The Fractal Self at Play

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In this article, the author draws on contemporary science to illuminate the relationship between early play experiences, processes of self-development, and the later emergence of the fractal self. She argues that orientation within social space is a primary function of early play and developmentally a two-step process. With other people and with objects in the environment, children first move from the inside out, using feedback provided through early play to calibrate internal systems. Once children coordinate sensory, affective, cognitive, imagistic, and behavioral systems, they then switch modes to navigate from the outside in, via conceptual maps provided by external social and informational cues. If they achieve full social orientation, their imaginations remain for them portals to reality throughout their lives. Otherwise, they mobilize inner resources in defense of a lost, disoriented, or fragile self. A fractal model suggests that the whole of the self, intact during early play, exhibits self-similar resonances in the content and forms of self-expression throughout life.

This article approaches play through the contemporary sciences of interpersonal neurobiology and nonlinear dynamics. Interpersonal neurobiology (Badenoch 2008; Cozolino 2005; Schore 1994; Siegel 1999) is the multidisciplinary study of how one system of the brain, mind, and body develops in the context of another system of brain, mind, and body. When new parents tickle their baby's toes or stick out their tongues in hopes that their newborn will imitate them, they follow a universal instinct. In issuing the call to play, parents enter into a lifelong relationship, linking brain to brain, mind to mind, and body to body, creating for both parents and child emotions of joy, curiosity, and discovery. Because interpersonal neurobiology examines how the brains, minds, and bodies of parents and child become entangled, the subject is inherently both complex and nonlinear.

Nonlinear dynamics studies how complex systems change over time. Chaos theory (Gleick 1987) addresses uncertainty, unpredictability, and spontaneous novelty in nature. Complexity theory (Bak 1996; Waldrop 1992) illuminates how natural systems organize themselves at the edge of chaos, from the bottom up, without centralized control or deliberate planning. In fractal geometry (Mandelbrot 1977), a fractal is a rough or fragmented geometric shape that can be split into parts, each of which is a smaller copy of the whole—a property called self-similarity. Because they appear similar at all levels of magnification, mathematical fractals are considered infinitely complex. In a sense, they offer a pattern (self-similarity) beneath chaos and complexity, i.e. the shape of the whole is reflected in all its parts, whether the parts are of different sizes or on different time scales (Mandelbrot 1977).

Fractals are ubiquitous throughout nature, found within the clouds, mountains, and rivers (Mandelbrot 1977; Schroeder 1991). Fractals also permeate our bodies, appearing in branching structures and processes within our arteries, lungs, and neurons (Liebowitz 1998; Mac Cormac and Stamenov 1996; West and Deerling 1995; West 2006). Fractals are holistic patterns that reveal how dynamics in time transform into structures in space. As we age, for example, the transient facial expressions that register our emotions become permanent fractal wrinkles etched into our faces. These wrinkled fractals, then, reflect not only the worries and anxieties that have lately consumed our lives but also the foundations established during our earliest play.

Play is chaotic, complex, and filled with fractals (Fromberg 2002; VanderVen 1998, 2004). It is chaotic through its unexpected turns and surprises. Play is complex because it is organized and novel. Play is filled with fractals that lurk within its basic grammars and recursive structures and themes; these fractals become elaborated in self-similar fashion over time. Many toys are fractal. They range from a baby's first nested cups to the self-similar blocks that encourage more complex constructions to the ornately decorated nesting dolls that accompany some children into adulthood.

Through the holistic lenses of contemporary science, I offer fractals as one mechanism for establishing continuity between the early play of children and later modes of adult self-expression. Children play, I suggest, to become oriented in and to learn how to navigate social space, which helps them weave strands of genetic inheritance with the intersubjective threads of their lives into an integrated fractal tapestry. This article offers the concept of orientation in social space as a central dimension of being, feeling, and relating. Such orientation locates the embodied self in both physical and social space, in order to chart a life course filled with meaning, one that aligns inner vision and outer expression.

I first introduce nonlinear science as a broad framework for exploring the development of the self through play. Next, I offer a constructivist framework for a developmental progression of play based on attachment and regulation theory. I define the self in neurobiological terms and examine how its enlivened core emerges first at implicit, unconscious levels through play with attuned caretakers. I then provide evidence for continuity between these early implicit, preverbal dynamics and later increasingly explicit, conscious ones. This sets the foundation for my main thesis: orientation of the self in social space builds on the orientation of the body in physical space. I draw evidence from two lines of research on mammalian brain structure, especially concerning the hippocampus within the temporal lobe. These show, in short, that, whereas rats need a free run of their environments to explore and orient themselves fully in physical space, children need the free play of imagination and pretend games to find their way through social space later. Finally, I suggest that the human self is best modeled as a fractal whose wholeness, intact from the start, appears within patterns of self-expression that remain invariant across space and time. I assert that wherever healthy emotional development exists, spontaneous play provides a fractal window into the developing self. I cite relevant empirical research, draw examples from important figures in history, and close with a personal narrative.

The Value of Nonlinear Approaches to Play

History has witnessed a broad shift from views of play as frivolous, a mere "aimless expenditure of exuberant energy" in children and young animals (Spencer 1873), to views of play as purposeful, even essential to human development (Piaget 1962). Generally, the focus of studying play has also shifted from a static and imitative depiction, which reflects society as it currently exists, to a more dynamic view of play's creative potential, which transforms both the individual and society at large (Linder, Roos, and Victor 2001).

Although play has become a serious subject for study, researchers do not agree about its effects, or even how to define it. The many approaches to the subject include molecular studies of evolutionary processes (Panksepp 1998) and neural development (Schore 1994). Psychological, sociological, and anthropological investigations have identified a host of affective, cognitive, social, and motor capacities that accompany play, including self-regulation (Berk, Mann, and Ogan 2006; Vygotsky 1986); symbolic representation (Piaget 1962); narrative skills (Nicolopoulou 2005); meaning making (Bruner 1990); divergent thinking (Baer 1993); creative expression (Singer and Singer 1998); self-transformation (Garvey 1977; Schwartzman 1978); metacommunication (Bateson 1976); gender identification (Davies 1997); social competence (Connolly and Doyle 1984); community membership (Sutton-Smith 1997); and even the origin of culture itself (Huizinga 1949; Winnicott 1972).

While linear science is useful for categorizing nature and collecting facts, play's exquisite idiosyncrasies often elude its research-based methods. Play's wholeness fragments under traditional research. Because nonlinear dynamics investigates how systems change over time, its empirical methods can link the "brain" time of milliseconds, the subjective or "real" time of minutes and hours, and the "developmental" time of years and decades (Lewis and Granic 2000). Within developmental psychology, such nonlinear approaches provide continuity despite change, while highlighting unique paths toward developmental milestones (Smith and Thelen 1993; Thelen and Smith 1994). Nonlinear methods also help avoid the debate about stages, because outward behaviors that appear discontinuous or that seem to occur in stages can be understood in terms of smooth movement and continuous changes in underlying components called parameters (Courage and Howe 2002).

Given that human development is filled with periods of critical growth and change followed by more stable periods, a nonlinear perspective and developmental studies of play seem like an obvious fit. Yet the paradigm has gained traction only recently among developmentalists (Howe and Lewis 2005), as the study of play has enjoyed growing recognition of its significance. Doris Fromberg (2002) notes the case elegantly: "The way that children put their experiences together resembles a moving web of connections more than a stored set of stationary drawers or a growing pile of packages" (x). Fromberg highlights play's dynamic qualities.

> Play is multifaceted. It changes constantly, and unfolds differently in different settings. For example, a young child's play in a department store differs from play in a classroom block corner, play at a beach, or, in the case of children in Africa, play beside the field in which mothers are working. Children play alone, with others, with objects, and with their imaginations. The unpredictable surface forms change as children

> play, but the relationship between reality and fantasy functions in predictable ways. Play functions as both a verb and a noun. Rather than a category, property, or stage of behavior, play is a relative activity. . . . The shifting functions in different settings may contribute to problems many researchers experience in defining play. (8, 10)

Helen B. Schwartzman (1978) similarly cautions against using definitions, classifications, and metaphorical transformations that reduce play to something else. Karen VanderVen (1998) introduces play as "a significant complex adaptive system within the human development, with chaotic aspects that embrace and generate within it other complex adaptive systems continuously representing and generating information" (121). VanderVen notes Margaret Wheatley's (1992) observation that, through play, children seek out what adults so often strive to avoid—disequilibrium, novelty, loss of control, and surprise. VanderVen offers the metaphor of the "protean self," suggesting that play helps children learn to adapt and respond to change, preparing them to live in a chaotic world. VenderVen's (1998) list of chaotic features of play illustrates its adaptive uses.

Play is recursive

Play can be repeated time and again, which makes it valuable in learning to construct things. Play helps children create a self as they build an outside world. For the child, this inner and outer construction occurs through the recursive enfolding of feedback gleaned from continual interactions with people and objects. To understand the notion of recursion, consider an example relevant to play—game theory (Stahl and Wilson 1995). In the typical scenario, a pair of gamers plays several rounds; the success of each player depends upon the choices of the other. During every round, each participant decides anew whether to act cooperatively, which promises big pay-offs but also threatens big losses, or to act selfishly, which offers greater certainties but delivers smaller rewards. The game is recursive, because its feedback—the new information generated by the outcome of each round—gets continually recycled into the system. Through recursion, each round changes the system as a whole while serving as a foundation for the next round. Game theory has become an important tool in the study of social decision making as well as the neurobiology of risk taking (Sanfey 2007).

Play uses recursive feedback to build complexity in children's system of brain, body, and mind. Each round is holistic because it calls on the history of all previous rounds. At the cognitive level, information from the novel explorations of games, toys, and other things is recycled, helping children build internal structure, gather insights, take small risks, and create new schemes. By recursively enfolding end products as new foundations for future rounds of play, children bootstrap developmental competencies into their daily activities. Recursion also proves important at the neurobiological level. As I discuss later, early play provides critical feedback to calibrate and coordinate sensory, affective, cognitive, and behavioral systems.

Play is entraining

In the absence of external stimulation, the brain produces a myriad of endogenous electrical rhythms that oscillate at various frequencies even in the womb (Kitzbichler et al. 2009). During experience-dependent interactions, the nervous system tracks perturbations, or disturbances, of these natural rhythms (Buzsáki 2006). *Entrainment* is a term physicists have long used to describe the phenomenon of resonance, the tendency for two oscillating bodies to lock into phase so that they vibrate in harmony. Brain-wave entrainment, then, is any activity that causes, or can be used to help cause, the brain-wave frequencies of these various brain states to fall into step. Through entrainment, which is really the creation of synchrony in time, information produced in various areas of the brain becomes coordinated, even in the absence of spatially connected pathways. In this way, the dimension of time, which includes varying degrees of synchronous firing, becomes a primary means for forging new neuronal interconnectivity. Just think of Donald Hebb's rule (1949): "Neurons that fire together, wire together." Brain-wave entrainment may solve the problem of how different sensory modalities blend into coherent experience (Buzsáki 2006). Brain-wave entrainment may even reveal how consciousness emerges from widely distributed physiological underpinnings (Freeman 1999).

Play entrains people, their bodies, and their brain waves. In the womb, mother and baby's physiological processes are naturally coupled; their hearts, brains, and interior worlds inextricably linked. After birth, baby still relies on mother for internal regulation. Given that the right brain is the primary vehicle for regulating autonomic functions, emotions, and stress (Schore 2005), right brain to right brain synchronized communication remains a primary way to promote the growth of neural structure and circuitry in a baby's rapidly developing brain.

Through attuned responding (Beebe and Sloate 1982; Schore 1994), early play between mother and child enables complex coordination of interpersonal rhythms based upon safety, trust, and full engagement in positive emotion.

Early dyadic play promotes mutual immersion in Stern's (1985) "vitality affects" of excitement, joy, interest, desire, and curiosity.

Play is self-organizing

Play, like all complex, nonlinear systems, organizes itself. Play's form and coherence arise spontaneously, emerging from bottom-up processes, rather than from top-down control. The developing brain is a good example of a self-organized system (Friedenberg 2009; Kauffman 1995; Kelso 1995; Schore 2001). A developing brain has more connections among its synapses than molecules in the known universe (Edelman 1992), thus, a blueprint to specify every connection would prove unimaginably and probably unmanageably long. Instead, the brain organizes itself using a limited set of guidelines. As genetic instructions for protein construction are set into motion, a myriad of local interactions leads to the emergence of cells, which organize into specialized units, like neurons, which cluster into cell assemblies, neural circuits, a central nervous system, and other systems.

Early play between parent and child is also self-organizing, forming more by bottom-up, intuitive processes than by top-down, cognitive control. Early play is a call-and-response song, a spontaneous love fest, an improvisational dance. Even when a child plays alone, processes and products of early play take on lives of their own. When this self-organizing quality continues in adulthood—it does not matter what the activity consists of—perception and response alight upon fresh discovery in the play of each moment.

Play is disequilibrious

To say that play is disequilibrious means a buildup of energy occurs that drives the system towards novel realms. The energetic, motivational, and arousing dimensions of play lie at the root of this disequilibrium. Feelings of safety and trust are necessary for play to occur, but they are not sufficient to set play in motion. Safety and trust promote relaxation, low-arousal restorative states regulated by the parasympathetic component of the autonomic nervous system (Fogel 2009; Schore 1994). Safety and trust bring baby back to homeostatic balance through interactive regulation. But the call to play is triggered by something more—an internal itch, a flicker of excitement, a moment of curiosity. These are states of high arousal. The motivation to play can be tinged positively with interest, passion, or novelty seeking. Play can be negatively goaded by boredom, frustration, or disquietude. Either way, play requires enough peace of mind to engage outwardly through the release of the parasympathetic, vagal brake

(Porges et al. 1996) but also enough excitement to induce the arousal driven by the sympathetic nervous system. By helping children create fully absorbed, positive feelings—plus build the capacity to tolerate high-intensity emotion—early play tunes the dopamine-rich reward circuits of the brain within a relational context (Shore 1994). In these ways, early disequilibrious states set the stage for passion, drive, full absorption, and intrinsic motivation throughout life.

Play is attractor driven

All species of mammals (Panksepp 1998) throughout the world (Haight et al. 1999) play, which in part indicates that it is an attractor in early development. Attractors represent the end points, towards which dynamical systems are drawn and help establish their underlying patterns. Play is a divergent rather than a convergent concept, partly because of its complexity and multiple qualities. Play is simultaneously a species, a cultural, a developmental, and a neurobiological attractor. When we think of play as both a verb and a noun, we detect the embedded attractors organizing children's physiology, their behavioral expressions, their emotions, their psychology, and their social groupings—all at the same time.

Contemporary science's emphasis on a holistic perspective makes it meaningless to seek the true essence of play as if it were a unitary thing. One important advantage of today's nonlinear approach is its multidimensional capacity to track simultaneous, embedded levels of description (Marks-Tarlow 2008). Each level has its own set of attractors; each unfolds on its own time and size scales; each operates according to its own set of intrinsic and emergent dynamics.

Play is fractal

Fractals are common attractor patterns for many chaotic and nonlinear systems (Briggs 1992; Briggs and Peat 1989; Gleick 1987). Recall that the hallmark of a fractal is self-similarity, where the pattern of the whole is reflected in the pattern of various parts. Given that play is chaotic and is a significant attractor within species and cultural development, perhaps it is not so surprising that play reflects fractal themes, processes, and products that emerge on multiple temporal scales from brain time, through real time, to the developmental time that spans a life.

Not only do many toys possess self-similar structure, I also suggest that an early fractal stage exists when children experiment with drawings of self-similar shapes (Marks-Tarlow 2008a). At five years old, my daughter drew four self-similar heart people that resembled our own family. Each was a slightly different size; each was rendered slightly differently. When I mention my daughter's drawing to other parents, they invariably light up with recognition, often producing their own child's family rendition consisting of self-similar ovals, stars, triangles, or other shapes. Akin to the tadpole stage that child experts have identified, when kids draw people with oval faces and stick limbs (Gardner 1982), this later stage might represent the protean exploration of flexible adaptation through shape, a possibility in need of systematic empirical investigation.

Fractals are evident in aspects of nature and in development characterized by self-organizing processes including the brain and nervous system (Kitzbichler et al. 2009; Mac Cormac and Stamenov 1996; Pritchard 1992); psychophysics (Lee, et al. 2007); cognition (Van Orden, Tuvey, and Holden 2003; 2005); language (Wildgen 2008); and emotions (Takehara, Ochiai, and Suzuki 2002). My observations as a clinical psychologist have led to me to assert that the self is also a self-organizing system with fractal structure (Marks-Tarlow 1999, 2008a), a topic to which I later return here.

Play is sensitive to and dependent on initial conditions

Being both fractal and chaotic, play also possesses the hallmark quality of chaos—sensitive dependence on initial conditions. Sensitive dependence means that small inputs, or perturbations to the system, can sometimes trigger huge outputs, or cascading changes in direction or behavior. Sensitive dependence does not characterize linear systems, because their outputs remain proportional to their inputs. A game of pool is the prototypical linear system: what a player gets out of each shot depends essentially on what he or she puts in, e.g., aim, force, English, and the like. If instead, the cue ball could send another ball careening into outer space, then we might discuss pool as nonlinear.

Nonlinear systems often change suddenly and unpredictably, yielding outputs highly disproportionate to their inputs in the process. Due to tight interdependence among underlying elements, to shift even the tiniest aspect of an underlying element or parameter carries the potential to change the entire system radically. To understand the property of sensitive dependence more intuitively, consider the children's book, *Because a Little Bug Went Ka-Choo*, by Rosetta Stone (1975). A bug sneezes at the beginning of the book, an event that takes place on a size scale no bigger than a dewdrop. By the book's end, this tiny trigger has set into motion a large-scale social avalanche that includes marching circuses, flying helicopters, and people running amok down city streets. A related plot revealing sensitive dependence can be found in *The Cat in the Hat Comes Back* by Dr. Seuss (1958). Here a brother and sister are home alone and bored. They respond to a knock on the door (a metaphorical call to play?) by letting in the naughty Cat in the Hat. This seemingly harmless, tiny act escalates into complete havoc, when a pink ring left from the cat's bath eventually soils the entire house, inside and outside. This includes mommy and daddy's bed (how Freudian). In a feedback loop of grand proportions, each effort to clean up the mess only makes matters worse. Eventually, only the smallest cat of all, the one so tiny as to be invisible, is powerful enough to reverse the damages and restore the house to its original condition. Perhaps such books remain popular because their nonlinear wisdom parallels how novelty and change emerge in nature (Marks-Tarlow 2008a). These narratives, and the fractal images in the case of Dr. Seuss, tap into the receptivity and magic of children's open minds. Here the future can change on a dime, and anything is possible—even when facing life's most helpless or hopeless conditions.

To illustrate how sensitive dependence comes into play during childhood, Fromberg (2002) cites the example of a youngster who chooses to attend a sibling's violin lesson. This tiny act alters the child's entire future by sparking a lifelong passion for music. Another child, making a similar choice, might hear unbearable squeaks and cacophony in a sibling's musical play, only to wind up with a lifelong distaste for music. "Children's play and their grasp of meaning are therefore unpredictable. In a similar way, different children doing the same thing at the same time may have different experiences; the same children doing different things at different times may have equivalent experiences" (Fromberg 2002, 46). Meaning making clearly contributes a nonlinear element to the subjective experience of play, rendering this realm highly idiosyncratic, if not downright paradoxical.

Play and Paradox

The unpredictability of play demonstrates dangers of comparing apples to apples within nonlinear realms. With paradox so frequently embedded into the core of complex systems (Marks-Tarlow 2004, 2008b; Marks-Tarlow, Robertson, and Combs 2002), it is not surprising that numerous researchers (Monighan-Nourot 1998; Schwartzman 1978; Sutton-Smith 1995) point toward opposites within play. VanderVen (2004) cautions against adopting an overly simplistic, either-or stance as she lays out play's common dichotomies: fantasy-reality;

work-play; process-product; pleasurable-serious; rule based–free flowing; choice-requirement; freedom-constraint, and past-future. Fromberg (2002) highlights opportunities for insight and learning afforded to children through the dialectic tension of bipolar pairs.

Rather than resolving the tension of opposites, the nonlinear paradigm elevates paradox to a pivotal role during the emergence of novelty and creativity (Marks-Tarlow 2004, 2008b). We understand this readily when reflecting on qualities of young children's pretend play. Twists and turns in play narratives not infrequently trigger a 180-degree turn into self-contradiction. One minute a child, as fireman, urgently rushes to the scene of a blazing fire intent on saving a house from the flames. The next minute, our little hero morphs into a villain determined to toss the house into the fire instead. The coexistence of such opposites fires up children's passions within a safe environment, where nothing really burns and everything fuels the flames of creative inspiration.

Sigmund Freud (1900) identified the coexistence of opposite feelings, motives, and impulses as the stuff of the unconscious, or the primary process. He contrasted this mode of understanding with the more reason-bound consciousness of the ego, or mode of secondary process. From a neurobiological perspective, Allan Schore (1997) speculates that the mode of primary process characterizes the nonlinear, emotional, relational, intuitive style of the right brain, while the more secondary process characterizes the more linear, language- and logic-dominated style of left-brain conscious thought.

From an evolutionary point of view, laterality—or the specialization of hemispheric function—developed half a billion years ago in early vertebrates, long before mammals and humans existed (MacNeilage, Rogers, and Vallortigara 2009). Later, to divide up the functions necessary for a more efficient brain, the right brain specialized in dealing with novelty, while the left brain became reserved for habitual tasks. Play, emerging through right-brain intuitive processes, helps children create and discover new things.

Constructivist, Interactionist Foundations

Following in the footsteps of luminaries such as Jean Piaget, Jerome Bruner, George Mead, and Donald W. Winnicott, I suggest that through early play, children create inner identity at the same time they discover outer worlds. Piaget (1962) emphasizes a constructivist role for play within cognitive development, as children move from undifferentiated, egocentric perception to a more decentered, reality-based understanding of surroundings. By molding the environment through their own activities and then observing the results, children function as if they are little scientists conducting experiments. They learn to assimilate new information into existing schemas and to accommodate new paradigms when needed. Children move through developmental stages initially dominated by bodily and sensory processes to ever greater capacities for symbolization and abstraction. Along the way, they learn to solve problems, acquire concepts, and manipulate symbols.

Mead's symbolic interactionist theory (Mead 1934; Denzin 2005) emphasizes the socializing aspect of play. As children enter into relationships with playmates, with objects, and with the surrounding world—first through unstructured activities and later through games with rules—they imitate and internalize the roles and expectations of adults to make meaning out of society. A child might adopt the role of doctor in one round of play and that of patient during the next one. By enacting the various attitudes and scripts they observe, children begin to relate to adult norms and to acquire what it takes to be accepted as a player in society.

Mead introduced the notion of the "generalized other" as central to understanding how the social self emerges. The generalized other involves the holistic capacity to comprehend a given activity from the global perspective of all players and all roles. The concept is nonlinear because it involves feedback and recursion. A child must adopt the role of patient in order to understand the role of doctor. In the process, circular feedback loops function like social mirrors, and identity emerges from how one thinks one's group perceives oneself. Brian Sutton-Smith (1979) similarly emphasizes the importance of social perspective taking in play, as does Lev Vygotsky (1978), whose concept of self-regulation in play involves self-talk and self-control internalized recursively through interactions with others.

British psychoanalyst Donald Winnicott (1971) offers an interactionist, constructivist theory of play by which symbol, self, and culture all emerge. To Winnicott, play is "what life is about." Play is the origins of a body-based experience of life as both real and worth living. Play is where meaning becomes infused with active engagement. Play provides a source of continuity from the present into the future, which is conceived of as an open arena of fuzzy fusion between imagination and reality. For Winnicott (1971), play emerges relationally, in the space between baby and mother, between subjective and objective realms. Here lies a field of open potentiality, an ambiguous place Winnicott calls *transitional space*. Transitional space is filled with "electricity," as in love, and characterized by the "infinite variability" of the imagination at play. Within transitional space, Winnicott defines a baby's first possession, such as a blanket or teddy bear, as a *transitional object.* Transitional objects are simultaneously created and discovered within this open zone of negotiation between mother and child. The transitional object represents a baby's first act of symbolizing, connected with the creative potential to construct meaning throughout life, as the infant both absorbs and creates anew.

> Cultural experience begins with creative living manifested in play. . . . For every individual the use of this space is determined by life experiences that take place at the early stages of the individual's existence. . . . From the beginning the baby has maximally intense experiences in the potential space between the subjective object and the object objectively perceived, between the me-extensions and the not-me (100).

Winnicott's concepts are highly paradoxical. Transitional space both separates as it connects baby with mother, self with other, individual with culture at large. Transitional objects possess the quality of being both of the self, or me, and of the world, or not-me. Transitional objects are simultaneously created, as if new, while discovered, as if already present. Winnicott establishes here an underdetermined space, a blur between fantasy and reality. By delineating as sacred the potential space between baby and mother, between child and family, and between individual and the world at large, Winnicott includes multiple descriptive levels, expanding outward into ever-widening spheres of influence. This builds in continuity between infancy and adulthood, between early attachment security and later creative living, and between the action of individuals and the transformation of society at large.

Winnicott's exploration of the paradoxical space between subjective and objective realms is well modeled by fractal boundaries (Marks-Tarlow 1999, 2008a). Mathematical fractals are the embodiment of paradox (Marks-Tarlow 2004, 2008b). They are simultaneously open and closed, bound and unbound, finite and infinite. Mathematically, fractals occupy the space between ordinary Euclidean dimensions. By being a one-dimensional object that meanders across two-dimensional space, a child's crayon scrawl assumes a fractal dimension, e.g., 1.247 or 1.798. The tighter and more chaotic the scrawl, the higher its dimensionality. If the child blackens the entire paper, the scrawl moves from occupying a fractal dimension into a two-dimensional expanse. If the child tires of drawing and wads her creation into a tight ball, the paper shifts from being a two-dimensional expanse back into a fractal object, characterized by self-similar folds within folds, which occupy a fractional dimension somewhere between two and three.

Given that fractal dimensionality defines infinitely expansive spaces between ordinary dimensions, perhaps it is not surprising that in nature, fractals frequently occupy boundary conditions, where they serve either as residues of chaotic forces or active arbiters of self-organizing processes (Mandelbrot 1977; Marks-Tarlow 2008a; Schroeder 1991). When fractals serve as boundary conditions, they both separate areas into semiautonomous processes and connect them within interdependent fields (Marks-Tarlow, Robertson, and Combs 2003; Varela 1979).

Consider the physical body as an example. While we perceive our skin as cleanly encasing us to hold in our organs, our skin is nonetheless pocked by fractally distributed pores (Kontturi and Murtomäki 1994) that simultaneously open up our bodies to the outside environment. We breathe in oxygen and various nutrients, while we sweat out water and toxins. This continual exchange across open borders reveals a paradoxical boundary that remains functionally closed while structurally open. Fractals are multidimensional processes. By possessing detail on multiple scales, each with its own set of dynamics and processes, fractals serve as fuzzy, dynamic zones of negotiation resembling Winnicott's transitional space.

By placing creativity in the space between subjective and objective realms, Winnicott points to the transitional space between knowing and not knowing, chaos and order, present and future, in which fractals are most prevalent. Meanwhile, Winnicott's model places creativity at the center of engaged living. If a mother can supply the right conditions of safety and trust, every object for her baby becomes a found object; every detail of baby's life exemplifies creative living.

The Interpersonal Neurobiology of Play

A linear perspective suggests that two individuals come together to form a relationship. A nonlinear view reverses this formulation, suggesting instead that the individual emerges out of the coupled dynamics of intersubjective space (Marks-Tarlow 2008a). Whereas linear views emphasize the accrual through play of various cognitive, affective, behavioral, and social competencies, a nonlinear view highlights the developing child as "an emergent self-organizing system, continuously changing or stabilizing in interaction with an environment, rather than a trajectory programmed by genetics, normative stages, or any other static variable" (Howe and Lewis 2005, 251).

Viewed neurobiologically, the self is both embodied and emotionally based (Damasio 1999; Varela, Thompson, and Rosch 1991). The "primary affective core" (Emde 1983) involves nonconscious, preverbal, and implicit processes present from the womb (Schore 1994; Siegel 1999). Feeding this core is a steady stream of present-centered sensory, affective, interoceptive (sensing the internal world), and exteroceptive (sensing the external world) experiences that compose the basic feelings of aliveness (Fogel and Garvey 2007) and embodied self-awareness (Fogel 2009). There is another parallel stream central to the self involving conceptual self-awareness, which develops later, in the second year of life. This more conscious-, language-, and reason-based aspect of the self consists of labels, judgments, narratives, autobiographical memories, intellectual descriptions, and defenses. Each stream of self-awareness implicates distinct brain structures, circuits, time scales and neurophysiological underpinnings. Ideally, the two function in an integrated manner. As I discuss shortly, play may help align them.

Developmentally, the self flowers through the intersubjective foundation of secure attachment (Bowlby 1969; Greenberg, Cicchetti, and Cummings 1990). After birth, the quantity and quality of ongoing interactions during periods of critical development shape cell growth, determine patterns of neural connectivity, and reduce neural connections (Schore 1994, 1997, 2001, 2003, 2005) as complexity builds (Marks-Tarlow 2008a; Siegel 1999). The precise nature of early interactions supplies the physiological underpinnings for the self-organized emergence of different qualities of mind.

Whereas the literature on self-regulation in play emphasizes the left brain, linguistic competencies of the developing child (Berk, Mann, and Ogan 2006; Vygotsky 1986), the literature on self-regulation within interpersonal neurobiology (Schore 1994; Siegel 1999) emphasizes the right brain, affective foundation necessary for words later to take hold (Panksepp 2008b). Along with emotional rupture and repair, play serves as the second interpersonal pillar for self-development. Soothing and stimulation are the caretaker's two main tools for attuned responding (Beebe and Sloate 1982). Soothing helps children regulate negative emotions, calming them down by internalizing the soothing responses to stressful states and events, such as bodily discomforts, unmet emotional needs, or perceptions of danger in the environment. By contrast, stimulating a baby with touch, smiles, and excited tones of voice elevates the dopamine-rich reward circuits of the child's limbic system, promoting experience-dependent maturation. During the first two years, it is the prosody of the words—the tone of voice and melody of the rhythm—and not the meaning of the words that matter. A mother understands this instinctively. She responds by playing with her voice (Snow and Ferguson 1977), letting the peaks and valleys of highly inflected voice, melodramatic and melodic tones, entrain with inner rhythms to carry her baby along for an emotional ride.

Most of a baby's early play is social, unwittingly staged within Vygotsky's zone of proximal development (1978), where new mastery is likely. Social play serves both to stimulate and to soothe, as it expands a baby's regulatory window of affect tolerance (Fosha, Siegel, and Solomon 2009). Parents intuitively stage games like peek-a-boo and hide-and-seek at the edge of abandonment fears. The danger of the Other potentially lost dissolves into the joy of the Other soon found. The roller coaster ride from negative to positive emotional states enhances resilience and tolerance for intense emotion. When a father tosses his baby high up into the air and catches her, his game builds trust amid her terror of falling. Rough-and-tumble play at the edge of real fighting helps calm aggression. It may also ward off hyperactivity (Panksepp 2008a) as it establishes the safety of social hierarchies in humans and other mammals. The mutual arousal these games cause, including rapid oscillations between fear and excitement, stimulate the brain's reward circuits to provide a foundation for pleasurable flows throughout life.

Orientation in Social Space

Given that the volume of children's brains increases fourfold from birth to teenage years (Johnson 2001), early play represents a major avenue for stimulating healthy neuronal growth and connectivity. Along with promoting emotional regulation and brain development in the context of secure attachment, I suggest that early play also helps children orient themselves and navigate social space. To support this claim, I draw on the work of nonlinear neuroscientist György Buzsáki (2006) who integrates two separate lines of research, each involving the hippocampus in the temporal cerebral lobe: clinical findings in humans indicating that damage to the hippocampus-entorhinal system results in profound memory problems; and single-cell research in rats concerning spatial navigation via place cells in the hippocampus.

In its study of spatial navigation in rats, Buzsáki's lab identifies two distinct phases by which rats become oriented to the environment. During the first stage, rats freely explore their surroundings while individual place cells in their hippocampuses fire in recognition. Buzsáki likens this phase, based on a continual one-dimensional stream of present-centered experience, to the nautical technique of *dead reckoning*. Much like early sailors who kept track of their direction, speed, and time of travel on an ongoing basis, rats begin by feeling their way through the environment from the inside out. By recursively folding in enteroceptive feedback (internal organs), with exteroceptive feedback (smell, taste, touch, sight, sound, balance), and proprioceptive feedback (whether the body is moving; where various body parts are relative to one another), internal systems get calibrated as maps are created of the outer world.

Once rats have achieved this calibration, they have a reliable foundation to switch modes. During the second phase, called *map-based navigation*, they gain the potential to move from the outside in, according to external landmarks and recognizable cues, such as the sight of a food tray or familiar wall. Buzsáki likens this stage to landmark navigation that became possible only after mathematics advanced to making complicated calculations of a sailor's whereabouts relative to celestial bodies like the stars, sun, and moon. At this point in nautical history, ships no longer needed to track their position continually, and sailors switched to more infrequent updates once or twice a day.

A classic study of perceptual development by Held and Hein (1963) corroborates the necessity of moving by feel, from the inside out, before becoming capable of outside-in navigation through sight alone. This experimental paradigm involves two newborn kittens yoked in a carousal that circles a visually restricted environment. One kitten has free locomotion while the other is passively carried in a basket. Both enjoy similar views; yet only the kitten free to move develops normal vision. Similar contingencies hold for people. Thus, restoring vision to a congenitally blind adult can be futile (Ostrovsky, Andalman, and Sinha 2006). Despite normal sensory signals, the critical window for internal calibration has passed. These people are left "in the dark," unable to make meaning out of the chaos of their perceptual worlds. Whether in rats, kittens, or people, movement-produced sensory feedback is critical for visually guided behavior.

In their normal habitat, rats explore their environments by meandering along irregular paths. As animals move in chaotic trajectories (Cole 1991), their unpredictable twists and turns enhance safety from predators. Buzsáki suggests another purpose for chaotic exploration. If restricted to exploring only in straight lines, rats fail to orient themselves to their surroundings. Their explorations become limited to one-dimensional sensory streams. Yet place cells in the hippocampus are omnidirectional. They need to be triggered from multiple angles in order to establish a two-dimensional grid of external space. Only by enjoying the full freedom to meander chaotically, to approach any point from any other point, do rats truly internalize the where of experience. Doesn't this sound a lot like Mead's notion of the generalized other?

In evolution, as new functions arise, an old structure commonly becomes more complex by co-opting new uses. This is apparently what happened in the mammalian hippocampus. In rats, to navigate physical space, place cells in the hippocampus developed to detect the what and where of ongoing experience. Buzsáki highlights the importance of timing, both for encoding memory and for establishing inner maps. Illuminating this implicit level of when, establishes the spatiotemporal grid necessary to make the leap from rats to human encoding of autobiographical memory. Because people explore the outside world within the relational context of secure attachment, we can understand why navigation at concrete, physical levels becomes, from the start, so tightly coupled and continuous with the exploration of symbolic, social levels.

I suggest that the same two-part sequence that holds for rat orientation and navigation of physical space also applies to humans within social space. During the first phase of development, children must explore their environment freely through unstructured play. This allows them to meander through social space according to internal direction or to the feel of things from the inside out. Within this chaotic zone where anything is possible, children are free to approach any point in social space from any other point. No wonder wild and erratic turns of imagination occur typically during pretend play.

By moving from the inside out, according to inner feelings, urges, and impulses, as guided by the inner light of imagination, children calibrate the feedback from implicit interoceptive, exteroceptive, and proprioceptive systems. In this way, they align the sensory, affective, cognitive, imagistic, and behavioral aspects of early experience. Once they calibrate these systems, children have a foundation to switch modes and navigate from the outside in, according to external information and to social cues. As an example, many young kids dream about being an astronaut. They build spaceships. They fly to other planets. They picnic on other galaxies during pretend play. But only a few children are capable of transitioning this early fantasy into later reality. To do so requires more than just inside-out vision and motivation. It also requires the outside-in capacity to navigate a host of social institutions and politics.

I suggest further that this two-step transition from inside-out to outside-in navigation amounts to an alignment between Fogel's (2009) parallel streams of self-awareness—the earlier embodied flow of right-hemisphere, implicit processes and the later developing conceptual flow of left-brain explicit processes. When aligned, both through the resonance of entrained timing and feedback carried across the corpus callosum, then, the minute-to-minute subcortical stream of body-based information can feed into and ground the more disembodied, conceptual flow of words, thoughts, and evaluations.

Only if the two streams of self-awareness are fully aligned, can imagination serve as an inner beacon for outer travels throughout life. By contrast, in less successful cases where inner calibration is not achieved, the two streams of embodied and conceptual self-awareness will not line up, and we might expect somatic or social disorientation or both. Perhaps this is why people speak of feeling lost in the world. Here, rather than serving as a beacon into a real future, imagination acts defensively to wall off and protect a fragile self, resulting in a constricted, suppressed, repressed, or dissociated affective core (Fogel 2009).

I suggest that once these maps and modes of social navigation are in place, it becomes the job of the right orbitofrontal cortex, the executive control system of the brain (Fuster 1997), to integrate and navigate. The right orbitofronal area of the limbic prefrontal cortex comes online between ten and eighteen months of age, when parent-child play is in full swing. The orbitofrontal cortex undergoes tremendous growth during the first few years of life and then undergoes massive reorganization during adolescence (Schore 1997, 2003). Schore speculates that the right orbitofrontal cortex serves as the seat of the self, being the one aspect of brain function with a panoramic view of both inside and outside environments. Given that the right orbitofrontal cortex is key for processing new information (Frey and Petrides 2000), this area may be enriched by social orientation and maps internalized during free play.

Why Imagination Goes Underground

The ideas put forth in this article are new and highly speculative. They await systematic empirical investigation. In the meantime, indirect clues exist. If this theory is correct, we would expect children to exhibit two distinct phases of development. We would also expect a bifurcation, or transition point where navigation styles would flip, moving from inside out, when they are guided more by imagination and fantasy, to outside in, when they are guided more by the dictates of reality and socially mediated processes. This is exactly what seems to happen during middle and late childhood, when creativity appears to go underground.

Recall Piaget's cognitive model. By focusing on the epistemology of what children know, Piaget outlines a sequence where fantasy gets increasingly subjugated to constraints of reality as children shift from early sensory-motor play, through mastery play, to symbolic play, and finally to games with rules. Smilansky (1990) expands Piaget's system from purely cognitive into social realms: (1) functional or exploratory play, a sensorimotor foundation to learn about the physical and social world; (2) constructive play, a more active somatically based engagement with the world where children combine elements like blocks; (3) dramatic play, where reality is imbued with imagination and objects serve a metaphorical function, e.g., a sardine can becomes a cell phone; (4) sociodramatic play, a more complex form of dramatic play with implicit rules and multiple players organized around a common play theme; (5) games with rules, the most highly organized form of cooperative play, characterized by explicitly defined rules.

These categories reflect increasing complexity as the left-brain competencies of language, logic, narrative, and conceptual self-awareness develop in the second year of life to combine with the right-brain foundation of affective processes and embodied self-awareness set in place by the early attachment system. As play becomes increasingly symbolic, social, and imaginative, it moves from implicit, preconscious, and nonverbal to include more explicit, conscious, and verbal elements. While still facilitated by safe attachment and primary caretaker involvement, children's play develops in opposite directions simultaneously—toward greater autonomy as well as towards fuller coordination with others.

Within both Piaget's and Smilansky's stages, the final step of games with rules is the least creative and most externally dictated. As children enter late childhood, they grow increasingly interested in, if not preoccupied with, the opinion and culture of peers. They slow, if they do not stop, fantasy play in favor of joining social clubs and playing sports with fixed rules. As they learn more about the geographical areas in which they live, play, and go to school, they become increasingly self-conscious of what they wear and how they look. They gain interest in fitting into preexisting structures, like peer groups, social clubs like the boy scouts, and organized sports. They read sheet music, play instruments, and join bands. They try card games like hearts, board games like Risk or Parcheesi, and games of pure skill, like chess.

By using these outer cues and external aspects of society to locate the self and navigate through social space, children move from their small-world focus to a large world view as they begin to try their hands in the game of life. This is the time when children fall in love with the world and become most receptive to absorbing facts and new information, precisely because they begin to practice an opposite set of skills—those of navigating social and physical space from the outside in.

Continuity throughout the Lifespan

Singer and Singer (1990) are troubled by Piaget's emphasis on the importance of reality over fantasy. They suggest instead that creativity does not become subjugated to reality so much as it goes underground. Here it runs like an invisible stream of internalized speech and fantasy, activated in daydreams and hobbies that often extend throughout life. In their extensive examination of continuity between motives, themes, and structures of early play as these relate to later forms of self-expression, Singer and Singer conclude that "there are some common threads in early childhood that are linked to the appreciation of the cosmic . . . a necessary element in creativity and in the development of a capacity for fantasy and mind magic" (1).

The perspective I propose concords with the Singers' view. Through recursive enfolding, a fractal model suggests continuity throughout life, despite distinct phases and developmental discontinuities. If early play serves as a chaotic container for inner calibration in preparation for later navigation in social space, then there should be fractal resonances and continuity in how imagination either guides or fails to guide outer competencies.

Let us consider a smattering of the available research. Harrington, Block, and Block (1983) find that at ages four and five, children who were rated imaginative and sensitive to task constraints were also judged higher in creativity at age eleven. Schaefer reports that the presence of imaginary companions of childhood is predictive of adolescent creativity among high school students. A major longitudinal study by Ruth Richards and colleagues (1988) also indicates strong correlations between the creative expression and fantasy production during childhood and creativity in adulthood. A recent book by James Catterall (2009) addresses a study that followed more than twelve thousand adolescents longitudinally from high school to young adulthood, while controlling for family socioeconomic status. Children who participated in the visual and performing arts during high school were much more likely to advance in education and develop prosocial values as adults than children who were less engaged in the arts.

While research points toward a relationship between early imaginative capacities and later success in self-expression, my model more specifically suggests self-similar resonances between the forms and processes of early play and later self-expression. Again, no direct empirical evidence yet exists, and there are further complications. A nonlinear approach to development asserts idiosyncratic developmental trajectories, based on unpredictable twists of events and turns in the road of imaginative play. In addition, the notion of sensitive dependence on initial conditions means that tiny differences between children or chance happenings get amplified into major life occurrences. Twenty children might play cops and robbers as kids, but only one grows up to become an FBI agent. There is limited utility in research designs based on traditional linear statistics that flatten out differences while collapsing towards central tendencies (West 2006). New methods need to be employed. In the meantime, I turn now to the fractal structure of self more broadly and hint at fractal resonances of early play through a few case studies.

The Fractal Geometry of Human Nature

I suggest the self be considered a self-organizing, nonlinear system with deep fractal structure (Marks-Tarlow 1999, 2008a). Fractal patterns of behavior relate to the neurodynamics of personality (Grigsby and Stevens 2001). As a clinician, I frequently observe self-similar patterns that serve as behavioral attractors unfolding across different time and event scales. Consider the Type-A personality who aggressively pushes others aside to get ahead. The same dynamic occurs at the microlevel of interrupting conversations and at the macrolevel of developing road rage and cutting off cars on the highway. It often extends to even larger frames such as pushing aside colleagues at work to gain unfair advantage.

When I first proposed fractal structure to the self, I hypothesized that changes relevant to the self should follow fractal statistical distributions known as *power laws*. Delignières, Fortes, and Ninot (2004) tested this assertion in a prospective study which tracked fluctuations in the self-esteem of four adults and changes in their feelings about their own bodies. Researchers collected self-rated measures from the four twice a day for 514 days. Findings confirmed power-law distributions in fluctuations, indicating an exponent for each subject suggestive of a uniquely idiosyncratic pattern for each individual.

Recent research by Pincus (2009) likewise reveals a fractal structure to the self. Pincus assessed fluctuations in reaction times within a forensic sample for subjects who completed self-referential statements of the MMPI (Minnesota Multiphasic Personality Inventory), a robust measure of personality and psychopathology. Similar to the Delignières group, Pincus found power laws in the distributions of response times for each participant. Further, the complexity of each fractal (i.e., fractal dimension) was correlated to clinical scales, such that rigidity within the fractal structure of personality was related to higher levels of psychopathology.

My recent case-based book (Marks-Tarlow 2008a) presents clinical examples of how the core self carries self-similar resonances, not only from early to later interactions, but also within the intersubjective space of the transference-countertransference dynamics between therapist and patient. Fractal ideas are reflected in the holistic quality of dreams, where the whole of the psyche is reflected in bits of a dream. Fractal ideas are embodied by contemporary ideas like James Hillman's (1996) acorn theory. Hillman proposes that much as the acorn implicitly contains the shape of the oak, the self begins in a state of wholeness that permeates different parts and aspects of an individual's life. This perspective has ancient roots as in the Jewish mystical arm of Kabala, the central metaphor of which is the tree of life. The theory is not new; what is new is the capacity to fuse ancient ideas with contemporary scientific findings.

A Few Case Studies

If intensity of affect, including curiosity, interest, and passion, is the driving force for fractal resonances later in life, then we might expect extraordinary people in the sciences and arts to have the most elaborate stories about the role of play in their lives. Consider the recollections of Nobel prize–winning physicist Richard Feynman (Feynman, Leighton, and Hutchings 1997) whose father frequently placed a set of colored blocks on his son's highchair tray, encouraging the toddler to discover different patterns. Feynman learned about gravity by playing with a toy wagon: he watched a ball roll from the front of the wagon to the back as the wagon to moved. Such play and the observations it sparked may have triggered the insatiable curiosity and capacity for pattern recognition for which Feynman was so famous.

After being the youngest physicist in the Manhattan Project, Feynman was invited to Princeton University. In the presence of Albert Einstein and expected to produce something ground shaking, Feynman froze; he felt unable to produce anything creative. Only after giving up and returning to play, after noticing the wobble in a pizza crust tossed into the air, did Feynman experience the breakthrough leading to his discovery of a new field—quantum electrodynamics. Feynman's recollections reveal the importance of play. Early play helped establish his creative inspiration and his continuing motivation; his return to play freed up his creativity.

The story of W. H. Auden, as offered by Jerome Bruner and colleagues (Bruner, Jolly, and Sylva 1976), suggests another example of fractal resonances. As a youngster between the ages of six and twelve, Auden had the run of the Pennine Moors in North England. There, he constructed a game for his own amusement. Over and over, Auden returned to the limestone and lead-laden landscape to build miniature, private, and very sacred worlds. In a previous paper (Marks-Tarlow 1989), I speculate that Auden had constructed at a concrete, symbolic level an entire universe that he later captured linguistically in his poems. The Root-Bernsteins (Root-Bernstein and Root-Bernstein 1999; 2004) have shown that the construction of imaginary worlds, termed *paracosms* (MacKeith 1982–1983; Silvey and MacKeith 1988), are early manifestations of the kind of adult consciousness and thought processes displayed by many creative people, scientists, and inventors.

Bruner and his colleagues (1976) also present the case of Simone de Beauvoir, who endured a rather austere childhood mostly devoid of toys. De Beauvoir's imagination filled the space that toys might have otherwise occupied. Her sister served as playmate and accomplice in the secret performances she arranged. In the most secret of all, de Beauvoir cast herself as Jeanne de Arc, victim and martyr. She cast her sister in the supporting role of the torturer who wielded sugar tongs, little sticks, and other small objects of pain. I speculate that de Beauvoir's passion and fervor for women's rights must have emerged partly out of her suffering for them, albeit in make-believe play.

Singer and Singer (1990) draw on the autobiography of Leo Tolstoy to illuminate the importance of his early pretend play to his later writings. Here are Tolstoy's own words (in Singer and Singer 1990, 2–3): "In the long winter evenings we decked out an armchair with shawls, turning it into a carriage . . . one of us took the coachman's seat, another the footman's, the girls sitting in the middle, and . . . with three chairs for horses, we set out on our travels." Orphaned by the death of his mother at nearly two and his father at age nine, Tolstoy wrote stories that became the connecting thread to his remaining family. His brother Nicholas inspired him with fantastic tales and plans for imaginary expeditions. Meanwhile Tolstoy and his grandmother were often tucked in side-by-side in their respective beds and fell asleep listening to an old blind professional storyteller brought in to amuse Tolstoy's grandfather.

All three cases—Auden, de Beauvoir, and Tolstoy—illustrate a structural similarity between the forms of early free play and those of later self-expression. Singer and Singer (1990) provide further examples of vocational choices prefigured by early play.

> The magician Teller's childhood fun house fantasy and magic tricks also eventuated in a vocational goal. Goethe's early play with puppet theaters certainly foreshadowed his later choices as a dramatist and as a theatrical manager. In addition, his middle-childhood fantasy of having seven siblings in far-flung regions, with whom he communicated, also seems a subtle anticipation of his later willingness to become a government administrator for the Duchy of Weimar and a cosmopolitan "citizen of the world" with an international correspondence (263).

My final example of self-similar development is drawn from my own reflections. I include this vignette having read the surprisingly similar self-referential musings of Jerome Singer. He grew up in New York City during the early 1930s when boys banded together into gangs on the streets. As a child, he was assigned to spy on a rival gang. Later, he received military training during World War II and became a special agent in military intelligence. Singer notes that he continued his investigative work within internal realms by becoming a psychoanalyst.

My story is similar. I grew up in the suburbs of New Jersey during the 1950s and 1960s, and I too was captivated by spy stories. Fascinated by *The Man from U.N.C.L.E.* and *I Spy* on television, my best friend and I devised many of our own episodes of these espionage series. Usually one of us got captured and tied up by foreign enemies; the other, of course, came to a daring rescue. I was equally enthralled by an irreverent, even shocking, little girl portrayed in the book *Harriet the Spy*. Harriet lived in New York City, where my father worked. Like Harriet, I was raised by a nanny, to whom I felt closer than to my own parents. Like Harriet, I unconsciously attempted to traverse the emotional distance I felt from loved ones through my predilection to spy. Whereas Harriet kept a journal about the fascinating things she noticed in her friends and neighbors, I drew elaborate maps, always intending to sneak as close as possible to my nanny, mother, father, or my parents' guests.

It is easy to see parallels between my early history of spying on others and the mental maps and book writing of my current profession as a clinical psychologist. I have always been drawn to the intimacy of my work. I still aspire to "sneak" as close as I can, in an emotional sense, to "solve" the mystery of people's problems, "unbind" them from symptoms, and "free" them through transformative experiences. And rather than map out physical territory, I have graduated to making maps of the fractal geometry of intersubjective space.

Summary and Conclusions

This article uses nonlinear science broadly and fractal geometry specifically to offer play as a benchmark for early identity and later self-expression. Our imaginative play as children relates to the whole of ourselves and so bears resemblance to how we continue to unfold in work, play, and creative self-expression as adults. I argue that play emerges in the space between inner and outer realms, between self and other, between imagination and reality. I also argue that early play serves to calibrate and integrate perceptual, affective, imagistic, cognitive, and behavioral systems and helps align inner with outer worlds, self with other, imagination with reality. Play occurs initially in the context of secure attachment and becomes increasingly complex as exploration of concrete objects within physical space merges into social exploration within ever more symbolic realms.

Whether at preverbal or verbal levels, the orientation of self is always a two-step process. The first step involves exploration from the inside out, where active engagement with the physical and social environment provides feedback that serves to calibrate internal faculties. Once the self-system is fully calibrated, it becomes possible to navigate from the outside in, using external cues. When the developing child enjoys the safety, trust, and positive motivation for free play, the creatively expressive self is preserved into adulthood, and imagination remains a portal into reality rather than a defense against it. In these cases, chances are best that early fractal seeds of self-expression are detected within the passions and occupations of later life.

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