, the borderlands of reality and fantasy, of earnestness and frivolity, of sense and nonsense, and it engages in those interstices with uncertainty and its entourage—duality, ambiguity, incongruity, novelty, paradox, irony, possibility, chance, synchronicity, the interstitial, the ineffable, the ephemeral, the absurd, the heterostatic, the unexpected, and the unknown. Like a Möbius strip, it is dualistic inside and out. Like a drawn line, it is simultaneously figure and ground. It is the life and death duality of Schrödinger's cat. It has the anthromorphic ambiguity of Mickey Mouse. Playfulness is Mr. In-between.

"The unpredictability that exists in play, particularly when coupled with its inherent ambiguity," makes it ideal for learning to expect the unexpected (Pellis and Pellis 2009, 155). Betwixt and between phenomena are often described as *liminal* (Latin *limen—threshold*), a concept developed by Victor Turner from a term coined by French folklorist Arnold van Gennep and since used widely in many disciplines to refer to the phenomenon of duality. Turner saw liminality as "full of potency and potentiality . . . full of experiment and play" (1977, 34). He described play as the essence of liminality; it might include "a play of ideas, a play of words, a play of symbols, a play of metaphors. In it, play's the thing."

A musician improvising variations on a theme plays liminally between theme and variation, the expected and the unexpected, stability and chaos, music and noise. Waldrop describes this enigmatic playground as "the edge of chaos," a place where "life has enough stability to sustain itself and enough creativity to deserve the name of life" (1992, 12). It is the essence of Koestler's (1964) "bisociative thinking" in a creativity context, where connections are made in the

thresholds between previously unconnected matrices. Similarly, Mark Turner's (1996) conceptual blends are the dynamic liminal spaces where a playful synthesis of, for example, speech and animals, might beget a talking beast. These too are the spaces of Derrida's (1970) endless play of signifiers, of Barthes's (1980) feeling of jouissance engendered by the playful writerly text, and of Bakhtin's (1981) dialogical interplay of multiple voices and meanings.

Duality is the essence of metaphor, and the connection between sensation, emotion, feeling, and meaning is based primarily on the cross-modal associations of metaphor and metonymy (Modell 2006). Metaphor is Ramachandran's (2004) most important neuroaesthetic law of art, and he relates it to its cross-sensory relation, synesthesia. Metaphor is a creative fusion, an enigmatic interplay of similarity and difference that may have its evolutionary origins in symbiogenesis. Biosemiotics, the study of signs in the biological sphere, provides insights into how this capacity for creative joining together of different, even competing, phenomena in nature (evidenced in most cells in our bodies) may emerge as semiosymbiogenesis in culture through a capacity for metaphor (Wheeler 2006). All art, indeed all media, are liminal. They are, by definition, intermediate spaces—the threshold, the interface, the enigmatic play space between the creator and consumer, between the artist and the audience.

Lighthearted

Whereas the word *playfulness* certainly connotes something positive, something pleasurable, something fun, perhaps the word *lightheartedness* best captures the quality of feeling or mood associated with playful affect. Sutton-Smith (1997) argues that the opposite of play is not work, but depression, and lightheartedness, in contrast, is a compound word embodying a metaphor signifying buoyancy of feeling or uplifting emotion.

This quality of lightheartedness distinguishes playfulness from many forms of play as behavior. The positive mood aspect of game play is by no means a given (Panksepp 1998), and players in many sports can be anything but lighthearted. There is also a difference between playfulness, and what Csikszentmihalyi (1996) calls *flow* or what Ackerman (2000) calls *deep play*, although playful states can encompass either. Though both these concepts are characterized by positive affect and complete involvement, they do not necessarily encompass lightheartedness or wit. Fun is a closely related concept of an intrinsically motivated quality often called *autotelic*. Seen by Sutton-Smith (1997) as signifying a modern rhetoric of self, fun is considered by some to be central to playfulness

(Ackerman 2000; Huizinga 1949; Lieberman 1977). The phrase *having fun* perhaps describes a more generally enjoyable behavior than does the phrase *being lighhearted*, which better calls to mind a playful mood. It connotes lightness not gravitas and hence carries with it a whiff of triviality and frivolity. But as Sutton-Smith asserts (1997), such denigration of playfulness is a serious subject in its own right. Echoing Dewey's views on seriousness and playfulness, the philosopher Theodor W. Adorno, considered all true art to be both serious and lighthearted: "Art vibrates between this seriousness and lightheartedness. It is this tension that constitutes art" (1992, 249). He considered the plays of Samuel Beckett exemplary in this regard. The tragic gravitas of *Endgame* or *Waiting for Godot*, then, finds its counterpoint in their playfulness.

It is important to remember that more than one emotion module can be active at any one time and that these can have variable states of activation, entraining different cognitive patterns. Panksepp (1998) gives several examples of variable levels of activation, including frustration as low-level rage and anxiety as low-level fear. "We may think of our emotions as pretty pure states," says Christopher Butler in *Pleasure in the Arts*, "but most of them come to us mixed" (2004, 34). Fear could be activated, for example, on a roller coaster or anger in play fighting, but in each case, the negative emotion could be simultaneously regulated by the coactivation of play circuits. In order to regulate these emotions, one needs to feel them in play, and it is not clear whether a playfully entrained cognitive this-is-play reminder helps keep the playful mood dominant. What is clear, however, is that mixed emotions can be a creative or regulatory aspect of playfulness. While remaining playful, we may feel a hint of aggression in a chess game, a flash of anxiety or panic in hide-and-seek, or a frisson of fear in celebrating Halloween.

Lightheartedness is a complex, layered state entraining several emotion circuits, which enable a "powerful positive emotional state" (Panksepp 1998, 297). At base, playfulness is a feeling of security, confidence, and well-being, while its higher notes include cheerfulness, impishness, and good humor, and it can vary in intensity from mild good humor to exuberance. Play requires a safe environment for its full expression (Panksepp 1998), and thrives in an environment that is "familiar, not overly charged with tension, and not ego threatening" (Lieberman 1977, 144). This lack of threat and tolerance of mistakes is important also to creativity since "safe environments expand consciousness" (Modell 2006, 140).

Although playfulness seems more dynamic than stable, it is underpinned by affective security that enables playful engagement with instability, just as the

structure and stability of a theme underpins and enables artistic variation in a musical performance. This phenomenon also mirrors "two intertwined core concepts within nonlinear dynamic systems—namely, local unpredictability and global stability" (Fredrickson and Losada 2005, 680).

Being playful is generally autotelic because it feels lighthearted. Fredrickson's broaden-and-build theory directly links positive emotion and the ideational aspects of creativity. The title of Fredrickson and Brannigan's paper "Positive Emotions Broaden the Scope of Attention and Thought-Action Repertoires" says it succinctly (2005). This theory has extensive empirical support, and "20 years of experiments by Isen and her colleagues show that when people feel good, their thinking becomes more creative, integrative, flexible, and open to information" (Fredrickson 2003, 333).

Humorous

The feeling of lightheartedness is often accompanied by its cognitive companions, wit and humor, evoking mirth, jollity, and laughter. Indeed humor is a cognitive form of play, with "incongruity, unexpectedness, and playfulness" at its core (Martin 2007, 6). Symbolic play—puns, jokes, and verbal jibes—involve advanced cognitive and linguistic processes that have a basis in the brain's play circuits (Panksepp 1998). *Good humored* refers primarily to a mild positive mood or disposition, while having a good sense of humor can indicate either receptivity to humor, or, more actively, the ability to be funny or witty. Social context and hierarchy can be critical in determining who is being funny and who laughs (Martin 2007). Think of the countless scenes in westerns or gangster movies where the sycophantic sidekicks laugh on cue only after the boss laughs or cracks a joke. A state of mind characterized by low activation of the play circuits can enable us to respond to play, as a sense of humor enables us to respond to humor, while increased activation can energize humor, make it more salient.

Positive affect can have beneficial effects on health and well-being, and humor and playfulness are linked in this respect. While stress "appears to erode both cognitive and motor function," playfulness, in contrast, can help "greatly enhance the ability of animals to function effectively in a wider range of contexts" (Pellis and Pellis 2006, 253). Humor boosts positive emotions, counteracts negative moods like depression and anxiety, enhances sociability, and offers "a valuable mechanism for coping with stressful life events" (Martin 2007, 269).

The fact that *ludic* and *ludicrous* share the same root is no coincidence, and playfulness as humor can be irreverent and subversive. Sutton-Smith quotes

theater director Richard Schechner's adage, "A playful nip is a bite that's not a bite, but it's also not not a bite" (1997, 1). Playful humor can similarly make a point without necessarily drawing blood. While some kinds of humor such as sarcasm or ridicule are not associated with positive states, they are the exceptions to the rule. Generally, however, playfulness is humorous and humor, playful.

While spontaneous humor, impishness, and lighthearted wit are creatively playful, creative humor can come in more structured forms such as comedy, satire, or farce. Although creativity does not have to be humorous, humor is inherently creative. Both play and humor can blend lightheartedness (as mood) and seriousness (as a cognitive quality). John Dewey regarded the "harmony of mental playfulness and seriousness" as "the artistic ideal" (1910, 219–20) and considered being playful and serious at the same time as "the ideal mental condition" (1910, 218).

Humor often relies on incongruity, on disrupting pattern and expectation. We are all familiar with established patterns, with habitual, lazy, or clichéd ways of perceiving, thinking, and feeling. Ellen Langer, a Harvard professor of psychology, calls these "premature cognitive commitments" (1990, 22). Through wit or humor, (and the creative arts), we can disrupt these default attractors by playfully switching perspectives, by collapsing categories, by creating fresh blends and unexpected connections, and by confounding expectations. Premature cognitive commitments can comprise universal or cultural norms or expectations established as the set-up for a gag. It is the incongruity of the unexpected that we often find funny, as in nineteenth-century humorist Bill Nye's quip, quoted by Mark Twain (1924), that "Wagner's music is better than it sounds."

Imaginative

To feel playful is to feel the optimistic energy of imaginative possibility. Imagination takes many forms; however, not all of them areassociated with playfulness. It can involve planning, hypothesizing, or daydreaming, and it is integral to everyday consciousness (Dutton 2009). Although in its broadest sense, "every act of perception is to some degree an act of creation, and every act of memory is to some degree an act of imagination" (Edelman 2007, 100), in its narrower sense, imagination is relatively free from objective constraints and generally involves precepts generated internally rather than those generated externally. In this context, it can be envisioned as quasi-perceptual experience, pretense, counterfactual or what-if thinking, or the generative process of creatively envisioning possibility.

Dewey describes imagination as a "vision of realities that cannot be exhibited under existing conditions of sense-perception" (1910, 224). It is our mode not only of prediction, but of engagement with possibility and make-believe. What is not immediately sensed externally has to be imagined, and this process can combine external percepts, memory, or pure imagination. This lattermost sense most often gets associated with ideas of creativity. Historically—through the lens of Romanticism—it acquired a new dignity previously denied it (Sutton-Smith 1997). Koestler (1964) saw creativity as the imaginative *bisociation*, or the bringing together of separate associative frames in three distinct ways, each with a different effect. They can collide as in the case of humor (the part over the whole), they can synthesize into a new coherent frame as they do with scientific discovery (a balance of part and whole), or they can synergize as aesthetic pattern as in the arts (the whole over the parts). Such bisociative what-if modelling of possibility can be particularly prolific in playful imagination.

Bakhtin's work *The Dialogic Imagination* (1981) considers literature, as the play of multiple voices and meanings, not only the product of imagination but a trigger for it, too. For Sutton-Smith (1997) imagination is one of the primary rhetorics of play and the one most closely associated with creativity and art. Imagination, like play, is protean by nature, and playful imaginings enable visionary experimentation with proposition, fantasy, make-believe, and the exploration of possible worlds. "To play is to create and then to inhabit a distinctive world of one's own making" (Henricks 2008, 159).

Imagination is generally understood as the wellspring of novel ideas. Philosopher Mark Johnson describes the question of "how is novelty possible" as "one of the most difficult problems in all of philosophy, psychology and science" (2007, 13). Edelman, who won the Nobel prize for his work on the immune system, has proposed a solution in his theory of neural Darwinism, suggesting that the brain operates (as does the immune system) through natural selection, based on the generation of diversity and on the retention of useful patterns (for example, through strengthened connections). He does not attempt to equate this process with creativity, but suggests "it can provide an underlying basis for creative actions" (2007, 99). Though Edelman's ideas have been attacked for lack of evidence, more recent research has also suggested that neuronal replicators may be responsible for creative thinking (Fernando and Szathmáry 2010).

As for how diversity is generated in the first place, Boyd (2009) sees randomness as an intrinsic part of brain function and considers it nature's way of exploring new possibilities at that level. Rolls and Deco argue likewise in *The*

Noisy Brain: Stochastic Dynamics as a Principle of Brain Function (2010, 224), holding that a stochastic (or random) property in brain processing caused by noisy neuron firing times is the basis of several brain phenomena, including aspects of creativity. Evolutionary modes of replication, generation of diversity, and selection at brain level are mirrored at the level of the mind in our imaginative processes, and the imagination in play is a synergy of our two most powerful generators of ideational diversity.

Open-Minded

To feel playful is to feel freedom from many of the restrictions of mundane reality, to play with cultural, political, or personal constraints, or to bypass our internal inhibitions. Playful open-mindedness is optimistic and permissive—and not just in the conventional sense. It enables holistic, open, and creative responses to stimuli in the environment. It is integrative and synergistic and gives better access to feelings, to the unconscious mind, and to intuition. Positive emotions and playfulness in particular involve a more global, integrative, holistically oriented mindset, and they demonstrate a greater propensity for creative thought in psychological tests (Fredrickson 2003).

Dewey equated playfulness with open-mindedness, and described mental play as "pure interest in truth" that "coincides with love of the free play of thought, . . . incompatible with carelessness or flippancy" (1910, 219–20). Both James and Dewey argued that an emotion-driven holistic or global grasp of a situation precedes more reductionist analyses. This view is supported by recent neuroscientific evidence that structures in the limbic brain are massively interconnected compared to the more sparsely connected and modular neocortex, so "the limbic core, with its dense interconnections and emotional valences, would present us with a holistic, feeling-rich, emotionally nuanced grasp of a situation" (Johnson 2007, 100). In addition, positive emotions such as playfulness dampen inhibition and engage broader repertoires in both attention and action (Fredrickson and Branigan 2005). This broaden-and-build effect is open-mindedness in action.

Spontaneous musical improvisation is, perhaps, the epitome of playful creativity, and a recent fMRI study of improvising jazz musicians (Limb and Braun 2008), found brain patterns that included activation of the medial prefrontal cortex (associated with self-expression) and a simultaneous deactivation of the dorsolateral prefrontal cortex (associated with self-monitoring and conscious volitional control). These players were inhibiting their inhibitions and enabling

flexible responses by dampening constraints and control impulses that might impede the flow of creativity.

Playfulness also enables spontaneous, innovative, and holistic hyperconnectivity based on affect, a visceral phenomenon variously labelled as gut feeling, hunch, or intuition (Gigerenzer 2008). Intuition is a spontaneous emotion-based, information-processing mode, which results in direct knowing and decision making without any use of conscious reasoning. We feel intuitively rather than think intuitively, and positive emotion increases the potential for both intuition and creativity (Fredrickson 2000). An important aspect of creative ideational cognition, intuition finds fertile ground in the open-minded spontaneity of playfulness. Its holistic nature is summed up by Heidegger who considered intuition the "ideal of all knowledge, the ideal of understanding of being in general" (1993, 167). The seventeenth-century Dutch philosopher Baruch Spinoza considered intuition "the most sophisticated means of achieving knowledge" (Damasio 2003, 274). William James argued that even logical relations were felt and not just thought (Johnson 2007) and insisted that whereas logic may be the ideal of a disembodied system, emotion-driven cognition is in itself rational and is our embodied reality.

Open-mindedness is a salient quality of what Koestler (1964) called "ripeness" in a creative context, i.e. under optimal conditions for new insights and gestalts to become conscious. Allan Schore (2007) sees emotion, intuition, the unconscious, and creativity as linked phenomena in the brain's right hemisphere, an area various studies have associated with emotion, intuition, and creativity, though some consider the evidence patchy.

Since Sigmund Freud unveiled the unconscious, hidden thoughts and emotions have been associated with creativity. Edelman suggests that "the play between the core and non-conscious portions of the brain" (2007, 104) can be important in creativity. Freud's free association technique, still in use today in psychoanalysis, is a form of free play intended to access the unconscious, as the relatively uncensored open-minded spontaneity of play has more global access. This approach has much in common too with creative stream-of-consciousness techniques, used by writers such as James Joyce and Marcel Proust in some of the classics of modernist literature.

Transformative

To feel playful is to enter a world transformed from the earnestness of mundane reality. If in its dynamic quality playfulness moves flexibly and in its enigmatic

quality it oscillates, then in its transformative sense it moves on through subtle metamorphoses that never quite return the organism to its initial state.

Playfulness is transformational both subjectively and objectively, both in the present moment and in the longer term. Subjectively, in its phenomenological sense playfulness transforms the way emotions move us—directly, immediately. Objectively, playfulness alters our outlook and influences our interactions with our environment, which in turn, transforms us. Thus Dewey insisted that "*situations* were the locus of emotions, not *minds* or *brains*" (Johnson 2007, 67). Over long periods of time, playfulness is a mutating evolutionary adaptation. Developmentally (across all age groups) playfulness transforms our options by broadening our response repertoires and by building our resilience, our adaptive ability to recover quickly from stressors and to bounce back from negative emotional experiences.

In addition to transformation directly through experience and learning, recent advances in genetic research show that change can occur through epigenetic effects resulting from environmental influences on gene expression over a lifetime, or even over a few generations. "It appears that epigenetic programming from real experiences in society, culture, and the world in general molded higher brain regions much more so than the information encoded in genes" (Panksepp 2008b, 58) And play is likely to be influential in this respect. Panksepp argues that epigenesis can operate at a cultural as well as an individual level, and play can be encouraged or hampered by social and cultural policy.

Playfulness can transform other emotions. One example is the role it assumes in the modulation and regulation of emotion. Regulation can have two distinct meanings here. In a general sense, emotion regulates the organism as a whole, but emotions themselves can be regulated—that is, fine tuned—by several processes, especially by play. Fear of falling can be transformed into exhilaration (as in a bungee jump), sadness into humor (as in wry self-deprecating wit) or subliminal tension into enjoyable antics (as in a snowball or pillow fight). In addition, there is a longer-term regulatory effect that helps build more nuanced and useful emotional responses over time. This transformation only becomes possible when the composite processes that make up emotion become accessible at the mental level as feelings and are accessible to cognitive and affective metaphorical interpretation and transformation. Damasio (2003) suggests that various processes can temporarily transform the brain's emotion body maps that give rise to feeling and create simulated feelings. This is important for understanding playful transformation of other emotions.

Modell insists (2006) that metaphor mediates, categorizes, and thus organizes the perception of bodily sensations (i.e. feelings) in conjunction with memory and that metaphor provides the link between current perceptions and emotional memory, not only transferring meaning but transforming it. So, turbulent emotional memories, for example, might be transformed through method acting into an aesthetically convincing performance of King Lear. Modell considers metaphor as "doubly embodied, first as an unconscious neural process" (the mirror-neuron system) and second in that "metaphors are generated from bodily feelings, so that it is possible to speak of a corporeal imagination" (2006, 27). Damasio also suggests that the brain's mirror neurons can initiate as-if body loops that can transform the body-mapping regions in the "playground" of the right somatosensory cortices and thus simulate false body states enabling virtual feelings (2003). For example, this may be the basis of empathy (a simulation of how someone else feels) and could conceivably be the basis of a plethora of playful as-if states. Some researchers make extravagant claims for mirror neurons, implicating them in everything from theory of mind to the human capacity for culture, but much of the research—though promising—is speculative. In any case, because mirror neurons are sensorimotor controls, their effects are as much physiological as mental, and although automatic, they may well become attuned through physical and social play.

Russ and Schafer experimented with fantasy play scenarios involving some levels of negative affect for participants (playing a social outcast, for example, like Charlie Chaplin's character of The Tramp). Participants showed increased levels of divergent thinking, and results indicate that "negative affect in fantasy play may not be the same type of affect as a negative mood state. Negative affect in play is a pretend event that may be accompanied by a positive mood state" (2006, 352). Although the authors speculate that this outcome is "consistent with the psychoanalytic theory that constriction of associations will result from repression of conflictful affective content," an alternative explanation involves altered body-state maps. Although the body's emotional state likely remained positive during play (enabling an increase in divergent thinking), the brain's body-sensing areas (and hence feelings) were temporarily augmented through play, enabling simultaneous immersion in negative affect-tinged fantasy. In brief, as Damasio puts it, the brain's "body-sensing areas constitute a sort of theater where not only the 'actual' body states can be 'performed,' but various assortments of 'false' body states can be enacted as well" (2003, 117–18). His examples include the temporary masking of pain to enable coping in critical situations or

the simulation of other's emotions, as in empathetic response (perhaps to the character played by the method actor in *King Lear*).

Playfulness can also help transform us in deeper ways akin to transcendence and flourishing. Sutton-Smith argues that play "refreshes or fructifies" our feelings about our everyday existence, enabling us "to live more fully in the world" in the face of everyday adversity. Its gift is "perhaps the sense that life, temporarily at least, is worth living" (2008, 97). Qualitatively, playfulness moves us to enjoy the moment, to attempt to transcend our fears and existential angst, to replace them—however briefly—with more pleasurable perspectives that enable well-being and enhance our quality of life.

Playing with Ideas

Playful behavior is both intrinsically motivated and autotelic. In other words, it is something that both feels good and gets engaged in for its own sake. Playfulness is concerned with process, not product, and, in this respect, it differs from but is supportive of creativity, which is normally goal oriented and focused on outcomes. Nevertheless, play and creativity are closely related both behaviorally and evolutionarily. When it comes to evolution, Brian Boyd (2009) sees creativity arising from cognitive play, which evolves, in turn, from physical play.

Creativity is generally defined as a process with output or results that are judged on "the dual standards of (1) novelty or uniqueness and (2) usefulness or value" (Davis 2009, 25). The primary phases of the creative process can be defined as problem finding, ideation, and evaluation. Whereas the preliminary phase of problem finding (not always included) involves problem identification and definition, and the final phase of evaluation (or convergent thinking) involves selection and judgement to ensure that ideas are both original and fitting or useful, the interim phase of ideation (or divergent thinking) is the process of generating new ideas and connections (Davis 2009) and is the epitome of what we normally think of as creativity. Ideation is a "major cognitive process important in creativity," involving free association, broad scanning ability, and fluidity of thinking in the generation of a variety of ideas and associations to a problem (Russ and Schafer 2006). Often used as an initial stage in structured brainstorming sessions, ideation is a free-flowing, spontaneous phase of the process in contrast to the more logical convergent-thinking phase, in which ideas and solutions thrown up by ideation are rejected or selected then organized and structured in terms of utility.

The core qualities of creative ideation as embodied in the majority of divergent-thinking tests are fluency (quantity of ideas), flexibility (variability of idea categories), and originality (uncommonness of ideas) (Cropley 2004). The effectiveness of positive emotions and of playfulness in particular, in an ideation or divergent-thinking scenario, can be judged on whether or not it helps promote fluency, flexibility, and originality of thinking.

The creativity process, though heavily influenced by mood and emotions, is not definitively tied to any particular affect, and the same applies to divergent and ideational phases of the process. For different people in disparate environments involved in distinct creative endeavors at different stages of the process, the affect profile will differ. Numerous empirical tests, however, show positive emotions increase a propensity for ideation, and the demonstrated broadening effects of positive emotions include "flexible, creative and unusual thinking" (Fredrickson and Branigan 2005, 316). The broaden-and-build theory of positive emotions is particularly insightful in this respect, and the broadening aspect has particular relevance because "positive emotions widen the array of thoughts and actions called forth (e.g. play, explore), facilitating generativity and behavioural flexibility" (Fredrickson and Losada 2005, 679). The broaden-and-build theorists are not the only ones to come to this conclusion. Damasio (2003) also suggests that emotion causes consonant modes of thinking—with happiness in contrast to sadness, for example—involving rapid switching between images and ideas. And a recent meta-analysis comprising sixty-two (mostly empirical) studies on the relationship between creativity and mood concluded that "if one's focus is creative ideation—fluidity, originality, and flexibility—the data support a positive-mood-enhances creativity generalization" (Davis 2009, 35).

In addition to bringing a positive mood or attitude to creative thinking, playfulness comes with added value. To be simultaneously dynamic, interactive, enigmatic, lighthearted, humorous, imaginative, open-minded, and transformative, is to be primed for ideation in a creative environment—all that is needed is some appropriate focus. It appears that the ideation-relevant qualities entrained by positive moods are amplified in playfulness. Whereas they may be boosted in other upbeat moods, they are the essence of playful cognition.

We should nevertheless remember that, in terms of divergent-thinking tests, "divergent thinking is not synonymous with creativity. It is, instead, a predictor of it" (Runco 2006, 250). Cropley counsels against overpraising divergent thinking: "Free production of variability through unfettered divergent thinking holds out the seductive promise of effortless creativity but runs the risk

of generating only quasicreativity or pseudocreativity if it is not adapted to reality." He suggests that "in practical situations, divergent thinking without convergent thinking can cause a variety of problems including reckless change" (2006, 391). Bountiful ideas are fine, but they will remain just that unless they are winnowed and worked on productively to create output. As Stuart Brown attests, "The impulse to create art is a result of the play impulse" (2009, 61). But it is worth remembering that creativity produces useful ideas and artifacts; play creates possibilities. Playfulness is creatively important, but so is application. Without application, the process may only amount to daydreaming. As the creative writing adage—widely attributed to either Kingsley Amis or Mary Heaton Vorse—puts it: "The art of writing is the art of applying the seat of one's trousers to the seat of one's chair."

The brain works largely through pattern recognition, which is based on association and metaphor and is imbued with affect. The necessary price of successful pattern recognition in creative thinking is initial degeneracy, ambiguity, and complexity in novelty and variety generation (Edelman 2007). Pattern signifies regularities in the world rather than chance, and because predicting what comes next can be hugely significant, most organisms have evolved as pattern extractors. But pattern needs to play a little hard to get. We find regular pattern too predictable, and it loses our attention. But an open-ended, inference-rich, and complex pattern, we find beautiful and rewarding (Boyd 2009).

In evolutionary terms, Boyd believes physical play leads to our enjoyment of cognitive play with pattern, which leads in turn to useful creative innovation. These activities have adaptive value for stimulating a flexible mind, and for engendering creative options. He defines art, both in terms of engagement and creation, as "cognitive play with pattern," and he sees artistic output as a "playground for the mind" designed to engage human attention (2009, 15). Social play, in particular, is the evolutionary basis for the communal attention paid to art and for the emotion involved in the shared experience of arts, for example, in the theater or cinema. Pattern generation (making art) can be far more complex, however, than pattern recognition (responding to art), and the capacity for both collaborative and individual creativity and innovation emerge from engagement with, and participation in traditional, imitative, and communal play with pattern (Boyd 2009).

Rule-bound play and games are patterns of constraint that enable free variation on pattern within those constraints. Playfulness, however, engenders possibility through spontaneous generation of new and potentially significant

patterns, recognizable as deviation from habituated patterns. Playfulness flounts the rules and crosses boundaries. It ignores conventions, despises clichés, undermines habits, and overturns expectations. With creativity, as with play, starting from scratch is not efficient, and both build on established pattern. Boyd (2009) sees most rule-bound play as zero-sum games (closed and competitive), and both playfulness and art as nonzero-sum games (open-ended and potentially cooperative). In *Finite and Infinite Games*, James Carse (1986) also equates finite games with restrictive, competitive, or goal-oriented attitudes and infinite games with a more playfully open-minded or creative attitude to life. Boyd argues that "creativity ultimately benefits us in producing a wider array of behavioural options," and that although many of these creative choices will not lead directly to the ability to survive, they strengthen the capacity to do so through enabling confidence in thinking beyond the obvious (2009). He might well have been talking about play.

Summary and Conclusions

This exploration of playfulness synthesizes recent findings from diverse areas of study and suggests a theoretical model as a conceptual structure for understanding both subjective and objective aspects of playful phenomena. It reaches conclusions regarding playfulness and the creative process that are well supported through empirical research, suggests some hypotheses that are more speculative but have explanatory potential, and, finally, raises issues that pose questions that may prove fertile for further research.

Playfulness can be understood as a dynamic affective process that entrains diverse cognitive correlates enabling action potential for aspects of creative behavior. It is easy to idealize playfulness because it seems on first analysis to have overwhelmingly positive attributes. But playfulness is environmentally situated with contextual constraints, and even young mammals with a strong propensity to play need to learn these limitations quickly if they are to survive. Anyone who has experienced inapt playful antics knows how annoying, disruptive, or even potentially lethal they can be. Playfulness is not always creative, and in play, as in stories, "destruction is a way of causing maximum impact for minimum effort" (Boyd 2009, 185). Nevertheless, as Thomas Henricks attests, "Most theories of human play associate play with the freedom of human beings to express themselves openly and to render creatively the conditions of their lives" (2008, 159).

Creativity can involve many moods and emotions, and there is not a creative mood that characterizes most creative effort. Creative feelings are neglected, however, compared to creative thinking. And although playfulness is not always appropriate, a playful attitude towards ideation in most environments can enable more successful and more innovative creative activity. It also gives pleasure (individually and through contagion), helps improve quality of life, and contributes to self-actualization.

Postdevelopmental playfulness is generally sparsely documented, and a dearth of research exists on playfulness in the context of adult creativity. Langer (1990) queries why the concept of development should be restricted to childhood, as if adults do not develop at all (aging is what adults do), and she argues that adults and older people can develop cognitively and emotionally and be continually creative. Lieberman (1977) also sees playfulness as having lifelong effects with profound implications for creativity and well-being. Humans retain some juvenile characteristics longer than most other animals. This human neoteny enables us to extend a level of playfulness into later years and is likely to help stimulate neurogenesis in healthy adults and similarly forestalls mental decline in cases of dementia (Brown 2009). However, cultural influences can sometimes be constraining, and the often pervasive effect of the rhetoric of play as frivolity, which is an essentially puritanical attitude toward playfulness in adults, can have real repercussions for adult play, creativity, and quality of life. And why should we cease being playful when "the joyfulness of infinite play, its laughter, lies in learning to start something we cannot finish" (Carse 1986, 26)?

All eight qualities of playful states of mind in this model have the potential to enhance ideational creativity. Indeed, in most respects, playfulness and optimal ideational states can be seen as congruous. As the broaden-and-build theory predicts, positive emotions in general are directly connected with expanded repertoires of fluency, flexibility, and originality, while being playful in particular dynamically embodies their divergently creative qualities.

That playfulness is involved in the regulation of emotion seems fairly well established, but hypotheses regarding the processes by which this happens are somewhat more speculative. Regulation may function either through coactivation of emotion systems other than play, involving cognitive this-is-play control, or more likely, through adaptation of feelings by the affective play system, involving association and metaphor. In many kinds of play, mirror-system activation may be involved in simulating feelings by creating as-if body-state mappings that simulate states other than the body's playful emotional state. All of these scenarios involve temporary manipulation and transformation of the brain's body-sensing regions that give rise to feelings.

The research areas of play, emotion, and creativity have huge potential for theoretical, experimental, and applied research both separately and at their confluence, while pluralistic and interdisciplinary research approaches are critical to their development. Some avenues for further research are suggested by issues raised in this article. How does the potential for playfulness transform in adulthood, and how can it be extended or deepened in maturity? Is synergistic operation of the adult brain's exploratory and play circuits in the consciously playful destabilization of habitual cognitive commitments a prime difference between adult playfulness and its childhood equivalent? Is there any clear connection between playfulness and right-hemisphere dominance? How are the brain's body maps (at brain level) or feelings (at mind level) manipulated in play, and will different kinds of play involve different modes of manipulation? In which environments can playful approaches prove optimal for ideation? More broadly, how can adult playful potential be induced and applied as a creative catalyst, as research practice, and as a force for individual and collective well-being?

What is hardly in question is that feelings are what contribute most to our perception of our quality of life—and positivity confers a plethora of long-term health benefits, including a tendency to live a longer and happier life. Being playful can generate possibilities for applied creativity and help develop a more versatile, optimistic, and creative outlook on life. Because playfulness is energizing, optimistic, and transformative, it is the embodied mind's expression of exuberance at its own versatility.

References

Ackerman, Diane. 2000. *Deep play*.

Adorno, Theodor W. 1992. Is art lighthearted? In *Notes to literature,* vol. 2, trans. Shierry Weber Nicholsen, 247–53.

Apter, Michael J. 1989. *Reversal theory: Motivation, emotion and personality*.

———. 2003. On a certain blindness in modern psychology. *The Psychologist* 16:474–75.

Bakhtin, Mikhail. 1981. *The dialogic imagination: Four essays*.

Barthes, Roland. 1980. *The pleasure of the text*.

Berridge, Kent C., Kyle S. Smith, Stephen V. Mahler, and Susana Pecina. 2009. Hedonic hotspots: Generating sensory pleasure in the brain. In *Pleasures of the brain*, ed. Morten L. Kringelbach and Kent C. Berridge, 1–35.

Boyd, Brian. 2009. *On the origin of stories: Evolution, cognition, and fiction*.

Brown, Stuart L. 2009. *Play: How it shapes the brain, opens the imagination, and invigorates the soul.*

Burgdorf, Jeffrey, Roger A. Kroes, Margery C. Beinfeld, Jaak Panksepp, and Joseph R. Moskal. 2010. Uncovering the molecular basis of positive affect using rough-and-tumble play in rats: A role for insulin-like growth factor I. *Neuroscience* 168:769–77.

Burghardt, Gordon M. 2006. *The genesis of animal play: Testing the limits.*

Butler, Christopher. 2004. *Pleasure and the arts: Enjoying literature, painting, and music.*

Campbell, Ginger. 2010. Affective neuroscience with Jaak Panksepp. http://brainsciencepodcast.com.

Capodagli, Bill, and Lynn Jackson. 2010. *Innovate the pixar way: Business lessons from the world's most creative corporate playground.*

Carrera, Pilar, and Luis Oceja. 2007. Drawing mixed emotions: Sequential or simultaneous experiences? *Cognition & Emotion* 21:422–41.

Carse, James P. 1986. *Finite and infinite games.*

Cropley, Arthur J. 2004. Creativity in education & learning: A guide for teachers and educators.

———. 2006. In praise of convergent thinking. *Creativity Research Journal* 18:391–404.

Csikszentmihalyi, Mihaly. 1996. *Creativity: Flow and the psychology of discovery and invention.*

Damasio, Antonio R. 2003. *Looking for Spinoza: Joy, sorrow, and the feeling brain.*

Davis, Mark A. 2009. Understanding the relationship between mood and creativity: A meta-analysis. *Organizational Behavior and Human Decision Processes* 108:25–38.

Derrida, Jaques. 1970. Structure, sign and play in the discourse of the human sciences. In *The languages of criticism and the science of man: The structuralist controversy,* ed. Richard Macksey and Eugenio Donato, 247–64.

Dewey, John. 1913. Play. In *A Cyclopedia of Education*, vol.4, ed. Paul Monroe, 725–27.

———. 1910. *How we think.*

Dreisbach, Gesine M., Johannes Muller, Thomas Goschke, Alexander Strobel, Katja Schulze, Klaus-Peter Lesch, and Burkhard Brooke. 2005. Dopamine and cognitive control: The influence of spontaneous eyeblink rate and dopamine gene polymorphisms on perseveration and distractibility. *Behavioral Neuroscience* 119:483–90.

Dutton, Denis. 2009. *The art instinct: Beauty, pleasure, and human evolution.*

Edelman, Gerald M. 2007. *Second nature: Brain science and human knowledge.*

Fernando, Chrisantha, and Eörs Szathmáry. 2010. Natural selection in the brain. In *Towards a theory of thinking: Building blocks for a conceptual framework*, ed. Britta M. Glatzeder, Vinod Goel, and Albrecht von Muller, 291–322.

Fischer, Kurt W., Zheng Yan, and Jeffrey Stewart. 2003. Adult cognitive development: Dynamics in the developmental web. In *Handbook of developmental psychology*, ed. Jaan Valsiner and Kevin Connolly, 491–516.

Fredrickson, Barbara L. 2000. Cultivating positive emotions to optimize health and well-being. *Prevention & Treatment* 3. http://www.unc.edu/peplab/publications/cultivating.pdf.

———. 2003. The value of positive emotions. *American Scientist* 91:330–35.

Fredrickson, Barbara L., and Christine Branigan. 2005. Positive emotions broaden the scope of attention and thought-action repertoires. *Cognition & Emotion* 19:313–32.
Fredrickson, Barbara L., and Marcial F. Losada. 2005. Positive affect and the complex dynamics of human flourishing. *American Psychologist* 60:678–86.
Frijda, Nico H. 2007. *The laws of emotion*.
Gibbs, Jr., Raymond W. 2005. *Embodiment and cognitive science*.
Gigerenzer, Gerd. 2008. *Gut feelings: Short cuts to better decision making*.
Guitard, Paulette, Francine Ferland, and Élisabeth Dutil. 2005. Toward a better understanding of playfulness in adults. *OTJR: Occupation, Participation and Health* 25:9–22.
Heidegger, Martin. 1993, first published 1975. *Die Grundprobleme der phanomenologie*.
Hemenover, Scott H., and Ulrich Schimmack. 2007. That's disgusting! . . . , but very amusing: Mixed feelings of amusement and disgust. *Cognition & Emotion* 21:1102–13.
Henricks, Thomas. 2008. The nature of play: An overview. *American Journal of Play* 1:157–80.
Huizinga, Johan. 1949. *Homo ludens: A study of the play-element in culture*.
Hunter, Patrick G., E. Glenn Schellenberg, and Ulrich Schimmack. 2008. Mixed affective responses to music with conflicting cues. *Cognition & Emotion* 22:327–52.
———. 2010. Feelings and perceptions of happiness and sadness induced by music: Similarities, differences, and mixed emotions. *Psychology of aesthetics, creativity, and the arts* 4:47–56.
Isen, Alice M. 1999. Positive affect. In *The handbook of cognition and motion*, ed. Tim Dalgleish and Mick J. Power, 521–40.
Johnson, Mark. 2007. *The meaning of the body: Aesthetics of human understanding*.
Koestler, Arthur. 1964. *The act of creation*.
Kuba, Michael J., Ruth A. Byrne, Daniela V. Meisel, and Jennifer A. Mather. 2006. When do octopuses play? Effects of repeated testing, object type, age, and food deprivation on object play in *Octopus vulgaris*. *Journal of Comparative Psychology* 120:184–90.
Langer, Ellen J. 1990. *Mindfulness*.
LeDoux, Joseph. 1998. *The emotional brain: The mysterious underpinnings of emotional life.*
Lewis, Marc D. 2005. Bridging emotion theory and neurobiology through dynamic systems modeling. *Behavioral and Brain Sciences* 28:169–94.
Lewis, Marc D., and Isabela Granic. 1999. Self-organisation of cognition-emotion interactions. In *The handbook of cognition and emotion*, ed. Mick Power and Tim Dalgleish, 683–701.
Lieberman, Josepha Nina. 1977. *Playfulness: Its relationship to imagination and creativity*.
Limb, Charles J., and Allen R. Braun. 2008. Neural substrates of spontaneous musical performance: An fMRI study of jazz improvisation. *PLoS ONE* 3. http://dx.plos.org/10.1371%2Fjournal.pone.0001679.
Liston, Conor. 2001. An interview with Antonio R. Damasio. *The Harvard Brain* 8:2.
Martin, Rod A. 2007. *The psychology of humor: an integrative approach*.
Maslow, Abraham H. 1987. *Motivation and personality*. 3rd ed.

Mihov, Konstantin M., Markus Denzler, and Jens Förster. 2010. Hemispheric specialization and creative thinking: A meta-analytic review of lateralization of creativity. *Brain & Cognition* 72:442–8.

Modell, Arnold H. 2006. *Imagination and the meaningful brain*.

Mumford, Michael D. 2003. Taking stock in taking stock. *Creativity Research Journal* 15:147–51.

Panksepp, Jaak. 1998. *Affective neuroscience: The foundations of human and animal emotions*.

———. 2008a. The affective brain and core-consciousness: How does neural activity generate emotional feelings? In *Handbook of emotions*, ed. Michael Lewis, Jeannette M. Haviland-Jones, and Lisa Feldman Barrett, 47–67. 2nd ed.

———. 2008b. Play, ADHD and the construction of the social brain: Should the first class each day be recess? *American Journal of Play* 1:55–79.

Pellis, Sergio M., and Vivien C. Pellis. 2006. Play and the development of social engagement: A comparative perspective. In *The development of social engagement: Neurobiological perspectives*, ed. Peter J. Marshall and Nathan A. Fox, 247–74.

———. 2009. *The playful brain: Venturing to the limits of neuroscience*.

Postrel, Virginia. 1999. In praise of play. A Bradley Lecture delivered at the American Enterprise Institute, January 11, 1999. http://www.dynamist.com/speaking/speeches/speeches-bradley.html.

Power, Patrick. 2008. Character animation and the embodied mind-brain. *Animation: An Interdisciplinary Journal* 3:25–48.

———. 2009. Animated expressions: Expressive style in 3D computer graphic narrative animation. *Animation: An Interdisciplinary Journal* 4:107–29.

Ramachandran, Vangi S. 2004. *A brief tour of human consciousness: From impostor poodles to purple numbers*.

Rolls, Edmund T., and Gustavo Deco. 2010. *The noisy brain: Stochastic dynamics as a principle of brain function*.

Runco, Mark A. 2006. Introduction to the special issue: Divergent thinking. *Creativity Research Journal* 18:249–50.

Russ, Sandra W., and Ethan D. Schafer. 2006. Affect in fantasy play, emotion in memories, and divergent thinking. *Creativity Research Journal* 18:347–54.

Schore, Allan N. 2007. Psychoanalytic research: Progress and process. Developmental affective neuroscience and clinical practice. *Psychologist-Psychoanalyst* 27:6–15.

———. 2009. Right-brain affect regulation: An essential mechanism of development, trauma, dissociation, and psychotherapy. In *The healing power of emotion: Affective neuroscience, development, and clinical practice*, ed. Diana Fosha, Marion Solomon, and Daniel J. Siegel, 112–44.

Siemer, Matthias. 2005. Moods as multiple-object directed and as objectless affective states: An examination of the dispositional theory of moods. *Cognition & Emotion* 19:815–45.

Sternberg, Robert J. 2002. *The creativity conundrum: A propulsion model of kinds of creative contributions*.

Sutton-Smith, Brian. 1997. *The ambiguity of play*.

———. 2008. Play theory: A personal journey and new thoughts. *American Journal of Play* 1:82–125.

Thagard, Paul. 2002. How molecules matter to mental computation. *Philosophy of Science* 69:497–518.

Tops, Mattie, Sascha Russo, Maarten A. S. Boksem, and Don M. Tucker. 2009. Serotonin: Modulator of a drive to withdraw. *Brain and Cognition* 71:427–36.

Turner, Mark. 1996. *The literary mind.*

Turner, Victor. 1977. Frame, flow and reflection: Ritual and drama as public liminality. In *Performance in Postmodern Culture*, ed. Michel Benamou and Charles Caramello, 33–55.

Twain, Mark. 1924. Mark Twain's Autobiography, vol. 1. *Project Gutenberg*. http://gutenberg.net.au/ebooks02/0200551h.html.

Waldrop, Mitchell M. 1992. *Complexity: The emerging science at the edge of order and chaos.*

Wheeler, Wendy. 2006. *The whole creature: Complexity, biosemiotics and the evolution of culture.*

Wittmann, Bianca C., Nico Bunzeck, Raymond J. Dolan, and Emrah Düzel. 2007. Anticipation of novelty recruits reward system and hippocampus while promoting recollection. *NeuroImage* 38:194–202.