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CREATIVITY AND DEVELOPMENT

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CHAPTER ONE

Emergence in Creativity and Development

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In this chapter, I introduce our volume's focus on process in creativity and development. I explore parallels between the creative process of the artist or scientist and the developmental process that children undergo as they age and mature. For example, the core insight of constructivism—a long-established developmental paradigm associated with both Piaget and Vygotsky—is that children participate in the creation of their own knowledge. Likewise, much of creativity theory has been based on stage models that are fundamentally developmental. In many cases, these parallels lead to very similar theoretical issues being addressed in both fields but being studied and resolved in somewhat different ways. In this chapter, I review the history of theoretical development in creativity research and developmental psychology, and I demonstrate that the two fields share many concepts and theoretical frameworks. I show how each field could benefit from incorporating aspects of the other field's theoretical frameworks, and I identify several common issues facing contemporary researchers in both areas.

I first noticed these parallels soon after I began to teach three related courses at Washington University in St. Louis: educational psychology, play and development, and the psychology of creativity. Often, I taught two of these courses in the same semester. I found myself teaching Piaget's stage theory of development to a class on Monday and then analyzing stage theories of the creative process on Tuesday. It began to seem increasingly obvious that Piaget's constructivist theory of development was fundamentally a theory of creativity. Later, as I began a more thorough examination of Piaget's thought, I discovered that Piaget (1971a) himself had noted these parallels: "The real problem is how

to explain novelties. I think that novelties, i.e., creations, constantly intervene in development" (p. 192). In fact, Piaget always claimed that his theory of development was a theory of "genetic epistemology" and, as such, applied both to individual development and to the historical development of scientific fields. In his three-volume 1950 work, *Introduction à l'épistémologie génétique* (never translated into English, although see Piaget, 1970/1972), Piaget analyzed the development of mathematics (Volume 1), physics (Volume 2), and biology (Volume 3) using his developmental concepts of equilibration, abstraction, generalization, accommodation and assimilation (see Messerly, 1996, chapter 3).[1]

My exploration of these parallels is guided by my empirical studies of the improvisational creativity of verbal performance (Sawyer, 1997, 2003). In about 1998, these studies led me to an exploration of the long history of the theoretical concept of *emergence*. In the early twentieth century, philosophers defined emergence as the creation of something new that was unpredictable, even given a full and complete knowledge of the world prior to its emergence. The concept was originally developed to address issues in the theory of biological evolution. At the same time that I studied this philosophical tradition, I began to explore emergentist thinking in developmental psychology (Sawyer, 2002a) and in creativity research (Sawyer, 1999). In this chapter, my guiding theme is that both development and creativity are emergent processes and that dominant theories in both areas have been deeply influenced by emergentist thinking in philosophy and biology.

The first U.S. psychologist to elaborate Piaget's parallel between creative insight and developmental transitions was David Henry Feldman (1974), who noted that "Piagetian stage-to-stage advance and creative accomplishments share certain common attributes" (p. 57). The crucial assumption of Piaget's theory of intellectual development is that new schemas are constructed by the child and that these schemas are not simply continuous accumulations of new knowledge, but represent complete reorganizations of thought. Piaget acknowledged that he had no good explanation for how these reorganizations occur, referring to it as "the great mystery of the stages" (1971b, p. 9) and noting that "the crux of my problem . . . is to try and explain how novelties are possible and how they are formed" (1971a, p. 194). In his seminal 1974 study of Darwin's creative process, Gruber explored the relation between Piagetian universal thought structures and Darwin's highly original ones, and he suggested that Darwin's thought structures were transformed through a Piagetian constructivist process (cf. Feldman, 1980; also see the end of this chapter).

In this chapter, I show that these parallels are merely the most recent manifestation of over a century of theoretical parallels. Theories of both creativity and development have strong emergentist foundations and thus have their origins in nineteenth-century thought. I identify these emergentist foundations and show how they have influenced theories of creativity and development.

EMERGENCE

The concept of emergence is a unifying thread underlying both creativity theory and developmental theory. Theories of emergence have influenced psychological theory since the beginning of the field in the late nineteenth century (Sawyer, 2002a). Emergentism in psychology has its roots in nineteenth-century *organicism*: the theory that the organism is different from the sum of its parts and that it depends on the structural arrangement of the parts. Social organicism—the notion that society formed an integrated unity similar in some sense to that of living organisms—can be traced to classical social philosophy, but the publication of Darwin's account of evolution gave new energy to social organismic theories (see Giddens, 1970, p. 172). In the nineteenth century, organicism was prominent in German social philosophy; influential advocates included Schäffle and Lilienfeld. These theories influenced German psychologists including Wundt and the early gestaltists.

The nineteenth century was characterized by a preoccupation with evolution, and organicist metaphors almost always incorporated evolutionary themes. Evolutionary and organicist thinking were strong influences on psychology's founders. For example, many neurological theories proposed that the nervous system was composed of different levels that represented different levels of evolutionary development. Ernst Haeckel's famous "biogenetic law" stated that "ontogeny is the short and rapid repetition of phylogeny" (cited in Sulloway, 1979, p. 199), thus suggesting that the development of a child recapitulates the history of the species. Such ideas would later be explicitly invoked by Freud, Piaget, and Werner.

Theories of emergence and evolution were the focus of an influential group of British philosophers and evolutionary biologists just after World War I, a group that has been called the "British emergentists" (McLaughlin, 1992). Influential figures from this period include Broad (1925), Morgan (1923), and Whitehead (1926). The philosopher Broad (1925) defined emergentism in terms of irreducibility and nondeducibility: "The characteristic behavior of the whole *could* not, even in theory, be deduced from the most complete knowledge of the behavior of its components, taken separately or in other combinations" (p. 59). In spite of irreducibility, emergentists were materialists, holding that only physical matter existed and thus rejecting the vitalist belief in a nonmaterial life-giving substance. Because they were materialists, they held that emergent properties must *supervene* on microlevel properties. The supervenience account of emergentism requires that the behavior of the whole be determined by the nature and arrangement of its components. Even so, the emergentists rejected mechanistic theories which held that the behavior of the whole "could, in theory at least, be *deduced* from a sufficient knowledge of how the components behave in isolation or in other wholes of a simpler kind" (Broad, 1925, p. 59).

The emergentism of both Broad and Morgan involved several related claims (Kim, 1992; Teller, 1992):

- There are basic, nonemergent entities and properties, and these are material entities and their properties.
- Emergence is a process that occurs through time.
- When aggregates of basic entities attain a certain level of structural complexity, properties of the aggregate emerge. New stuff does not emerge; rather, it is properties of the higher level entities that emerges.
- What emerges are new levels of reality, corresponding to evolutionary or historical stages. In Morgan's account of "emergent evolution," the stages are matter, life, and mind. Other emergentists proposed more detailed systems of levels.
- Because these properties are properties of complex organizations of matter, they emerge only when the appropriate lower level material conditions are present.
- What emerges is novel; it did not exist before the process of emergence.
- What emerges is unpredictable, and could not have been known analytically before it emerged.
- Emergent properties are irreducible to properties of their lower level parts, even though they are determined by those parts.

Although first given explicit expression in the 1920s, these ideas derive from a current in nineteenth-century thought that has been called *evolutionary historicism* (Kitcher, 1992, p. 214). Nineteenth-century social and biological explanations were largely historical: A phenomenon was to be explained by offering an account of its development from earlier conditions (Kitcher, 1992, p. 66). Evolutionary historicism combined Hegel's dialectic theory of history, Darwin's evolutionary theory, and subsequent organicist metaphors. Hegel's model influenced the developmental psychologies of Freud, Werner, and Piaget; all three of these developmental theories incorporate the Hegelian idea that each stage of development bears within it the tensions and contradictions that propel development to the next stage (Brent, 1978). Evolutionary thought influenced the founding figures in developmental psychology, including Baldwin, Piaget, Werner, and Vygotsky (Morss, 1990; Siegler, 1996, pp. 22–26). Stage theories were also prominent in sociology, to a large extent independent of Darwin's work; Comte's theory of successive stages in historical development preceded Darwin (Comte, 1830–1842/1854), and Spencer's social evolutionary theory of stages was contemporary with Darwin.[2]

Morgan's final book, *The Emergence of Novelty* (1933), emphasized the importance of novelty in emergent evolution and in other developmental processes. For Morgan, emergent novelty "is some new pattern of relatedness.

In a sense, the 'items' of stuff are not new; and yet, in a sense, at each stage of substantial advance, the 'units' of stuff *are* new" (p. 33). Not only things are new, but also the laws that apply at the emergent stage: "There are, at successive stages of advance, new games in play, each with new rules of the game" (p. 39); knowing the lower level rules isn't enough to predict the higher level rules. Not only developmental stages but also the creative products of art and science are "instances of original novelty as emergent" (p. 103). Like Morgan, other 1920s thinkers argued that individual creative insights were emergent. In McDougall's 1929 account, the "creative synthesis" of individual minds was the only true emergence, because physical emergence always has the potential to be reductively explained with the progress of science (p. 122).

Because these thinkers drew on the same nineteenth-century influences as the founders of developmental psychology, they made observations associated today with figures such as Freud and Piaget. For example, Morgan (1933) claimed that thought proceeds in stages that are characterized by their distinctive mental structures: "In the recurrent development of each individual mind, there is, I believe, advance through new modes of organization to further novelty in organization" (p. 79). In other words, each stage of mental development emerges from the prior, and this process of emergence always involves a restructuring that is novel. Consequently, Morgan proposed a stage theory of development (p. 80), from *sentient* (before birth) to *perceptive* (0 to 36 months), to *reflective* (36 months onward). He referred to the study of cognitive development as both "mental evolution" and "genetic psychology" (p. 157), with *genetic* having the same emergentist connotations as Piaget's phrase *genetic epistemology*; in both cases, the term means that structures at each developmental stage emerge from interaction between the organism and its environment at the prior stage (p. 165).

The nineteenth-century notion that development proceeds in stages, and that each stage emerged from the prior stage, was second nature to both Freud and Piaget. Staged developmental concepts formed the backbone of Piaget's theory of cognitive development and of Freud's theory of affective development. At roughly the same time, writers on creativity such as Poincaré, Wallas, and Hadamard were proposing stage theories of the creative process. In developmental theory, the stages proceed over childhood, with each stage lasting several years; in creativity theory, the stages culminate in the production of a single creative work or creative thought. Thus, the latter stages were markedly shorter, lasting only a few months or even, in some cases, a few days.

Through the 1930s, the ideas of the British emergentists had a wide-ranging impact in psychology and the social sciences and were explicitly acknowledged as influences by theorists as diverse as Wolfgang Köhler, George Herbert Mead, and Talcott Parsons. Piaget never referenced these philosophers, and I am not claiming that Piaget read Morgan or even that Morgan was the first to notice the

connections between creativity and development that have often been attributed to Piaget. Rather, my claim is that both Morgan and Piaget were working on issues that naturally presented themselves in the context of nineteenth-century evolutionary historicism, that these issues centered on the topic of emergence, and that the same themes were part of the intellectual background of early creativity theorists.

A theory of development or creativity as emergent is an intermediate position between two potential alternative explanations. First, one could explain the final state of the system by arguing that it is predetermined by the initial state of the system. In evolutionary biology, this position was known as *preformationism*, and this term was also frequently used in early twentieth-century developmental psychology; Piaget frequently used it in criticizing this view, which today corresponds to an overly simplistic conception of innatism (as criticized by Elman, Bates, Johnson, Karmiloff-Smith, & Parisi, 1996). In contrast, in emergentism, each stage emerges from activity and process at the prior stage and thus is a result of organism-environment interaction. Without this interaction, there would be no development. Thus, emergentism rejects a preformationist position that holds that the final state of the mature organism is present in the newborn.[3]

A second alternative to emergentism represents the empiricist pole; it explains development by arguing that the final state of the system is determined by the environment of the organism. Such a stance was common in sociology and in the radical empiricism of behaviorist psychology. Instead, emergentism holds that an explanation of the final state of the system requires an examination of the step-by-step interaction between organism and environment as it passes from stage to stage, because the state of the organism changes at each stage. Thus, the environment is not directly imposed on or internalized by the organism; rather, development results from a constructivist process of organism-environment interaction.

EMERGENCE IN COLLABORATING GROUPS

I originally began to study emergence theory as a way of helping me to understand collaborative group processes. In a series of studies, I have documented that collaborating groups have the key characteristics of emergence (Sawyer, 1997, 2001, 2003). I call this form of social group emergence "collaborative emergence." In collaborative emergence, novelty is a collective process. To demonstrate, here is a transcript of an improvised theater performance taken from a 1993 performance by Off-Off-Campus, a Chicago theater group. This is the first few seconds of dialogue from a scene that the actors knew should last about five minutes. The audience was asked to suggest a proverb, and the suggestion given was "Don't look a gift horse in the mouth."

Lights up. Dave is at stage right, Ellen at stage left. Dave begins gesturing to his right, talking to himself.

1	Dave	All the little glass figurines in my menagerie, The store of my dreams. Hundreds of thousands everywhere!	*Turns around to admire.*
2	Ellen		*Slowly walks toward Dave.*
3	Dave	Yes, can I help you?	*Turns and notices Ellen.*
4	Ellen	Um, I'm looking for uh, uh, a present?	*Ellen is looking down like a child, with her fingers in her mouth.*
5	Dave	A gift?	
6	Ellen	Yeah.	
7	Dave	I have a little donkey?	*Dave mimes the action of handing Ellen a donkey from the shelf.*
8	Ellen	Ah, that's . . . I was looking for something a little bit bigger . . .	
9	Dave	Oh.	*Returns item to shelf.*
10	Ellen	It's for my dad.	

By Turn 10, elements of the dramatic frame are starting to emerge. We know that Dave is a storekeeper, and Ellen is a young girl. We know that Ellen is buying a present for her dad and, because she is so young, probably needs help from the storekeeper. These dramatic elements have emerged from the creative contributions of both actors. Although each actor's incremental contributions to the frame can be identified, none of these turns fully determines the subsequent dialogue, and the emergent dramatic frame is not chosen, intended, or imposed by either of the actors.

It's important to emphasize that this emergent process cannot be reduced to actors' intentions in individual turns, because in many cases an actor cannot know the meaning of his or her own turn until the other actors have responded. In Turn 2, when Ellen walks toward Dave, her action has many potential meanings; for example, she could be a coworker, arriving late to work. Her action does not carry the meaning of a customer entering the store until after Dave's query in Turn 3. In improvised dialogues, many actions do not receive their full meaning until after the act has occurred; the complete meaning of a turn is dependent on the flow of the subsequent dialogue. This sort of retrospective interpretation is quite common in improvised dialogue, and it is one reason that the frame is analytically irreducible to the intentions or actions of participants in individual turns of dialogue (Sawyer, 2001b, 2003).

In each turn of dialogue, an actor proposes a new elaboration to the frame. But not all proposals are accepted; the other actors may decide they don't like the proposed change, they may attribute an unexpected meaning to it, or they may choose to modify it or elaborate it further. Only after the other actors have responded can we know whether or not an actor's proposal will become a part of the frame.

In improvisation as in everyday conversation, speakers proceed with the assumption that all turns of dialogue must be consistent with the frame. After Turn 4, because Ellen is now a young child and a customer, she cannot suddenly begin to act as a coworker; likewise, she cannot act as if she had a prior relationship with Dave, because his query in Turn 3 makes it clear that they have not met before. As the dialogue proceeds and the frame progressively emerges, each actor is increasingly constrained by the requirement to maintain coherence with the frame.

As the dialogue continues beyond Turn 10, we learn that Ellen is buying her dad a present because he has not been feeling well; in fact, he has been exhibiting psychotic behaviors. A third actor then enters the scene, enacting the character of Ellen's psychotic dad, and his condition is cured through some clever actions by the storekeeper. These dramatic elements—the characters, motivations, relationships, and plot trajectory—emerge from the collective interaction and creative contributions of all three actors.

The social process of creativity is analogous to collaborative improvisation; in both an improvised dialogue and a scientific discipline, creativity emerges from a complex interactional and social process (Sawyer, 1995). In the *systems model*—outlined by Csikszentmihalyi (1988b) and Gardner (1993)—the creative individual completes a creative product and then attempts to disseminate it to the broader community, or *field*. For example, a scientist may submit a manuscript to a journal to be considered for publication. The editors of the journal may decide to reject the manuscript, or they may send it to two or three scholars for peer review. This review process could also result in the rejection of the article. If the article—the individual's creative product—is rejected by this group of "gatekeeper" individuals, then it will never enter the *domain*, the shared body of accepted scientific knowledge.

Thus, in a sense, all creativity is an emergent process that involves a social group of individuals engaged in complex, unpredictable interactions (Sawyer, 1999). The systems model proposes that the analysis of creativity requires not only a psychological focus on the creative individual, but also a consideration of the social system. It is the entire system that creates, not the individual alone. Therefore an explanation of an improvisational performance requires a social level of analysis, a microinteractional analog of what occurs in the field of the systems model.

Many creativity researchers have observed that scientific insights often occur in collaborating groups (Csikszentmihalyi & Sawyer, 1995; John-Steiner,

2000). Ludwig Fleck (1935/1979), one of the earliest scholars of the history of science, was perhaps the first to comment on this socially emergent process: "A stimulating conversation between two persons" can result in the emergence of a "thought structure that belongs to neither of them alone" (p. 44). Based on this analogy, Fleck compared scientific work to "a soccer match, a conversation, or the playing of an orchestra," in that the result is not a summation of the participants' work but is "the coming into existence of a special form" (p. 99). These collaborative insights result from a social process of emergence.

THEORIES OF THE CREATIVE PROCESS

I have defined emergence, provided an example of collaborative emergence, and claimed that emergence is a key theoretical thread linking twentieth-century conceptions of creativity and development. I introduced this connection and demonstrated its plausibility by briefly discussing what Morgan and Piaget had to say about these connections.

To further elaborate these connections between creativity and development, I now delve more deeply into theories of both creativity and development. In this section, I discuss twentieth-century theories of creativity, and in the subsequent section, twentieth-century theories of development.

Creativity is notoriously difficult to define. Theorists have debated what the term means, and empirical researchers have employed different operationalizations of the term. For my purposes, I hold to a broad conception of creativity that has been widespread among creativity researchers since the 1970s: Creativity is "a socially recognized achievement in which there are novel products" (Barron & Harrington, 1981, p. 442). First of all, a creative idea or work must be *novel*. Yet novelty is not enough, because a novel idea may be ridiculous or nonsensical; many dreams are novel but rarely have any impact on the world after breakfast. In addition to novelty, to be creative an idea must be *appropriate*, recognized as socially valuable in some way to some community.

In the 1950s and 1960s, psychological studies of creators focused on their personalities and roughly fell under the aegis of personality or trait psychology. For example, creative individuals were found to be active, curious, and unconventional (Barron & Harrington, 1981). Beginning in the 1970s, the cognitive revolution began to influence creativity studies, with experimental methods being used to identify the internal cognitive processes associated with creativity, and with computer models that simulate the creative process (see chapters 5 to 9 in Sternberg, 1988). However, the individualistic trait conception of creativity tended to emphasize the generation of novelty and to neglect the appropriateness criterion. Feldman's 1974 article was an influential early argument for a focus on process rather than traits; he noted that the process approach is

less individualistic than the trait approach, because it involves both individual and situation, organism and environment.

There are two substantive analogies between emergence theory and contemporary theories of the psychology of creativity (Sawyer, 1999). First, emergence theory of the 1920s was primarily an evolutionary theory, and many of the most influential contemporary theories of creativity are based on an evolutionary metaphor. The evolutionary approach to creativity is usually traced to Campbell (1960), who proposed that creativity was subject to the same three-stage process as evolution: blind variation, selective retention, and preservation and reproduction. Csikszentmihalyi followed Campbell in arguing that creativity was not a property of an individual, but a function of both the individual and the selective environment. Csikszentmihalyi's influential systems model (1988b) is also based on evolutionary metaphors, and includes three components analogous to Campbell's: the *creative individual,* who generates a novel product; the *field,* a social system of individuals in a discipline, that evaluates novel products and selects some of them according to established criteria; and a *domain*, an external body of work whose stable physical traits allow it to serve the function of preservation across time.

There is a second substantive comparison between emergence theory and the contemporary psychology of creativity: A creative insight is hypothesized to emerge from the subconscious mind of the creator. Morgan (1933) viewed emergence as "new modes of relatedness" that arise from a system of smaller, interacting entities; today, a novel creative insight is often considered to be a new configuration of mental elements, none of which are individually novel. The mathematician Henri Poincaré (1913/1982) described the emergence of an insight in a widely quoted passage: "One evening, contrary to my custom, I drank black coffee and could not sleep. Ideas rose in crowds; I felt them collide until pairs interlocked, so to speak, making a stable combination. By the next morning, I had established the existence of a class of Fuchsian functions" (p. 387). A contemporary example of such a theory is Simonton's cognitive model (1988), which proposes that the individual first internalizes *mental elements*—facts, theories, images, and information from the creative domain—and that these are stored in the brain; during a subconscious creative process, these mental elements combine into *chance configurations*, and although many of these novel configurations never make it into consciousness, some of them are stable enough to emerge and cause the subjective sensation of having an insight.

In sum, the contemporary conception of the creative process corresponds quite closely to concepts of emergence:

- Creativity is theorized as a process through time, rather than a static trait of individuals or of certain creative products.
- The creative product is novel.

- The creative product emerges from the combination of lower level elements, in combination in a complex system. In other words, no new substance is created, only combinations of elements in complex systems.

In the following sections, I elaborate on some specific emergentist aspects of contemporary creativity theory.

The Stages of the Creative Process

> The mind being prepared beforehand with the principles most likely for the purpose . . . incubates in patient thought over the problem, trying and rejecting, until at last the proper elements come together in the view, and fall into their places in a fitting combination.
>
> ALEXANDER BAIN, *The Senses and the Intellect*

In addition to the previously noted broad parallels between current conceptions of creativity and the history of emergentist thought, there is a more specific parallel. Throughout the history of creativity theory, creativity has been thought of as a staged process. Many contemporary creativity researchers attribute the insight that creativity proceeds in stages to Henri Poincaré (1913/1982) or Joseph Wallas (1926). In developing their stage theories, both of these theorists attributed the original description of the stages to the physiologist Hermann von Helmholtz. Yet, as the epigraph indicates, such ideas were widespread in the nineteenth century, well before Helmholtz.[4] In an address delivered near the end of his life in 1891, Helmholtz reflected on his own creative work and identified the same three stages that Bain proposed: an initial investigation, a period of rest, and then the emergence of the sudden, unexpected solution (Helmholtz, 1971, p. 474).

An influential elaboration of these ideas was presented by Poincaré in a talk before the *Société de Psychologie* in Paris. Hadamard—whom Poincaré nurtured, and who in 1912 was elected to the Academy of Sciences to succeed Poincaré—was present at the talk. He later built on the work of Poincaré and others to elaborate the stages and the role of the unconscious (in a book published in English in 1945, after he had emigrated to the United States). Based on an introspective analysis of his own mathematical insights, Poincaré (1913/1982) proposed that the creative process must begin with "a period of conscious work," which should then be followed by a rest period where the mind is focused on other activities. It is during this rest period that one receives "the appearance of sudden illumination," and this illumination is the result of "long, unconscious prior work" that was taking place during the rest period (p. 389) The illumination does not appear fully formed, but must be verified and elaborated by a subsequent period of conscious work.

Graham Wallas (1926), drawing on both Helmholtz and Poincaré, coined the names for the four stages that are in most widespread use today: *preparation, incubation, illumination,* and *verification* (p. 80). Preparation is the initial phase of preliminary work: collecting data and information, searching for related ideas, listening to suggestions. Incubation is a term for the frequently-observed delay between preparation and the moment of illumination; Wallas presumed that, during this period, the prepared material did not just sit in the mind passively but underwent some sort of internal elaboration and organization. Illumination is the subjective experience of having the idea, the moment of insight. By verification, Wallas meant both evaluation of the worth of the insight, and elaboration of its complete form (p. 81). The insight must be evaluated and verified by the conscious mind; not all insights are good ideas, and some of them don't pan out. Shortly after Wallas's book appeared, Catherine Patrick (e.g., 1937) conducted several studies of creative individuals and found broad evidence for these four stages.

A few stage theories are somewhat independent of this tradition; these tend to originate in practical studies of business creativity and innovation. For example, Joseph Rossman (1931/1964, p. 57) conducted a questionnaire study of 710 inventors and identified seven stages: (1) observation of a need or difficulty; (2) analysis of the need; (3) a survey of all available information; (4) a formulation of all objective solutions; (5) a critical analysis of these solutions, identifying advantages and disadvantages; (6) the insight or invention; and (7) experimentation to test the invention, and perfection of the final product. Rossman referred to the moment of insight of the invention in emergentist terms; it is "greater than the sum of the parts that have entered into it" (p. 61). But Rossman's stages place most of the creative work in conscious stages; particularly, Stages 4 and 5 seem to correspond to the configuration-and-selection aspect of Poincaré's unconscious. This shift in emphasis to conscious process is probably due to the fact that invention is more like problem solving than the more problem-finding types of creative insights; problem finding is likely to require longer incubation periods and a more significant role for the unconscious (Csikszentmihalyi & Sawyer, 1995).

The Unconscious Incubation Stage

In these stage models, the incubation stage is both the least understood and the most essential. The incubation stage is usually associated with the unconscious, or what is sometimes referred to as the preconscious or fringe consciousness (to reflect the fact that it is often just below the surface of awareness).[5] In incubation, elements are hypothesized to combine, and certain combinations are hypothesized to emerge into consciousness. Yet, the exact nature of these

processes remains unknown. How do elements combine, and which combinations make it into conscious awareness?

One persistent explanation is that the combinations are random. Wallas (1926) ridiculed Poincaré's idea that the process of association could be directed by sensibility or beauty (pp. 75–78). Campbell (1960) argued that the process is blind or trial-and-error; the creative individual "just happened to be standing where lightning struck" (p. 390). Simonton's theory of chance configurations is explicitly grounded in Campbell's model. Scientific innovations arise when mental elements are combined through "chance permutations," although these may not be completely random (Simonton, 1988, pp. 6–8; also see Gruber, 1988).

Other theorists believe that incubation is directed in some way. Poincaré (1913/1982) was the first to claim that the subconscious mind does not randomly generate combinations but only generates combinations "which have to some extent the characteristics of useful combinations" (p. 386; also see pp. 390–391). Poincaré argued that this unconscious work is directed, with a sense of the domain of work (pp. 389–394); the unconscious possesses "esthetic sensibility" (p. 392). Poincaré noted that anyone could make new combinations from known entities, but the combinations that resulted would be "infinite in number and most of them absolutely without interest" (p. 386). In the mind of the inventor, "the sterile combinations do not even present themselves" (p. 386); rather, an "unconscious machine" generates good combinations because the conscious work of preparation has "mobilized" certain elements (p. 389). The combinations that become conscious are those that seem "beautiful" to the conscious mind (p. 391). If verification determines that an insight is false, "had it been true, [it] would have gratified our natural feeling for mathematical elegance" (p. 392).

Hadamard (1945) agreed with Poincaré: The ideas that emerge are those that are beautiful and that appeal to the creator's "emotional sensibility" (p. 31). The unconscious not only generates all of the combinations, but also has to select those that satisfy our sense of beauty. The conscious mind must still verify, because sometimes beautiful ideas are wrong (p. 57). Using Wallas's term, Hadamard suggested that the fringe-consciousness is "at the service of full consciousness" (p. 81) and can be called on when necessary.

Several psychoanalytic theorists have likewise proposed that the creative unconscious is guided by the conscious mind. Arieti (1976) studied the contributions of primary process (unconscious) and secondary process thinking to creativity, in what he called a "tertiary process." Rothenberg (1979) proposed that the combinations were "active, directed forms of cognition in which the creator intentionally and in distinct ways brings particular types of elements together" (p. 11); the elements are "integrated" rather than being "merely added or combined" (p. 12).

Cognitive psychologists have also argued that some criteria must be applied at the ideation stage. For example, Johnson-Laird (1987) argued on algorithmic grounds that constraints must be applied at the ideation stage; otherwise, the search space of ideas resulting from the ideation stage will be too large. Both Johnson-Laird and Sawyer (2002b) used the example of jazz improvisation in making this argument. Jazz improvisation is a real-time creative task; evaluation and ideation must proceed in parallel, because there is no opportunity for revision or selection during a live performance. Johnson-Laird referred to staged models with a constrained variation stage as "neo-Lamarckian" to contrast them with the random variation of Campbell's neo-Darwinian model.

Many researchers have noted that the unconscious process can be facilitated by taking time off from the problem. Wallas (1926) noted that incubation can be made to occur by either working on another problem, or by retreating from creative activity altogether (p. 86), for example by engaging in physical exercise (p. 89). This allows the mind to engage in a form of parallel processing; Hadamard (1945) noted that "the unconscious has the important property of being manifold; several and probably many things can and do occur in it simultaneously" (p. 23). This parallelism contrasts with the conscious mind, which can only focus on one thing at a time (also see Csikszentmihalyi & Sawyer, 1995). This multiplicity allows the unconscious to make many combinations simultaneously and in parallel.

There is one important alternative to the dominant combination-of-mental-elements approach to incubation. This is Wertheimer's (1945) gestalt theory of "productive thinking." For Wertheimer, the creative process involves a transformation from one whole situation (S1 in his notation) to another (S2). Wertheimer accounted for the motivation of the transformation in terms of holistic systemic properties of S1: "S1 contains structural strains and stresses that are resolved in S2," and he argued that the transformation springs directly from these structural troubles (p. 193). Structural features determine the transformation, not the goals of the individual (p. 196). These conceptual structures always tend to move toward "objectively better or adequate structure" (p. 198). Insights cannot be analyzed as elements combining, but rather must be analyzed as transformations in complex structures.

Piaget was one of the first to identify the key problem with gestaltism: Gestalts are irreducible and thus must always spring to mind as a totality. They cannot be analyzed in terms of the empirical origins of the elements that contribute to them. Gestalts are ahistorical; they are not thought of as the product of past interactions with an environment. A Piagetian schema, on the other hand, is dynamic and is always continuous with the prior schemas from which it emerged: "The schema is therefore a gestalt which has a history" (Piaget, 1936/1952b, p. 384). Schemas are elastic structures and continually modify themselves, whereas gestalt forms are static (cf. Flavell, 1963, pp. 72–75). Un-

like gestalts, schemas "do not replace each other, but . . . are integrated into one another. The simplest ones become incorporated into later, more complex ones" (Piaget, 1971b, p. 7). As I discuss below, Piaget's theory of schema emergence has interesting similarities to element combination theories of unconscious incubation.

The Nature of the Creative Insight

In stage theories, the creative insight emerges from unconscious incubation. The creator experiences this emergence as an "Aha!" or "Eureka!" moment. As I showed previously, most creativity theories describe the mental process that leads up to this moment in terms familiar from emergence theory; the insight is a higher level holistic combination, configuration, or system of lower level elements, units, or ideas.

How do creative insights emerge from the incubation process? How do combinations form at all? Most serious contenders are variations of associationism, as first suggested by Bain. Bain (1855/1977) argued that creative novelty was "constructive association" and that the construction of "new combinations" (p. 573) is a form of "associating force" because "the new combinations grow out of elements already in the possession of the mind" (p. 572). Most creativity theories have proposed that a creative insight results in the mind of a creator when a set of more basic elements, none of them novel, is brought together to form a more complex cognitive structure. Like Morgan's account of emergence, no new substance is created; rather, novelty is a new mode of relatedness, a combination of elements into complex systems.

Subjective reports from creative individuals provide some support for these theories of creativity. Creativity researchers have long been familiar with the first-person accounts of scientists such as Poincaré and Kekulé. Einstein wrote in a letter to Hadamard that the "psychical entities which seem to serve as elements in thought are certain signs and more or less clear images which can be combined. . . . This combinatory play seems to be the essential feature in productive thought" (as cited in Hadamard, 1945, p. 142). Both Einstein and Poincaré referred to this process as associative. Wallas's (1926) theory of the associations that occur in the incubation stage is taken directly from early British associationism (e.g., see Wallas, pp. 61–65). The illumination is the "culmination of a successful train of association" (p. 94). As partial evidence for this claim, Wallas noted that some creators have a premonition that the insight is about to come; he called it "intimation" (p. 97).

One of the earliest modern statements of this theory of creativity was made by the psychologist Sarnoff Mednick (1962), who defined creative thinking to be "the forming of associative elements into new combinations." This associationist theory of creativity was based in the history of British associationist definitions from Locke to Bain (Mednick, 1962, p. 221). Mednick elaborated on associationism by proposing three distinct mechanisms of association: serendipity, similarity, and mediation. He identified several mental variables that contribute to the likelihood of creativity, including the organization of an individual's *associative hierarchy*, or what in the cognitive era of the 1970s would be called the "semantic network," the strength and structure of associations invoked by a given concept; the *number of associations* the individual has to the relevant elements of the problem; the individual's *cognitive style* (concrete vs. conceptual, visual vs. verbal); and the ways that individuals *select* the creative combination. For example, Mednick proposed that in problem-solving creativity, the selection criteria join the associative elements, whereas in problem-finding creativity, the task of selection also involves identifying relevant criteria (p. 225). Mednick contrasted his associative theory with theories that required connections based on "elaborate rules of logic, concept formation, or problem solving" (p. 227). He developed a psychometric test based on his theory and used the test to support several of his theoretical claims (Mednick & Mednick, 1965).

Many contemporary theories, including Rothenberg's and Simonton's, propose that creative insights result from combinations of mental elements; yet it is often unclear whether or not these models are associationist, because the details of the combinatory mechanism are rarely theorized. For example, Rothenberg's (1979) concept of "homospatial process" is one in which "discrete entities are fused and superimposed" while they "continue to interact and relate to one another" (p. 365). His theory is short on exactly how the distinct components interact with each other and join together in combination to form emergent wholes; instead, he simply observed that they are occupying the same space. The theory provided insufficient detail to determine how it was similar to or different from any other associationist theory. The same lack of detail characterizes Simonton's (1988) chance configurations. A complete theory of this process should include (a) a theory of the internal structure of preconscious cognition; (b) a structural theory of what mental elements and combinations are, and how elements combine; (c) a theory of what, if anything, motivates that preconscious process—of what elements come together in what protocombinations, and why.

Associationism provides another account of how the incubation stage might be guided, supporting arguments such as those of Poincaré (1913/1982, p. 393) and others that the ideation stage is not independent of evaluation. Mednick (1962) argued that the ideas generated are not unrelated, but instead reflect associative patterns. If incubation is not random, then the ideation stage is not completely independent of evaluation; this prefigured arguments such as those

of Runco (1993) that evaluation processes must take place during divergent thought, beyond conscious awareness. Even if it is psychologically meaningful to distinguish ideation from evaluation, there is no compelling reason to insist that they cannot occur in parallel. Both types of thought may be constant, ongoing components of the creative mind.

Critiques of Stage Theories

For almost as long as there have been stage theories of creativity, there have been critics of stage theories. I have even found a textbook that criticized the stage conception (Lowenfeld & Brittain, 1987, p. 76). These critics accept that the researcher can identify distinct aspects of creative thought but argue that they occur in parallel rather than in series. This is a difference in emphasis rather than a diametric opposition; even Wallas (1926) noted that "in the daily stream of thought, these four different stages constantly overlap each other" (p. 81) and that when exploring a problem, "the mind may be unconsciously incubating on one aspect of it, while it is consciously employed in preparing for or verifying another aspect" (p. 82). Yet ultimately, Wallas felt that these four stages could "generally be distinguished from each other" (p. 82).

Vinacke's (1952) critique of stage theories (pp. 243–251), directed at Patrick and Rossman, was inspired by Wertheimer's holistic thinking; he proposed that, rather than looking for distinct stages, "it would be better to conceive of creative thinking in more holistic terms, a total pattern of behavior in which various processes overlap and interweave between the occurrence of the original stimulus and the formation of the final product" (p. 248). He reconceived the stages as "parallel processes" and argued that "it is necessary to conceive of creative thinking in terms of dynamic, interplaying activities rather than as more or less discrete stages" (p. 249). He noted that in many creative fields, especially fine art, there is a series of insights beginning with the first draft or sketch and continuing until the work is completed. He argued that incubation does not occur in a particular stage but operates to varying degrees throughout the creative process. For example, poems and plays do not emerge suddenly or completely but are gradually developed through a process of many incubations and insights.

The psychoanalytic theories of both Arieti and Rothenberg echoed Vinacke's criticism. Arieti (1976) noted that "complex works that can be divided into parts" involve a series of insights, with incubation occurring throughout the creative process. He concluded that the distinct phases exist only as abstractions (p. 18). Rothenberg (1979) argued that creation is not found in a single moment of insight but is "a long series of circumstances . . . often interrupted, reconstructed, and repeated" (p. 131). He criticized stage theories, arguing that "the temporal distinction made between inspiration and elaboration in the creative process is an incorrect one; these phases or functions alternate—sometimes extremely rapidly—from start to finish" (p. 346).

Guilford's (1967) "structure-of-intellect" model proposed a multifactor conception of intelligence based on five operations. From the most basic to the least, the operations are cognition, memory, divergent production, convergent production, and evaluation. Guilford was critical of staged conceptions such as Rossman's, arguing that all five operations proceed in parallel during the creative process, with "evaluation all along the way" (p. 329), although he acknowledged that there are probably higher levels of evaluative processes toward the end of the creative process.

Howard Gruber (1988) also criticized stage theories of creativity (pp. 47–49). He argued that each creative individual is likely to be unique and therefore that there are not likely to be general stages of creativity that apply universally. As evidence for his claim, Gruber (1974) appealed to his study of Darwin's creative process: "Darwin's achievement was realized not in a golden moment of insight but in the slower process of constructing an original point of view" (p. xiv). This criticism echoed those of Arieti and Rothenberg. Gruber applied Piagetian notions of schema transformation to Darwin's development of the theory of natural selection over a 2-year period, to argue that Darwin's theory could not simply be an isolated, sudden insight. For example, the principle of natural selection was well-known before Darwin; Darwin's creativity was not in the insight of natural selection but in his development of a conceptual schema within which natural selection could be perceived as an evolutionary force, whereas prior statements had conceived of it as a conservative force (Gruber, 1974, p. 7).

Although Gruber argued that Darwin's creative process was not staged, Gruber's application of Piagetian concepts seems to imply a staged conception of Darwin's creative process, because Piaget's theory is a stage theory. Gruber resolved this apparent contradiction by taking the somewhat unconventional position that Piaget's theory was not a stage theory (Gruber & Vonèche, 1977). This raises the question of what *would* count as a stage theory for Gruber. Gruber was probably reacting to comments by Piaget to the effect that the details of his stages were not as important as the fundamental processes of assimilation and accommodation (e.g., Piaget, 1945/1962, p. 291). Nonetheless, Piaget always insisted that development occurred in stages.

To further explore these conflicting accounts of the creative process, it is instructive to turn to developmental theory. Many developmental theories are based on stage conceptions, and there has been a great deal of theory surrounding the nature of stages, the number of stages, and how transitions between stages occur. Throughout the history of developmental psychology, these theories have been influenced by nineteenth-century emergentist and evolutionary theory.

THEORIES OF DEVELOPMENTAL PROCESS

Theories of development are partially defined by their rejection of the behaviorist concept of *learning*. The field of developmental psychology has always been based on nonbehaviorist assumptions; when behaviorists study similar phenomena, the endeavor is called *the psychology of learning* or *learning theory*. In the behaviorist conception, learning proceeds according to associationist mechanisms: The individual perceives two stimuli at the same time, or in succession, and after enough perceptions of the two stimuli in this relation, the mind begins to associate them. Forms of learning include habituation, classical conditioning, and operant conditioning.

In the behaviorist framework, learning is a linear, monotonic process: Skills and knowledge increase linearly with experience of the world. Learning can be explained in terms of experience, without incorporating theories of the internal mental models of individuals. In contrast, theories of development involve elements of either *maturationism* or *cognitivism*. Maturationism is the position that the organism is biologically determined to develop at a certain pace; cognitivism is the position that development cannot be explained without incorporating conceptions of the inner mental structures of the developing organism.

Although theories of the creative process retain elements of associationist thinking, such theories are typically based on stage models, and they assume that complex cognitive structures play an essential role in processes of creative insight. There are no stages or cognitive structures in learning theories, only in developmental theories, because stages can only result from qualitative transformations in internal mental structures. In fact, Piaget (1971a) equated novelty with stages: "If there are novelties, then, of course, there are stages. If there are no novelties, then the concept of stages is artificial" (p. 194).

In the following sections, I review theories of the developmental process proposed by Freud, Piaget, and Vygotsky. All three of these thinkers were socialized in the nineteenth-century intellectual environment of evolutionary historicism, all three were influenced by biological conceptions of evolution and development, and all three explicitly discussed artistic or scientific creativity in addition to their better known theories of developmental process.

Freud

I begin with Freud for two reasons. First, his ideas had a significant influence on creativity theory throughout the twentieth century; second, his ideas were a major influence on Piaget's developmental theory, and beginning with Freud will help to underscore the nineteenth-century origins of Piaget's thought.

Many recent scholars have observed that Freud is essentially a nineteenth-century thinker; his developmental theory was based on biological and evolutionary conceptions of development as staged and as emergent from a dialectic of successive tensions in each stage (Kitcher, 1992; Sulloway, 1979). In addition to the general influences of this nineteenth-century perspective, a wide range of direct influences has been documented.

In nineteenth-century evolutionary conceptions of biological development, the nervous system was thought to be composed of different levels that represented different stages of evolutionary development. Today, the best-known statement of this position is Haeckel's biogenetic law that "ontogeny recapitulates phylogeny." Sulloway (1979) argued that Haeckel's recapitulationism was a major influence on Freud (pp. 258–264). Freud read British neurologist John Hughlings Jackson, who developed an elaborate version of this theory in which the lower levels represented more primitive thought processes (Kitcher, 1992, p. 24). This formed the basis of Freud's famous distinction between primary and secondary process thought, and the basic psychological framework that could explain regression to a prior stage of development; regression could occur because the primitive structures survived alongside the more sophisticated, developmentally later mechanisms (Kitcher, 1992, p. 72). Thus, Freud's familiar stage theory of erotogenesis was an emergentist, nineteenth-century account. Each stage—oral, anal, genital, oedipal—provides the context within which the next stage can emerge (see Freud, 1917/1966, pp. 397–444, for a canonical statement).

In addition to these biological influences, Freud was familiar with Comte's staged theories of social history. Mill, an English admirer of Comte, was also well-known by Freud; for example, Freud translated four of Mill's essays into German (Kitcher, 1992, pp. 12–13). Freud read anthropologist Edward B. Tylor (1832–1917); Tylor, like Comte, proposed a social evolutionary model in which culture evolved through different levels of civilization. Like Wundt, Freud believed that knowing how civilization arose and developed would provide important clues to understanding the development of human intelligence (Kitcher, 1992, p. 21).

Thus Freud's theory of development was essentially emergentist, and he used this same theory to explain creativity. Freud located the creative impulse in repressed wishes, which were associated with primary process thought and unconscious thought. This theory of creativity remained influential late into the twentieth century (e.g., Arieti, 1976; Martindale, 1990; Rothenberg, 1979). In his most explicit statement on the topic, the essay "Creative Writers and Day-Dreaming," Freud proposed that the play of the child gradually transforms into adult fantasies, or daydreams (Freud, 1907/1989, p. 438). Daydreams are always motivated by unsatisfied wishes (p. 439). A neurosis is simply an "overluxuriant" fantasy, and fantasies are the "immediate mental precursors" of neuroses (p. 440); in this way, Freud connected the creative impulse with his general theory of neurosis. For example, Freud wrote that "every child at play

behaves like a creative writer, in that he creates a world of his own" (p. 437). Childhood is the source of fantasies and imagination, just as childhood is the source of most neuroses: "A strong experience in the present awakens in the creative writer a memory of an earlier experience (usually belonging to his childhood) from which there now proceeds a wish which finds its fulfillment in the creative work" (p. 442).

Piaget

One of the oldest oppositions in developmental theory is that between theorists who propose that development is a process of passive *transmission* to the child (either from the environment or from adult instruction) and those who propose that development is an active process in which the child *transforms* sense impressions and information from the external world. Transformationist theories view development as a creative process. Almost all twentieth-century theories of development, including behaviorism, psychoanalysis, and socioculturalism, accept some form of transformationist view (Lawrence & Valsiner, 1993), yet this perspective attained its most sophisticated expression in the constructivism of Jean Piaget.

Piaget's *genetic epistemology* was a direct outgrowth of the nineteenth-century currents that I identified previously. Piaget called his theory "constructivist," emphasizing that the child invents rather than discovers new ideas. For Piaget, the ideas do not exist out in the world waiting to be discovered; rather, each child invents them for himself. Yet, the child's construction is not free and undirected; rather, the functioning of the logic of each stage determines the structure of the stage that follows (Gruber & Vonèche, 1977, p. xxxvii).

Piaget's genetic psychology was opposed to the reductionist atomism of behaviorist associationism (see Taylor, 1985, p. 140). The contrast with associationism is that once a child has successfully constructed a fundamental schema—such as number, equivalence, or conservation—the child's thought is fundamentally transformed; the presence of that new schema then influences the manner in which the child apprehends the world from that point forward. Thus, development is not linear; it proceeds in stepwise, staged fashion.

Piaget's experiments demonstrated that perception was influenced by the cognitive schemas of the child. Thus perception was not unmediated by thought, as empiricist associationism claimed; rather, perception was foundationally guided by the categories of thought. It was in this limited sense that Piaget was a neo-Kantian, although like Durkheim (1912/1915), Piaget rejected the idealism of Kant and argued that the categories of thought were not a priori. Whereas Durkheim argued that the categories were socially constructed, Piaget proposed that they were constructed by the child in the course of development.[6]

Piaget's constructivism was emergentist; schemas at one stage emerge from the interaction between activity and schemas at the prior stage. His empirical research focused on the detailed incremental mechanisms of this emergence. By providing bottom-up explanations of the emergence of mental schemas through time, Piaget rejected the claim of the gestaltists that higher level phenomena could be analyzed and explained without reference to their components or to the history of their emergence.

Conceptions of development as staged derive from nineteenth-century biological thought, and Piaget was always explicit about the biological motivations behind his theory (Messerly, 1996). His degrees were in the biology of mollusks, and even late in his career, he said that schemas "have essentially a biological meaning, in the sense that the order of the stages is constant and sequential. Each stage is necessary for the following one" (1971b, p. 7). These nineteenth-century concepts also influenced Piaget through Freud. After Piaget received his Ph.D. in biology, he spent 8 months in analysis in Geneva before moving to Paris to study pathological psychology with mental patients. Piaget (1945/1962) acknowledged a series of parallels between Freud's theory of affective development and his own theory of intellectual development: "The two fundamental facts discovered by Freud and his school are: firstly that infantile affectivity passes through well-defined stages, and secondly that there is an underlying continuity, i.e., that at each level the child unconsciously assimilates present affective situations to earlier ones, even to those most remote. These facts are all the more interesting from our point of view in that they are completely in line with those of intellectual development" (p. 185).

Piaget and Freud shared a nineteenth-century focus on biological emergentism, which included a belief in biological explanations of mental phenomena, a focus on structures that result from the adaptation of an organism to its environment, a search for stages of these structures and transitional forms between them, and a focus throughout on homeostasis of the organism.[7] Their common emergentism accounts for many of the parallels between the theories of Piaget and Freud: (a) Each stage involves a shift from object fixation to generalized, symbolic fixation; (b) each stage has an inherent tension that propels development to the next stage; (c) after a transition to the next stage, the prior stage remains in the subconscious mind, latent, and there is occasional reversion to the prior stage; (d) equilibrium results from the tension between assimilation and accommodation, which Piaget explicitly acknowledged was modeled directly on Freud's contrast between the reality principle and the pleasure principle; and (e) this tension results in the symbol becoming detached from its referent. (In Freud, this process results in dreams, paraphrases, and neuroses; in Piaget, in symbolic thought). For two versions of Piaget's stage theory of development that have these characteristics, see particularly 1923/1955 and 1945/1962; for

his comments on Freud and psychoanalysis, see particularly 1945/1962, pp. 182–212, and 1936/1952b, pp. 383–384.[8]

Piaget always emphasized that it was the dynamic process of emergence, and not the specifics of particular stages, that were most essential to his theory (1945/1962, p. 291; also see Gruber & Vonèche, 1977, p. xxvi). For example, a close reading of Piaget's 1945/1962) account of how symbolic thought develops during play reveals the ways that the tension between assimilation and accommodation at each stage propels the transition to the next stage (pp. 182–212). Thus, for Piaget, the transition to the next stage always involves a moment of emergence. Piaget (1971a) did not believe that these stages and their ordering were innate or preformed; although the ordering of the stages was the same in every individual, it could only be determined by documenting processes of emergence through time, and it could not be found in the genetic code of the individual. All that must be innate is a very general ability to coordinate the actions that are needed to jump-start the whole developmental process (Piaget, 1968/1970, pp. 61–68; see Gruber & Vonèche, 1977, p. xxxv).

There is a history of controversy about whether Piaget is an elementarist or a holist, and this relates directly to his status as an emergence theorist. Van der Veer (1996) and Kitchener (1985) both claimed that Piaget's structures were additive and thus not emergent, in contrast to gestalt structures, which were nonadditive. The schema is the product of past interactions, and therefore it is "a gestalt which has a history" (Piaget, 1936/1952b, p. 384). Thus, although his schemas are additive, they are always seen as evolving structures, and lower level structures are constrained by higher level emergent structures (see Gruber & Vonèche, 1977, p. xxxii). Kitchener (1985) concluded that Piaget rejected emergence, because the whole is reducible to the relations between the parts, and thus the composition is reversible (p. 291).

Yet, although the 1920s emergentists were antireductionists, nineteenth-century biological emergentism more generally was not incompatible with reductionism, because in a sense the emergent later forms are reductively explained in terms of the dynamical relations and processes of the earlier forms (see Wimsatt, 1997). Piaget referred to himself as a "relationist," and his discussion makes clear that this is a form of emergentism; Piaget is emergentist because he places his position between reductionist atomism and holism (e.g., see Piaget, 1967, p. 1228). Piaget (1968/1970) rejected the antireductionism of holists such as the gestaltists (pp. 8–9) and accepted that wholes or cognitive schemas are additively composed of elements and their relations; in his view, this process is a continual dynamic and occurs through time, such that a schema cannot be reduced to its elements at a given time but must be explained in terms of its origin from elements in the past. For this reason, schemas *as wholes* are analytically prior to their elements, in that they have causal downward effects over those elements (p. 7).

Vygotsky

Like Piaget, Vygotsky rejected behaviorist conceptions of learning and maturationist conceptions of development (1978, chapter 6). He identified three possible relations between learning and (maturationist) development. First, learning does not influence development; rather, the ability to learn from the world is determined by the developmental level of the child, and this level is determined by endogenous biological factors. Vygotsky placed Piaget's theory in this category (p. 80), but this misrepresented the emergentist nature of Piaget's theory; see the similar critique by Beilin (1971) and Piaget's response (1971a). Second, learning and development can be viewed as identical processes. Vygotsky placed behaviorism in this category. Third, learning and development can mutually influence each other. Vygotsky placed Koffka's gestaltism in this category; Koffka proposed that development is based on both the maturation of the nervous system and on experience of the external environment.

Vygotsky rejected all three of these positions to propose his theory of the *zone of proximal development*. Like Koffka, he agreed that learning and development are related. Learning must be "matched" with the child's developmental level (Vygotsky, 1978, p. 85). Vygotsky's innovation was to elaborate the notion of developmental level by defining it as a "zone": the difference between the child's "actual developmental level," as determined by independent problem solving, and the level of "potential development," as determined by problem solving under the guidance of someone more capable. These latter represent "functions that have not yet matured but are in the process of maturation" (p. 86). Thus, a child can only learn things that are appropriate to his developmental level.

Thus the relation between learning and development was that "learning awakens a variety of internal developmental processes" and that "the developmental process lags behind the learning process" (Vygotsky, 1978, p. 90). At its root, this perspective is not that different from Piaget's, because in both—contrary to Vygotsky's interpretation of Piaget—interaction with the external world drives development.[9]

Because Vygotsky's works were composed primarily between 1924 and 1934, it is not surprising that he was influenced by the same emergentist conceptions as Piaget. Like the gestaltists, Vygotsky rejected the reductionist atomism of both behaviorism and introspectionism (Vygotsky, 1965/1971, p. 18; also see Cole & Scribner, 1978, p. 5, and Wertsch, 1985, p. 4). Although he was heavily influenced by the gestaltists, Vygotsky agreed with Piaget that they did not explain the origins of complex mental phenomena. Whereas Piaget explained mental schemas by documenting their emergence from individual-environment interaction, Vygotsky drew on several strands of nineteenth-century sociological theory in proposing that irreducible psychological wholes origi-

nated in collective life; his belief in the social origins of higher psychological processes was influenced by both Marx and by the Durkheimian school of French sociology (see Cole & Scribner, 1978, p. 6).

EMERGENTISM AND CONNECTIONS BETWEEN CREATIVITY AND DEVELOPMENT

In the preceding two sections, I reviewed theories in creativity and development. I focused on the elements of twentieth-century theories that are emergentist, and I argued that these elements are central to the dominant theories of both creativity and development.

Based on this brief discussion, in the following sections I consider some additional connections between creativity and development that are revealed by the emergentist perspective. My purpose in these discussions is to show that a comparison of theories in these two areas has the potential to provide insights and new perspectives to researchers in both areas. I show that, in some cases, developmentalists and creativity researchers are grappling with similar issues and considering analogous hypotheses. At times they take similar paths, at other times different paths, to resolving these issues. I argue that theories in these fields face common issues because they are both theories of emergence.

Process Versus Product

Emergence requires a focus on process rather than on end product. A shift to process has been characteristic of recent work on both creativity and development. Socioculturalists such as Rogoff (1990) and Cole (1996) emphasized the focus on developmental process and on microgenetic studies, in contrast to prior developmental work that focused on end points of development. Creativity researchers such as Feldman, Getzels, and Csikszentmihalyi have been influential in shifting the focus from an emphasis on creative products to the creative process. Consequently, both fields have been faced with parallel sets of issues: What is the relationship between processes and products? How do products evolve and change during the process—for example, the gradual redrafting and editing that slowly accumulate into a finished book?

For example, my own studies of group improvisation (Sawyer, 2003) reveal a collaborative creative process that could not, even in theory, be analyzed as a creative product. To understand why, compare an improvisational performance to a scripted theater performance (cf. Sawyer, 2001a). A traditional scripted play is composed and prepared by a single creative individual, the playwright. The staging and dramaturgical preparation for a given performance are typically controlled by the director. The actors are thus controlled by two different

creative individuals: their words, stage entrances, and emotional expressions by the playwright; their stances, physical positions, and interpretation by the director. As a result of our literate tradition, many people consider a play to be represented by the script, a creative product that results from the creative process of the playwright. Many plays are studied in English literature departments, using similar techniques to those used for texts such as poems and novels; the performative and processual aspects of the play are thus neglected.

An improvisational performance is radically different, because the actors do not start with a text. There is no creative product that is being performed or executed. Instead, the creative process occurs on stage, between the actors, in front of the audience. The goal of this collective creative process is not to generate a creative product; there is no resulting product, as there is with the creative process of individuals such as painters, composers, and playwrights. Instead, the goal of the performance is the process itself; the process is the product. Consequently, studies of improvisational performance must be foundationally focused on its processual, emergent qualities.

Emergentist approaches to development are also processually focused. Perhaps more than any other contemporary developmentalists, the socioculturalists continue Piaget's emphasis on the processes of development, rather than focusing on a detailed structural description of the individual stages that represent static developmental states. Although many standard readings of Piaget emphasize his stages and their properties, his own writings emphasized the processual dynamics of assimilation and accommodation that led to the emergence of new schemas. It is this emphasis that led some Piagetian scholars to deny that Piaget is primarily a stage theorist (e.g., Gruber and Vonèche, 1977).

For those focused on developmental process, a promising research methodology is the *microgenetic method*, in which the child is closely observed as his or her psychological structures are changing, and frequent samples of children's mental states are obtained throughout the process. Most of the early developmental psychologists who were influenced by nineteenth-century evolutionary naturalism used some form of microgenetic method, including Werner, Piaget, and Vygotsky. Werner first used the term "microgenesis" to describe the extremely short processes of development that occur during the performance of a single task (Werner, 1940, p. 37; see also Flavell & Draguns, 1957). A microgenetic focus is a focus on process through time; such a focus is necessary to understand the dialectic between organism and environment that results in emergence. Piaget was engaged in a form of microgenetic research: his close analyses of his own children from day to day as they engaged in specific tasks. From Vygotsky's work onward, Soviet developmental psychology has emphasized microgenetic or "microstructural" methods (Zinchenko & Gordon, 1979; see Wertsch & Stone, 1978). Microgenetic studies of parent-child dyads have revealed evidence for Vygotsky's zone of proximal development, or what

Bruner (1983) called "scaffolding": At the beginning of the task situation, the parent and child interact to jointly solve the task, and toward the end, the child gradually takes over more of the responsibility for the task.

One consistent finding of microgenetic studies of cognitive development is that children do not ordinarily substitute a more advanced strategy for a simpler one (Kuhn, 1995). Older strategies continue to be used even after they are clearly seen to be less effective. A second consistent finding is that children generally think about a problem in many ways at once. This cognitive variability is most evident during a period of rapid change (Alibali & Goldin-Meadow, 1993). The implications of such findings for creativity theory are that the different stages of the creative process are probably not completely distinct. As even most stage theorists acknowledge, the stages are somewhat artificial constructs, and there is likely to be overlap among them. However, creativity theorists have not done much detailed empirical work to study the exact nature of these overlaps, or the exact microgenesis of the steps that lead from one stage to another, with as much detail as these developmental studies of cognitive change. Part of the problem is that the creative process is hard to re-create in the laboratory and typically occurs on a longer timescale than the cognitive transitions studied by developmentalists.

Timescales

Development has been conceived of as occurring on many different timescales. The shortest timescale is change during a single task: Werner and his colleagues studied transitions that took less than a second (e.g., Werner, 1940). The longest timescale is the cultural-historical; this approach includes nineteenth-century theories of social development such as those of Comte, Spencer, and Tylor, as well as the more practice-based theories of Vygotsky and Soviet psychology (see Wertsch and Stone, 1978). Of course, perhaps the longest timescale is that of biological evolution, the nineteenth-century developmental theory that first gave rise to emergentist thinking. Most developmental research takes place in an in-between territory—the study of ontogenesis, or the development of the single organism across successive tasks and many types of psychological events (cf. Rogoff, 1998).

Creativity research is also characterized by a range of timescales. Csikszentmihalyi and Sawyer (1995) proposed that big *C* Creativity required a long time span, and little *c* creativity could occur within a shorter time span. In their account, a more revolutionary insight required a longer period of preparation and incubation, both because more elements of information had to be gathered during preparation, and because more combinations would have to be attempted by the preconscious before the insight would emerge. In contrast, the small insights of everyday creativity require fewer internalized elements and a shorter period of trial and error before an appropriate combination emerges.

Some psychologists have explicitly compared the stages of creativity to the stages of problem solving, a form of microgenetic study (Flavell & Draguns, 1957, p. 201; Guilford, 1967). Artificial intelligence models of creativity largely assume that creativity is a form of problem solving (e.g., Boden, 1991); consequently, these models draw on general theories of the microgenesis of problem solving. Klahr (2000) was the latest in a long artificial-intelligence tradition of considering scientific discovery to be a special case of everyday problem solving. His main influences included Herbert Simon and Allen Newell, two developers of one of the first artificial intelligence (AI) systems, the General Problem Solver (Newell & Simon, 1972; also see Klahr & Simon, 1999). In Klahr's (2000) view, both scientific discovery and general problem solving are forms of "constrained search in problem spaces" (p. 201). In response, many creativity researchers have argued that creativity involves both problem solving and *problem finding* and have argued that artificial intelligence models are inadequate for modeling the latter (Csikszentmihalyi, 1988a). Unfortunately, creativity theorists have not yet developed theories of problem finding that would be suitable for computational modeling.

Long-timescale cultural-historical changes have been studied for many years by historians of art and science. Some creativity researchers have begun to apply the quantitative methods of historiometrics (e.g., Martindale, 1990; Simonton, 1988). Evolutionary models have been influential in creativity research at least since Donald Campbell's seminal 1960 article that proposed variation-selection-reproduction as a model of creativity. Campbell also argued that the same three-stage model could be used to describe learning; he held to a trial-and-error learning theory (p. 382). Siegler's recent developmental theory (1996) was based on this three-stage evolutionary metaphor, although Siegler rejected Campbell's hypothesis that variation is blind, instead proposing that it is directed through various mechanisms (pp. 24–25). And of course, Campbell was an early precursor of the amorphous field of memetics, which has explored cultural variation and retention using evolutionary models (e.g., Csikszentmihalyi, 1993; Dennett, 1995).

Thus both creativity and development can be studied on multiple timescales. Rather than arguing that one or another timescale is the proper one for study, in both fields we need a combination of research projects. To get a complete picture of development, developmentalists realize that they need to understand the second-to-second changes of microgenesis, the life-span changes of ontogenesis, and the cultural-historical changes that result in different contexts and end points of development. Different methodologies are required for each form of study; microgenesis can be studied experimentally, ontogenesis requires longi-

tudinal or cross-sectional methods, and cultural-historical study requires both historical study and the comparative methods of ethnography.

Likewise, a complete picture of creativity will require analysis at multiple timescales. Many creativity researchers have taken a life-span developmental approach (e.g. Simonton, 1988; Gardner, 1993). Other researchers (e.g., Csikszentmihalyi, 1996) have focused on the day-to-day work processes of creative individuals, a mid-range approach. The microgenesis of the creative process has been neglected (although see Getzels & Csikszentmihalyi, 1976). Those researchers who created experimental tasks to measure divergent thinking ability also focused on a short timescale of analysis, but one that was not microgenetic, because it measured only the number of ideas accumulated by the end of the task, and it only analyzed a single stage of the creative process. Thus, one area of promising future study would be microgenetic analysis of the creative process.

Creativity and the Life Span

Most theories of the creative process examine the process that leads to a single creative product, and in most creativity theories, this process is hypothesized to have two broad stages. In the first, new ideas are generated, and in the second, the good ideas are selected from those generated in the first stage. These two stages correspond to Campbell's (1960) blind variation and selective retention, to Guilford's divergent and convergent thinking (Guilford, 1967), and to Freudian theories of primary process and secondary process thinking (Kris, 1952).

Stage models of development are generally more complex; there are more stages, and each stage may have substages (as in Piaget's theory). For example, Klahr's model (2000) is an elaborate hierarchical stage model, with the three main stages—search hypotheses, test hypotheses, and evaluate evidence—each broken down into substages, and some of those substages further separated into sub-substages (p. 37). Creativity theory could benefit from a close consideration of the life-span and stage theories of developmentalists. For example, they could learn to think about creativity as a longer term process, one in which individual creative products are only small pieces of the whole story rather than the point of the story, as Gruber (1988) argued in proposing his "networks of enterprise" model. For example, developmentalists have focused on how small incremental changes gradually accumulate to result in a major stage transition, the prototype being Piaget's close case studies of his children.

The idea that the generation of a product involves two stages, with ideation preceding convergent thought, overly simplifies the complexity and hard work of most creativity; in most cases, creators experience small insights throughout

a day's work, with each small insight followed by a period of conscious elaboration. These only gradually accumulate to result in a finished work, as a result of a process of hard work and intellectual labor of the creator. Many influential studies have demonstrated the complexity of creativity by focusing on what could be called the ontogenesis of the creative product—biographical studies of the day-to-day development of creative products over months and years. The seminal study of this type is Gruber's (1974) close reading of Darwin's journals. Creativity researchers are still fleshing out theories about these long-term processes: how long creative periods are sustained and how one multiyear period is succeeded by a shift to another research question or another style of visual representation (cf. Csikszentmihalyi & Nakamura, this volume; Gruber, 1988).

For example, Howard Gardner and others observed a "10-year rule": There seem to be 10-year gaps between major significant works. Gardner (1993) interpreted this as evidence that it takes 10 years to internalize the domain. Elliott Jacques (1965), in the famous paper that coined the term *midlife crisis*, identified two distinct types of creativity associated with early adulthood and later life (and separated by the midlife crisis at approximately age 35). The early creativity is "hot-from-the-fire," "intense and spontaneous, and comes out ready-made" (p. 503). In contrast, creativity in later adulthood is a "sculpted creativity." There is a longer period between the first inspiration and the final creative product; the inspiration comes more slowly, rather than in a sudden burst; and the creator spends much more time "forming and fashioning" the product, in a process of sculpting that results in "externally emergent creation" (p. 503).

The study of life-span creativity would be a form of emergentist study, but with emergence processes occurring over the longer timescale of an entire career, rather than over the timescale of a single creative task or product.

The Unconscious in Development and Creativity

Many schools of twentieth-century art were based on the idea that art involves the revelation of unconscious material, including expressionism, dadaism, and surrealism. Both Freud and Piaget considered the role of the unconscious in both creativity and development. Freud's definitions of *primary process* and *secondary process* thinking were developed to describe developmental processes; however, these concepts have often been applied to creativity. According to Freud, the creative insight emerges into consciousness from primary process or subconscious processes. Freud drew continuities between creativity and daydreams, fantasy, and full-fledged neuroses (1907/1989). This led many subsequent theorists to connect creativity with other manifestations of primary process thought, such as dreams and children's play.

Piaget's (1945/1962) book about these connections was one of the most ambitious. He argued that symbolic thought as manifest in children's play is not qualitatively different from the unconscious symbolic thought discussed by Freud, that "children's dreams seem to be closely related to symbolic play" (p. 182), and that adult dreams are, as well (p. 209). Therefore, regarding children, he disagreed with Freud's claim that symbolic play was discontinuous with unconscious thought; rather, Piaget argued that the symbolism associated with Freud's unconscious was outwardly manifested in symbolic play, and that often, it could be demonstrated that children were consciously aware of what they were doing. Piaget also noted that Freud's theory of symbolism was dependent on classic associationism and thus that Freud denied that symbolic thought is a constructive activity (p. 189).[10]

Freudian-influenced psychoanalytic thinkers have continued to apply these Freudian developmental concepts to the creative process. Many influential thinkers have argued that creativity involves both primary processes and secondary processes. The first theorist to move in this direction was Ernst Kris (1952), who argued that the creator was an individual who could manage some degree of conscious ego control over his own primary process thought, using it in service of his work. In this sense, creativity is a product of the preconscious rather than the unconscious: "A part of the work is done in preconscious elaboration, the result of which comes into consciousness in sudden advances," and the insight is "observation impregnated with previous preconscious experiences" (p. 296).

Whereas Freud's emphasis on the connection between creativity and primary process led to a hypothesized link between creativity and madness, Kris's ideas imply that the creative individual requires a rather sophisticated balance between primary and secondary process thinking that would be hard to maintain in the presence of mental illness. Rothenberg (1979) denied that creative people are more likely to be mentally ill than anyone else; he claimed that the creative process is "an advanced type of secondary process" rather than primary process (p. 42) and that it is "not only *not* primitive but [is] consistently more advanced and adaptive than ordinary waking thought" (p. 43). He rejected the idea that there is unconscious incubation that results in a surprise of insight (p. 130).

Although psychoanalysis has not played a significant role in the post-1980s resurgence of creativity research, the phenomenon to be explained remains the same as that first identified by Freud: the relation between the preconscious and the conscious. The preconscious is different from the unconscious in that it can easily become conscious, given the proper conditions. In contrast, the unconscious cannot become conscious without considerable effort. These relationships are central to several influential contemporary theories, even those that are not explicitly psychoanalytic (e.g., Martindale, 1990; Simonton, 1988).

Stage Transitions and Novelty

The processes that lead to the emergence of the next stage are the central unresolved questions in both creativity research and developmental psychology. In developmental stage theories such as those of Freud and Piaget, the child is propelled to the next stage by a disturbance in the equilibrium of the prior stage. For Piaget, disequilibrium was caused when the dominant schemas of a stage could no longer successfully assimilate external experiences. Piaget's empirical work documented the microgenesis of the emergence of the next stage from the logical necessity of the clash between the current schema and environmental interaction. Piaget also documented the process of development within a stage—which was typically a transition from a more concrete to a more abstract set of schemas.

Some developmentalists have proposed that there is something like an incubation period between developmental stages, because it takes time for individuals "to appropriate the complex knowledge that they co-construct during social interaction" (Azmitia, 1998, p. 240). Complex ideas must ferment or percolate in our unconscious until they fully develop and begin to influence cognitive performance. These ideas are reinforced by experimental studies that have documented extended periods of stage transition during which multiple schemas and strategies are active (Siegler, 1996). In Siegler's evolutionary model, development is a process of age-related changes in the repertoire of cognitive strategies and in the preference for and ability to use different cognitive strategies. Siegler's *overlapping waves approach* proposed that the child has multiple strategies available at any one time, and that these strategies compete; over time, the more effective strategies are increasingly used, in a process of selection that Siegler (1998) explicitly compared to biological evolution (p. 92). With time, the more successful strategies thrive and become more frequent, and the less successful strategies fade away. Siegler also hypothesized that children can create or discover new strategies, but he admitted that his theory is weakest in explaining the emergence of novelty, our concern here (p. 96).

Note the similarities between Siegler's (1998) non-stage version of development and the criticisms of stage theories of creativity (pp. 28–29). For example, Guilford (1967, p. 329) made a point similar to that of Siegler; he accepted that there are different aspects to the creative process—his five operations correspond closely to the four-stage model—he argued, however, that all operations are present simultaneously, but with various operations coming to dominate as the creative process proceeds.

Late in his life, Piaget noted that the most serious unresolved problem was the issue of novelty—how a child makes the transition to the next stage. Like Piaget, many other developmentalists have argued that we have very little knowledge of what happens during stage transitions. Beginning in the 1970s and in-

spired by the growth of cognitive psychology, advocates of cognitive models of development claimed that they could provide new conceptual tools with which to understand the transition mechanisms of development (e.g., Case, 1985; Simon & Halford, 1995). Many of these scholars argued that Piagetian theory was largely focused on structures and thus neglected the processes of development (e.g., Case, 1985, p. 410; Klahr, 1982, p. 80), although a more recent line of Piagetian scholarship has argued that these are mischaracterizations of Piaget. As I demonstrated above, Piaget was at root a theorist of developmental process. Case's (1985) information-processing model was neo-Piagetian in that it retained four universal stages, although it tended to shift Piaget's theory away from an emergence theory and toward a maturational theory; Case argued that stage transitions were dependent on biologically determined increases in working memory capacity.

Creativity researchers might benefit from developmental studies of how a stage emerges from a prior developmental stage. Piaget's close empirical studies documented, in great incremental detail, how a cognitive schema emerged from an interaction between a prior cognitive schema and physical objects. Creativity researchers could learn from the complex and varied theories proposed by developmentalists for how the transformation from one stage to another occurs; for the most part, creativity theorists don't have very sophisticated theories of these stage transitions. For example, they don't have very good theories about why or when a transition from divergent to convergent thinking takes place.

Cognitivists hypothesize that children increasingly *encode* features of the environment, helping them to perceive the critical features of a situation more rapidly and to determine what is relevant to a problem or task. Encoding has obvious parallels with the creative process, because it involves discrimination, differentiation, identification of critical features, and the formation of mental models (Siegler, 1998, p. 323). In creativity terms, encoding is the process whereby mental elements are formed. An adequate developmental theory of the process of encoding will of necessity be a theory of creativity, because the emergence of a new encoding is a creative process.

Creativity theories are weak in the explicit theorization of mental elements and how they combine into higher level configurations. Researchers could draw on cognitivist theories of cognitive structure, semantic networks, and mental associations to provide more rigor to such theories.

Domain Specificity

In the 1970s, 1980s, and 1990s, developmentalists increasingly found evidence that children seem to progress through Piagetian stages at different rates in different realms of cognitive competence (Callanan, 1999, p. 150). Piaget's theory

was foundationally based on the claims that the stages are general properties of the child's cognition and that when a child transitions to the next stage, the mental schemas of that stage will be manifest in all activities of the child, regardless of the topic, sensory modality, or social context. Feldman (1974, 1980) coined the term "domain" to describe a culturally-derived symbolic system associated with a given realm of creative activity.

This critique of Piaget was a claim for the *domain specificity* of cognitive development. This claim was readily accepted by creativity researchers, because of the failure of trait psychology and factor analysis studies of the creative personality in the 1960s. In the 1960s, personality studies of creativity resulted in the development of several tests to measure a "creativity quotient," or the several factors that were hypothesized to contribute to creativity. However, this research was generally considered to have failed because it was unable to predict actual creative performance in specific domains of creative endeavor.

Beginning in the 1970s, many researchers began to argue that creativity was domain-specific (Feldman, 1974, 1980; John-Steiner, 1985; Csikszentmihalyi, 1988b). In the first argument for this position, Feldman (1974) explicitly opposed this notion to the trait conception of creativity. Feldman's (1986) work on prodigies showed that the prodigial ability is domain-specific. John-Steiner's (1985) studies of creativity showed that creativity requires fluency in the language, symbols, and tools of a domain. Domain-specific conceptions of creativity attained their widest dissemination in Gardner's (1983) influential theory of *multiple intelligences*, which he has applied both as a general theory of development and to creative individuals (see Feldman, this volume).

Why are individuals creative in only one domain? Most theorists believe this is because a large number of mental elements must be internalized before the individual is capable of generating a novel creative combination. Most domains of creative activity have a long history of prior activity—for example, the periods of twentieth-century painting, or the history of empirical research in particle physics. Without first internalizing this domain, an individual does not have the raw material with which to create novel combinations. Similar ideas have long been influential in the history and philosophy of science. Fleck (1935/1979) wrote of how the "thought style" of a scientific discipline "constrains the individual by determining 'what can be thought in no other way'" (p. 99). He also noted that if two people belong to different "thought collectives," they cannot have the exactly same thought (p. 100). A variant of Fleck's ideas, Kuhn's *paradigm* (1960), became influential in the 1960s and 1970s and no doubt indirectly contributed to theories of creative domains.

A concern with the physical and symbolic tools that are used by individuals is found in both fields. Wertsch (1998) drew on Vygotsky in analyzing "mediated action" in development; John-Steiner (1985), also drawing inspiration from Vygotsky, studied how "languages" affect the creative process. Regarding

domain specificity, creativity theory might be able to inform developmental theory, because creativity theorists have spent a great deal of effort identifying the language of a domain of creative activity, how that language is internalized by creative individuals, and how they can generate novel combinations in that language. The issue of exactly what domains exist in the child, and how development proceeds in these distinct domains, remains unresolved in developmental psychology.

Internalization of the Domain

The existence of creative domains—complex symbol systems representing the attainments of past creative individuals—forces us to confront issues of internalization, appropriation, and mastery. Vygotsky argued that development involved a process of internalization (Lawrence & Valsiner, 1993). Some sociocultural psychologists have rejected the term *internalization*, arguing that it implies a passive child absorbing information from the environment without transformation or creative construction. Socioculturalists, like constructivists, insist on a transformation view of development rather than a transmission view. From a constructivist perspective, the child does not internalize information passively, but rather constructs information endogenously as a by-product of interaction with the environment.

For example, Wertsch (1993) argued that better terms for internalization would be appropriation or mastery. Rogoff (1998) argued that there is no sense at all in which the child can be said to internalize, appropriate, or master anything; such concepts imply a boundary between the child and the social environment. In contrast, Rogoff argued that the child and the social world are inextricably linked, such that it doesn't make sense to speak of information or knowledge crossing over a boundary from the environment to the child, as implied by the term *internalization* (Sawyer, 2002c).

Although all creativity theorists agree that an important part of the creative process is the internalization of the language and symbols of the domain that occurs in the preparation stage, they do not claim that this is sufficient for creativity; it is only a prerequisite. Creativity results when the individual somehow combines these internalized elements and generates some new configuration. Thus creativity theory provides a subtly different perspective on internalization. Creativity researchers accept that much knowledge is internalized in a rather passive and direct way; the student of physics must learn Maxwell's equations and Einstein's theories as they already are, and this process does not have to be creative. Nonetheless, once the existing elements of the domain are internalized, novel combinations can be formed. Thus, creativity theory retains a conception of internalization that is compatible with creative construction and novelty.

By analogy, the child could be said to internalize many elements and components of knowledge in some domain, and this internalization could be compatible with a transformative, constructivist view of development. After internalization, the child has to go through some sort of integrative or transformative process in which those elements or components are placed into a structure or framework of knowledge. This is similar to the information-processing theory that the child encodes and "automatizes" knowledge into increasingly complex combinations.

Some socioculturalists claim that there is no role for internalization in development, and that constructive appropriation is always taking place. This observation can be applied to the creative process as well. Creative people rarely simply internalize; they often transform and appropriate, even as they are gathering new knowledge. An artist walking through a gallery views paintings very selectively, looking for ideas or inspirations that can solve creative problems with which he or she is currently working. This can lead the artist to see something in a painting that its creator may not have intended or been aware of. For a scientist reading a historical work by a long-dead theorist, it is a commonplace to read into the work those perspectives or issues with which the reader is currently working. In neither case does the creative individual first simply internalize the work and then transform it; the transformation is a part of the original perception.

Piaget's notion of the schema is a proposal that the child executes a process similar to that of the scientist; the schema causes a child to perceive the world in certain ways, whether or not it is accurate, as in the famous fluid conservation experiments. The analogy to creativity theory is with the internalized creative domain, or paradigm; the domain functions like a working schema that guides how the creator perceives new works by other artists or scientists (cf. Carey, 1986). Piaget has been criticized for considering the child to be a "little scientist" (Kuhn, 1989); yet even the cognitive scientist David Klahr, who is critical of Piaget, developed computational models that he then applied to both developmental processes and scientific discovery (Klahr, 2000).

In sum, the common issues in creativity and development are the relations between a cognitive schema and the new knowledge that is apprehended from the world. How is the perception of the new knowledge influenced by the current schema? How can the schema be changed by the new knowledge? The construction of a new schema roughly corresponds to a Kuhnian scientific revolution, when the old paradigm is completely replaced by a new domain, a new language, or a new way of thinking. Having a transformative creative insight is like advancing to a new developmental stage. In contrast, normal science corresponds to development within a stage. After having an insight, the creative individual might spend years executing or implementing that insight, and this corresponds to a child's cognitive processing during the period in a single developmental stage.

The Social and the Individual

The role of social interaction first entered creativity research in the early 1960s, with the influential publications of Osborn and Gordon. Osborn (1953) coined the term *brainstorming* and emphasized the importance of group interaction in developing ideas. Gordon's *synectics* (1961) was based on the claim that group thinking is always superior to individual thinking. Although influential, these claims were not based on empirical evidence; many attempts to compare individual performance to group performance find that individuals generate more ideas, more original ideas, and better ideas than groups do (e.g., Larey & Paulus, 1999; Taylor, Berry, & Block, 1958).

Sociological studies of scientific discovery have long downplayed psychological factors, preferring to identify the social properties associated with creations, for example, by studying the incidence of multiple invention and the sociological processes whereby novel ideas or theories are accepted or rejected by a discipline. This approach came to prominence in the 1960s, when Kuhn's 1960 book led to a burst of activity in the history of ideas. Sociologists argue that discovery can be analyzed as a sociological-historical process. One empirical path toward demonstrating this has been the studies of *multiple discovery*, which sociologists argue are evidence that the insight should be attributed to collective properties of the scientific discipline rather than to psychological processes in any individual scientist (but see Simonton, 1988).

Such sociological theories often propose that scientific disciplines develop in stages. For example, Nicholas Mullins (1983) proposed a four-stage model of the growth of a scientific specialization. In the first stage, the founding figures produce their innovations but remain on the fringe of the dominant paradigm. There is only an informal group around the leading figure(s). In the second stage, layers of networks begin to connect numbers of people. In the third stage, other centers are colonized and distinct clusters begin to form. A focus on jobs, publications, and meetings becomes important; secondary works explaining the paradigm begin to appear. Structurally, the group divides into a core of less than 25 people, and a periphery. In the fourth and final stage, the specialty paradigm has attained maturity. The founding figure may move on, but organizational structures are in place; new research using the ideas develops outside the primary clusters (an index that the work has become routine), and textbooks appear. According to Mullins, this process takes between 8 and 25 years (pp. 320–321).

In the 1980s, developmental researchers known as socioculturalists began to examine how groups develop through time. Some ethnographers (for example, Kevin Dunbar and Ed Hutchins) began to examine how groups create novelty by studying workgroups. Rather than focusing on specific individuals in the group, they treated the group itself as an entity that develops through time, in

successive stages, and as a result of interaction with its environment. More in keeping with Vygotsky than with Piaget, socioculturalists such as Rogoff proposed a social version of constructivism, arguing that knowledge is emergent from a social process. This was continuous with the Piagetian tradition of constructivism, because it emphasized "the active role of children and of their social partners" (Rogoff, 1990, p. 197). But Rogoff made the stronger sociological claim that children not only create their own knowledge but also "are active in creating culture" as well (p. 198).

Rogoff (1990) briefly discussed adult creativity within the sociocultural framework. First, the creative process "builds on the technologies already available, within existing institutions. A creative idea is in some sense a reformulation of existing ideas" (p. 198). This, of course, is the familiar *domain* from contemporary creativity theory: the collection of symbols, symbol systems, and artifacts that must be internalized as the raw material of the creative process. Second, Rogoff noted that creativity always occurs within a social context of apprentices, colleagues, coworkers, and evaluators.

In the late 1980s, in parallel with this sociocultural movement in developmental psychology, creativity researchers began to emphasize the need to move beyond a psychological study of the individual creator. Among creativity researchers, this recent development is often attributed to an article published by Mike Csikszentmihalyi in 1988, in which he proposed the "systems view" of creativity. The creative system is a social system that includes three elements: the *individual*, the social institution or *field*, and the cultural symbol system or *domain* (p. 325). This tripartite model was also used by Howard Gardner in a chapter in the same 1988 volume, and he has drawn on it heavily in several books about creativity (e.g., Gardner, 1993). Rogoff's first book appeared in 1990, soon after the 1988 statements of the systems model by Csikszentmihalyi and Gardner.

There are close connections between socioculturalism and contemporary creativity theory; it is interesting that the shift from an individual to a social perspective occurred almost simultaneously in both developmental psychology and in creativity theory. The full story of this shift is a task for the history of ideas and is beyond the scope of this chapter. However, both Csikszentmihalyi and Gardner developed their socially oriented theories of creativity while in interdisciplinary institutional settings that placed them in close contact with both cultural anthropologists and developmental psychologists; Csikszentmihalyi was in the Committee on Human Development at the University of Chicago, where the cultural psychologist Richard Shweder was based, and Gardner was based in the Harvard Graduate School of Education's Department of Human Development, with the cultural anthropologist Robert Levine. Shweder and Levine were both closely associated with the socioculturalists during this time.

Thus, at about the same time, both developmental psychology and creativity research shifted from a purely individualistic level of analysis to increasingly incorporate a social level of analysis. Many creativity researchers now focus on how individual and social factors combine during the creative process (cf. John-Steiner, 1993, p. 103). This requires the researcher to decide on an appropriate level of analysis for the phenomenon. If both individual and social levels are involved, what is the nature of the relationships and causal connections between these levels? Are there similar developmental processes at both levels of analysis? In fact, these are long-standing issues in sociological theory. Particularly in the last two decades, theorists of the *micro-macro link* have attempted to reconcile the reductionism of methodological individualism and various antireductionisms such as sociological realism and sociological holism (Sawyer, 2001b).[11]

The failure to explicitly address these sociological considerations has led to lacunae in socially-oriented creativity theories: The exact nature of the individual-social relationship is not fully elaborated, and the ontological status of the social is not directly addressed (Sawyer, 2001b, 2002a). These issues are widely debated among socioculturalists but remain unresolved. Fleck (1935/1979) said that a thought style "constrains the individual by determining 'what can be thought in no other way'" (p. 99), using Durkheimian language regarding social facts; but psychologists who study creativity are, perhaps by style and nature, averse to formulations that explicitly state that the individual is constrained by social forces.

Throughout the history of sociology, and in several influential contemporary theories, the micro-macro link has been conceived of as a relation of emergence. Social properties are thought to emerge from the collective actions and interactions of the component individuals of the system (Sawyer, 2001b). In many of these theories of emergence, the social properties are thought to then take on some causal powers, such that individuals can be causally influenced by social properties, even though those social properties emerged from the actions of those same individuals. Such theories can provide a useful framework within which to conceptualize socially oriented theories of creativity.

CONCLUSION

The above review of emergentist elements in both creativity and developmental theory shows that studies of creativity could provide insights into developmental processes; likewise, developmental psychology could provide a valuable set of data and techniques for creativity researchers. Yet, in spite of these similarities, the fields are different in some fundamental ways.

Modern creativity research began as a branch of personality psychology, with Guilford's 1950 presidential address to the American Psychological Association (APA). This talk emphasized a factorial model of personality traits and focused on scientific and technological creativity. Guilford's comments seemed remarkably prescient when the Soviets beat the Americans into orbit with the launch of Sputnik in October 1957. The U.S. response was a mobilization in the schools to attempt to identify and nurture scientific talent and creativity. During the 1960s, a wide variety of metrics and tests were developed by creativity psychologists. These tests were meant to be applied to children in school contexts to determine who had the most creative potential, particularly in science and math. In the 1970s, in response to perceived weaknesses with the personality approach, psychologists increasingly began to examine creative processes.

The study of developmental processes has an older history, with its roots in the late nineteenth-century psychology of G. Stanley Hall and James Mark Baldwin. Developmental psychology continued with Piaget in Switzerland, Vygotsky in the Soviet Union, and Dewey in the United States. Developmental psychology grew rapidly after World War II and is now one of the largest nonmedical research sciences. For example, the major conference for developmentalists, the biannual Society for Research in Child Development (SRCD), typically draws well over 5,000 scholars, whereas there are so few creativity researchers that they have no annual conference.

Thus there is an obvious asymmetry between these two fields. Developmental psychology is a large field with a lot of resources, grant money, and institutional structures of support, whereas creativity research has never quite established itself as a research field in its own right. Creativity research does not yet have a textbook, indicating that it has not yet become a mature specialty paradigm (Mullins, 1983). Job ads often specify their search for developmental psychologists, but I have never seen a job ad for a creativity researcher. Creativity researchers in psychology tend to study creativity as a secondary endeavor, making their livings by studying some other topic.

As a result of this asymmetry, it is perhaps unavoidable that when creativity researchers and developmentalists talk shop, the developmentalists will have more to say—more experiments to report on, more theories to discuss, and more articulated theories. Yet developmentalists can also benefit from the unique focus of creativity researchers. The greatest potential benefit to developmentalists lies in conceptions of the developmental process—in the unresolved questions of how novelty occurs in development and how children make the constructive and creative transition to the next conceptual stage.

Piaget intended his genetic epistemology to apply to both ontogenetic development and to scientific development, and I have drawn several parallels between creative and developmental processes. These parallels have been debated before. In an afterword to Feldman's 1980 book, Gruber took issue with similar parallels drawn by Feldman (1974, 1980) that Feldman had partially attributed to Gruber's 1974 study of Darwin. Instead of claiming credit for the idea that

creativity and development were similar processes, Gruber argued that there were many differences between creative insight and developmental stage transitions (Gruber, 1980). In response to Feldman's claim that Piaget's disequilibration model applies to both ordinary development and to creativity, Gruber countered by arguing that creativity is "purposeful work," whereas ordinary development is not (p. 177). Creative work does not result from a single step, but from "the concatenation and articulation of a complex set of interrelated moves" (p. 178). In this context, it is relevant to note that Gruber was generally opposed to creativity theories that focus on a single important moment of insight (Gruber, 1981).

Gruber (1980) argued that the creative process is guided by the creative person's sense of purpose. Piaget's disequilibrium model cannot account for this sort of directionality, because for Piaget, development proceeds without the influence of intentions toward remote goals (p. 178). The transition to the next stage is thus an unintended effect of the child doing something for another reason entirely (p. 179).

In his response, Feldman (1980) agreed that creativity and development are not identical; in fact, he proposed a "universal to unique" continuum to account for these differences. In response to Gruber's insistence that the creative process is directed, Feldman noted that creative individuals aren't always aware of their goals, and that much creative work proceeds without a final end product in sight.

The lesson of this debate is that the parallels between the processes of creativity and development are not simple and direct. There are many parallels, but these must be closely examined to ascertain that they are more than surface similarities, and to determine what, if any, substantive implications they have for research in either field. This book is a continuation of the debate between these two important scholars. And, like that debate, it is a continuation of themes and issues that were first addressed in the nineteenth century.

NOTES

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1. Creativity was a familiar topic in the Geneva school of Piaget's era. Two of Piaget's predecessors in Geneva, Claparède and Flournoy, collaborated on one of the first studies of creativity, published in 1902 and 1904 (see Hadamard, 1945, pp. 8, 137). De Saussure was also concerned with these issues (see Hadamard, 1945, pp. 128, 131).

2. Morss (1990) has documented the influence of these and other non-Darwinian evolutionary concepts on the key founders of developmental psychology, including Hall, Baldwin, Freud, Piaget, and Werner.

3. Beilin (1971) argued that Piaget's emergentism was essentially a maturationist and preformationist position, because the organism goes through the same stages regardless of the external environment. He noted that a purely environmentalist position would allow for a wide range of developmental paths, varying with the environment, and would also allow *reversibility* (rejected by Piaget) if the environment changed in a certain way. In his response, Piaget (1971a) accepted that there were elements of maturationism in his position. However, he insisted that he was not preformationist because the stages emerged during development and were not present in the organism at birth.

4. For other nineteenth-century precedents, see Campbell, 1960, pp. 385–387.

5. Wallas first applied the term *fringe consciousness* to creativity (1926, pp. 95–96); the term *fringe* is taken from William James (1890, Vol. 1, pp. 258–264; see Hadamard, 1945, p. 25).

6. Although all Piaget scholars have noted the relation to Kant, none of them have noted the connection to Durkheim's epistemology. This may be because Piaget himself only occasionally noted the influence of Durkheim (although see Piaget, 1952a, pp. 240–242; 1995, pp. 39–40). Durkheim (1912/1915) was the first to argue that Kantian a priori categories were constructed contingently in the individual (see Rawls, 1996); in his case, the categories derived from emergent social forms, whereas in Piaget's case, the categories emerged from organism-environment interaction.

7. See Morss, 1990, and Litowitz, 1999. For purposes of my argument, it is not necessary to determine the exact lineage of influence, because I have claimed that such ideas were widespread and deeply ingrained in nineteenth-century thought. There are competing hypotheses; this shared influence could derive from Darwin or Spencer (or, in the case of Piaget, Baldwin, who was influenced by Spencer). Freud's debt to Darwin has been documented by Kitcher (1992) and Ritvo (1990). Others have criticized the idea that Darwin was a significant influence on Piaget, instead attributing the biological influences to other nineteenth-century evolutionary theorists such as Spencer (Ghiselin, 1986).

8. Note however that Piaget clarified that his stages were described in terms of overall structures, whereas Freud's were in terms of dominant characteristics, such that all of the characteristics exist at all stages (Piaget, 1971b, p. 2).

9. For an exploration of Vygotsky's writings on creativity, see Moran and John-Steiner, this volume.

10. Rothenberg's (1979) psychoanalytic theory of "homospatial thinking" also seems influenced by associationism; see p. 27.

11. Socioculturalists often attribute micro-macro thinking to the Soviet Marxian psychologist Lev Vygotsky. However, Vygotsky represents only one figure in a long sociological tradition of thinking about micro-macro relations; in this broader view, his theories are not qualitatively different from those of Marx. Vygotsky has not played any role in contemporary sociological theory, although Marx remains indirectly relevant, through the practice theories of Giddens and Bourdieu.

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CHAPTER TWO

Creativity in the Making

Vygotsky's Contemporary Contribution to the Dialectic of Development and Creativity

Seana Moran and Vera John-Steiner

In representing creativity as a social as well as an individual process, L. S. Vygotsky introduced some of the most critical new notions that characterize current systems approaches. Although his contributions are best known in developmental psychology and education, his ideas regarding the growth of creative imagination, the changing impacts of creative activities on individuals over their life spans, and how creativity works in expanding individual and cultural meaning are timely to creativity studies.

Vygotsky died of tuberculosis at age 38, leaving many of his manuscripts unpublished. In addition, his writings were suppressed for more than 20 years in the Soviet Union under Stalin and were further neglected in the West as a consequence of the Cold War. But once his work became more broadly available with the publication of *Thought and Language* (1934/1962), it was acknowledged as an important contribution to the cognitive revolution.

Vygotsky's career was framed by work on creativity, starting with his study of the aesthetic reaction in literary works, *The Psychology of Art* (1965/1971), which was accepted as his dissertation in 1925 but was not published during his lifetime. In this early work, he first formulated his important principle that creative work is profoundly social: "Art is the social within us, and even if its action is performed by a single individual it does not mean that its essence is indi-