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## Where Have We Been, Where Are We Going? Taking Stock in Creativity Research

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*ABSTRACT: The dedicated work of numerous scholars has, over the last 10 years, led to some radical advances in our understanding of the nature and implications of creativity. This work has been summarized in 2 recent handbooks—Mark Runco's Creativity Research Handbook and Robert Sternberg's Handbook of Creativity. In this article I use these handbooks as a starting point to take stock in both what has been accomplished and what still needs to be done in our attempts to understand creativity. I begin by noting that both handbooks clearly describe the major approaches being used in studies of creativity and the findings resulting from each approach. A careful review of the chapters presented in these handbooks, however, brings to the fore a number of issues. For example, we need critical comparative tests contrasting the merits of different methods and theories, elaboration and extension of our traditional samples and our traditional measures, and more attempts to develop integrative models. However, some topics, such as the demands of practical innovation, cross-field differences in the nature of creative thought, and the effects of creativity on people and social systems need more thorough treatment. By laying a foundation for cumulative research along those lines, publication of these handbooks represents an important step toward development of a coherent, scientific model of the creative act.*

“We take our cue from science, at once the source of our material achievements and the model of cumulative, self-perpetuating inquiry, which guarantees its continuation precisely by its willingness to submit every advance to the risk of suppression” (Lasch, 1991, p. 45). In this quotation, Lasch succinctly described the two key elements that shape progress in any field of scientific

endeavor. We must use our research to build a cumulative body of evidence, and we must be willing to revise and restructure our understanding of the phenomenon based on the available evidence and extant theory.

These observations about the nature of the scientific enterprise underscore the fundamental importance of handbooks. Handbooks exist to provide a comprehensive, cumulative summary of what we know about a phenomenon. As a cumulative summary, handbooks serve both to define the field “as it is” and provide a point of departure for subsequent work. In this sense, the publication of two authoritative handbooks, Mark Runco's (1997a, 1997b) *Creativity Research Handbook* and Robert Sternberg's (1999) *Handbook of Creativity*, represents a watershed event in the history of creativity research. Accordingly, in this article, I will use these handbooks as a point of departure for a commentary examining the progress we have made in studies of creativity.

### Method and Theory

#### Multiple Methods

In their chapter on history, Albert and Runco (1999) note that studies of creativity were relatively

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I would like to thank the editors of our two new creativity handbooks, Mark Runco and Robert Sternberg, whose thoughtful work provided the basis for this article. I would also like to thank Shane Connelly and Roni Reiter-Palmon for their comments concerning earlier drafts of this article.

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rare before the 1950s. With Guilford's (1950) seminal address, however, the systematic study of creativity became an active area of scientific investigation. These initial efforts did not arise as a result of some miraculous new appreciation of the importance of the creative act. Instead, what Guilford provided was a viable new method for studying creativity as an empirical phenomenon—the infamous, and ubiquitous, divergent thinking test. In their chapters, Bachelard and Michael (1997) and Plucker and Renzulli (1999) remind us that divergent thinking studies continue to play an important role in creativity research, with recent work examining alternative scoring systems, the structure of divergent thinking abilities, and the ways in which divergent thinking interacts with, or contributes to, other processes involved in a creative thought. Nonetheless, it is unwise to rely on one method in studying any complex phenomenon. One can argue, in fact, that our overreliance on divergent thinking tests became a real problem unduly limiting the scope of creativity research while raising the specter of method bias in both theory and findings.

Over the course of the last decade, however, a wider range of new, or alternative, methods for studying creativity have been applied. Explicitly recognizing this noteworthy advance, both handbooks devote chapters to new methods, such as Simonton's (1997, 1999) historical approach, the case study approach advocated by Gruber and Wallace (1999) and Policastro and Gardner (1999), Csikszentmihalyi's (1999) systems model, neuroscience studies of the type described by Katz (1997) and Martindale (1999), as well as the cognitive and computer modeling studies described in chapters by Boden (1999); Finke (1997); Ward, Smith, and Finke (1999); and Weisberg (1999). Disciplined application of these varied new approaches has, with time, led to a new and more encompassing understanding of certain aspects of people's creative efforts. For example, Csikszentmihalyi (1999) used his systems approach to articulate a series of propositions about the social conditions likely to influence creativity, including available economic resources, contact with other cultures, power dispersion, and wealth concentration. Gruber and Wallace (1999) use their case study approach to show (a) how belief structures concerning a phenomenon are linked to creative breakthroughs, specifically Darwin's theory of evolution, and (b) how these cognitive systems change over time as a function of a person's network of enterprise. Although other examples of this sort

might be cited, these two examples nicely illustrate how new methodological applications have led to a richer, more comprehensive understanding of the creative act.

Despite the many merits of these new, alternative methods, their introduction poses some problems. In reviewing the chapters presented in these two handbooks, one finds signs indicating the emergence of three potentially significant problems: (a) methodological isolation, (b) method equating, and (c) inadequate depth of methodological development. By the term *methodological isolation*, I refer to the tendency of investigators to apply and advocate one methodological approach to the exclusion of others—a problem illustrated in Policastro's and Gardner's (1999) statement that “while the psychometric approach to intelligence is generally considered one of psychology's greatest successes (Brown & Herrnstein, 1976), the same cannot be said about the cumulative approach to the study of creativity... particularly once one transcends the ‘cocktail party’ variety of creative production” (p. 213). This kind of isolationist view possesses two problems: It can make the integration of findings far more difficult than need be the case, and it can lead to a situation where creativity research is little more than a collection of methodological subdisciplines. More centrally, however, with methodological isolation we lose what is potentially the great benefit associated with development of a multimethod perspective, that is, the ability to link methods in formulating more comprehensive designs. In fact, recent work by Khandwalla (1993) and Reiter-Palmon, Mumford, Boes, and Runco (1997) illustrates the potential value of such multimethod designs in studies of creative thought.

Methodological isolation, with the emergence of a kind of “gentleman's agreement,” often results in a methodological equating, or the tendency to see all methods as techniques of equal value. Of course, some approaches permit better description, some better generalization, and some stronger causal inferences. In creativity research, as in any other area, we must attend to these relative strengths and weaknesses applying the approach, or approaches, that best serve the goals of the study at hand. Further, we must attend to the limitations inherent in our approach when drawing conclusions. Thus, extreme caution is called for if case studies, a descriptive technique, are to be used in drawing general causal inferences about underlying dispositional attributes or cognitive capacities. One

illustration of the problems associated with failure to take a critical methodological stand is that we are left with contradictory statements: for example, creativity calls for interpersonal intelligence (e.g., Policastro & Gardner, 1999), and creativity calls for psychoticism (e.g., Eysenck, 1997).

My final concern with regard to methodology pertains to the depth of methodological development. The excitement that surrounds new methods and new approaches can lead us to lose sight of the value of progressively refining and extending old, "tried and true" methods. The value of these methodological extensions is nicely illustrated in Runco's and Sakamoto's (1999) review of the experimental method. Initially, experimental work on creativity was based primarily on instructional manipulations (e.g., be creative), a type of manipulation useful for addressing some issues but not others. Over the course of the last 10 years, however, the introduction of new manipulations and new dependent variables, for example, manipulations of problem features, the development of attentional monitoring measures, and the use of affect manipulations, has allowed experimentalists to address a far wider range of issues than has hitherto been the case. Plucker and Renzulli (1999), in their chapter on the psychometric method, made a similar point. They note that consensual assessment techniques, new measures derived from cognitive experimental tasks, and the application of perceptual or climatic measures represent extensions of the traditional psychometric approach that may, with time, have a significant impact on our understanding of the creative act. Thus, recent work extending our long-standing methodological traditions may be as important as the development and introduction of new techniques.

### Multiple Theories

Paralleling our widening methodological horizons, both handbooks indicate that the creativity literature is also a place where the development and application of multiple theoretical perspectives is accepted and, indeed, encouraged. In fact, after reading these handbooks, one is left wondering whether we have in psychology developed any theoretical system that has not been used, at one time or another, to explain some aspect of the creative act. A partial list of the theoretical systems considered in these handbooks includes trait theory, operant models, associational models, conscious

analogical reasoning models, expert systems theory, economic models, perceptual processing theories, and clinical theories concerning bipolar disorders. However useful it is to have a number of theoretical options available, the plethora of systems under consideration broaches a question: Have we really made any progress toward formulating a coherent conception of creativity and innovation?

In answering this question, I would argue that because for many years we lacked multiple alternative theoretical perspectives, progress was slow and halting. Early students of creativity often took what might be referred to as a "magic bullet" approach, proposing one simple, all-encompassing mechanism to account for creative thought. Thus, creativity was seen as blind variation (Campbell, 1960), divergent thinking (Torrance, 1972), motivation (Kris, 1952), and so forth. As Mumford and Gustafson (1988) point out, however, creativity is a complex phenomenon involving the operation of multiple influences as we move from initial generation of an idea to delivery of an innovative new product. Thus, different theoretical models may be needed to account for different aspects of the creative process. Under these conditions, however, it is crucial that investigators clearly define exactly what aspects of the creative act are being addressed by a proposed theoretical system. In this regard, the chapters by Feldman (1999), on development, and Collins and Amabile (1999), on motivation, are exemplary.

Although we need different theories to account for different aspects of creativity, it is also true that multiple theories are often proposed to account for similar aspects of the creative act. This use of multiple and often apparently contradictory theories to account for a given aspect of the creative act is, of course, something of a problem. One way these apparent contradictions might be handled is by trying to integrate relevant theoretical perspectives (Sternberg & Lubart, 1996). In fact, one contribution of these handbooks is that they delineate the areas where model integration is needed. One example may be found in the need for theories of creative thought that consider both the analogical mechanisms (e.g., Ward, Smith, & Finke, 1999) and associational mechanisms (e.g., Eysenck, 1997). Another example may be found in the area of motivation, where some investigators stress the importance of intrinsic rewards (e.g., Collins & Amabile, 1999), others extrinsic rewards (e.g., Sternberg & Lubart, 1999), and still others compensatory growth (e.g., Gedo, 1997).

A third example may be found in the area of development, where expertise models (e.g., Weisberg, 1999) need to be reconciled with models that emphasize the importance of marginality (e.g., Feldman, 1999).

Of course, in some cases, integration may not prove possible. Under these conditions, there is a need for the kind of critical comparative studies that will allow us to identify the best alternative available. Again, these handbooks point out areas where such critical comparative tests are needed. A case in point may be found in comparing the chapter prepared by Martindale (1999) for Sternberg's handbook and the chapter prepared by Katz (1997) for Runco's handbook. In Martindale's (1999) chapter, a strong case was made for left brain dominance, whereas Katz (1997) argued that hemispheric dominance is task specific. Clearly, both propositions cannot be true, and some kind of comparative test is needed.

With regard to theory, one further point seems in order. Traditionally, students of creativity have sought to understand creativity as a general phenomenon. The chapters by Feist (1999), on scientific and artistic creativity, and Jay and Perkins (1997), on problem finding, however, remind us that this one-size-fits-all approach may not apply in studies of creativity because different types of problems and different kinds of task demands may call for different backgrounds, skills, cognitive strategies, and motivations. One implication of this statement is that investigators must specify models with reference to available task types, problems types, person types, and settings. A second implication of this statement is that we need to build taxonomic systems that allow us to recognize these similarities and differences with regard to task types, problem types, and other factors (Fleishman & Quaintance, 1984; Guilford, 1970). A third implication of this statement is that these taxonomic efforts must be used to frame theory development, integrative efforts, and critical comparative tests, providing a reference point to contrast observed similarities and differences in our substantive findings.

### Who and What Not to Study

In the early days of creativity research, the very nature of creativity was the subject of long, heated debate (Ghiselin, 1963). Over the course of the last decade, however, we seem to have reached a general agreement that creativity involves the production of

novel, useful products. Students of creativity, moreover, have begun to clearly distinguish creativity from other related forms of behavior, such as adaptability, intelligence, and humor (O'Quinn & Derks, 1997; Sternberg & O'Hara, 1999). Although these steps represent noteworthy progress, they should not be taken to imply that we can now put all definitional issues aside.

Runco and Charles (1997) brought this issue back into focus by noting that in the field, particularly in the developmental arena, we have an inherent conflict—more specifically, a conflict over whether we should study performance or the potential for performance. My own view is that we should study potential as well as performance, but only when we are sure we have adequate markers of potential. In other words, studies of potential require measures that have demonstrated adequate validity and reasonable validity generalization. This proposition, of course, brings to question many developmental studies, in fact, any study based on potential measures, that have used poor tests. This proposition, moreover, suggests that measures of potential should, whenever possible, be referenced against reasonably realistic creative performance tasks that call for open-ended, generative production.

In studies of creativity, however, we often circumvent the performance versus potential issue simply by studying groups of people who are doing creative work. In Sternberg's handbook, the chapters by Boden (1999), Feist (1999), Gruber and Wallace (1999), Howe (1999), Policastro and Gardner (1999), Simonton (1999), and Weisberg (1999) all, in one way or another, focus on people doing creative work. Although this approach long ago demonstrated its value (McKinnon, 1962), exactly who does creative work came to me as something of a surprise. Although the chapters employing this approach talk about artists, scientists, and musicians at great length, I could find no mention of engineers, computer programmers, designers, marketing and advertising executives, consultants, or managers. Thus, there appears to be a tendency in the field toward a platonic, class-stereotypic view of the creative act. One must recognize, however, that the creativity of invention, and all these fields involve invention (Mumford, Peterson, & Childs, 1999), are of great importance for both practical and theoretical reasons (Mumford & Connelly, 1993; Weber & Perkins, 1991). Further, because these practical

inventive efforts may emphasize different aspects of creative thought and call for different skills and motives (Mumford, Zaccaro, Harding, Jacobs, & Fleishman, 2000) one must wonder whether we are building an overly restrictive conception of creativity—one that may have little value when developing and assessing creative capacities in real world settings.

### Findings and Implications

Up to this point, my comments have, for the most part, focused on general structural considerations. As noted earlier, however, the ultimate goal of handbooks is to provide a cumulative summary of research in an area. Accordingly, it would seem germane to consider the findings described in these chapters and the conclusions indicated by these observations. My intent is not to replicate the comprehensive reviews provided by each chapter included in these handbooks. Instead, I will try to describe these findings that seem to have lead to real progress in our understanding of the creative act with respect to four major areas: (a) creative thought, (b) motivation, affect, and dispositions, (c) situational influences, and (d) development.

### Creative Thought

Beginning with the work of Dewey (1910), creative thought has served as a foundation, or reference point, for most studies of creativity. If we do not know how people generate new ideas, it is difficult to place observations about motives, dispositions, situations, and developmental change in context. Over the course of the last decade, we have been privileged to witness some dramatic advances in our understanding of creative thought. In Ward, Smith, and Finke (1999) chapter, a variety of evidence is reviewed indicating that creativity may involve two key cognitive capacities: conceptual combination and idea generation. Within this framework, the new concepts, or new understandings, emerging from conceptual combination provide a basis for the subsequent generation of new ideas. This conclusion is of some importance, in part because it suggests that divergent thinking, an ability tied to idea generation, may represent a “late cycle” process—a process dependent on the prior execution of other processes, specifically, conceptual combina-

tion and the kind of analogical reasoning mechanisms that make conceptual combination possible.

The chapters by Jay and Perkins (1997) and Weisberg (1999), however, serve to remind us that conceptual combination may not be the only cognitive antecedent of idea generation. Jay and Perkins (1997) examined the literature on problem finding, noting that in the real world the kind of problems that elicit creative thought tend to be problems that must be identified and defined by the individual. In fact, the available evidence indicates that skill in identifying and defining problems is an important influence on creative performance. They make a compelling argument, moreover, that problem definition may be a particularly complex process serving an executive, directional, and evaluative function that provides a locus integrating cognition, attention, motives, and dispositional characteristics. Thus they stress the potential impact of values and goals on peoples’ identification of worthwhile problems and evaluation of their own problem-solving efforts. One interesting implication of this argument is that problem finding and evaluation may depend on a specific form of expertise: internalization of the values and standards applied in a domain. Weisberg (1999) examined issues bearing on the role of expertise in greater detail, arguing that expertise, typically acquired over 10 years with extensive practice, is essential to all forms of creative thought providing the rich, conceptually based, knowledge structures needed for conceptual combination. Although few would dispute the need for expertise, Boden (1999), in his chapter on computer modeling, reminds us that the search, retrieval, and encoding strategies used in grappling with complex information also influence creative thought. Thus expertise must involve both procedural and declarative knowledge.

By proposing that creative thought is not simply a matter of idea generation, depending as well on conceptual combination, problem finding, and information search and evaluation, recent studies paint a far more complex picture of the creative act than has hitherto been the case. By the same token, however, this more complex picture broaches a number of new issues. Jay and Perkins (1997), for example, remind us that the need for, and difficulty in executing, any of these mental operations can vary as a function of problem type. This observation is of some importance because it suggests that although creative efforts involve some common elements, we may see marked

differences in the characteristics of creative thought as we move across domains and problem types. To complicate matters further, any given process may be executed using a variety of mechanisms or mental operations. Thus conceptual combination may occur through analogical feature mapping, use of metaphors, or construction of a visual image, whereas information search may involve the elimination of irrelevancies, identification of anomalies, or a search for structuring principals. Substantial work will be needed to determine how different operations influence performance on different types of novel problems. Finally, there is a need to understand how problem finding, information gathering, conceptual combination, and idea generation operate as a dynamic, interactive system as people generate and solve novel problems.

With regard to these complex system dynamics, another point, one articulated in a number of handbook chapters, should be borne in mind. Just as these processes do not operate in isolation from each other, neither do they operate in isolation from other aspects of human cognition. Sternberg and O'Hara (1999) described a number of different models that might be used to account for the relationship between intelligence and creativity. Although comparative studies are needed, it is quite possible that all those models evidence some validity, with different models applying to different types of problems or work in different domains. Along somewhat different lines, Finke (1997) examined the role of visual imagery in creative thought, reviewing findings that suggest that images, because they can be scanned, transformed, and manipulated as holistic entities, may help people work with complex relationships while allowing more rapid identification of incongruous events. Smith and Amner (1997) examined the impact of perceptual mechanisms on creative thought, finding that people who can rapidly construct images from ambiguous stimuli often evidence greater creativity.

Although recent research has emphasized the need for the conscious acquisition and manipulation of information, some scholars continue to stress the importance of unconscious, associational processes in shaping creativity thought. Both Eysenck (1997) and Martindale (1999) argued that creativity depends on associational linkages with the flatness of the associational gradient, the range of connections made, being positively related to production of novel ideas. Gedo (1997), in his review of the psychoanalytical approach,

also stressed the importance of unconscious associations. However, he argued that the real problem confronting students of creativity may lie in identifying when, where, and how associational and conscious analogical reasoning processes interact, noting that true creativity may well require flexible integration of these two modes of thought.

### **Motivation, Affect, and Disposition**

The need to orchestrate multiple cognitive systems while executing a number of complex, parallel processing operations indicates that creative thought is inherently a demanding, resource-intensive undertaking. The difficulty of, and demands imposed by, creative work presents a motivational question: What gets people to make this kind of psychological investment? Collins and Amabile (1999) argued that this investment of effort depends on intrinsic motivation derived from task-focused, internally based rewards. Although Collins and Amabile presented an impressive body of evidence supporting this proposition, intrinsic motivation may not be a simple unitary process: Instead, intrinsic motivation may be based on curiosity, the need to extend feelings of mastery, the potential for self-expression, resolution of incongruities, and contribution to others. Thus, like Gedo (1997), I would argue that we need studies examining the effects of different aspects of intrinsic motivation on people's creative efforts.

In recent years, however, students of creativity have become more aware of the role that extrinsic factors (e.g., praise, status, pay, etc.) play in motivating creative work (Eisenberger & Cammeron, 1996; Sternberg & Lubart, 1999). It is, of course, possible that extrinsic and intrinsic motivation might serve somewhat different functions. Thus, extrinsic motives might influence choice of field, type of task, or implementation strategy, rather than work on the task itself. Collins and Amabile (1999), moreover, argued that extrinsic and intrinsic motivations may operate synergistically, with extrinsic motivations resulting in poor performance only when they draw attention away from task performance. This argument is consistent with Kluger and Denisi's (1996) findings concerning the effects of feedback on performance, where feedback was found to lead to diminished performance when it drew away the attentional resources needed to perform well on complex, ambiguous tasks.

One of the more important trends evident in these handbooks is, in fact, the growing interest in the role of attention and affect on creative work. Martindale (1999) and Runco and Sakamoto (1999) both considered this issue, noting that creative people (a) tend to be oversensitive to stimulation, (b) have a broad attention focus, (c) habituate slowly, (d) show greater variability in arousal, (e) withdraw to reduce stimulation, and (f) seek out controlled, task-focused stimulation to compensate for this withdrawal. Taken as a whole, these findings suggest that task-focused cognition may represent a stimulus control strategy used by creative people to manage arousal and affect. These findings, however, have three other implications. One is that stress, or high levels of arousal, will inhibit creativity when requisite coping strategies are not available. Another implication is that moderate, positive affective states (e.g., interest or a sense of accomplishment), by virtue of the buffering provided, will tend to enhance creative thought (Vosberg, 1998). Still another implication is that the introversion, independence, and subclinical bipolar states evidenced by many creative people may represent, at least in part, an outcome of characteristic arousal levels (Eisenman, 1997; Feist, 1999).

Studies of dispositional characteristics, such as introversion, autonomy, and bipolar functioning, have long been of interest to students of creativity (Barron & Harrington, 1981). In reviewing the dispositional characteristics evidenced by creative scientists and artists, Feist (1999) once again replicated this pattern, finding that they evidenced high (a) autonomy, independence, and introversion; (b) energy, achievement, drive, and self-confidence; (c) openness, flexibility, imagination, and tolerance for ambiguity; and (d) arrogance, hostility, and power needs. Feist's (1999) findings, however, extended this traditional picture in three ways. First, in comparing artists and scientists, he found that artists, but not scientists, tend to be less socialized and less conscientious, suggesting the existence of cross-field, or cross-domain, differences that need to be more carefully explored. Second, the nature of these dispositional patterns indicate that they might be related to functional work requirements and the kind of creative thinking required, suggesting that there is a need for studies delineating exactly how different dispositional characteristics influence, or are related to, different aspects of people's creative efforts. Third, one must remember that many of these characteristics, for example

extroversion, arrogance, and hostility, can have negative social consequences. Thus, one must ask how creative people go about adapting to social environments and institutional settings, such as schools, where hypersensitivity, hostility, and arrogance are seen as disruptive (Cropley, 1997).

### Situational Influences

Creative thought and "the creative personality" have long fascinated students of creativity. In recent years, however, we have seen an emerging interest in the situational forces that influence the nature and success of creative efforts. Lubart (1999), in Sternberg's handbook, presented one of the few truly thoughtful pieces on cross-cultural manifestations of creativity available in the literature. He reminded us that creativity can take different forms in different cultures. Thus, in the East, as opposed to the West, creativity is not seen as a product-oriented activity, but as a form of self-expression within a collective social context. This difference in cultural expectations, in turn, implies we might see shifts across cultures in stylistic manifestations of art, acceptance of creative people, and the rewards provided for creative work, all effects worthy of further investigation. Work along these lines may prove particularly useful if, as suggested by Csikszentmihalyi (1999), it can be extended to examine the specific structural variables that promote or inhibit creativity. Earlier, I pointed out some hypotheses flowing from this approach (e.g., resource availability and resource concentration) that might be tested using historiometric or economic techniques. Tests of this sort might, moreover, allow us to develop an understanding of how macro-level social factors direct, enhance, or restrict people's creative efforts.

In contrast to these macro-level, cultural or societal situational influences, one might study situational influences from a more limited micro-level perspective. In fact, Csikszentmihalyi (1999) and Feldman (1999) both take those micro influences into account in their discussion of how the domain and field influence creative work. This domain poses problems and, by providing certain knowledge, resources, and technological capabilities, sets the stage for certain kinds of advances. The field influences the nature and acceptance of people's work as others judge the work, establish standards, and build corrections. However important the effects of domain and field, one must



remember that these are not the only kind of micro-level situational factors that influence creative work. Many forms of creative work occur in institutional settings (e.g., research and development laboratories, marketing departments, etc.). Both the management and sociology literatures have devoted some real effort to understanding creativity in institutional settings (e.g., Bahrimi and Evans, 1987; Damanapour, 1991; Dougherty & Hardy, 1996; Hitt, Hoskisson, Johnson, & Mosel, 1996), moving beyond the traditional, somewhat superficial platitudes found in Williams and Yang's (1999) chapter on organizational behavior to examine effects such as the impact of financial and strategic control structures, the tradeoffs between integration and differentiation, the effects of overabundant resources, and the impact of organizational values. To their credit, chapters by Rickards (in press) and Service (in press) in the later volumes of Runco's handbook address these issues in some detail.

Neither handbook, however, gives much attention to group influences on creativity. This lapse in coverage, one of the few evident in these handbooks, may reflect our current fascination with the creative individual. This lapse, however, may also reflect an abiding belief that groups, and group interaction, tend to inhibit creative work. Recent studies, however, indicate that the effects of groups on creativity may be far more complex than we typically assume (e.g., Dunbar, 1995; Oldham & Cummings, 1996; Redmond, Mumford, & Teach, 1993; Shalley & Oldham, 1997; Sosik, Kahai, & Avolio, 1998). In team settings, creativity seems to be encouraged by supportive, charismatic leadership; reasonable diversity in members' backgrounds; competitiveness, particularly externally focused competition; and an open approach to emerging issues. Given the importance of collaboration and teamwork to many creative ventures (Abra, 1994), future research will hopefully extend this initial work and examine issues such as communication structures, intimacy versus objectivity in group interactions, and the time frame needed to build creative collaborative interactions across different types of tasks.

### Development

We often study creativity, particularly situational influences on creativity, with the hope that we might be able to devise interventions that will help people become more creative. In keeping with this tradition,

both handbooks include a number of chapters that focus on developmental or educational issues. Feldman's (1999) chapter on development is perhaps the most wide ranging, reminding us that the development of creativity is indeed a complex phenomenon involving a supportive, encouraging family, exposure to appropriate values and knowledge in the family environment, mentoring, the availability of requisite educational opportunities, and opportunities to practice, and interact, with peers. Thus, the development of creativity is not solely a matter of ability, but depends on a number of events occurring throughout the life span (Howe, 1999). Simonton (1999) made a similar point, noting that historiometric studies indicate the operation of early life-cycle influences (e.g., parental loss) as well as late life-cycle influences (e.g., consolidation at the end of a career).

Although we often tend to see development as a response to externally imposed situational influences, the reality of individual development is more complex (Lerner & Tubman, 1989). Development may be influenced by maturational demands as the skills needed to master other life tasks are acquired. Thus, Runco and Charles (1997) argued that when maturational requirements, for example, role socialization or acquisition of basic skills, require conventionality, one may see slumps in divergent thinking. Development, moreover, is full of chance encounters and often involves active manipulation of the environment. Although some studies have begun to examine the effects of chance encounters and crystallizing experiences on the development of creativity (Feldman, 1999), we have hardly begun to answer the question of how people go about creating the conditions needed to live creative lives.

The complex unfolding of creativity across the life span poses a problem for those who hope to develop creativity through evaluation and training. Although only limited evidence is available examining the effectiveness of these programs, the available evidence would not lead one to believe that these programs have been an unqualified success. As Cropley (1997) pointed out, given the many influences on the development of creative potential, one would not expect single-shot, short-term interventions to have much affect. He argued that, instead, we should use a long-term, multiple intervention strategy that begins by (a) building requisite knowledge and expertise, including a firm grasp of principals; (b) creating exercises

that build skills needed to work with this knowledge; (c) encouraging a search for novel solutions and effective strategies for testing these solutions; (d) openly evaluating progress and errors; and (e) extension of these efforts into independent, collaborative projects. Both Cropley (1997) and Nickerson (1999) argued that this kind of approach, when extended across multiple courses over a long period of time, may lead to real gains in creative thinking skills, particularly when combined with a classroom environment being managed to promote autonomy, minimize premature criticism, and appreciate effort, persistence, and curiosity.

Nickerson (1999), however, also took the position that targeted short-term interventions can prove successful, provided that they are focused on a limited number of key skills or critical processes. This focused developmental approach received some support in Jay and Perkins's (1997) review of the problem-finding literature. Their review indicated that interventions focusing on a particular skill (problem finding) as applied in a particular domain (e.g., science) can yield tangible improvements in creative performance. The apparent success of this focused approach indicates the need for precision in defining within-domain requirements. It also brings to question the value of the one-time, one-week, one-size-fits-all general training courses intended to enhance creativity across the board.

### Emerging Issues

These observations about training and development point to a broader conclusion. Apparently, the work summarized in these two handbooks has allowed us to develop a more comprehensive and sophisticated understanding of the creative act than has hitherto been the case. Successful handbooks, however, should not only summarize what we know but should also articulate the implications of our knowledge for future work. Given my comments in earlier sections concerning the need to look at creativity across a range of manifestations, the need to study creativity in groups, and the need to take institutional influences into account, it would seem that both handbooks have been successful in this regard. In pointing out needed work, however, these handbooks also underscore a number of emerging issues. Thus, in this section, I will

consider three emerging issues that seem, at least in my opinion, to warrant some attention in future studies of creativity: (a) assessing creative potential, (b) "late cycle" creative activities, and (c) the effects of creativity.

### Assessing Creative Potential

Students of creativity have long been interested in assessing creative potential. Thus, one might wonder why assessment should be considered an emerging issue in the creativity literature. Attempts to assess creative potential, however, have relied on divergent thinking tests supplemented by other tests examining general intellectual abilities and domain-specific skills (Cropley, 1997; Plucker & Renzulli, 1999). Although the findings obtained in recent studies of creativity do not necessarily contradict this approach, they do suggest a number of strategies that might be used to improve our assessments of creative potential.

To begin, it is clear that recent cognitive work has provided a richer, far more detailed description of creative thought than has been available in the past (e.g., Ward, Smith, & Finke, 1999). One noteworthy, albeit often overlooked, implication of this more comprehensive description is that it provides a framework for the development of new measures (Snow & Lohman, 1993). One might, for example, develop a test examining information gathering that assesses how well someone can identify key facts and anomalous observations. Conceptual combination skills might be assessed by having people reorganize existing categories or identify different ways two or more concepts might be related. Problem-finding skills could be measured by asking people to identify the problems posed by a situation or the hypotheses that need to be tested. Although other examples of this sort might be cited, the foregoing seem sufficient to make the point that our current understanding of creative thought provides a framework that might be used to develop a number of new measures for assessing creative potential.

The development of new measures of the sort described previously seems advantageous from both a substantive and practical perspective. With regard to substance, measures of this sort would provide a more comprehensive assessment of potential. These new tests, moreover, might allow the psychometric method to make a stronger theoretical contribution, one not bound to a single skill or method. With regard to

practice, introduction of new measures not only offers the hope of improved prediction but also the possibility of diagnosing key deficiencies in creative thinking skills if new tests are appropriately designed (Lohman & Ippel, 1993; Mumford, Baughman, Supinski, & Anderson, 1998).

One issue likely to arise in developing new tests of creative thinking skills is the extent to which content should reflect performance in a given domain of knowledge. Although we continue to debate the domain specificity issue (e.g., Baer, 1994; Plucker & Rezulli, 1999) from a purely psychometric perspective, the need to take domain specificity into account depends on the inferences we wish to make. Embedding tests within a domain is likely to prove useful when we are interested in performance within a domain, developed levels of a skill, or assessment with respect to fixed, externally defined standards. Moreover, given the impact of expertise on creative thought, it may be useful to expressly examine the breadth, complexity, and structure of knowledge using these indexes as predictors in their own right. However, when our interest focuses on creativity as a general phenomenon, a potential across domains, it would seem more appropriate to apply tests that control for expertise differences by focusing on common forms of knowledge.

Up to this point, I have discussed assessment primarily with reference to cognitive skills. As the chapters by Collins and Amabile (1999) so amply illustrated, creative potential also depends on the individual's particular pattern of dispositional and motivational characteristics. Thus, assessments of creative potential should examine noncognitive influences on creative achievement. Recent work in dispositions and motives, moreover, suggests some new strategies for developing noncognitive measures. For example, fit assessments might be obtained using dispositional characteristics such as contentiousness and rebelliousness, which differentiate creative people working in different domains. Given the apparent involvement of self-concepts and arousal in creative work (Gruber & Wallace, 1999; Martindale, 1999), story elicitation techniques or role-attraction measures might prove useful. Alternately, indexes of arousal and positive affect obtained as people are exposed to images of work within a domain might yield effective prediction. Thus, as was the case for cognitive skills, recent work suggests some new strategies for assessing creative

potential in terms of the dispositional and motivational characteristics.

### **"Late Cycle" Skills**

Traditionally, students of creativity have focused on "early cycle" activities, or the capacities and dispositional characteristics that make it possible for people to generate new ideas. This same trend is evident in both handbooks and is consistent with most current research in the field. However, a close reading of certain chapters presented in these handbooks evidences a growing concern with what might be referred to as "late cycle" idea implementation capacities. Cropley (1997) and Simonton (1997, 1999) both discussed the importance of communicating the value of a new idea, or approach, to relevant audiences. Along somewhat different lines, Policastro and Gardner (1999) reminded us that real-world performance—the expression, shaping, and execution of an idea—represents an important component of creative work.

At first glance, it is far too easy to dismiss these implementation issues as simply an execution problem. However, in real-world settings, implementation may be every bit as demanding and time consuming as initial idea generation, requiring the individual to address multiple novel problems as an idea is shaped into a viable innovation. One implication of the statement is that creative thought may involve a number of cognitive capacities, in addition to idea-generation capacities, that are unique to creative work. Creative people must be able to generate the likely downstream consequences implied by a new idea; they must be able to project other's reactions to an idea; they must be able to identify the resources needed for idea implementation; they must be capable of forming viable, perhaps somewhat opportunistic, plans for implementing these ideas; they must be able to identify significant problems emerging during implementation; and they must be able to adjust their initial plan, or approach, to take those implementation issues into account, considering both immediate and long-term objectives. There is, accordingly, a need for research examining the cognitive capacities involved in the implementation of ideas. Studies along these lines, moreover, may prove particularly useful if they examine creativity in fields that place a premium on practical innovation, such as engineering, management, and computer programming.

Implementation of new ideas, of course, is not simply a matter of cognition. To implement an idea, people need to be persuaded, resources must be acquired, and work teams must be formed. All of these performance-based implementation issues involve social interaction. This observation, in turn, implies a need for work examining how creative people manage social interactions and the strategies used to integrate competing social and intellectual demands. Studies along these lines take on special significance because the evidence reviewed by Feist (1999) suggested that creative people, by virtue of their autonomy, introversion, arrogance, and hostility, may have some difficulty working with others in idea implementation. In fields where implementation is of paramount importance, however, it is possible that some of these characteristics will be less pervasive than is the case for artists and scientists.

The need for effective idea implementation brings to the fore a final consideration. If implementation is of concern, then the quality of the idea and its implementation is an important aspect of the creative act. This statement, in turn, implies that a fully adequate description of creativity must consider how people appraise and judge their own work and the work of others (Runco, 1997b). It is possible, moreover, particularly given the findings of Collins and Amabile (1999) with regard to motivation, that some evaluation strategies will be far more effective than others. For example, evaluation strategies focusing on progress and potential may prove more useful than strategies that stress fixed, absolute, performance standards. Along somewhat different lines, it is possible that creative people become creative quite simply because they apply unique standards in evaluating their work and the work of others.

### **Creativity as Cause and Effect**

Implicit in many of my proceeding observations is an assumption that permeates most studies of creativity. We assume that creativity, the production of novel useful products, is the criterion of interest. Thus, most studies of creativity seek to identify the causes of creativity examining thinking skills, motives, and dispositional characteristics, among other variables. One might, however, ask a different question: Exactly what are the effects of creativity on the individual, the people around him or her, and the broader social system?

Our apparent lack of interest in the effects of creativity may be traced to an assumption that creativity and motivation are universal goods. Policastro and Gardner (1999) reminded us that creative work, by virtue of its intensity, may lead to a disrupted, rather shallow family life. Runco and Charles (1997) noted that rather than drinking causing creativity, creativity, as a result of the associated frustration and ambiguity, may cause alcohol abuse. Thus, creativity, like most other human actions, may have good and bad outcomes.

To truly describe creativity, we must understand how creativity affects our world in a multilayered social system. We need to know how successful innovation by a corporate research and development group effects the innovative capabilities of other organizational units. In other words, does innovation lead to the kind of snowball effects frequently observed in studies of organizational behavior? We need to know how creative individuals affect others working on team projects: Do they inspire creativity? Engender jealousy? Create conflict? We need to know how people evaluate the tradeoffs between the cost of changes and the potential gains from adoption of a new idea. All these questions, in one way or another, imply that creativity should be viewed as a cause as well as an effect. Careful examination of these causal relationships, especially the reciprocal causal relationships that emerge as creative people both act on and are influenced by their world should, over time, lead to a far more robust understanding of creativity as a force shaping our daily lives.

### **Conclusions**

Each of these emerging issues is of some interest in its own right. Taken together, however, they point to a broader set of conclusions pertaining to both the state of creativity research and the quality of the handbooks summarizing this research. In reviewing these handbook chapters, it is clear that they have served not only to summarize the findings obtained in various studies, they also suggest a number of directions for future research. In this sense, it is fair to say that both handbooks, especially when taken together, represent unusually successful ventures.

The success of these handbooks, however, is also a reflection of the state of creativity research and the progress made in our understanding of creativity over

the course of the last decade. When I began to study creativity in the late 1970s, the field at times seemed moribund. Creativity was studied as it had always been studied, using a limited set of techniques that, however useful, were difficult to generalize to real world creativity. Over the course of the intervening years, we have seen the development, or importation, of new methods and theories. These have resulted in a more comprehensive systematic understanding of the creative act while providing new techniques for addressing key questions. The findings flowing from this work have led to a more sophisticated understanding of creative thought, along with the motivational, situational, and developmental influences that shape the expression of creativity.

The rapid development of creativity research over the course of the last decade, however, also presents some new challenges. There is a need to begin integrating theories and findings into coherent systems. We need studies that are expressly designed to test critical theoretical issues. Moreover, we need to be more inclusive when we study creative people, recognizing that different forms of creativity may exist in different domains. None of these extensions, however, is an unattainable grail, ever on the horizon but never in our hands. In fact, in examining the findings presented in Runco's and Sternberg's handbooks, they paint a coherent picture of the creative act—a picture of sufficient coherence that we can expect more integrated, comprehensive theoretical systems and more focused research as the field grows over the next decade.

## References

- Abra, J. (1994). Collaboration in creative work: An initiative for investigation. *Creativity Research Journal*, 7, 1–20.
- Albert, R. S., & Runco, M. A. (1999). A history of research on creativity. In R. J. Sternberg (Ed.), *Handbook of creativity* (pp. 16–34). Cambridge, England: Cambridge University Press.
- Bachelor, P. A., & Michael, W. B. (1997). The structure of intellect model revisited. In M. A. Runco (Ed.), *Creativity research handbook* (Vol. 1, pp. 155–182). Cresskill, NJ: Hampton.
- Baer, J. (1994). Generality of creativity across performance domains. *Creativity Research Journal*, 4, 23–39.
- Bahrini, H., & Evans, S. (1987). Stratocracy in high-technology firms. *California Management Review*, 30, 51–66.
- Barron, F., & Harrington, D. (1981). Creativity, intelligence, and personality. *Annual Review of Psychology*, 32, 439–476.
- Boden, M. A. (1999). Computational models of creativity. In R. J. Sternberg (Ed.), *Handbook of creativity* (pp. 351–373). Cambridge, England: Cambridge University Press.
- Brown, R., & Herrnstein, R. (1976). *Psychology*. Boston: Little, Brown.
- Campbell, D. T. (1960). Blind variation and selective retention in creative thought as in other knowledge processes. *Psychological Review*, 67, 380–400.
- Collins, M. A., & Amabile, T. M. (1999). Motivation and creativity. In R. J. Sternberg (Ed.), *Handbook of creativity* (pp. 297–312). Cambridge, England: Cambridge University Press.
- Cropley, A. J. (1997). Fostering creativity in the classroom: General principals. In M. A. Runco (Ed.), *Creativity research handbook* (Vol. 1, pp. 83–114). Cresskill, NJ: Hampton.
- Csikszentmihalyi, M. (1999). Implications of a systems perspective for the study of creativity. In R. J. Sternberg (Ed.), *Handbook of creativity* (pp. 313–338). Cambridge, England: Cambridge University Press.
- Damanapour, F. (1991). Organizational innovation: A meta-analysis of effects of determinants and moderators. *Academy of Management Journal*, 39, 555–590.
- Dewey, J. (1910). *How we think*. Boston: Houghton, Mifflin.
- Dougherty, D., & Hardy, B. F. (1996). Sustained innovation production in large mature organizations: Overcoming innovation to organizational problems. *Academy of Management Journal*, 39, 826–851.
- Dunbar, K. (1995). How scientists really reason: Scientific reasoning in real world laboratories. In R. J. Sternberg & J. E. Davidson (Eds.), *The nature of insight* (pp. 365–396). Cambridge, MA: MIT Press.
- Eisenberger, R., & Cammeron, J. (1996). Detrimental effects of reward: Reality or myth? *American Psychologist*, 51, 1153–1156.
- Eisenman, R. (1997). Mental illness, deviance, and creativity. In M. A. Runco (Ed.), *Creativity research handbook* (Vol. 1, pp. 295–313). Cresskill, NJ: Hampton.
- Eysenck, H. S. (1997). Creativity and personality. In M. A. Runco (Ed.), *Creativity research handbook* (Vol. 1, pp. 41–66). Cresskill, NJ: Hampton.
- Feist, G. J. (1999). The influence of personality on artistic and scientific creativity. In R. J. Sternberg (Ed.), *Handbook of creativity* (pp. 273–296). Cambridge, England: Cambridge University Press.
- Feldman, D. H. (1999). The development of creativity. In R. J. Sternberg (Ed.), *Handbook of creativity* (pp. 169–188). Cambridge, England: Cambridge University Press.
- Finke, R. A. (1997). Mental imagery and visual creativity. In M. A. Runco (Ed.), *Creativity research handbook* (Vol. 1, pp. 183–202). Cresskill, NJ: Hampton.
- Fleishman, E. A., & Quaintance, M. K. (1984). *Taxonomies of human performance: The description of human tasks*. Orlando, FL: Academic.
- Gedo, J. E. (1997). Psychoanalytic theories of creativity. In M. A. Runco (Ed.), *Creativity research handbook* (Vol. 1, pp. 29–40). Cresskill, NJ: Hampton.
- Ghiselin, B. (1963). Ultimate criteria for two levels of creativity. In C. W. Taylor & F. Baron (Eds.), *Scientific creativity: Its recognition and development* (pp. 30–43). New York: Wiley.

- Gruber, H. E., & Wallace, D. B. (1999). The case study method and evolving systems approach for understanding unique creative people at work. In R. J. Sternberg (Ed.), *Handbook of creativity* (pp. 93–115). Cambridge, England: Cambridge University Press.
- Guilford, J. P. (1950). Creativity. *American Psychologist*, 5, 444–454.
- Guilford, J. P. (1970). Creativity: Retrospect and prospect. *Journal of Creative Behavior*, 5, 77–87.
- Hitt, M. A., Hoskisson, R. E., Johnson, R. A., & Mosel, D. D. (1996). The market for corporate control and firm innovation. *Academy of Management Journal*, 39, 1084–1196.
- Howe, M. J. (1999). Prodigies and creativity. In R. J. Sternberg (Ed.), *Handbook of creativity* (pp. 431–448). Cambridge, England: Cambridge University Press.
- Jay, E. S., & Perkins, D. N. (1997). Problem finding: The search for mechanism. In M. A. Runco (Ed.), *Creativity research handbook* (Vol. 1, pp. 257–294). Cresskill, NJ: Hampton.
- Katz, A. N. (1997). Creativity and the cerebral hemispheres. In M. A. Runco (Ed.), *Creativity research handbook* (Vol. 1, pp. 203–226). Cresskill, NJ: Hampton.
- Khandwalla, P. N. (1993). An exploratory investigation of divergent thinking through protocol analysis. *Creativity Research Journal*, 6, 241–260.
- Kris, E. (1952). *Psychoanalytic explorations in art*. New York: International University Press.
- Lasch, C. (1991). *The true and only heaven: Progress and its critics*. New York: Norton.
- Lerner, R. M., & Tubman, J. G. (1989). Conceptual issues in studying continuity and discontinuity in personality development across the life span. *Journal of Personality*, 57, 343–374.
- Lohman, D. F., & Ippel, M. J. (1993). Cognitive diagnosis: From statistically based assessment towards theory based assessment. In N. Friedricksen, R. J. Mislevy, & I. I. Bejar (Eds.), *Test theory for a new generation of tests* (pp. 41–71). Hillsdale, NJ: Lawrence Erlbaum Associates, Inc.
- Lubart, T. I. (1999). Creativity across cultures. In R. J. Sternberg (Ed.), *Handbook of creativity* (pp. 339–350). Cambridge, England: Cambridge University Press.
- Martindale, C. (1999). Biological biases of creativity. In R. J. Sternberg (Ed.), *Handbook of creativity* (pp. 137–152). Cambridge, England: Cambridge University Press.
- McKinnon, D. W. (1962). Personality and the realization of creative potential. *American Psychologist*, 20, 273–281.
- Mumford, M. D., Baughman, W. A., Supinski, E. P., & Anderson, L. E. (1998). A construct approach to skill assessment: Procedures for assessing complex cognitive skills. In M. D. Hakel (Ed.), *Beyond multiple choice: Evaluating alternatives to traditional testing for selection* (pp. 75–112). Hillsdale, NJ: Lawrence Erlbaum Associates, Inc.
- Mumford, M. D., & Connelly, M. S. (1993). Cases of invention. *Contemporary Psychology*, 38, 1210–1212.
- Mumford, M. D., & Gustafson, S. B. (1988). Creativity syndrome: Integration, application, and innovation. *Psychological Bulletin*, 103, 27–43.
- Mumford, M. D., Peterson, N. G., & Childs, R. A. (1999). Basic and cross functional skills. In N. G. Peterson, M. D. Mumford, U. C. Borman, P. R. Jeanneret, & E. A. Fleishman (Eds.), *An occupational information system for the 21st century: The development of O\*NET* (pp. 21–30). Washington, DC: American Psychological Association.
- Mumford, M. D., Zaccaro, S. J., Harding, F. D., Jacobs, T. O., & Fleishman, E. A. (in press). Leadership skills for a changing world: Solving complex social problems. *Leadership Quarterly*.
- Nickerson, R. S. (1999). Enhancing creativity. In R. J. Sternberg (Ed.), *Handbook of creativity* (pp. 392–430). Cambridge, England: Cambridge University Press.
- Oldham, G. R., & Cummings, N. (1996). Employee creativity: Personal and contextual factors at work. *Academy of Management Journal*, 39, 607–628.
- O'Quinn, K., & Derks, P. (1997). Humor and creativity: A review of the empirical literature. In M. A. Runco (Ed.), *Creativity research handbook* (Vol. 1, pp. 227–256). Cresskill, NJ: Hampton.
- Owens, W. A. (1969). Cognitive, non-cognitive, and environmental correlates of mechanical ingenuity. *Journal of Applied Psychology*, 53, 199–208.
- Plucker, J. A., & Renzulli, J. S. (1999). Psychometric approaches to the study of human creativity. In R. J. Sternberg (Ed.), *Handbook of creativity* (pp. 35–66). Cambridge, England: Cambridge University Press.
- Policastro, E., & Gardner, H. (1999). From case studies to robust generalizations: An approach to the study of creativity. In R. J. Sternberg (Ed.), *Handbook of creativity* (pp. 213–225). Cambridge, England: Cambridge University Press.
- Redmond, M. R., Mumford, M. D., & Teach, R. J. (1993). Putting creativity to work: Leader influences on subordinate creativity. *Organizational Behavior and Human Decision Processes*, 55, 120–151.
- Reiter-Palmon, R., Mumford, M. D., Boes, J. O., & Runco, M. A. (1997). Problem construction and creativity: The role of ability, cue consistency, and active processing. *Creativity Research Journal*, 10, 9–23.
- Rickards, T. (in press). Organizational creativity. In M. A. Runco (Ed.), *Creativity research handbook* (Vol. 2). Cresskill, NJ: Hampton.
- Runco, M. A. (1997a). *The creativity research handbook* (Vol. 1). Cresskill, NJ: Hampton.
- Runco, M. A. (1997b). Developmental trends in creative potential and creative performance. In M. A. Runco (Ed.), *Creativity research handbook* (Vol. 1, pp. 115–154). Cresskill, NJ: Hampton.
- Runco, M. A. (1997c). Introduction. In M. A. Runco (Eds.), *Creativity research handbook* (Vol. 1, pp. i–ix). Cresskill, NJ: Hampton.
- Runco, M. A., & Charles, R. E. (1997). Developmental trends in creative potential and performance. In M. A. Runco (Ed.), *The Creativity Research Handbook* (pp. 115–154). Cresskill, NJ: Hampton.
- Runco, M. A., & Sakamoto, S. O. (1999). Experimental studies of creativity. In R. J. Sternberg (Ed.), *Handbook of creativity* (pp. 62–92). Cambridge, England: Cambridge University Press.
- Service, R. (in press). Innovation in organizations. In M. A. Runco (Ed.), *Creativity research handbook* (Vol. 3). Cresskill, NJ: Hampton.
- Shalley, C. E., & Oldham, G. R. (1997). Competition and creative performances: Effects of competition, presence, and visibility. *Creativity Research Journal*, 10, 337–346.
- Simonton, D. K. (1997). Historiometric studies of creative genius. In M. A. Runco (Ed.), *Creativity research handbook* (Vol. 1, pp. 3–28). Cresskill, NJ: Hampton.

- Simonton, D. K. (1999). Creativity from a historiometric perspective. In R. J. Sternberg (Ed.), *Handbook of creativity* (pp. 116–136). Cambridge, England: Cambridge University Press.
- Smith, G. J. U., & Amner, G. (1997). Creativity and perception. In M. A. Runco (Ed.), *Creativity research handbook* (Vol. 1, pp. 67–82). Cresskill, NJ: Hampton.
- Snow, R. E., & Lohman, D. F. (1993). Cognitive psychology, new test design and nontest theory: An introduction. In N. Friedricksen, R. J. Mislevy, & I. I. Bejar (Eds.), *Test theory for a new generation of tests* (pp. 1–18). Hillsdale, NJ: Lawrence Erlbaum Associates, Inc.
- Sosik, J. L., Kahai, S. K., & Avolio, B. J. (1998). Transformational leadership and dimensions of creativity: Motivating idea generation in computer-mediated groups. *Creativity Research Journal*, 11, 111–122.
- Sternberg, R. J. (1999). *Handbook of creativity*. Cambridge, England: Cambridge University Press.
- Sternberg, R. J., & Lubart, T. I. (1996). Investing in creativity. *American Psychologist*, 51, 677–688.
- Sternberg, R. J., & Lubart, T. I. (1999). The concept of creativity: Prospects and paradigms. In R. J. Sternberg (Ed.), *Handbook of creativity* (pp. 3–15). Cambridge, England: Cambridge University Press.
- Sternberg, R. J., & O'Hara, L. A. (1999). Creativity and intelligence. In R. J. Sternberg (Ed.), *Handbook of creativity* (pp. 251–277). Cambridge, England: Cambridge University Press.
- Torrance, E. P. (1972). Predictive validity of the Torrance tests of creative thinking. *Journal of Creative Behavior*, 6, 236–252.
- Vosberg, S. K. (1998). The effects of positive and negative affect on divergent thinking performances. *Creativity Research Journal*, 11, 165–172.
- Ward, T. B., Smith, S. M., & Finke, R. A. (1999). Creative cognition. In R. J. Sternberg (Ed.), *Handbook of creativity* (pp. 189–212). Cambridge, England: Cambridge University Press.
- Weber, R. J., & Perkins, D. N. (1991). *Inventive minds: Creativity in technology*. New York: Oxford University Press.
- Weisberg, R. W. (1999). Creativity and knowledge: A challenge to theories. In R. J. Sternberg (Ed.), *Handbook of creativity* (pp. 226–250). Cambridge, England: Cambridge University Press.
- Williams, W. M., & Yang, L. T. (1999). Organizational creativity. In R. J. Sternberg (Ed.), *Handbook of creativity* (pp. 373–391). Cambridge, England: Cambridge University Press.