Creativity

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Abstract

The psychological study of creativity is essential to human progress. If strides are to be made in the sciences, humanities, and arts, we must arrive at a far more detailed understanding of the creative process, its antecedents, and its inhibitors. This review, encompassing most subspecialties in the study of creativity and focusing on twenty-first-century literature, reveals both a growing interest in creativity among psychologists and a growing fragmentation in the field. To be sure, research into the psychology of creativity has grown theoretically and methodologically sophisticated, and researchers have made important contributions from an ever-expanding variety of disciplines. But this expansion has not come without a price. Investigators in one subfield often seem unaware of advances in another. Deeper understanding requires more interdisciplinary research, based on a systems view of creativity that recognizes a variety of interrelated forces operating at multiple levels.

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INTRODUCTION

Why study creativity? Even if this mysterious phenomenon can be isolated, quantified, and dissected, why bother? Wouldn't it make more sense to revel in the mystery and wonder of it all? From a purely theoretical standpoint, researchers and scholars are anxious to learn as much as possible about the distinctively human capacity to generate new ideas, new approaches, and new solutions. We strive to understand the experiences of Picasso, da Vinci, Einstein, and the like, and we question what, if anything, we ourselves have in common with these amazing individuals. On a more practical level, educators, parents, employers, and policy makers realize all too well that it is only with creativity that we can hope to address the myriad problems facing our schools and medical facilities, our cities and towns, our economy, our nation, and the world. Creativity is one of the key factors that drive civilization forward. As he began his administration in January 2009, U.S. President Obama called for substantial increases in federal funds for basic research and efforts to boost math, science, and engineering education; he entered office with the first-ever presidential arts platform as well. But it will take more than money and rhetoric. If we are to make real strides in boosting the creativity of scientists, mathematicians, artists, and all upon whom civilization depends, we must arrive at a far more detailed understanding of the creative process, its antecedents, and its inhibitors. The study of creativity must be seen as a basic necessity.

Creativity: the generation of products or ideas that are both novel and appropriate

In fact, scholarly research on creativity is proliferating; a variety of new publication outlets have emerged. When we started our own research careers, the *Journal of Creative Behavior* was the one periodical dedicated to the study of creativity. That publication was supplemented in 1988 by the *Creativity Research Journal*. The inaugural issue of *Psychology of Creativity, Aesthetics and the Arts*, a publication of APA division 10, came in 2007; in recent years, a variety of additional journals have also proven to be important outlets for creativity research. These include the *International Journal of Creativity and Problem Solving* and the *Journal of Thinking Skills and Creativity*. Add to this lineup the long list of books and general psychology journals publishing research in the area of creativity, and the prospect of reviewing the creativity literature becomes both daunting and exciting.

Our review attempts to encompass most of the subspecialties in the study of creativity, including the social psychology of creativity—our own area of specialization. We followed a two-part process. The first step involved the polling of colleagues, and the second step involved winnowing through our own search of the literature. To begin, we brainstormed a list of active researchers and theorists whom we believe have made the most significant contributions to the creativity literature and asked them to nominate up to 10 papers, published since about 2000, that they considered "must have" references. We contacted 26 colleagues and heard back from 21. Some of these suggested papers were self-nominations, but most were by others. In total, we received over 110 suggestions for specific journal articles, book

chapters, books, or entire volumes of a journal devoted to a particular topic.

For our own search of the literature, we conducted a thorough electronic (EBSCO) review—searching for empirical journal articles, chapters, and entire books published between 1998 and 2008 and focused on creativity. This search yielded over 400 additional citations that we believed were interesting, relevant, and potentially important. This list too had to be significantly reduced.

Perhaps our biggest surprise, in examining the suggestions made by colleagues, was just how wide reaching their recommendations were. In fact, we came to wonder and worry about why there was so very little overlap in terms of material suggested. Of the 110 nominated papers, only seven were suggested by two colleagues, and only one was suggested by three colleagues. What did this diversity of opinion, this lack of consensus, say about the state of the field? As we compiled this review, we were consistently struck by what can only be termed a growing fragmentation of the field. For the first three decades of modern psychological research into creativity (starting circa 1950), there were a small number of "big questions" that most researchers focused on: creative personality and creative thinking techniques. Then, for many years, there was an additional focus on the social psychology of creativity. Since the 1990s, we have seen a virtual explosion of topics, perspectives, and methodologies in the creativity literature. Yet there seem to be few, if any, "big" questions being pursued by a critical mass of creativity researchers. In many respects, scholars' understanding of the psychology of creativity has grown amazingly sophisticated, and we are excited by the contributions of researchers representing an ever-expanding variety of disciplines and backgrounds. But this expansion has not come without a price. It is our firm impression that investigators in one subfield often seem entirely unaware of advances in another. This means that research is often done at only one level of analysis—say, the individual or the group—and within only one discipline at a time. Of course, some of the work we review does cross levels of analysis. Where appropriate, we recognize and emphasize the overlap that already exists between the various subspecialties and approaches to the study of the psychology of creativity.

The underlying theme of this review is the need for a systems view of creativity. We believe that more progress will be made when more researchers recognize that creativity arises through a system of interrelated forces operating at multiple levels, often requiring interdisciplinary investigation. **Figure 1** presents a simplified schematic of the major levels at which these forces operate. The model is simplified because, as noted, existing research does cross levels. And, in fact, the "whole" of the creative process must be viewed as much more than a simple sum of its parts. Individuals are much

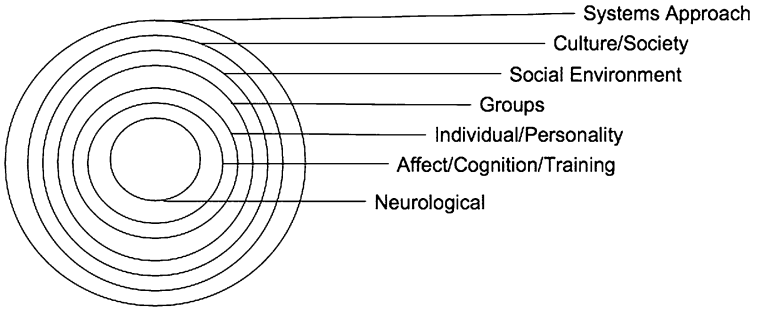

Figure 1

The increasingly large concentric circles in this simplified schematic represent the major levels at which creativity forces operate.

more than their affect, cognition, or training. And social environments or groups may be embedded within particular cultures or societies, but they also crosscut them, as when multiple cultural or religious groups live together within a society.

Figure 1 also provides the scheme we use for organizing this review. We begin with an examination of research directed at the most microscopic level—neurological activity in the brain. We then work out through ever-broadening lenses of focus and toward a review of the literature devoted to the impact of classroom or workplace environments as well as entire cultures on creative behavior. Our review ends with an overview of some of the more comprehensive theories of creativity and a call for researchers and theorists to work toward the development of entire systems perspectives.

REVIEW OF THE LITERATURE: CREATIVITY AS SEEN FROM DIFFERENT LEVELS OF ANALYSIS

Definition and Measurement

Before exploring the research being done at the various levels of our concentric circle model, it is essential to examine the current thinking and theorizing surrounding the identification of the creative person or process and the assessment of the creative product. What is it that contemporary creativity researchers claim to be investigating, and how do they operationalize this entity they call creativity? Criteria for assessing persons or products may appear to be straightforward after decades of research. But appearances deceive. Debates surrounding definition and measurement continue to loom large. Although most researchers and theorists agree that creativity involves the development of a novel product, idea, or problem solution that is of value to the individual and/or the larger social group, psychologists have had great difficulty finding consensus as to definitional components that reach beyond these two criteria of novelty and appropriateness (value).

"Big C" (eminent) creativity: relatively rare displays of creativity that have a major impact on others

"Little c" (everyday) creativity: daily problem solving and the ability to adapt to change

But this doesn't mean that researchers and theorists have given up on trying to refine their definitions and measurement techniques. Plucker & Runco's seminal (1998) review rightly declared that the death of creativity measurement had been greatly exaggerated; in fact, a number of researchers are probing issues of definition. Sullivan & Ford (2005) examined the relation between assessments of product novelty and creativity in an organizational setting. And Glück et al. (2002) investigated whether artists who face strong external constraints differ in their conceptions of creativity from artists who are free in their choice of topics, materials, and time schedule. Questions of definition and the experimental paradigms employed are becoming increasingly complex, yet our ability to precisely define what we mean by creativity remains fairly stagnant. Kaufmann (2003b) argued that the concept of creativity has been too loosely defined and inappropriately driven by a bottom-up operationalist approach. Kaufmann called for a clear-cut distinction between novelty on the stimulus and novelty on the response end as well as a new taxonomy of different kinds of creativity and intelligent behavior, including proactive and reactive creativity. In a follow-up to this proposal, Beghetto & Kaufman (2007) argued that in addition to the study of "Big C" (eminent) creativity and "little c" (everyday) creativity, it is also essential to explore what might be termed "mini c" creativity, or the creative processes involved in the construction of personal knowledge and understanding. Clearly, a creativity researcher's chosen metric and methodology will largely depend on which of the concentric circles in our model is being investigated.

The Creativity of Products. The creativity of products is typically the focus of experimental paradigms that vary the conditions under which one or more individual's creativity is assessed. Here creativity is seen as a fleeting and largely situation-dependent state (rather than a relatively stable and enduring personality trait). Although Runco maintained in his 2004 *Annual Review* article that the assessment of

product creativity is rarely used with noneminent individuals, this approach was expressly developed for and is particularly useful in the study of everyday (little c) creativity. In the contemporary literature, the identification and assessment of creative products, be they poems, paintings, scientific theories, or technological breakthroughs, rests largely on a consensual assessment process. Researchers wishing to assess the creativity of tangible products have long relied on the consensual assessment of experts, formalized for nearly 30 years in the Consensual Assessment Technique (Amabile 1982, Hennessey & Amabile 1999). Because of its relative simplicity and the consistently high levels of interrater agreements reached, this methodology enjoys wide use and continued examination in the creativity literature (e.g., Baer et al. 2004, Kaufman et al. 2007). In recent years, consensual assessment methodologies have also been extended to far more "messy" real-world classroom and workplace environments, including cross-cultural contexts (e.g., Amabile & Mueller 2008, Lee et al. 2005).

The Creativity of Persons. The creativity of persons is typically the focus of experimental paradigms, case studies, or questionnaire-based investigations that operationalize creativity as a relatively enduring and largely stable personality trait. The death of E. Paul Torrance (1915–2003) marked the end of one of the most influential careers in creativity research of this genre. Researchers have employed the Torrance Tests of Creative Thinking (TTCT; Torrance 1966/1974) for more than four decades, and these measures continue to dominate the field when it comes to the testing of individuals. With Torrance's passing came a proliferation of research projects dedicated to his memory (Fryer 2006, Kaufman & Baer 2006). Some of this research used contemporary statistical methods to address the underlying structure, reliability, and validity of the TTCT (K.H. Kim 2006, Plucker 1999). In addition, Cramond et al. (1999) and Wechsler (2006) were among a dozen or more researchers to examine and firmly establish the cross-cultural application and validity of the TTCT over the past 10 years.

Despite the wide acclaim accorded to the TTCT, many question the utility and/or psychometric properties of general tests of creative ability. Baer (2008) concluded that creativity is best conceptualized as domain specific and argued that this domain specificity explains why divergent-thinking tests have not met with more success; research by Mumford and colleagues (1998, 2008) also questioned the validity of divergent-thinking tests. However, other researchers have defended divergent-thinking measures, such as those used in the Wallach-Kogan Creativity Tests (Cheung et al. 2004, Lee 2008). A host of other researchers and psychometricians have been busy with the close examination of existing creative-ability and creative-personality measures and the development of new ones (e.g., Epstein et al. 2008, Nassif & Quevillon 2008, Silvia et al. 2008). Finally, Silvia (2008) reanalyzed "old" data with the use of advanced methodology to explore the relation of creativity and intelligence. Research has generally shown these two constructs to be modestly related; yet, some studies have contradicted this assumption. Silvia found that latent originality and fluency variables significantly predicted intelligence. The relations' magnitude ($r = 0.20$) was also consistent with previous research.

Neurological/Biological Basis

The advancement of technology, particularly functional magnetic resonance imaging (fMRI), coupled with increases in access to equipment for researchers is in large part responsible for the virtual explosion of information on the "creative brain." How does the brain generate creative ideas or solutions? At the neurological level, is there only one creative process or are there many? Is it possible to look into the brain and find evidence of creative thinking in the same way that modern cognitive neuroscientists have uncovered some of the neural underpinnings of memory, emotion, and attention? Or is creativity outside the realm of neuroscience

TTCT: Torrance Tests of Creative Thinking

fMRI: functional magnetic resonance imaging

understanding? One growing body of research attempts to uncover information about the neurological basis of creative behavior based on the study of individuals displaying aphasia or other brain abnormalities and injuries. Mell and colleagues (2003) traced the progression of aphasia symptoms associated with frontotemporal dementia in a talented artist. They observed that language is not required for, and may even inhibit, certain types of visual creativity. Miller and coworkers (2000, 2004) focused their attention on the emergence of new skills in patients with dementia and found that loss of brain function in one area may lead to facilitation of artistic or musical skills.

As early as 1998, Bowden and Jung-Beeman presented data suggesting that semantic activation in the right hemisphere may help solve insight problems. And subsequent papers by these same authors (Jung-Beeman & Bowden 2000, Bowden & Jung-Beeman 2003) built on the view that there is a strong association between semantic activation in the right hemisphere and the "Aha!" experience when people recognize solutions to insight-like problems. Using electroencephalographic topography and frequency as well as fMRI, Kounios and colleagues (2006) went on to suggest that mental preparation leading to insight involves heightened activity in medial frontal areas associated with cognitive control and in temporal areas associated with semantic processing. Noninsight preparation, in contrast, appears to involve increased occipital activity consistent with an increase in externally directed visual attention. Taken together, these investigations have offered exciting evidence of how behavioral priming and neuroimaging methods can provide information about neural activity during insight.

In addition to empirical explorations of the creative process at the neuronal level, there is theoretical work. For example, Vandervert and his coinvestigators (2007) cited the centrality of novelty and originality in creative thought and argued that, because the cerebellum increases the rapidity and efficiency of memory routines, it likely plays a central role in the creative process. However, several authors offered incisive critiques of this model (Abraham 2007, Brown 2007). In summary, although technological advances have increased exponentially, scientists interested in the neurological basis of creative behavior have a long way to go before they can hope to reach consensus. As they proceed down this groundbreaking and ever-changing investigative path, researchers must make certain that it is sound theorizing and data that drive their use of new technologies and not the technologies themselves that dictate future research questions and directions. The possibilities are promising, but we are not anywhere near the point of being able to image the creative process as it unfolds in the human brain. Even cutting-edge instruments mask the order in which various brain areas become activated in the massive parallel processing that results in high-level creativity (Miller 2007).

Affect, Cognition, and Training

Affect. Most experimental studies of affect and creativity have shown that positive affect leads to higher levels of creativity. When negative affect has an influence, it is generally negative. The bulk of this research indicates that positive affect facilitates not only intrinsic motivation (e.g., Isen & Reeve 2005) but also flexible thinking and problem solving even on especially complex and difficult tasks (see Aspinwall 1998, Isen 2000). Yet the affect-creativity association is complicated. Kaufmann (2003a) refutes the mainstream argument that positive mood reliably facilitates creativity. Some studies have shown that positive mood may facilitate productivity but not quality of ideas (e.g., Vosburg 1998). Other researchers have found that although positive affect manipulations may enhance mood and reduce state anxiety, they do not necessarily enhance divergent thinking (e.g., Clapham 2001).

Conflicting evidence comes from nonexperimental settings, as well. George & Zhou (2002) found that, under certain specific conditions within an organization, negative affect can lead to higher creativity than positive

Intrinsic motivation: the drive to engage in a task because it is interesting, enjoyable, or positively challenging

Divergent thinking: spontaneous, free-flowing thinking with the goal of generating many different ideas in a short period

affect: the work context must call for high levels of creativity, and the individual's clarity of feelings must also be high. On the other hand, another organizational study (Madjar et al. 2002) found a generally positive role for positive affect in the workplace. In this study, positive mood mediated the significant positive relationship between the support that employees received for workplace creativity and their creative performance at work. Searching for more definitive answers, Amabile and colleagues (2005) obtained multiple daily measures of affect from 222 employees in seven different companies over several weeks, as well as multiple measures of creativity. They found a positive linear relationship, with positive affect an antecedent of creativity. Another study (George & Zhou 2007) also suggested a primacy for positive affect. In this study of employees in a single company, creativity was highest when both positive and negative moods were high and the supervisory context was supportive. However, this study also found a positive main effect for positive mood.

These opposing viewpoints and the data driving them argue for more nuanced views of the impact of affect on cognitive activity. In their mood-as-input model, Martin and colleagues (1993) proposed that positive moods signal to individuals that they are safe, motivating them to seek stimulation and think expansively, making more flexible associations. Negative moods signal that there are problems at hand, motivating individuals to think precisely and analytically. Similarly, the dual-tuning model proposed by George & Zhou (2007) asserts that employees should benefit creatively by experiencing both positive and negative moods over time in a supportive context. Positive mood leads to expansive, playful, divergent thinking and the generation of new ideas. Negative mood signals that something is problematic and pushes employees to try hard to improve matters through creative ideas—careful, systematic information processing. The result of both processes is good, well-thought-out ideas that are really creative. Some recent experiments support these views of the different supporting roles that positive and negative affect might play in the creative process (De Dreu et al. 2008, Friedman et al. 2007). Clearly, the question of the role of affect in creativity is not settled. However, it appears likely that, all else being equal, positive affect is more conducive to creativity than is negative affect.

Cognition. A review of recent work focused on the cognitive processes underlying creative performance reveals that this branch of the literature is also particularly diverse. Recently, an entire volume of the *Korean Journal of Thinking and Problem Solving* (Volume 18, 2008) offered a representative sample of the wide range of experimental and theoretical approaches being taken by researchers. The variety of investigative paths is almost as great as the variety of experimental questions being asked. For example, Kaufman & Baer (2002) employed both self-report and case-study methodologies to conclude that the cognitive mechanisms underlying creative performance are domain specific, with the likely exception of g (a general intelligence factor). Kray and colleagues (2006) explored what they termed a "relational processing style" elicited by counterfactual mind-sets. More specifically, they asked study participants to compare reality to what might have been and in so doing encouraged them to consider relationships and associations among stimuli. They found that, although such mind-sets can be detrimental to novel idea generation, they can improve performance on creative association tasks. Miller (2007) found a significant relation between field independence and creativity on a collage-making task. Necka (1999) presented experimental evidence linking creativity with impaired functioning of what he termed the "filter of attention." Groborz & Necka (2003) reported data arguing for the importance of "cognitive control" in the attentional process, and Zhengkui and colleagues (2007) provided a comprehensive review of the research on creativity and attention.

A large body of research has pointed to the importance of conceptual combination in creative thought. Ward (2001) argued for a

"convergent approach" to the study of conceptual combination—incorporating both anecdotal accounts and laboratory investigations of the creative process. Treffinger & Selby (2004) presented a rubric intended to characterize individual differences in problem-solving style involving Orientation to Change, Manner of Processing, and Ways of Deciding. And Scott et al. (2005) described an elegant experiment designed to compare and contrast an analogical approach to generating combinations (involving feature search and mapping) with a case-based approach (integrating and elaborating on event models). In summary, the literature linking cognitive processes and components to creative behavior is plentiful but murky. Perhaps Mumford & Antes (2007) best summarized the state of the field when they called for caution to be applied in any attempt to account for creative achievement based on a single model of the kind of knowledge or cognitive processes involved.

Training. Armed with these new investigations of the role of affect and cognition in the creative process, are we any better equipped to *train* persons to be creative? When compared to the ongoing extensive investigative work on individual differences or affect and creativity, studies of the efficacy of creativity training have been relatively sparse. Svensson and colleagues (2002) undertook three experimental studies involving high school and university students in Sweden. In one study, the efficacy of two creativity-enhancement techniques borrowed from the work of deBono, random word input and provocation, was investigated. In a pretest/post-test design, it was found that post-training levels of fluency were lower, in fact, for the experimental group than for a no-training control group. The remaining two studies reported in this paper contrasted the effects of working individually or as a group. In both of these investigations, group work was found to produce better results on various measures of creativity (fluency, flexibility, and originality), but total fluency was higher for study participants working alone.

Interestingly, many of the more recent training investigations have focused on populations outside the United States. For example, Basadur et al. (2002) reported that training methods previously shown to be effective in helping North American and Japanese adults improve their divergent thinking skills were also applicable to Spanish-speaking South American managers. Arguing that training for divergent thinking skills often involves a large number of moderated sessions, Benedek and colleagues (2006) then set out to explore whether a computer-based divergent thinking training approach could effectively enhance the ideational fluency and originality of Austrian adults through the provision of repeated practice. A study comparing computer-based training designed to promote creativity in the verbal domain (e.g., generating nicknames and slogans) with computer training focused on creative tasks not requiring verbal creativity (e.g., coming up with unusual uses for objects) and a control (no training) group revealed significant training effects for both computer training approaches. Study participants receiving training showed significant gains in what the authors termed "intelligent-independent" aspects of ideational fluency, but no training effects were found for originality of ideas.

Focusing on insight problem solving among American adults, Dow & Mayer (2004) asked whether problem solution depends on domain-specific or domain-general problem-solving skills. Across two separate investigations, study participants who received training in spatial insight problems performed better than a verbal-insight-trained group on spatial problems. However, no other performance differences emerged between subjects receiving verbal, mathematical, spatial, or verbal-spatial training who were later asked to solve insight problems in these four category groups. Garaigordobil (2006) also explored the efficacy of training, this time with a sample of Spanish children. There was a positive effect of the intervention, with children making significant improvements in verbal creativity (originality) and graphic-figural

creativity relative to a control/no-intervention group.

Is it possible to generalize about the efficacy of well-designed creativity training attempts? Scott and colleagues (2004) believe so. These researchers carried out a quantitative, meta-analytic review of 70 prior studies and found that carefully constructed creativity training programs typically result in gains in performance, with these benefits generalizing across criteria, setting, and target population. Delving deeper, these authors found that the more successful training programs tend to employ realistic exercises that focus on the development of cognitive skills and heuristics for the application of those skills.

Individual Differences/Personality

The empirical study of creativity was originally focused at the level of the individual, and many recent contributions to the literature continue to explore the question of what distinguishes highly creative persons from the rest of us. Research and theorizing in the area of creativity has much in common with studies of personality, as both fields concentrate on uniqueness. An extensive literature review focused on the personality and individual difference variables common to highly creative persons reveals that many things seem to be true of at least some creative people but not necessarily all of them. In other words, this body of work is especially difficult to decipher, although a meta-analysis carried out by Feist (1998) highlighting personality differences between scientific and artistic creators has proven helpful in this regard.

The Big Five model of personality continues to shape investigations in this area, and a good deal of research attention has also been paid to the traits labeled "openness to experience" and "latent inhibition." Low levels of latent inhibition, associated with the inability to shut out the constant stream of incoming stimuli, have been found to predict trait creativity (e.g., Carson et al. 2003). Trait creativity has also been linked to high levels of openness to experience (e.g., McCrae 1987, Perrine & Brodersen 2005), and at least two investigations have shown a negative correlation between latent inhibition and openness to experience (Peterson & Carson 2000, Peterson et al. 2002). Amabile et al. (1994) were among the first to explore a link between creativity and trait-intrinsic motivation, describing it as the drive to engage in work out of interest, enjoyment, and personal challenge. Although most of the literature linking motivational orientation with creativity has focused on intrinsic motivation as a situation-specific state, interesting recent work by Prabhu and colleagues (2008) confirmed that intrinsic motivation is also an enduring personality trait with a positive relation to creativity. There has also been ongoing interest in the developmental trajectory of a variety of other personality traits linked to creativity, with work done by Helson and colleagues continuing to dominate in this area (Helson & Pals 2000, Helson & Srivastava 2002).

Case studies published in *American Psychologist* (April 2001) revealed just how difficult the attempt to identify individual difference variables essential for creativity has proven to be. In a follow-up discussion of individual differences and creativity (*American Psychologist*, May 2002), a second set of papers argued for the central importance of a sense of curiosity (Kashdan & Fincham 2002) and self-confidence for creative behavior. Lower levels of self-confidence may actually predict higher levels of creativity (Kaufman 2002).

Individual Differences in Intelligence. Individual differences in intelligence were explored by Feist & Barron (2003) as they traced the developmental trajectories of creative persons and placed particular emphasis on the stability/instability of intelligence and intellectual giftedness. Similarly, James & Asmus (2001) examined the interface between personality and cognitive ability as they attempted to better understand sources of creativity within the individual. Although some researchers and theorists have found important parallels between the investigation of creativity and giftedness (Hennessey 2004), research tells us that these

Trait creativity: creativity viewed as a relatively stable individual-difference variable

two constructs should not be equated. Winner (2000) and Runco (1999) found that the skills and personality factors required to be a creator are very different from those typical of highly gifted children. And taking a different approach, Sternberg (2001) argued that creativity is best understood in terms of its dialectical relation to intelligence and wisdom. According to this formulation, intelligence is most often used to advance existing societal agendas, whereas creative thinking often opposes these agendas and proposes new ones. Wise people recognize the need to strike a balance between intelligence and creativity/the old and the new to achieve both stability and change within a societal context.

Gender Differences. Gender differences also continued to garner research attention, with mixed results. Ai (1999) investigated the relation between creativity and academic achievement in Spanish secondary students and showed that when operationalized by teachers' ratings, creativity was related to academic achievement for both males and females. For males, flexibility was the predominant factor. For females, elaboration and fluency played a significant role. In a related investigation again involving adolescents, Jiliang & Baoguo (2007) found no gender differences in scientific creativity on ratings of fluency or flexibility, but on originality, high school males significantly outperformed females. In addition, male scores on figural tasks were significantly higher than female scores. One possible explanation for these gender differences comes from Conti and coinvestigators (2001), who found that boys and girls react very differently to situations of extrinsic constraint. In situations involving competition, boys who had been segregated by gender reported significantly higher levels of both intrinsic and extrinsic motivation than did girls who had also been segregated by gender. Finally, Lee (2002) found that for college students completing problem-solving and problem-finding tasks, neither gender nor education exerted significant influence on creative thinking abilities in real-life situations.

Psychopathology. Psychopathology and the age-old question of whether there exists a systematic relation between creativity and mental illness continue to loom large in the literature. Becker (2001) and Sass (2001) examined how specific intellectual assumptions have, over time, transformed into a widely held belief that precludes the possibility of total mental health and sanity for the creative genius. Rothenberg (2006) also made a strong case for the fact that the literature linking creativity and mental illness is severely flawed. Despite these protestations, there is substantial research evidence of a link between psychopathology, most especially schizotypy, and creative behavior. Prentky (2001) found a greater-than-chance probability that highly creative individuals will evidence signs or symptoms of mental illness and proposed that certain biologically based cognitive styles that are peculiar to extraordinary creativity possess common biological ancestry with another group of cognitive styles that are associated with a predisposition to major mental illness. Other studies, using nonclinical populations, have found similar associations (e.g., Abraham & Windmann 2008, Cox & Leon 1999).

However, Chávez-Eakle and colleagues (2006) observed that highly creative achievers scored especially low on psychopathology and that psychopathology was more related to personality than to creativity. In another study focused on psychiatric patients, Ghadirian and colleagues (2001) reported no difference in the creative abilities of persons with bipolar illness as compared to those with other types of psychopathology. In an attempt to synthesize this work, Nettle (2006) suggested that these findings might be explained by a sort of "hybrid" model whereby schizotypal personality traits can have fitness advantages or disadvantages, with mutational load and neurodevelopmental conditions determining which outcome (promotion or hindrance of creativity) is observed.

Groups and Teams

Investigations of creative behavior and the creative process have, over time, shown a

progression from attention to the individual to a focus on the creative performance of groups. In recent years, much of the theorizing and research surrounding the creative process has been targeted at this group level, and there are many important parallels between this work and the creativity training literature reviewed above. Continued and widespread interest in the question of whether creative thinking and problem solving can be trained is clearly due to the fact that in most organizational settings requiring innovative product development and problem solutions, workers are expected to become increasingly creative as they collaborate in project teams. The organizational literature is presented in a later section. Here the focus is on more general studies of creativity in groups.

Over the past decade, research on creativity within groups has undergone a significant shift—away from the simplistic conclusion that individuals can almost always be expected to outperform groups toward a far more nuanced understanding of the group process and a fine-tuning of experimental design as well as models of group interaction, motivation, and disposition. Much remains unknown about the creative process within groups, but significant progress has been made. In two separate investigations, a comparison of students working alone or in a group revealed that although group work produced better results on various measures of creativity, fluency scores were higher for individuals working alone (Svensson et al. 2002). In fact, research on creative problem solving (Osborn 1953, 1957, 1963, 1967; Parnes 1966; Treffinger & Isaksen 1992; Treffinger et al. 2006) typically shows that the performance of individuals is generally superior to that of groups. But some investigators have speculated that this pattern of results may have been driven by the specific experimental tasks, concepts, and research methods employed. Brophy (1998a,b) proposed a "tri-level matching theory" as a way of integrating and explaining contradictory experimental findings. He pointed out that creatively solvable problems vary considerably in their complexity, requisite knowledge base, and the amounts of divergent and convergent thinking that are needed. This model emphasized the fact that a complete creative problem-solving process entails both considerable convergent and divergent thought in continuing alternation, and it predicted that individuals, teams, and entire organizations with different preferences and abilities, knowledge, and work arrangements would be good matches for some problems and poor matches for others. Brophy (2006) later found empirical support for this model. In the same vein, Larey & Paulus (1999) found that brainstorming groups performed better when their members were assigned to the groups based on their preferences for working and interacting in groups. Paulus & Yang (2000) discovered two important factors that enabled idea sharing in groups to become more productive: (*a*) the extent to which group members carefully processed the ideas exchanged in the group (attention) and (*b*) the opportunity for group members to reflect on the ideas after the exchange process (incubation).

Convergent thinking: more disciplined thinking, focused on narrowing possibilities to a workable solution

Increasingly, research, theory, and applied work on group creativity has merged with and relied on the use of computers. Brown & Paulus (2002) argued that group brainstorming can be an effective technique for generating creative ideas, based on computer simulations of an associative memory model of idea generation in groups. Also working from a cognitive/computer modeling perspective, Nijstad & Stroebe (2006) offered the SIAM model (Search for Ideas in Associative Memory), which they believe could account for various research findings on group idea generation. This model assumes that idea generation is a repeated search for ideas in associative memory, which proceeds in two stages (knowledge activation and idea production) and is controlled through negative feedback loops and cognitive failures (trials in which no idea is generated). This formulation showed that turn taking (production blocking) interfered with both stages of the process. Ideas suggested by others aided the activation of problem-relevant knowledge, and cognitive failures were important negative determinants of brainstorming persistence, satisfaction, and enjoyment. The different ways

that computers can be involved in creative work were further examined in a special issue of the *International Journal of Human-Computer Studies* (2007, volume 63), where the contributing authors concluded that computers may facilitate not only communication between persons collaborating on creative projects but also the management of creative work, the use of creativity-enhancement techniques, and the creative act through integrated human-computer cooperation during idea production.

Creativity in Workplace Groups. There has been a general acknowledgment that most creative work that gets done in organizations is accomplished by two or more individuals working closely together (see Thompson & Choi 2006). Thus, although our section on organizational creativity appears later in this article, we review this part of the literature here. (As we noted in the introduction, the neatly nonoverlapping nature of the concentric circles in **Figure 1** is a convenient artifice.) One study in the comic book industry uncovered evidence that simply working in a team can, under the right circumstances, produce more creative results than working individually (Taylor & Greve 2006). On average, single creators had lower performance than did teams, and the team experience of working together increased performance. Hargadon & Bechky (2006) did a qualitative study of six professional service firms to identify behaviors leading to "moments of collective creativity." They identified four sets of interrelated behavior patterns that moved teams beyond individuals' insights: (*a*) help seeking, (*b*) help giving, (*c*) reflective reframing, and (*d*) reinforcing.

Taggar (2002) studied some facilitative team processes, examining the performance of 94 groups on 13 different open-ended tasks. At the individual-team-member level, domain knowledge and performance-relevant behavioral measures of the three components of Amabile's (1983, 1996) model of individual creativity related in predicted ways to individual differences. Support was found for new cross-level processes, labeled "team creativity-relevant processes." At the group level, these processes moderated the relationship between aggregated individual creativity and group creativity.

Work Group Diversity. Research on diversity has been one of the more active areas in organizational creativity scholarship over the past decade. Most of this work has focused on diversity in teams. Kurtzberg & Amabile (2001) suggested that the types and amount of team conflict that arise from the diversity of team members might be particularly influential in affecting outcomes. Two empirical studies exploring diversity (Kurtzberg 2005) compared and contrasted objectively measured creative fluency and subjectively perceived creativity in cognitively diverse teams. Results indicated that, although cognitive diversity may be beneficial for objective functioning, it may be detrimental to team satisfaction, affect, and members' impressions of their own creative performance.

Indeed, a recent review of the literature on this topic suggests that team diversity can just as easily lead to negative as to positive outcomes. Mannix & Neale (2005) conducted a review of 50 years of research and concluded that the preponderance of evidence yields a pessimistic view: Group diversity creates social divisions, with negative performance consequences. The authors suggest that more positive effects, such as creativity, can arise from underlying differences such as functional background, education, or personality—but only when the group process is managed carefully.

Polzer and colleagues (2002) studied one approach to managing group process that can yield creative benefits under team diversity: interpersonal congruence, the degree to which group members see others in the group as those others see themselves. This longitudinal study of 83 work groups revealed that diversity (on sex, ethnicity, and other dimensions) tended to improve creative task performance in groups with high interpersonal congruence but undermined the performance of groups with low interpersonal congruence. Surprisingly, some

diverse groups were able to achieve enough interpersonal congruence during their first 10 minutes of interaction to enable better group outcomes four months later.

The Social Psychology of Creativity

Previous research has firmly established that the social environment can significantly influence an individual's motivation for doing an activity, which in turn can significantly influence creative performance. This is the intrinsic motivation principle of creativity: Intrinsic motivation, defined as the drive to do something for the sheer enjoyment, interest, and personal challenge of the task itself (rather than for some external goal), is conducive to creativity, whereas extrinsic motivation is generally detrimental. Probing further, experimentalists have determined that a variety of extrinsic constraints and extrinsic motivators can undermine intrinsic motivation and creativity, including expected reward, expected evaluation, surveillance, competition, and restricted choice. Investigators examining the social psychology of creativity have found that intrinsic motivation for a particular task can be ephemeral and, thus, quite susceptible to social-environmental influences. In fact, the undermining effect of extrinsic constraints is so robust that it has been found to occur across the entire lifespan, with preschoolers and seasoned professionals experiencing the same negative consequences of expected reward and other extrinsic motivators and constraints. (For a review of this research, see Amabile 1996; see also Hennessey 2003.)

Two recent nonexperimental studies in organizations also support the intrinsic motivation principle of creativity. Shin & Zhou (2003) found that the intrinsic motivation of Korean high-tech employees partially explained their creativity. Another study, using survey data from 165 employees and their supervisors who worked in research and development in a large U.S. organization, assessed employee intrinsic motivation and willingness to take risks, along with supervisor-rated creativity (Dewett 2007). Results showed that "one fundamental antecedent to employee creativity is intrinsic interest in one's work" (p. 204). Interestingly, willingness to take risks mediated the effect of intrinsic motivation on employee creativity.

When investigations of the effects of extrinsic constraints began about 30 years ago, it was thought that the determinants of task-motivational orientation were straightforward. Intrinsic and extrinsic motivation were believed to interact in a sort of hydraulic fashion. High levels of extrinsic motivation were thought to preclude high levels of intrinsic motivation; as extrinsic motivators and constraints were imposed, intrinsic motivation (and creativity) would necessarily decrease. Now, many years and hundreds of investigations later, most researchers taking a social-psychological approach to the study of creativity have come to appreciate the many complexities of both motivational orientation and extrinsic motivators, particularly expected reward. They have come to supplement the original hydraulic conceptualization with an additive model that recognizes that under certain specific conditions, the expectation of reward can sometimes increase levels of extrinsic motivation without having any negative impact on intrinsic motivation or performance. Specifically, rewards undermine intrinsic motivation and creativity when they lead people to feel controlled by the situation—that is, when self-determination is undermined (see Deci & Ryan 2002, Ryan & Deci 2000). However, rewards can actually enhance intrinsic motivation and creativity when they confirm competence, provide useful information in a supportive way, or enable people to do something that they were already intrinsically motivated to do. These boosting effects are most likely when initial levels of intrinsic motivation are already strong (Amabile 1993).

Some researchers trained in the behaviorist tradition have offered the strongly contrasting view that creativity can be *easily* increased by reward and is seldom undermined. These scholars, most notably Eisenberger, Cameron, and colleagues (Cameron & Pierce 1994; Eisenberger & Cameron 1996, 1998; Eisenberger & Selbst 1994), maintain that any

detrimental effects of reward occur only under limited conditions that can be easily avoided. A debate over these issues surfaced in the literature in the mid 1990s, prompting researchers and theorists on both sides of the argument to publish a series of heated commentaries, critiques, and replies (see Eisenberger & Cameron 1996, 1998; Hennessey & Amabile 1998; Lepper 1998; Sansone & Harackiewicz 1998). At the core of this debate were important differences in the definitions of creativity driving investigations, the algorithmic or heuristic nature of the experimental tasks employed, and the instructions given to study participants.

Studies influenced by the behaviorist tradition have typically used dependent measures that equate creativity with novelty, and have often instructed participants to be creative (sometimes with details on the kinds of responses that would receive high creativity ratings). As Eisenberger & Shanock (2003) themselves point out, "Behaviorists have been careful to make sure the reward recipients understand that reward depends on novel performance" (p. 124). O'Hara & Sternberg (2001) specifically examined the effects of directives to "be creative." Precise instructions to be creative, practical, or analytical resulted in college students demonstrating higher levels of performance in whichever of the three areas had been targeted. These findings suggest that results of the behaviorist studies demonstrate positive effects of instructions, rather than positive effects of expected rewards, on creativity. Other experimental research also calls into question the purported ease of enhancing creativity through use of reward (Joussemet & Koestner 1999).

Despite results such as these, inconsistent with the assertion that expected rewards generally foster creativity, the debate has continued through much of the past decade. Perhaps as research programs and the theories they generate become increasingly nuanced, this rift between the two philosophical camps may narrow. In the meantime, researchers and theorists studying the social psychology of creativity have made good progress in expanding their investigative paradigms and theoretical perspectives. No longer do the variables of interest include only expected reward or other extrinsic motivators and constraints. Rather, they have expanded to include a wide range of social influences and processes. In addition, theoretical perspectives have broadened far beyond those of social and personality psychology. For example, Mouchiroud & Lubart (2002) studied the development of social creativity (original solutions to interpersonal problems) in children, and Perry-Smith (2006) studied the effects of social networks on creativity in an organizational setting.

Social Environment: Organizations

Scholars of organizations, many of whom are trained research psychologists, have increasingly turned their attention to creativity in the workplace. In the concentric circle rubric presented at the beginning of this review, the study of organizational creativity falls in the "social environment" circle. Although much research in this arena does focus on the work environment, a meaningful proportion of this literature considers more microscopic levels, including individual-difference studies and even some physiological studies. In recent years, a number of good reviews of this literature have been published, including those by prominent organizational creativity scholars Jennifer George, Christina Shalley, Jing Zhou, and Greg Oldham (George 2007, Shalley et al. 2004, Shalley & Zhou 2008). In addition, two recent edited volumes address organizational creativity (Thompson & Choi 2006, Zhou & Shalley 2008).

To some extent, the organizational creativity literature mirrors the creativity literature in general psychology. However, the greatest volume of work—and the most significant work in terms of application—concerns the social psychology of creativity. This work focuses primarily on the impact of the social environment or the work environment (generally as created by leaders or managers) on the creativity of individuals, groups, or entire organizations. Some research has even examined support for work creativity outside of the workplace.

Social Behaviors Supporting Creativity. A few studies have investigated particular behaviors of other people that support (or undermine) individuals' creativity in organizations. Team leader behavior was examined in microscopic detail in a longitudinal field study by Amabile and colleagues (2004). This study first established that perceived team leader support positively related to the peer-rated creativity of 211 individuals working on creative projects in seven companies. Qualitative analyses of the individuals' daily work diaries over several weeks revealed both positive and negative predictors of perceived leader support, in terms of specific leader behaviors. Positive predictors included showing support for the person's actions or decisions, providing constructive feedback on the work, and recognizing good performance. Negative predictors included checking on assigned work too frequently, failing to disseminate needed information, and avoiding solving problems.

The valuing of creative work is something that leaders of an organization do (or do not) communicate. Farmer and colleagues (2003) found that individuals' creativity at work was highest when they both perceived themselves as creative employees and perceived their organizations as valuing creative work. Creativity at work can even be supported by the behavior of important others outside of work. Madjar and colleagues (2002) found that the creative performance of employees was significantly related to support for creativity from both work (supervisors/coworkers) and nonwork (family/friends) sources. Positive mood mediated these relations.

Specific Aspects of the Work Environment. Of all specific aspects of the work environment, time pressure has perhaps received the most research attention recently from organizational psychologists studying creativity. Studies searching for simple linear relations have generally found no relation or weak negative relations (Amabile et al. 1996, 2002), indicating that, overall, time pressure may be detrimental to creativity at work. However, it appears that this is an oversimplification. Indeed, the influence of time pressure may be one of the most complex in the organizational creativity literature. For one thing, traits may play a role in people's response to time pressure at work, as demonstrated in an experiment by Madjar & Oldham (2006). Polychronicity is an individual-difference variable: the number of tasks with which an individual prefers to be involved at the same time. Participants exhibited higher creativity in the task condition that matched their individual preference, and perceived time pressure mediated these effects. Individuals perceived lower time pressure in conditions that matched their preference, which then contributed to higher levels of creativity.

Baer & Oldham (2006) showed that the level of time pressure matters, in a somewhat complicated person-by-situation interaction. They discovered an inverted-U relation between time pressure and creativity for employees who scored high on the personality trait of openness to experience while simultaneously receiving support for creativity. This inverted-U relation was essentially replicated by Ohly and coauthors (2006), who controlled for supervisory support for creativity but did not assess personality. Amabile and coauthors (2002) carried out a longitudinal field study suggesting that daily workplace creativity may depend on both the level and the type of time pressure. In general, the effects of time pressure on creativity were negative. However, the type of time pressure was important. Most high-time-pressure days were marked by fragmentation in the work and lack of focus on single important problems. But if individuals were protected from distractions and fragmentation under high time pressure, and if they believed in the importance of the problem they were trying to solve, creativity was enhanced. In fact, on such (relatively rare) high-time-pressure days, creativity could be as high as on low/moderate-time-pressure days.

Psychological safety, an environmental condition in which people believe that others in their group will respond positively when they

speak up about concerns, report mistakes, or propose new ideas, is another work environment aspect that can be important in organizational creativity. Edmondson & Mogelof (2006) proposed that psychological safety is crucial for creativity in organizations because creativity involves so much risk-taking, experimentation, and frequent failure. In a study using data collected at three points in time from teams working on complex projects, these researchers found that individual-level and team-level variables at a particular time predicted psychological safety at a later time, but that team-level variables accounted for considerably more variance. Positive interactions within the team and with the team leader were important, as was clarity of goals for the project (particularly toward the end of the project). Another study, involving 43 new product teams composed of diverse functions (e.g., research and development, marketing, and manufacturing), found that the effect of task disagreement on team innovativeness depended on how free members felt to express task-related doubts and how collaboratively or contentiously these doubts were expressed (Lovelace et al. 2001). Gibson & Gibbs (2006) found that a psychologically safe communication climate can help mitigate several challenges faced by virtual teams attempting to produce innovative outcomes.

Autonomy in the work, leading employees to feel a degree of empowerment, has long been postulated as an important feature of the work environment for fostering creativity. The theoretical argument is that to the extent that employees feel a degree of ownership in and control over their work, they will be more intrinsically motivated and thus more likely to fully engage their cognitive processes in solving problems in the work. Alge and colleagues (2006), in two studies, found a connection between empowerment and creativity: Organizations that respect the privacy of employees' personal information enhance employee perceptions of empowerment, which in turn enhances employee creativity.

Feedback, monitoring of work, and evaluation of work are closely related and can have quite different effects on creativity depending on how they are delivered. In a chapter reviewing a great deal of empirical research, Zhou (2008) presented a summary of how feedback can affect creativity. She suggested that supervisors can affect employee creativity positively by (*a*) giving positive feedback whenever possible; (*b*) delivering both positive and negative feedback in an informational style (with the supervisor suggesting that the goal of the feedback is not to control the employee, but instead to help the employee develop creative capabilities and performance); (*c*) adopting a developmental orientation when giving feedback—giving employees valuable information that will enable them to learn, develop, and make improvements on the job, implying that they can constantly get better; and (*d*) focusing feedback on the task, not the person.

Organizational creativity scholars have also studied the environmental condition of goal setting. General studies of the work environment (e.g., Amabile et al. 1996) suggest that clear overall goals for work projects support creativity. However, Shalley has carried out a systematic research program to examine the effects of setting specific creativity goals—a topic that others have recently investigated as well. In a review chapter on supervisory goal-setting research, Shalley (2008) suggested, "if managers would like their employees to be more creative, they need to find ways to encourage employees to undertake creative activities. A major way to do this is by creating role expectations either by setting goals or making creative activity a job requirement. Further, organizations need to make sure that the work context supports these goals or job requirements. . ." (p. 160).

Although goal setting might be viewed as a kind of constraint on creativity, other researchers have taken up the question of constraints much more directly, by studying the effects of external demands on workplace creativity. In a review chapter, West and coauthors (2005) defined external demands on a work group as crises or severe constraints that come from the external environment within the organization or the wider society and impinge on

the individual or team attempting to do creative or innovative work. These authors, like most in the field, see creativity as the generation of new and useful ideas, with innovation being the implementation of creative ideas. They suggest that because creativity requires a nonconstrained, undemanding environment, external demands have a negative impact on group creativity. However, because external demands can positively influence group processes such as cohesion, task focus, and clarity of team objectives, demands can have a positive impact on group innovation. Thus, it is important for managers to understand the stage of the creativity-innovation process in considering the imposition of demands on a team.

In summary, it appears that constraints and pressures in the work environment (except for one rare form of time pressure) are detrimental to creativity, whereas organization-wide supports, psychological safety, sufficient time, autonomy, developmental feedback, and creativity goals are facilitative.

Social Environment: Schools

In addition to the workplace, the other obvious setting for the real-world application of the social psychology of creativity literature is the classroom. Although creative performance may not be as central or universal a goal in schools as it is in the business world, the development of student creativity is crucial for economic, scientific, social, and artistic/cultural advancement. It is essential that we come to a far deeper understanding of how teaching techniques, teacher behavior, and social relationships in schools affect the motivation and creativity of students. Sternberg (2008) offered a thoughtful paper arguing for the application of psychological theories to educational practice, yet a review of the recent educational literature reveals surprisingly few direct investigations of creativity in the classroom. Plucker and colleagues (2004) reviewed the literature and concluded that a preponderance of myths and stereotypes about creativity as well as a failure to precisely define creativity has served to strangle most research efforts on the part of educators. A recent paper by Sawyer (2006) painted a similarly bleak picture. Sawyer contended that American educational researchers have paid very little scholarly attention to the fact that the majority of the world's most developed countries, including the United States, have now made a shift from an industrial economy to an economy that is knowledge based. According to Sawyer (2006), many features of today's schools have become obsolete—to the point that the U.S. educational system needs to be entirely restructured around disciplined improvisational group processes and creative collaboration. Essential to this restructuring will be carefully controlled empirical research investigations designed to help educators determine which educational innovations actually promote student creativity and why.

Innovation: the successful implementation of creative ideas

How are researchers to carry out such investigations? If the results warrant it, how are they to convince policy makers that the time has come for fundamental school change? How are they to convince educators that the promotion of student creativity is a desirable goal? A study carried out by Scott (1999) investigated attitudes held by elementary school teachers and college students about creative children. Results showed that teachers were significantly more likely than college students to rate creative children as more disruptive than their more "average" peers. In fact, this bias against unique answers or problem solutions was even found in a sample of prospective teachers who had yet to head up their own classroom (Beghetto 2007). In U.S. schools, creativity is not always seen as a desirable trait. Yet at least a small body of research into the psychology of educational creativity exists.

Ruscio & Amabile (1999) explored the impact of two different instructional approaches on the creative problem solving of college students. Study participants completed a novel structure-building task after receiving algorithmic instruction, heuristic instruction, or no instruction. Type of instruction influenced students' perceptions of the task, their behavior during the task, and their final solution to the

structure problem. Study participants receiving algorithmic instruction showed greater confidence and speed, but they were significantly less likely than students receiving heuristic instruction to engage in exploratory behavior or to produce final products that deviated from the sample structure.

Researchers in Great Britain have recently contributed a small number of important empirical investigations of creativity in the classroom. Focusing on the creativity of young students, Cremin and collaborators (2006) reported findings of a 12-month-long investigation of children's "possibility thinking" and their teachers' pedagogical practices that foster this important component of creative behavior. In another longitudinal study, Claxton et al. (2005) followed the developmental trends in creativity from the period of the so-called fourth-grade slump through the ninth-grade year. And in a related paper, Claxton and colleagues (2006) made the argument that British schools must move from "allowing" creativity to *developing* creativity in the classroom. In support of this position, these researchers offered practical examples from action research projects designed to develop "habits of mind" conducive to creativity.

The fact that, in recent years, relatively few investigators and theorists in the industrialized nations of the West have chosen to explore creativity in the classroom stands in striking contrast to the research situation in other parts of the world. In fact, a review of the literature reveals a virtual explosion of interest in this area—especially in Asia. Consider the example of Singapore. For more than 20 years, the nation of Singapore has made the fostering of creativity in the schools a top priority (see Tan & Law 2000). In the past decade, Tan and colleagues have conducted many empirical investigations of creativity in the classrooms of Singapore. In a 2000 paper, Tan explored students' and teachers' perceptions of activities useful for fostering creativity and found that as students grow older, their views begin to more closely reflect those of their teachers; these data were then supplemented with a second paper (Tan & Law 2002). Tan & Rasidir (2006) investigated children's views of the behaviors they believe make for a creative teacher. Also focused on students in Singapore was an empirical investigation carried out by Majid and colleagues (2003). This study contrasted the efficacy of the Internet and SCAMPER (Eberle 1997), a well-known technique based on the presentation of directed questions, in promoting the creativity of primary school children. Results revealed that students who used Internet resources targeting children's writing skills demonstrated improvement in their creative writing in terms of both fluency and elaboration. Children using SCAMPER did not show any obvious improvements.

Two studies considered Japanese educational approaches and their possible impact on creativity. DeCoker (2000) looked at U.S. education through the eyes of Japanese teachers. Twenty-four Japanese teachers visited a U.S. school for one month. Their unanimous conclusion was that schools in America were far stricter, discipline was far more punitive, and classrooms were far more rule bound, than in Japan. When it came to creativity in these schools, these visitors worried most about the strict grading policies in force at the high school level. In sum, DeCoker (2000) concluded that although the majority of Americans assume that Japanese schools are strict (and that American schools are undisciplined), in the eyes of these visitors, the American system runs the risk of being far too rigid, making student (and teacher) creativity an impossibility.

The research, theory, and applied work coming out of Mainland China and Hong Kong have been especially prolific and illuminating. Hongli (2004) asked the provocative question of why no Nobel Prize winner has ever been the product of the Chinese educational system and extracted from the literature a number of suggested strategies for nurturing the creativity of Chinese primary and middle school students. Huang and collaborators (2005) explored the implicit theories of creativity held by Chinese teachers and found that those attitudes played an important role in how teachers worked to

develop and train creative behavior in their students. Similarly, Chan & Chan (1999) examined the implicit theories held by Hong Kong teachers about the characteristics of creative and uncreative students. Like the results reported in similar U.S. studies, this investigation indicated that Chinese teachers regard some characteristics of creative students as socially undesirable. A number of other researchers in the Chinese literature have examined preferred thinking styles in teaching and their links to creativity in the schools (e.g., Zhang 2006).

With their focus on 27 primary classrooms and their teachers in Hong Kong, Forrester & Hui (2007) utilized a variety of creativity measures developed in the West. These included a classroom observation form, a measure of classroom climate, an index of behaviors used by teachers to foster creative behavior, and a creative personality scale. Also employed was a creativity test for students that had been developed in China. Findings lent support to existing system and componential theories involving both flow and the impact of environmental factors on student motivation and creative behavior. Finally, Dineen & Niu (2008) explored the effectiveness of Western creative teaching methods in China. This quasi-field experiment delivered the standard Chinese undergraduate graphic design curriculum to one class of Chinese students within the framework of a creative pedagogic model developed in the United Kingdom. Another class received the standard Chinese graphic design education. Visual products produced by the students from the two classes both before and during the intervention were evaluated for overall creativity, originality, design quality, and experimental range. Levels of effort, enjoyment, motivation, and confidence in experimentation were also assessed. Both quantitative and qualitative data showed that creative methods developed in the United Kingdom were highly effective in encouraging creativity and related constructs, including intrinsic motivation, among Chinese university students.

This proliferation of school-based research in Asia and beyond raises a variety of significant questions. In particular is the issue of why more U.S. researchers and theorists do not appear to share their non-U.S. colleagues' current interest in and concerns about the promotion of student creativity. One possibility is that with America's newfound emphasis on "high-stakes testing" and other manifestations of the accountability movement has come a general de-emphasis on creative behavior in favor of the more easily quantified and assessed mastery of reading, writing, and arithmetic. Without a doubt, this change in focus has made it far more difficult for U.S. researchers to secure funding for the study of creativity in the schools. An investigation of creative behavior in schools in China (Niu & Sternberg 2003) indicated that high-stakes educational testing coupled with societal values and school pedagogic approaches has for some time impaired the creativity of students of that nation. But now, many Asian educators, policy-makers, and researchers are calling for a shift of emphasis away from testing and toward the promotion of more open-ended, creativity-boosting teaching techniques.

One concern beginning to surface in the literature involves the fact that many non-Western investigators employ Western-based measures and paradigms when investigating the creativity of persons living, working, and learning in cultures fundamentally different from those of the West. As Kim (2005) cautioned, educational systems are formed based on cultural expectations and ideologies. Of course, the same can be said of workplace environments and any other milieus where creative behavior might occur. It is questionable to expect that research approaches and tools developed in one cultural context will serve investigators in another culture.

Social Environment: Culture

Does it make sense to presume that the models, paradigms, theories, and measures constructed by scholars in the Western world can adequately explain or tap the creativity of persons living in cultures very different from those of the United

States, Canada, and Western Europe? For example, can the intrinsic motivation principle of creativity (Amabile 1996) be assumed to apply to persons in Asia? Can the Consensual Assessment Technique (Amabile 1982, Hennessey & Amabile 1999) be expected to yield reliable and valid assessments of product creativity across cultures? Baer (2003) argued convincingly that cross-cultural creativity research can teach us a great deal both about creativity and about different cultures. Yet the potential pitfalls and challenges are many. Concrete examples of some of these difficulties come from Chiu (2007) and Leung (2007), who presented thoughtful and complementary treatises on the challenges faced by those attempting to construct and promote an "Asian social psychology." And in an especially comprehensive review, Lehman et al. (2004) reminded us that psychological processes influence culture, culture influences psychological processes, individuals' thoughts and actions have the potential to influence cultural norms, and these cultural norms and practices influence the thoughts and actions of individuals.

Another important demonstration of the complexity of cross-cultural considerations came from Rudowicz (2003), who made the case that creative expression is a universally human phenomenon. Yet despite this universality, Rudowicz argued that methodological and conceptual problems loom large in cross-cultural investigations. The effects of culture on creativity are complex and highly interactive, and include historical, societal, and individual cross-cultural factors. One obvious concern faced by investigators wishing to explore creativity cross-culturally is whether definitions and operationalizations of creativity coming from one culture can be validly applied in another potentially very different culture. In studying implicit theories of creativity across cultures, Paletz & Peng (2008) found that although Japanese, Chinese, and American university students all considered novelty to be important in evaluating creativity, appropriateness was more important for the Americans and Japanese than for the Chinese. Runco and collaborators (2002) also investigated implicit theories of creativity across cultures, examining teachers' and parents' ideas about children's creativity in the United States and India. Across cultures, significant differences emerged for intellectual and attitudinal clusters of trait adjectives. Such studies support the contention that implicit theories are influenced by cultural traditions and expectations.

Probably no cross-cultural contrast has received more research attention than the collectivist/individualistic distinction. In one investigation involving this dichotomy, Ng (2003) tested a theoretical model positing cultural individualism/collectivism as the antecedent variable, independent and interdependent self-construals as the mediating variables, and creative and conforming behaviors as the outcome variables. Survey responses of white undergraduates from Australia (individualistic orientation) and Chinese undergraduates from Singapore (collectivist orientation) were compared, and SEM results provided strong overall support for this theoretical model and the proposed relation between individualism and creativity (as well as collectivism and more conforming, less creative behavior). A subsequent paper (Ng 2005) then expanded on these findings with the demonstration of especially high indices of "fit." Zha and colleagues (2006) also explored individualism/collectivism and the impact of culture on creative potential. In this study comparing highly educated American and Chinese adults, Americans displayed significantly higher scores on a measure of creative potential. Chinese study participants showed significantly higher skill mastery in mathematics; as expected, Americans showed greater individualism, whereas the Chinese were more collectivistic.

Finally, although much of the literature in this area has been focused on cross-cultural comparisons of creative behavior, some researchers have chosen to explore directly the premise that multicultural experience fosters creativity. Leung et al. (2008) empirically demonstrated that exposure to multiple cultures can, in and of itself, enhance creative

behavior. More specifically, this investigation showed that extensiveness of multicultural experience was positively related to both creative performance and thought processes considered conducive to creative behavior.

CONCLUSION: TAKING A SYSTEMS PERSPECTIVE

Clearly, the great variety of research questions and investigative approaches outlined in this review can significantly broaden our understanding of the phenomenon of creativity in many important ways. Yet no single construct, no one investigative focus, can adequately account for the emergence of creative behavior. Like many students of psychology before them, contemporary creativity researchers and theorists are faced with the daunting task of disentangling the interplay between nature and nurture. Neurological events in the brain, behavioral manifestations of mental illness, or individual differences in personality must be studied not in isolation but in conjunction with the particular environment in which an individual's physical, intellectual, and social development has taken place. More than two decades ago, Amabile (1983, 1996) offered a three-pronged Componential Model of Creativity incorporating domain skills, creativity skills, and task motivation influenced by the social environment; Sternberg's (1988) Triarchic Model of Intelligence also got us thinking in threes. The most recent decade brought few new attempts to conceptualize creativity on a broad scale.

An evolutionary approach based on the work of Charles Darwin, first conceptualized by Campbell (1960) and later modified and elaborated by Simonton (1999, 2007), has continued to garner a great deal of attention. Drawing on Campbell's blind-variation-and-selective-retention theory of creativity, Simonton made the case that the Darwinian model might actually subsume all other theories of creativity as special cases of a larger evolutionary framework. Perhaps not surprisingly, comments on Simonton's call for creativity theorists to adopt a Darwinian perspective came swiftly. Feist (1999) argued that the application of evolutionary theory to creativity must be taken as metaphorical rather than literal. Gardner (1999) countered with the caution that true blind variation would imply that the creator, consciously or unconsciously, tries out every conceivable approach or idea in the process of finding an optimal solution or point of completion for a piece of work. Gabora (2007) and Dasgupta (2004) published particularly negative reviews of Simonton's approach and offered a number of counter examples demonstrating the essential role played by expertise. Seeking to strike a balance between these two frameworks, Weisberg & Hass (2007) suggested that "blindness" in the context of the creative process could be defined as the individual's inability to predict the outcome of his or her efforts and ended with the conclusion that although blindness may be a component of creativity, we need not assume that creative behavior must include free-association processes.

Another recent attempt at constructing a comprehensive model of creativity was also based on the application of well-established theory to the specific case of creative behavior. Over the past decade, a small group of researchers has repeatedly made the argument that the frameworks originated by Jean Piaget and Lev Vygotsky to explain cognitive development in children could also be fruitfully applied to the creative process. Ayman-Nolley (1999) challenged the assumption that Piaget failed to address the phenomenon of creativity in his exploration of the development of the mind and argued that the mechanisms of assimilation and accommodation can readily be applied to creative behavior. Vonèche (2003) applied Piaget's notions of invariance and transformations to the creative process, and J. Kim (2006) reminded researchers and theorists that Piaget had suggested reflective abstraction as the mechanism for creativity. In this same paper, Kim also explored the work of Vygotsky on the interrelation between imagination and creativity; Lindqvist (2003) argued that Vygotsky's notion of the "zone of proximal development"

might help explain how creative ideas or problem solutions take shape.

J.P. Guilford's research on creativity, particularly his work on creative problem solving, also resurfaced to garner some recent attention. Guilford is perhaps best remembered for his contention that divergent thinking plays a central role in creative thought. Reviewing Guilford's (1967) structure of intellect model, Mumford (2001) argued for a return to efforts to take a broad, comprehensive approach to the study of creativity. Richards (2001) echoed this call and made a strong case for the infusion of chaos theory into interpretations of Guilford's work. More specifically, Richards argued that chaos theory can provide models and metaphors for rapid, holistic nonlinear creative processes.

Interestingly, theories of organizational creativity have tended to include more levels of analysis than creativity theories within psychology. This may be because organizational scholars converge from the disciplines of economics, sociology, organizational behavior, and others, as well as psychology. The two most frequently cited organizational creativity theories include factors in the individual and the organization (Amabile 1988, 1996) or the individual, group, and organization (Woodman et al. 1993), as well as interactions between these levels. Other, more recent theories are similarly multilevel (Drazin et al. 1999, Ford 1996, Mumford 2000, Unsworth 2001). However, even in this realm, theories lack a truly systemic, dynamic quality.

Having seen the scholarly rigor underlying much of the contemporary literature on the psychology of creativity, we are heartened by the advances in knowledge made in recent years. However, although many theorists and researchers have broadened our perspective on creativity, their efforts do not extend far enough. Our review moves us to sound a cautionary note. The staggering array of disciplinary approaches to understanding creativity can prove to be an advantage, but only if researchers and theorists work together and understand the discoveries that are being made across creative domains and analytical levels. Otherwise, the mysteries may deepen. Only by using multiple lenses simultaneously, looking across levels, and thinking about creativity systematically, will we be able to unlock and use its secrets. What we need now are all-encompassing systems theories of creativity designed to tie together and make sense of the diversity of perspectives found in the literature—from the innermost neurological level to the outermost cultural level.

SUMMARY POINTS

1. The creativity literature has seen substantial growth in volume and scope as well as methodological and theoretical sophistication.
2. With the growth in outlets for publication has come increasing fragmentation in creativity research.
3. Researchers and theorists in one subfield often seem unaware of work being done in another.
4. The advancement of technology, especially fMRI, coupled with increases in access to equipment for researchers have contributed to a virtual explosion of information on the "creative brain."
5. Although creativity in persons has some trait-like (stable) aspects, it is also a state subject to influence by the social environment.
6. People are most creative when they are motivated primarily by the interest, enjoyment, satisfaction, and challenge of the work itself—i.e., by intrinsic motivation.

7. Scholars of organizations, many of whom are trained research psychologists, have increasingly turned their attention to creativity in the workplace.
8. We cannot presume that the models, paradigms, theories, and measures constructed by scholars in the Western world can adequately explain or tap the creativity of persons living in cultures very different from those of the United States, Canada, and Western Europe.
9. Deeper understanding of creative behavior will require more interdisciplinary research based on a systems view of creativity that recognizes a variety of interrelated forces operating at multiple levels.

DISCLOSURE STATEMENT

The authors are not aware of any biases that might be perceived as affecting the objectivity of this review.

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