Leadership and Creativity: Understanding Leadership from a Creative Problem-Solving Perspective

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Leadership and creativity: Understanding leadership from a creative problem-solving perspective

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Abstract

Employees in many jobs encounter novel, ill-defined problems, and finding creative solutions to these problems may be the critical factor that allows their organization to maintain a competitive advantage. Solving problems creatively requires extensive and effortful cognitive processing. This requirement is magnified further by the complex, ambiguous situations in which most organizational problems occur. Employees must define and construct a problem, search and retrieve problem-relevant information, and generate and evaluate a diverse set of alternative solutions. Creativity necessitates that all these activities are completed effectively. It is unlikely, therefore, that creative outcomes will be realized without a large degree of support from organizations and organizational leaders. To provide this support, leaders must understand the cognitive requirements of creative problem solving. To this end, this article reviews the cognitive processes underlying creative problem solving and suggests avenues through which organizational leaders can facilitate these processes in an effort to enhance the creative problem solving of their employees.

Keywords: Leadership; Creativity; Problem-solving perspective

In recent years, much attention has been given to understanding organizational creativity (Cummings & Oldham, 1997; Ford, 1996; Woodman, Sawyer, & Griffin, 1993). Rapid technological change, global competition, and economic uncertainty have all contributed to organizations seeking to improve creativity and innovation. While early research in organizational creativity has focused on occupations such as scientists and R&D, current thinking is that in almost any job or occupation employees can exhibit creativity (Mumford, Whetzel, & Reiter-Palmon, 1997). Therefore, organizational scholars have sought to identify those factors that facilitate or inhibit creativity in a variety of organizational settings.

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Much of the effort of understanding creativity in the workplace focused on the creative contribution of the individual, such as personality (Feist, 1999), cognitive processes (Ward, Smith, & Finke, 1999), attitudes (Basadur, Runco, & Vega, 2000), and problem-solving style (Scott & Bruce, 1994). However, organizational factors have also been investigated, such as organizational climate (Amabile & Gryskiewicz, 1989), group interactions (Scott & Bruce, 1994), and organizational structure (Arad, Hanson, & Schneider, 1997).

1. Models of creativity

Current views of creativity, particularly in organizational settings, focus on the outcome or creative product. A *creative product* is defined as one that is both novel or original and useful or appropriate (Amabile, 1996; Ford, 1996; Mumford & Gustafson; 1988; Woodman et al., 1993). Various factors contribute to the generation of creative products, both at the individual and organizational level (Mumford & Gustafson, 1988).

At the individual level, Amabile (1983) suggested that there are three key components that support creative production or the creative outcome: domain-relevant skills, creativity-relevant processes, and task motivation. Domain-relevant skills refer to knowledge and expertise. Creativity-relevant processes include cognitive styles, cognitive strategies, as well as personality variables that influence the application of these creativity-relevant processes. Task motivation includes attitudes and motivation, such as intrinsic motivation. Mumford and Gustafson (1988) suggested that creativity can be conceptualized as a syndrome with a number of elements: cognitive processes underlying the individual's ability to generate creative outcomes or products, personality, and motivational variables that facilitate the application of these cognitive processes, and contextual variables, such as climate, evaluation, and culture.

Models of organizational creativity have also included individual characteristics as part of the broader framework explaining creativity in the workplace. Woodman et al. (1993), in their model of organizational creativity, included several individual factors that affect creative production in organizations. Their model includes personality variables, cognitive factors, intrinsic motivation, and knowledge. Ford (1996) included three individual variables in his model of organizational creativity: sense making, motivation, and knowledge and ability. Sense making refers to the interpretation of the environment and identification of problems through processes, such as problem finding and problem construction. Motivation includes goals, emotions, and beliefs about the individual's capability to generate a creative product and whether others would accept the product. Knowledge and ability refer to the knowledge structures the individual brings to the creative process and the cognitive processes that are used on these knowledge structures.

All these models recognize that individual creative production is a complex phenomenon that is influenced by multiple individual-level variables as well as contextual and environmental variables. The focus of this special issue is on one specific contextual variable, that of leadership and the role that leaders play in the facilitation of creative production in their subordinates. Leadership has been identified as an important contextual variable contributing to the culture and climate of the organization and perception of support for innovation (Amabile & Gryskiewicz, 1989; Cummings & Oldham, 1997; Isaksen, Lauer, Ekvall, & Britz, 2001; Mumford, Whetzel, et al., 1997). Leaders can facilitate creative production through various mechanisms, such as influencing the motivation of employees. The effects of expected evaluations, rewards, and leader support are well-documented (Scott & Bruce, 1994; Zhou & Shalley, in press). Less is known about the role leaders play in the facilitation of the cognitive processes involved in creative production. The importance of cognitive processes for creative problem solving and creative production has also been emphasized by these various models (Amabile, 1996; Ford, 1996; Mumford & Gustafson; 1988; Woodman et al., 1993). Therefore, the purpose of this article is to review the cognitive processes involved in creative production and discuss how leaders can facilitate these creative processes in an effort to increase creativity in their subordinates.

2. Creative problem solving

As suggested by the models discussed above, cognitive processes associated with creativity are seen as central to the generation of creative output. Several models focusing specifically on the cognitive processes associated with creative problem solving also exist, and they have identified a core set of processes that are central to creative problem solving (Mumford, Mobley, Uhlman, Reiter-Palmon, & Doares, 1991). These models tend to view creativity as related to problem solving because the two share many processes. The exact relationship is debated, with some arguing that creativity is a special case of problem solving, while others arguing the opposite (Bink & Marsh, 2000; Finke, Ward, & Smith, 1992; Lubart, 2001; Runco & Nemiro, 1994). However, despite this debate, most authors agree that the core processes required for creative problem solving are problem identification and construction, identification of relevant information, generation of new ideas, and the evaluation of these ideas (e.g., Finke et al., 1992; Mumford et al., 1991). The first three processes typically are viewed as part of the idea generation phase, whereas as the latter is considered part of the implementation phase (Basadur, 1997; Mumford, 2001). The implementation phase also includes the actual implementation of the solution. However, because the focus of this article is that of cognitive processes involved in creative problem solving, and the solution implementation process involves mainly persuasion and social skills, it is not reviewed here.

3. Problem construction

Organizations face increased global competition and rapid technological change, which increase uncertainty and contribute to the need for increased creative performance by employees (Dess & Picken, 2000). This uncertainty means that employees are confronted with more ill-defined and ambiguous problems. Problems can be characterized on a continuum from well to ill defined (Dillon, 1982). Well-defined problems are characterized by having a known goal, a known methodology or way to reach an answer, and one correct answer (which may not be known to the problem solver, but is known to others). Ill-defined problems, on the other hand, are characterized by multiple possible goals, multiple ways of solving the problem, and multiple possible and acceptable solutions. It is this ambiguity that allows for creative solutions to arise (Mumford et al., 1991; Schraw, Dunkle, & Bendixen, 1995). As a result, the creative problem solver must first construct the problem to be solved. Many process models of creative problem solving suggest that problem construction or problem definition is the first step in the creative process (Basadur et al., 2000; Finke et al., 1992; Lubart, 2001; Mumford et al., 1991).

When facing an ill-defined and ambiguous problem, individuals must begin by structuring the problem and identifying the goals, procedures, restrictions, and information needed to solve the problem (Holyoak, 1984; Mumford, Reiter-Palmon, & Redmond, 1994). Because problem construction provides the context for the application of other processes in the creative problem-solving effort, it has been suggested that the way the problem is constructed will have a marked impact on creative production and solution generation (Adelman, Gualtieri, & Stanford, 1995; Getzels, 1979; Mumford et al., 1991; Runco & Okuda, 1988). Research has suggested that differences in the application of this process explain creativity above and beyond differences in intelligence and divergent-thinking skills (Runco & Okuda, 1988; Smilansky, 1984). Other studies have shown considerable effects of problem construction on the resulting creative outcome. In a landmark study on problem construction in art students, Getzels and Csikszentmihalyi (1975, 1976) found that problem construction predicted the creativity of a still-life painting. More importantly, problem construction predicted success as an artist measured seven years later. Problem construction has also been found to relate to the quality and originality of solutions to real-life problems (Okuda, Runco, & Berger, 1991; Reiter-Palmon, Mumford, & Threlfall, 1998).

In many instances, problem construction occurs automatically, resulting in rapid movement into the next phases of information search and idea generation (Mumford et al., 1994). When problem construction occurs in a more automatic fashion, the problem tends to be framed in ways that fit with the problem solver's past experience and mental representations (Holyoak, 1984; Johnson, Daniels, & Huff, 2001). Several studies have shown that when participants spent more time formulating and constructing a problem, the solutions they generated were of higher quality and originality compared to those individuals who did not spend time constructing the problem (Redmond, Mumford, & Teach, 1993; Reiter-Palmon, Mumford, O'Connor Boes, & Runco, 1997). In these studies, the automaticity of the problem-construction process was reduced by explicitly requesting participants to list all the ways in which the problem can be constructed prior to actually solving the problem. These participants reported that they spent more time and constructed the problem in more ways than participants that were not asked specifically to engage in this process. Additional support for the role that awareness plays in the problem-construction process is provided by studies investigating the effect of training the problem-construction process on creativity. Participants who learn how to construct the problem in multiple ways or to attend to the problem-construction process show an improvement in overall solution quality and originality (Baer, 1988; Basadur, Graen, & Green, 1982; Kobe, 2001).

Studies that have investigated the problem solving of experts and novices have also supported the importance of the problem-construction process. Experts spend a considerable amount of time structuring and defining ill-defined problems, whereas novices move directly to solving these problems (Kay, 1991; Rostan, 1994; Voss, Wolfe, Lawrence, & Engle, 1991). Experts are more aware that the problems they attempt to solve have multiple plausible constructions, again, suggesting that awareness of the possibility of multiple conceptualizations of the problem and therefore the need to construct the problem is linked to time spent on the problem-construction process. However, it has also been suggested that there is an optimal level of expertise for problem construction, and that too much expertise can lead to automaticity in problem definition or to tunnel vision (Basadur, 1994; Hoover & Feldhusen, 1994).

Ill-defined problems typically have multiple appropriate solutions, each of which may satisfy slightly different problem-solving goals. In addition, in some cases, competing goals may exist, such that a solution that satisfies one goal might even reduce the likelihood of satisfying a different goal (Butler & Scherer, 1997). Competing goals may occur between quality and efficiency, between short- and long-term benefits to the organization, between various departments differing in focus (e.g., production, marketing, or sales), or between an individual orientation and a more global, organization-wide orientation. When constructing a problem, individuals may chose to ignore these competing goals, or may not even be aware that multiple goals exist. The latter is more likely to occur when problem construction occurs automatically and a more simple construction of the problem results. However, reconciling these competing goals, redefining the problem in a way that would take these competing goals into account, or even awareness of the existence of the competing goals, will likely result in higher quality solutions as well as more creative solutions.

Supporting evidence can be found in a study by Mumford, Baughman, Threlfall, Supinski, and Costanza (1996), which looked at elements of problem construction and their effect on solution quality and originality. Mumford, Baughman, Threlfall, et al. (1996) found that those participants who used high-quality restrictions in problem construction generated more creative solutions. The existence of multiple and conflicting goals places a restriction on how a problem can be framed and the type of solutions that are appropriate, as multiple goals need to be integrated and satisfied (Butler & Scherer, 1997; Stokes, 1999). The need to integrate multiple goals and take into account the restrictions that are placed because of conflicting goals may result in a more complex and innovative problem construction, leading to higher quality and more original solutions.

3.1. Implications

One of the most consistent findings with regards to problem construction is that it is a time-consuming and effortful activity, and that those individuals who are actively engaging in this process by spending more time constructing the problem and constructing the problem in different ways, produce higher quality and more original solutions (Okuda et al., 1991; Redmond et al., 1993; Reiter-Palmon et al., 1998). Given these findings, one way a leader may facilitate creative problem solving is by the effect he or she has on the problem-construction process. First, leaders should allow for sufficient time for creative problem solving, including this process of problem construction. The importance of sufficient time is not new and has been stressed in several other discussions of creative problem solving in organizations (Mumford, Scott, Gaddis, & Strange, 2002; Mumford, Whetzel, et al., 1997).

However, providing enough time to allow for creative problem solving may not ensure that enough time will be spent on the problem-construction process. Leaders may facilitate problem construction by drawing the attention of their subordinates to the importance of this process and the need to think about a problem from multiple perspectives. While this may sound simple, research suggests that even simple instructions to construct the problem in multiple ways is enough to improve creative problem solving (Redmond et al., 1993; Reiter-Palmon et al., 1998). Additional support is provided by Farris (1972), who studied communication patterns in R&D groups. According to this study, innovative people were more likely to communicate with leaders in the initial phases of the problem-solving effort, while constructing the problem. While asking employees to think about a problem from multiple perspectives may provide some different constructions, leaders may further facilitate multiple problem constructions by providing a variety of assignments to individual employees, thereby increasing the diversity of experiences for each person. In addition, leaders can create teams that are more diverse by including members from a variety of background and experiences. Because problem construction is likely to be based on past problem-solving experiences, this would increase the likelihood of multiple and diverse problem constructions (Reiter-Palmon et al., 1998).

Leaders need to help their employees construct the problem in terms of organizational goals and encourage the reconciliation of multiple and even competing goals and constructions. When a problem is constructed in multiple ways, this may result in problem constructions and goals that are of varying degrees of importance and relevance to the organization. The leader's role is to facilitate the construction and selection of the problem definition that is most appropriate given the organizational goals and needs. In addition, leaders may need to facilitate the reconciliation of competing goals and problem constructions, particularly when these competing goals are a result of diverse teams. It is possible that different team members will not be able to understand the perspective taken by other team members or the way the problem is constructed. Leaders should promote open discussion of the various conceptualizations of the problem and allow team members to understand that these different conceptualizations are all plausible and appropriate and stem from the variety of experiences and backgrounds.

Leaders must also be careful not to allow the discussion to focus on personal and affective aspects, but rather focus on the problem at hand and its conceptualizations. Research suggests that group conflict resulting from differences regarding the problem (how it is conceptualized or solutions to it) may increase solution quality and originality, but group conflict resulting from personal or affective issues may result in reduced decision quality and originality (Amason, Thompson, Hochwarter, & Harrison, 1995; Lovelace, Shapiro, & Weingart, 2001; West, 2002).

4. Information search and encoding

After a problem construction is developed, a large and diverse set of information must be gathered and integrated. Information must be retrieved from internal and external sources and must be connected, synthesized, and encoded in a manner that facilitates creative production (Bink & Marsh, 2000). These search and encoding processes will be guided by the results of the problem construction stage (Mumford et al., 1994), and similar to problem construction, are critical in the ill-defined situations where creativity occurs (Finke et al., 1992; Frederiksen, 1984; Mumford & Gustafson, 1988; Perkins, 1992; Qin & Simon, 1990; Weisberg, 1988; Woodman et al., 1993).

Information necessary for creative solution generation will be acquired using two main processes, a search and collection of existing concepts and the creation of new concepts through the connection and modification of existing concepts. Concepts are organized and inner-connected in memory by knowledge structures or schemas (Finke et al., 1992). When encountering a problem, the knowledge structures most related to that problem will be activated and the concepts connected to those structures are likely to be retrieved. Because the information most related to a problem is activated automatically and quickly, it will structure the generation of solutions. For this reason, without additional search and encoding activities new ideas will closely resemble old ideas (Ward, Smith, & Vaid, 1997). In terms of problem solving, solutions to current problems will closely resemble solutions to similar past problems unless additional cognitive effort is directed at expanding the searching and encoding of information beyond that initially activated (Weisberg, 1988).

Searching and encoding activities are guided by cues resulting from the problem-construction process (Mumford et al., 1991). These cues will activate relevant knowledge structures, facilitating the retrieval of the concepts connected to them. All else being equal, the more cues provided, the more information that will be retrieved. Because creativity occurs in ill-defined situations, it is very likely that cues from a good problem construction will be very diverse and even inconsistent or contradictory. It is exactly this ambiguous nature that allows for creativity to occur (Simon, 1978). If an individual is able to integrate and use the diverse and inconsistent cues existing in these environments, he or she will retrieve more information.

The advantages of a plethora of search cues will be realized only if there is sufficient knowledge for these additional cues to activate. Many authors have discussed the critical role extant knowledge plays in solving ill-defined problems (e.g., Amabile, 1983; Chi, Glaser, & Rees, 1982; Voss & Post, 1988; Weisberg, 1999; Woodman et al., 1993). Existing knowledge will be used to assess the relevancy of searched information (Barrick & Spilker, 2003) and will lay the foundation for creative thinking (Ward et al., 1997). Initially activated structures will direct internal and external information search through the cues they provide and will serve as an initial organization guide for subsequently retrieved and modified information (Bink & Marsh, 2000). Thus, along with problem construction, domain-relevant knowledge will guide information-search behaviors and structure the encoding of new or altered information (Mumford et al., 1991).

The search for and retrieval of domain-relevant knowledge alone, although critical, will not be sufficient for creative problem solving (Finke et al., 1992; Weisberg, 1999). By definition, creativity is the generation of a novel idea or product (Amabile, 1996). Simply using existing knowledge in its current form, therefore, is unlikely to result in creative solutions. Once retrieved, information must be connected and synthesized in an original way and then must be encoded appropriately (Finke et al., 1992; Ward et al., 1997). The cognitive ability to modify and create new concepts from existing knowledge and information is a critical component of creative thinking. The more ways individuals can uniquely combine and modify existing knowledge, the more likely they are to come up with creative ideas (Barsalou & Prinz, 1997; Finke et al., 1992). As a further benefit, these newly combined and created concepts will also serve as additional cues for further information search activities (Bink & Marsh, 2000).

The automatic and therefore effortless way to organize and encode searched information is to combine concepts based on obvious conceptual overlap alone. The modifying of existing knowledge and creation of new concepts, on the other hand, requires more dedicated cognitive effort (Hampton, 1997). Generating novel ideas necessitates that individuals search, combine, and encode concepts from categories that on the surface, do not appear to relate (Chi, 1997). The construction and encoding of new concepts or knowledge categories typically occurs with a specific goal or purpose in mind (Barsalou, 1991). For creativity, that purpose must be to connect retrieved concepts and knowledge structures in original yet appropriate ways (Ward et al., 1999). As concepts are searched and retrieved, they need to be reinterpreted, modified, or expanded to make them applicable to the novel problem at hand (Finke et al., 1992; Ward et al., 1997). The amount of cognitive effort that will be required for these activities can be substantial.

It should be noted at this point that the effortful cognitive processes associated with creative problem solving do not operate in an isolated consecutive manner (Mumford et al., 1991). Just as the search for information will be begin before the problem-construction process is completed, the creation of new concepts and the modification and combination of extant knowledge will trigger solution ideas as these processes are occurring. However, as Finke et al. (1992) pointed out, the purpose of these processes is different during the search and retrieval stage than during the solution generation stage. During the search and encoding stage, retrieved concepts are combined and modified with the purpose of providing new search cues and creating new concepts related to the current problem (labeled generative processes by Finke et al., 1992). Later in the creative process, this information will be further integrated, albeit using similar creative processes, with the purpose of developing solution ideas (labeled exploration processes by Finke et al., 1992). These two activities, however, will not be isolated or distinct; they will overlap and occur simultaneously to some extent.

Up to this point, the discussion has been mainly focused on the search and encoding of internal information or information existing in an individual's memory. Seldom, however, do individuals possess internally or have the ability to create internally all the information required for generating a creative solution. An exhaustive search for external information as well as a search of internal information will be necessary (Amabile, 1996; Simon, 1978). This external information may come from others' memories and experiences or it may be obtained from some environmental source, such as the Internet. Externally searched information will also provide additional cues for further memory searches and will increase the number novel connections that can be discovered among concepts. The increased amount of information that will result from external sources will magnify the importance of organizing and encoding activities, especially in complex environments. Externally retrieved information must be integrated with internally retrieved information and encoded in such a way that solution generation will be facilitated.

4.1. Implications

Due to the complex and social nature of organizations, information can be hard to obtain and the relevance/importance of obtained information can be hard to determine (Mumford & Connelly, 1991). Search and retrieval activities can be facilitated or hindered by various external variables (Bink & Marsh, 2000; Finke et al., 1992), many of which can be managed by a leader. Most notably, similar to problem construction, individuals must have adequate time and resources to engage in search activities (Mumford, Whetzel, et al., 1997). Searching for information requires a large degree of cognitive effort, as does integrating searched knowledge and encoding it into new or altered categories and knowledge structures (Markman, Yamauchi, & Makin, 1997). Leaders who can effectively provide and manage the time, resources, and motivation required for exhaustive information search and encoding activities, therefore, will have a higher probability of seeing creative outcomes from their employees.

Illies and Reiter-Palmon (in press) demonstrated that searching for more information and spending more time on information search activities enhance the originality and appropriateness of solutions generated to ambiguous, real-world problems. Participants in this study were informed only that they had the opportunity to search for more problem-related information; they were not encouraged to search this information. Therefore, one of the most fundamental and effective avenues for enhancing information search and encoding may be simply providing employees with access to information and with the time needed to search that information. Without this access and time, most search and encoding activity will be sacrificed as people satisfice and search only for the most critical information (Weenig & Maarleveld, 2002) or most recent and easily accessed information (Bink & Marsh, 2000). Much more reliance will be placed on memory and existing knowledge rather than on the seeking of new and additional information (Hulland & Kleinmuntz, 1994).

Although additional time for searching and access to external information alone can positively influence creative problem solving, the benefits are likely to be modest unless some effort is directed at determining the relevance of searched information and cognitively manipulating and encoding that information appropriately. Mumford, Baughman, Supinski, and Maher (1996) revealed that people who spend more time searching for relevant information rather than distracting information tend to generate more creative solutions. Similarly, Davidson and Sternberg (1984) revealed that the ability to encode relevant rather than irrelevant information differentiated gifted children from other children. Also demonstrating the importance of searching for quality information, Smith (1989) showed that searching and encoding faulty or irrelevant information resulted in deficient problem solving, and Smith and Blankenship (1989) revealed that providing people with misleading information resulted in the retrieval of useless and even detrimental information.

Given that people differ on the nature of the information they decide to search and encode (Davidson, 1995; Mumford, Baughman, Supinski, et al., 1996) and given that the appropriateness or relevance of that information is critical for creativity (Mumford, Baughman, Supinski, et al., 1996; Sternberg & Lubart, 1991), the influence of leaders can be substantial during these processes. The structure and direction they can provide as a result of their technical expertise and past experiences will be very beneficial to creativity. Not only are they uniquely qualified to assess the relevancy of information gathered from diverse organizational sources, they also have the authority necessary to guide the search behaviors of others and to obtain relevant information from sources not easily accessed due to existing organizational policies or restrictions.

When structuring and facilitating information search activities, leaders must also be aware that both internal and external searches are important. These searches require somewhat different processes, and they will also require somewhat different facilitative leader behaviors. Leaders cannot directly monitor the search and retrieval of information from others' memory. However, they can encourage the cognitive processes involved in these activities (Mumford et al., 1991), including the combining, expanding, and encoding of new concepts based on retrieved information. If not motivated to exert the effort required for these expanded processes, individuals typically will integrate only those concepts that are quickly retrieved and obviously related, and creative outcomes will not be realized (Chi, 1997). In addition, without encouragement or motivation, individuals in groups, especially if those groups are highly homogenous, will tend to rely heavily on information that is shared by all group members (Larson, Foster-Fishman, & Keys, 1994) and search only for information that confirms the groups' shared beliefs (Schulz-Hardt, Jockims, & Frey, 2002).

It has been argued that constraints should not be imposed in a situation where creativity is desired until actual idea or solution generation has begun, after the information search and encoding stage (e.g., Finke et al., 1992). This argument brings into question the recommendation that leaders direct information search and encoding activities and assess the relevancy of searched information during these activities. However, it has been shown that environmental and/or task influences, such as outcome goals, time constraints, and task demands must be considered because they will frame the search for new and existing information, both externally and internally (e.g., Barsalou, 1991; Devine & Kozlowski, 1995; Kersholt, 1992). Given that organizational problem-solving situations will never be free from environmental influences, leaders will have to attempt to strike a balance between allowing for the free search and encoding processes required for creativity and providing the structure and direction necessary for obtaining a quality product in a timely manner. Also, because the search for irrelevant information and the dissemination of misleading information can hinder creative problem solving (Smith & Blankenship, 1989), it may even be beneficial for a leader to assess the quality of information as it is being retrieved as well as to structure and direct the search process.

In managing the search and encoding processes, leaders must also be careful not to provide cues that are too specific or restricting. Information that is retrieved quickly or automatically from these specific cues can prevent or hinder the retrieval and creation of additional information by causing fixation, mental sets, and other retrieval impairments (Finke et al., 1992). If focused in a specific direction or area too quickly, employees may not be able to proceed past initial solution ideas. Also, certain problems, such as those that are emotional or value-laden, may tunnel information search by causing employees to fixate on a course of action and search only for information consistent with personal beliefs (Illies & Reiter-Palmon, in press; Nabi, 2003). Leaders must be aware that their own opinions on how a problem should be solved, if communicated to employees in the cues they disseminate, can severely limit the amount and diversity of information retrieved.

The general theme in the above discussion is that to facilitate the information search and encoding process, leaders must manage the acquisition, sharing and distribution of knowledge and information among their employees. Leaders must collect and disseminate information as employees search and retrieve it in an effort to facilitate more retrieval and more connections among concepts. Knowledge management, defined as the creation, acquisition, integration, and dissemination of knowledge in organizations (Nonaka, 1994; Quintas, Anderson, & Finkelstein, 1996; Van Beveren, 2002) is essential for organizational creativity and innovation (Brand, 1998; Swan, Newell, Scarbrough, & Hislop, 1999), and in no other stage of the creative problem-solving effort will it be more critical than during information search and encoding.

5. Generation of alternatives/solution generation

Once information is available, according to many models of creative problem solving, the individual then moves toward generation of alternative solutions (Basadur, 1995; Lubart, 2001; Runco & Chand, 1995). This process of idea generation was the focus of much of the early research on creativity, starting with Guilford's seminal work on divergent thinking (Guilford, 1950, 1967). While some research has shown only weak relationships between divergent thinking and creativity (Brophy, 1998; Hocevar, 1980), other studies have found that divergent thinking was related to creative performance in a wide variety of settings, occupations, and populations, such as children, artists, scientists, and managers (Gough, 1975; Mumford, Marks, Connelly, Zaccaro, & Johnson, 1998; Plucker, 1999; Runco, 1991; Scratchley & Hakstian, 2001; Vincent, Decker, & Mumford, 2002).

The type of scoring procedure used may influence the relationship found between divergent thinking and creativity. Divergent-thinking tests have typically been scored in three ways. The most common approach has been to measure fluency, or the number of ideas generated (Runco, 1999). Another accepted way to evaluate divergent thinking has been to assess the originality or novelty of the ideas generated. This has been typically operationalized as an idea with a low frequency of occurrence, either evaluated objectively or rated subjectively (Runco & Charles, 1993). Finally, another relatively common approach to measuring divergent thinking has been to use a measure of flexibility or how often the individual breaks set (Runco, 1999). Less common is the evaluation of appropriateness or quality of the idea (Runco & Charles, 1993; Vincent et al., 2002). When researchers select only one index, it is typically that of fluency. However, measuring only fluency may mask the nature of the relationship between divergent thinking and creative performance, sometimes resulting in contradictory findings (Plucker & Runco, 1998; Runco, 1999). It is also important to note that for organizational purposes, the number of ideas is not as significant as the quality and originality of the solutions generated. While some research suggests that there is a positive relationship between fluency and quality and originality, others have not found this relationship (Cooper, 1991; Mouchiroud & Lubart, 2001; Runco & Marz, 1992; Runco, Okuda, & Thurston, 1987).

Because idea generation has been equated with creativity, many techniques have been suggested to enhance the cognitive processes involved in this activity. Smith (1998) identified 172 idea-generation techniques that have been described in scientific or practitioner publications. The most common approaches to facilitate idea generation or divergent production were decomposition (reducing the whole into parts, or means to an end), group interaction (using group interaction to facilitate idea generation), remote stimuli (using stimuli that are unrelated to the problem-solving task), and relationship search (looking at the relationships between two or more things). While most of the specific techniques identified by Smith were not the subject of scientific research but rather were prescriptive in nature, some components of these techniques have been investigated.

Decomposition has been studied as a way to enhance idea generation. In a problem-solving exercise, participants are asked to solve for one goal at a time (Pitz, Sacks, & Heerboth, 1980). Studies have found that when goals are presented sequentially, one goal at a time, participants generate more solutions then when no goals or multiple goals are presented (Butler & Scherer, 1997; Coskun, Paulus, Brown, & Sherwood, 2000; Pitz et al., 1980). Butler and Scherer (1997), in a study of alternative solution generation to ill-defined problems, found that the largest number of solutions were generated when goals were presented sequentially, one at a time, to the problem solver. However, the highest quality solutions were generated when two conflicting goals were presented simultaneously to problem solvers. This suggests that when participants consider multiple goals, fewer solutions may be generated, but those that are generated may be of higher quality because they address the complexity of the issues at hand. The importance of the selection of goals for the resulting creativity of the solution is also underscored by a study by Mumford, Supinski, Threfall, and Baughman (1996), which investigated the effects of concept selection on solution creativity. Participants were asked to select from eight different concepts those concepts that they thought would help them solve the problem. Four types of concepts were used: long-term goals, general principles, evaluation of others, and discrete action plans. The selection of long-term goals was associated with more creative solutions to a problem-solving task. These studies indicate that the type of goals generated during the problem-construction processes will have an impact on the number, quality, and originality of ideas generated.

Brainstorming has been suggested and researched as a way groups can use interaction to facilitate the generation of novel ideas (Rickards, 1999). Much of the research on brainstorming suggests that group idea generation is not better than nominal groups (that is, combining the responses of individuals working alone) and in some cases may be worse (Jung, 2001; Kurtzberg & Amabile, 2001; Paulus & Paulus, 1997). Unfortunately, many studies on brainstorming or other techniques for group idea generation focus only on fluency (Rickards, 1999). Thus, whether more ideas always translates into better and more creative ideas is left unknown.

Other research supports the use of analogical transfer (or the use of remote stimuli) as a way to facilitate new idea generation (Holyoak, 1984; Reeves & Weisberg, 1994). Studies using this method to facilitate creative problem solving found that participants who were exposed to an analogy were then able to solve a problem more creatively (and in a way similar to the analogy) than those exposed to other information (Dahl & Moreau, 2002; Gick & Holyoak, 1983). However, participants must be able to recognize the similarity between the analogy and target problem for the transfer to occur (Holyoak, 1984; Reeves & Weisberg, 1994). Individuals who have more information and more diverse information encoded may be more likely to create these analogical transfers, that is, find similarities between the current problem they need to solve and available information. Relatedly, several studies have looked at the effect of providing examples as a method to improve creativity. It was found that providing a specific example actually reduced creativity (Dahl & Moreau, 2002; Marsh, Landau, & Hicks, 1999). Individuals may use the specifics of the examples when developing their ideas instead of using the examples as a starting point to develop new ideas.

Relationship search has been investigated in a series of studies by Mumford and his colleagues (Baughman & Mumford, 1995; Mobley, Doares, & Mumford, 1992; Mumford, Baughman, Maher, Costanza, & Supinski, 1997). These studies focused on category combination and reorganization. Mumford et al. (1991) suggested that this process allows people to combine and reorganize existing information, knowledge, and categories, which provides new ways of solving the problem. A study by Mobley et al. (1992) investigating this process found that more original ideas were produced when people were asked to combine diverse categories whereas higher quality was produced when people work with similar categories.

In an effort to understand how people combine and reorganize categories, Baughman and Mumford (1995) evaluated whether the identification of central features of the categories (typical or atypical features of each category) and the mapping of shared or nonshared features (identifying similar or nonsimilar features of the two categories) of the categories onto new categories would result in creative combinations. Increased originality was observed only when both feature identification and feature mapping occurred. Similar to Mobley et al. (1992), related categories resulted in higher quality. Finally, Mumford, Baughman, et al. (1997) manipulated the degree to which categories were related or similar as well as instructions designed to influence the strategy individuals chose for the category combination task. Participants were instructed to identify features of each category and then map them onto each other or they were instructed to identify features of each category and then think about what those features might represent. When similar categories were used, the strategy of mapping features into other categories resulted in higher quality and more original ideas. When diverse categories were used, thinking about what those features may represent, resulted in higher quality and originality.

Instructions given to participants have also been evaluated as a way to facilitate divergent thinking and solution generation. When participants are instructed to be creative or original, they tend to generate more original solutions, and when they are told that the quantity of ideas is important, fluency scores tend to increase (Runco, 1986; Runco & Okuda, 1991; Ward & Sifonis, 1997). When no specific instructions are given, individuals may reach their own conclusion as to what the important aspects of the solution are, and will emphasize those aspects. Yuan and Zhou (2002) suggested that while some problems may intuitively call for more originality (art), others call for more appropriateness and practicality (business). Given the emphasis on practicality in business settings, it is likely that when employees are faced with a problem, unless told specifically that the goal is that of novelty and originality, the focus of the solution will be on appropriateness and practicality. The importance of instructions on solution generation is also seen in the study by Mumford, Baughman, et al. (1997), where instructions affected the strategy used by participants to combine categories and as a result affected category originality and quality.

As in previous processes, generation of ideas and solutions is a time-consuming and effortful endeavor (Johns & Morse, 1997). Studies have found that time constraints limit the number of ideas generated as well as the quality of those ideas (Morse, Morse, & Johns, 2001). Therefore, it is not surprising to find that attitudes toward ideation can play a key role in idea generation. Basadur et al. (2000) investigated the relationship between attitudes and creative-thinking skills and behaviors for 112 managers. Two types of attitudes relevant to idea generation were measured: (a) preference for active divergence and (b) preference for avoiding premature convergence. While they did not find a direct significant relationship between preference for active divergence and the number of ideas generated, they did find a relationship between preference for avoiding premature convergence and number of ideas generated. In addition, preference for avoiding premature convergence was also associated with preference for active divergence. These results suggest that avoiding premature convergence is as important or may be even more important for creative problem solving than the preference for active divergence. Given the time pressure in business and organizational settings, the tendency to satisfice, or to prematurely converge and decide on the best solution is a very real danger.

5.1. Implications

Managers have access to many books and articles promising fail-proof techniques that facilitate idea generation. However, only a few of these techniques have been investigated empirically (Smith, 1998). In addition, those techniques that were studied have typically evaluated fluency as the main dependent variable. Research on these techniques as well as on divergent thinking suggests that fluency is not always related to quality and originality (Butler & Scherer, 1997; Plucker & Runco, 1998). While the ability to generate multiple ideas is clearly important, the sheer number of ideas is not the only factor that determines creativity. The quality and originality of those ideas generated is also critical. Studies investigating the effect of divergent-thinking training on creative problem solving found that training in both divergent and convergent thinking is most effective (Basadur et al., 2000; Isaksen & Parnes, 1985). Managers must realize, therefore, that although techniques such as decomposition and to some extent brainstorming can facilitate fluency, they do not guarantee the generation of original and high-quality solutions.

Managers can influence the results of the idea generation process by the instructions they provide to subordinates. These instructions can be in the form of focusing on a specific technique to facilitate idea generation. As indicated, brainstorming and decomposition may result in many ideas, but not necessarily creative ones. For effective use of analogies, leaders may need to provide the analogy to their subordinates, and may also need to point out the similarities between the analogy and the problem at hand. This technique however, is limited, as it typically results in ideas and solutions that are similar to the analogy presented, and is dependent on whether the analogy is already available to the leader. Leaders may also promote idea generation by instructing followers to focus on information that is less similar (and therefore may seem less relevant), and think more in depth about the meaning of the information (Mumford, Baughman, et al., 1997). Again, the availability of diverse information that can be integrated to result in new ideas is particularly beneficial here.

The instructions leaders provide to subordinates at this point may include not only techniques to facilitate idea generation, but also what the goals of the specific process should be. If the goal is that of number of ideas, then instructions should be to that effect. If, and more likely, the goal is one of creative ideas, that should be conveyed to the subordinates. Finally, it is likely that in a business setting employees will focus on the appropriateness and quality of the solution and ignore originality unless specifically instructed to do so (Yuan & Zhou, 2002).

The effect of previous processes is apparent not only in the role that instructions play in this process (problem construction) but also in the effect divergent information has on this process. Availability of analogies and divergent information may facilitate solution generation (Mumford, Baughman, et al., 1997; Reeves & Weisberg, 1994; Reiter-Palmon et al., 1997). However, as indicated, availability is not enough. Leaders must ensure that their subordinates know what to do with the analogies and divergent information available to them. Leaders may facilitate idea generation by providing feedback, role modeling, and suggestions as to how to integrate and use the divergent information.

Finally, time and effort are important for this process as well as the previous ones. The techniques of idea generation reviewed here all require more time than routine application of problem solving. For example, decomposing the problem requires generating ideas to multiple components, group techniques such brainstorming take more time than individual efforts, and relationship search and analogies require spending time on what may seem like irrelevant information or spending time identifying similarities that are not apparent. In addition, studies have found that original ideas tend to be identified later in the process of idea generation. The first ideas generated tend to be routine and less creative (Runco, 1986). Finally, Basadur et al.'s (2000) finding on the relevance of premature convergence may be of particular importance here. When time constraints exist, it is more likely that employees will select the first available solution that solves the problem. If a creative solution is desired, time must be given to employees to prevent this premature convergence. Leaders may be able to represent the workgroup to others in the organization and allow the workgroup more time.

6. Idea evaluation

Processes involved later in the cycle of creativity have not received as much attention as those involved early in the cycle (Mumford, 2001), however, they are no less important. Idea evaluation requires the problem solver to evaluate those ideas that were generated and identify a set of ideas or one idea that works the best. In addition, this step requires the individual to identify potential pitfalls and difficulties that may arise and plan accordingly (Mumford et al., 1991). While divergent thought helps in generating a large number of ideas or solutions to choose from, it is this more convergent process of idea evaluation that is used to determine which solution should be implemented, or if there is a need to start all over again (Charles & Runco, 2001; Mumford et al., 1991).

Another important aspect of idea evaluation in organizational settings is that problems are ill defined. Ill-defined problems, by definition, have multiple goals, some of which will likely be competing. In an organizational setting, employees must be able to evaluate a chosen solution against these competing goals and identify both the short- and long-term consequences of implementing a particular course of action. Therefore, although idea evaluation is typically thought of as a convergent thought process (Michael & Bachelor, 1990), this suggests that divergent thought is involved as well—in this case, identifying the possible consequences of implementing the chosen course of action.

In addition, identifying possible consequences and obstacles allows the problem solver to formulate a better approach for implementing a solution and developing contingency plans in case the solution is ineffective or cannot be implemented successfully. Research has supported the notion that evaluative ability is not completely distinct from divergent processes. For example, the ability to evaluate originality has been found to correlate with the production of original ideas and fluency, whereas evaluation of common or nonoriginal ideas was negatively related to originality of ideas generated (Basadur et al., 2000; Runco, 1991; Runco & Chand, 1995). In addition, a study of 221 managers from various organizations, found that divergent thinking was predictive of an evaluation of creative performance on the job provided by the supervisor of that manager (Scratchley & Hakstian, 2001). That is, the ability to identify original ideas is related to the ability to generate original ideas.

The timing of the evaluation may also influence the creativity of the product. In a study of idea evaluation, students were asked to compose short stories and draw still-life drawings. During the task, the students were instructed to evaluate their work (Lubart, 2001). It was found that students who evaluated their work early in the writing process wrote more creative stories than did those that evaluated their work later in the production process or those that distributed the evaluations throughout their work. However, no effect was found for the drawing task suggesting that evaluation effects may differ depending on the task at hand.

It is important to understand that ideas are not being evaluated in a vacuum. When an idea is evaluated, some sort of a yardstick to which the idea is compared is necessary. Feist (1991) suggested that evaluation might depend on the domain such that the evaluation of works of art is more intuitive while the evaluation of science is more analytic. Similarly, evaluation of solutions to organizational problems will likely focus on practical aspects as well as on originality. The goals generated or given in the problem-construction process will usually serve as the yardstick for evaluating solutions. This explains the finding that instructions to be creative, original, or flexible, increase creativity, originality, and flexibility of the ideas generated (Runco, 1986; Runco & Okuda, 1991). If no specific instructions are given, individuals will compare their ideas to a yardstick that they generate based on their own past experiences, including experiences in other organizations, in their current organization, or expectations of others. Supporting the importance of expectations and instructions, Farris (1972) found that creative individuals were more likely to communicate with leaders when seeking feedback about a solution and its implications.

6.1. Implications

The findings reported above have several implications for leaders managing the idea evaluation process. First, it is important for leaders to articulate to followers what criteria are being used to evaluate solutions. Using different criteria will result in the selection of a different solution as the best. Second, part of the process of idea evaluation is the determination of consequences of the implementation, both positive and negative. In addition, identifying possible obstacles for idea implementation may also occur at this point. Leaders should facilitate not only the evaluation of each idea against various criteria but also should, as part of the evaluation scheme, facilitate the evaluation and consideration of the short- and long-term consequences of each idea for the organization as a whole and for various groups within the organization. Group members may lack the necessary knowledge or broader view necessary for this specific process and the input of the leader may be particularly valuable at this point, as Farris (1972) suggested.

Finally, the evaluation process may call for the use of evaluation by external sources such as other individuals in the organization. Different individuals will provide different points of view, criteria for evaluation, and possible consequences of implementation than those identified by the leader. While this diversity may facilitate the evaluation process, it is also important to remember that these evaluative pressures may hinder creativity if the focus is on practical and conforming ideas. In addition, group evaluation may hinder creativity as a result of group-think or premature consensus (Janis & Mann, 1977). The leader's role in facilitating this process may be in creating a culture in which ideas are exchanged openly and trust exists among group members and between group members and the leader (Amabile & Gryskiewicz, 1989; Isaksen et al., 2001). Additional support for this idea is provided by a study by Shalley and Perry-Smith (2001), which found that when developmental feedback was expected, solutions to a business problem were more creative than when evaluative feedback was expected, suggesting that leaders may encourage employee creativity by providing constructive feedback focusing on growth and learning rather than evaluative feedback focusing on right and wrong answers.

7. Conclusions

The need of organizations to be more flexible and innovative has influenced the interest in creativity in leaders and employees (Mumford et al., 2002). This article reviewed the relevant literature on creative problem solving and suggested how leaders may facilitate and promote creative problem solving in their followers by influencing the various cognitive processes involved in creative problem solving. This article was not intended as a comprehensive review of all the factors that may influence creative problem solving. Rather, we used the creative problem-solving processes as a guide, reviewing the factors that may affect the various cognitive processes that must be engaged in to solve problems creatively, and how leaders can help encourage these processes in their subordinates.

This article broadly divided the cognitive processes that underlie creative problem solving into idea generation and idea evaluation. Idea generation includes processes associated with the identification of the problem to be solved, the information needed, and the potential solutions. These processes tend to be viewed as more divergent in nature, requiring problem solvers to generate alternatives (Basadur, 1995; West, 2002). It is clear from that discussion that the availability and access to divergent information is helpful to problem construction, information search, and solution generation (Clapham, 2001; Shalley, 1995). One important role the leader can play in the facilitation of creative problem solving, one that may influence multiple processes simultaneously, is that of providing access to and encouraging the sharing of knowledge and information. The issue of knowledge management has received more attention in recent years (e.g., Davenport & Volpel, 2001; Swan et al., 1999; Van Beveren, 2002), but evidence has been largely anecdotal to this point and more scientific research is necessary to identify how various knowledge management systems promote creativity, and how they influence the specific creative problem-solving processes.

Having the available time and information is not enough, the problem solver must also be able to capitalize on and utilize this information, suggesting the importance of motivational variables (Reiter-Palmon et al., 1997). This in turn suggests the importance of time and effort in generating creative solutions. Studies on problem construction, information search, and idea generation found that more time for each step increased the creativity of the final product (Illies & Reiter-Palmon, in press; Redmond et al., 1993). Leaders may prove particularly influential here by allowing followers more time for the entire creative problem-solving effort. This is not a trivial matter. Because response speed is critical for many organizational problems, taking more time to think about problems and generate solutions may take a back seat. Leaders who recognize the importance of creative problem solving may also be able to provide more time by taking a more proactive rather than a reactive approach. By planning ahead and identifying those problems that are important for the organization's growth and development at an early stage, the leader may be able to allow employees to spend more time on those problems, developing solutions before time becomes a critical factor.

Finally, the effect of instructions has been studied for problem construction, information search, and idea generation. Instructions to spend more time on the specific processes or to actively engage in these processes enhance creativity (Mumford et al., 1991). Leaders can facilitate the creative process, therefore, simply through the instructions they give to their subordinates. However, it is important that leaders pay attention to the message they convey. As the studies of instructions have suggested, instructing subordinates to generate a large number of ideas or original ideas may result in different outcomes (Runco & Okuda, 1991).

The previous discussion brings about an important point. Much of the research on cognitive processes in creative problem solving suggests that instructions, guidance, and encouragement to engage in various processes promote creativity. However, it is also important to note that this does not mean that leaders should be restrictive in their guidance. By providing narrow instructions, leaders may actually hinder creativity as followers will ignore potentially relevant problem constructions, information, or ideas.

In contrast, the processes associated with idea evaluation are more convergent in nature (Basadur, 1995). However, even here, divergent thought is helpful and even necessary. These processes call for the evaluation of the plausibility of solutions, and selection of the best solution and the implementation of that solution. While the evaluation component calls for more convergent thought, the need for implementation planning, including the identification of possible obstacles and problems, and the generation of possible solutions to these obstacles, suggests that divergent thought and ideation are necessary (Basadur, 1995; Mumford et al., 2002). It is therefore not surprising that leaders that are more creative are also more capable of evaluating solutions and identifying the most creative ones (Basadur et al., 2000).

In addition, idea evaluation is contingent on the yardstick against which the solution is being evaluated. The goals generated in the problem construction phase (Mumford et al., 1994), as well as goals put forth by the leader will determine in part how subordinates will evaluate solutions. This again underscores the importance of the instructions given by the leader, which may occur in previous processes. In addition, a climate that is conducive to creativity, one that is open, where ideas are debated and discussed, and where feedback is used for developmental rather than evaluative purpose, will facilitate the selection of a solution that is more creative (Amabile & Gryskiewicz, 1989; Shalley & Perry-Smith, 2001). Finally, while research is somewhat limited on each of the creative problem-solving processes, it is particularly lacking on the process of idea evaluation. Future research should focus on the factors that influence the idea evaluation process and how leaders can facilitate this process.

Finally, our discussion of the cognitive processes necessary for creative problem-solving implied a somewhat linear progression, it should be noted that most cognitive models of creative problem solving suggest a more cyclical approach where the problem solver may return to previous processes if needed (Mumford et al., 1991). If new information is discovered during information search that requires a reformulation of the problem or if ideas developed in the idea generation phase require more knowledge, the problem solver may return to these previous processes. While the outcomes of processes occurring early on will determine the effectiveness of later processes, it is possible to return to these earlier processes and make corrections at any point in the creative problem-solving process. Recognizing that periodic re-examination of earlier processes may be necessary and encouraging employees to do so, as well as encouraging employees to make changes based on these evaluations is another way a leader may facilitate creative problem-solving.

References

Adelman, L., Gualtieri, J., & Stanford, S. (1995). Examining the effect of causal focus on the option generation process: An experiment using protocol analysis. *Organizational Behavior and Human Decision Processes*, *61*, 54–66.

Amabile, T. M. (1983). The social psychology of creativity: A componential conceptualization. *Journal of Personality & Social Psychology*, *45*, 357–376.

Amabile, T. M. (1996). *Creativity in context: Update to the social psychology of creativity*. Boulder, CO: Westview Press.

Amabile, T. M., & Gryskiewicz, N. D. (1989). The creative environment scales: Work environment inventory. *Creativity Research Journal*, *2*, 231–253.

Amason, A. C., Thompson, K. R., Hochwarter, W. A., & Harrison, A. W. (1995). An important dimension in successful management teams. *Organizational Dynamics*, *24*, 20–35.

Arad, S., Hanson, M. A., & Schneider, R. J. (1997). A framework for the study of relationships between organizational characteristics and organizational innovation. *Journal of Creative Behavior*, *31*, 42–58.

Baer, J. M. (1988). Long-term effects of creativity training with middle school students. *Journal of Early Adolescence*, *8*, 183–193.

Barrick, J. A., & Spilker, B. C. (2003). The relations between knowledge, search strategy, and performance in unaided and aided information search. *Organizational Behavior and Human Decision Processes*, *90*, 1–18.

Barsalou, L. W. (1991). Deriving categories to achieve goals. In G. H. Bower (Ed.), *The psychology of learning and motivation: Advances in research and theory, vol. 27* (pp. 1–64). San Diego: Academic Press.

Barsalou, L. W., & Prinz, J. J. (1997). Mundane creativity in perceptual symbol systems. In T. B. Ward, S. M. Smith, & J. Vaid (Eds.), *Creative thought: An investigation of conceptual structures and processes* (pp. 267–307). Washington, DC: American Psychological Association.

Basadur, M. (1994). Managing the creative process in organizations. In M. A. Runco (Ed.), *Problem finding, problem solving, and creativity* (pp. 237–268). Westport, CT: Ablex.

Basadur, M. (1995). Optimal ideation–evaluation ratios. *Creativity Research Journal*, *8*, 63–75.

Basadur, M. (1997). Organizational development interventions for enhancing creativity in the workplace. *Journal of Creative Behavior*, *31*, 59–72.

Basadur, M., Graen, G. B., & Green, S. G. (1982). Training in creative problem solving: Effects on ideation and problem finding and solving in an industrial research organization. *Organizational Behavior and Human Decision Processes*, *30*, 41–70.

Basadur, M., Runco, M. A., & Vega, L. A. (2000). Understanding how creative thinking skills, attitudes and behaviors work together: A causal process model. *Journal of Creative Behavior*, *34*, 77–100.

Baughman, W. A., & Mumford, M. D. (1995). Process-analytic models of creative capacities: Operations influencing the combination-and-reorganization process. *Creativity Research Journal*, *8*, 37–62.

Bink, M. L., & Marsh, R. L. (2000). Cognitive regularities in creative activity. *Review of General Psychology*, *4*, 59–78.

Brand, A. (1998). Knowledge management and innovation at 3M. *Journal of Knowledge Management*, *2*, 17–22.

Brophy, D. R. (1998). Understanding, measuring, and enhancing individual creative problem-solving efforts. *Creativity Research Journal*, *11*, 123–150.

Butler, A. B., & Scherer, L. L. (1997). The effects of elicitation aids, knowledge, and problem content on option quantity and quality. *Organizational Behavior and Human Decision Processes*, *72*, 184–202.

Charles, R. E., & Runco, M. A. (2001). Developmental trends in the evaluative and divergent thinking of children. *Creativity Research Journal*, *13*, 417–437.

Chi, M. T. H. (1997). Creativity: Shifting across ontological categories flexibly. In T. B. Ward, S. M. Smith, & J. Vaid (Eds.), *Creative thought: An investigation of conceptual structures and processes* (pp. 209–234). Washington, DC: American Psychological Association.

Chi, M. T. H., Glaser, R., & Rees, E. (1982). Expertise in problem solving. In R. S. Sternberg (Ed.), *Advances in the psychology of human intelligence, vol. 1* (pp. 1–75). Hillsdale, NJ: Erlbaum.

Clapham, M. M. (2001). The effects of affect manipulation and information exposure on divergent thinking. *Creativity Research Journal*, *13*, 335–350.

Cooper, E. (1991). A critique of six measures for assessing creativity. *Journal of Creative Behavior*, *25*, 194–204.

Coskun, H., Paulus, P. B., Brown, V., & Sherwood, J. J. (2000). Cognitive stimulation and problem presentation in idea-generating groups. *Group Dynamics*, *4*, 307–329.

Cummings, A., & Oldham, G. R. (1997). Enhancing creativity: Managing work contexts for the high potential employee. *California Management Review*, *40*, 22–39.

Dahl, D. W., & Moreau, P. (2002). The influence and value of analogical thinking during new product ideation. *Journal of Marketing Research*, *39*, 47–60.

Davenport, T. H., & Volpel, S. C. (2001). The rise of knowledge towards attention management. *Journal of Knowledge Management*, *5*, 212–221.

Davidson, J. E. (1995). The suddenness of insight. In R. J. Sternberg, & J. E. Davidson (Eds.), *The nature of insight* (pp. 125–155). Cambridge, MA: MIT Press.

Davidson, J. E., & Sternberg, R. J. (1984). The role of insight in intellectual giftedness. *Gifted Child Quarterly*, *28*, 58–64.

Dess, G. G., & Picken, J. C. (2000). Changing roles: Leadership in the 21st century. *Organizational Dynamics*, *28*, 18–34.

Devine, E. J., & Kozlowski, S. W. (1995). Domain-specific knowledge and task characteristics in decision making. *Organizational Behavior and Human Decision Processes*, *64*, 294–306.

Dillon, J. T. (1982). Problem finding and solving. *Journal of Creative Behavior*, *16*, 97–111.

Farris, G. F. (1972). The effect of individual roles on performance in innovative groups. *R&D Management*, *3*(1), 23–28.

Feist, G. J. (1991). Synthetic and analytic thought: Similarities and differences among art and science students. *Creativity Research Journal*, *4*, 145–155.

Feist, G. J. (1999). The influence of personality on artistic and scientific creativity. In R. J. Sternberg (Ed.), *Handbook of creativity* (pp. 273–296). New York: Cambridge University Press.

Finke, R. A., Ward, T. B., & Smith, S. M. (1992). *Creative cognition: Theory, research, and applications*. Cambridge, MA: MIT Press.

Ford, C. M. (1996). A theory of individual creative action in multiple social domains. *Academy of Management Review*, *21*, 1112–1142.

Frederiksen, N. (1984). Implications of cognitive theory for instruction in problem solving. *Review of Educational Research*, *54*, 363–407.

Getzels, J. W. (1979). Problem finding: A theoretical note. *Cognitive Science*, *3*, 167–171.

Getzels, J. W., & Csikszentmihalyi, M. (1975). From problem solving to problem finding. In I. A. Taylor, & J. W. Getzels (Eds.), *Perspectives in creativity* (pp. 90–116). Chicago: Aldine.

Getzels, J. W., & Csikszentmihalyi, M. (1976). *The creative vision: A longitudinal study of problem finding in art*. New York: Wiley.

Gick, M. L., & Holyoak, K. J. (1983). Schema induction and analogical transfer. *Cognitive Psychology*, *15*, 1–38.

Gough, H. G. (1975). A new scientific uses test and its relationship to creativity in research. *Journal of Creative Behavior*, *9*, 245–252.

Guilford, J. P. (1950). Creativity. *American Psychologist*, *5*, 444–454.

Guilford, J. P. (1967). *The nature of human intelligence*. New York: McGraw-Hill.

Hampton, J. A. (1997). Emergent attributes in combined concepts. In T. B. Ward, S. M. Smith, & J. Vaid (Eds.), *Creative thought: An investigation of conceptual structures and processes* (pp. 83–110). Washington, DC: American Psychological Association.

Hocevar, D. (1980). Intelligence, divergent thinking, and creativity. *Intelligence*, *4*, 25–40.

Holyoak, K. J. (1984). Mental models in problem solving. In J. R. Anderson, & K. M. Kosslyn (Eds.), *Tutorials in learning and memory* (pp. 193–218). New York: Freeman.

Hoover, S. M., & Feldhusen, J. F. (1994). Scientific problem solving and problem finding: A theoretical model. In M. A. Runco (Ed.), *Problem finding, problem solving, and creativity* (pp. 201–219). Westport, CT: Ablex.

Hulland, J. S., & Kleinmuntz, D. N. (1994). Factors influencing the use of internal summary evaluations versus external information in choice. *Journal of Behavioral Decision Making*, *7*, 79–102.

Illies, J. J., & Reiter-Palmon, R. (in press). The effects of type and level of personal involvement on information search and problem solving. *Journal of Applied Social Psychology.*

Isaksen, S. G., Lauer, K. J., Ekvall, G., & Britz, A. (2001). Perceptions of the best and worst climates for creativity: Preliminary validation evidence for the situational outlook. *Creativity Research Journal*, *13*, 171–184.

Isaksen, S. G., & Parnes, S. J. (1985). Curriculum planning for creative thinking and problem solving. *Journal of Creative Behavior*, *19*, 1–29.

Janis, I. L., & Mann, L. (1977). *Decision making: A psychological analysis of conflict, choice, and commitment*. New York: Free Press.

Johns, G. A., & Morse, L. W. (1997). Research note: Divergent thinking as a function of time and prompting to "be creative" in undergraduates. *Journal of Creative Behavior*, *31*, 156–165.

Johnson, P., Daniels, K., & Huff, A. (2001). Sense making, leadership, and mental models. In S. J. Zaccaro, & R. J. Klimoski (Eds.), *The nature of organizational leadership: Understanding the performance imperatives confronting today's leaders* (pp. 79–103). San Francisco: Jossey-Bass.

Jung, D. I. (2001). Transformational and transactional leadership and their effects on creativity in groups. *Creativity Research Journal*, *13*, 185–195.

Kay, S. (1991). The figural problem solving and problem finding of professional and semiprofessional artists and nonartists. *Creativity Research Journal*, *4*, 233–252.

Kersholt, J. H. (1992). formation search and choice accuracy as a function of task complexity and task structure. *Acta Psychologica*, *80*, 185–197.

Kobe, L. M. (2001). *Computer-based creativity training: Training the creative process.* Unpublished doctoral dissertation, University of Nebraska.

Kurtzberg, T. R., & Amabile, T. M. (2001). From Guilford to creative synergy: Opening the black box of team-level creativity. *Creativity Research Journal*, *13*, 285–294.

Larson, J. R., Foster-Fishman, P. G., & Keys, C. B. (1994). Discussion of shared and unshared information in decision-making groups. *Journal of Personality & Social Psychology*, *67*, 446–461.

Lovelace, K., Shapiro, D. L., & Weingart, L. R. (2001). Maximizing cross-functional new product teams' innovativeness and constraint adherence: A conflict communications perspective. *Academy of Management Journal*, *44*, 779–793.

Lubart, T. I. (2001). Models of the creative process: Past, present and future. *Creativity Research Journal*, *13*, 295–308.

Markman, A. B., Yamauchi, T., & Makin, V. S. (1997). The creative of new concepts: A multifaceted approach to category learning. In T. B. Ward, S. M. Smith, & J. Vaid (Eds.), *Creative thought: An investigation of conceptual structures and processes* (pp. 179–208). Washington, DC: American Psychological Association.

Marsh, R. L., Landau, J. D., & Hicks, J. L. (1999). How examples may (and may not) constrain creativity. *Memory and Cognition*, *24*, 669–680.

Michael, W. B., & Bachelor, P. (1990). Higher-order structure-of-intellect creativity factors in divergent production tests: A re-analysis of a Guilford data base. *Creativity Research Journal*, *3*, 58–74.

Mobley, M. I., Doares, L. M., & Mumford, M. D. (1992). Process analytic models of creative capacities: Evidence for the combination and reorganization process. *Creativity Research Journal*, *5*, 125–155.

Morse, D. T., Morse, L. W., & Johns, G. A. (2001). Do time press, stimulus, and creative prompt influence the divergent production of undergraduate students? Yes, yes, and no, not very much. *Journal of Creative Behavior*, *32*, 102–114.

Mouchiroud, C., & Lubart, T. (2001). Social creativity: A cross-sectional study of 6- to 11-year-old children. *International Journal of Behavioral Development*, *26*, 60–69.

Mumford, M. D. (2001). Something old, something new: Revisiting Guilford's conception of creative problem solving. *Creativity Research Journal*, *13*, 267–276.

Mumford, M. D., Baughman, W. A., Maher, M. A., Costanza, D. P., & Supinski, E. P. (1997). Process-based measures of creative problem-solving skills: IV. Category combination. *Creativity Research Journal*, *10*, 59–71.

Mumford, M. D., Baughman, W. A., Supinski, E. P., & Maher, M. A. (1996). Process-based measures of creative problem-solving skills: II. Information encoding. *Creativity Research Journal*, *9*, 77–88.

Mumford, M. D., Baughman, W. A., Threlfall, K. V., Supinski, E. P., & Costanza, D. P. (1996). Process-based measures of creative problem-solving skills: I. Problem construction. *Creativity Research Journal*, *9*, 63–76.

Mumford, M. D., & Connelly, M. S. (1991). Leaders as creators: Leader performance and problem solving in ill-defined domains. *The Leadership Quarterly*, *2*, 298–315.

Mumford, M. D., & Gustafson, S. B. (1988). Creativity syndrome: Integration, application, and innovation. *Psychological Bulletin*, *103*, 27–43.

Mumford, M. D., Marks, M. A., Connelly, M. S., Zaccaro, S. J., & Johnson, J. F. (1998). Domain-based scoring of divergent-thinking tests: Validation evidence in an occupational sample. *Creativity Research Journal*, *11*, 151–163.

Mumford, M. D., Mobley, M. I., Uhlman, C. E., Reiter-Palmon, R., & Doares, L. M. (1991). Process analytic models of creative capacities. *Creativity Research Journal*, *4*, 91–122.

Mumford, M. D., Reiter-Palmon, R., & Redmond, M. R. (1994). Problem construction and cognition: Applying problem representations in ill-defined domains. In M. A. Runco (Ed.), *Problem finding, problem solving, and creativity* (pp. 3–39). Westport, CT: Ablex.

Mumford, M. D., Scott, G. M., Gaddis, B., & Strange, J. M. (2002). Leading creative people: Orchestrating expertise and relationships. *Leadership Quarterly*, *13*, 705–750.

Mumford, M. D., Supinski, E. P., Threlfall, K. V., & Baughman, W. A. (1996). Process based measures of creative problem-solving skills: III. Category selection. *Creativity Research Journal*, *9*, 395–406.

Mumford, M. D., Whetzel, D. L., & Reiter-Palmon, R. (1997). Thinking creatively at work: Organization influences on creative problem solving. *Journal of Creative Behavior*, *31*, 7–17.

Nabi, R. L. (2003). Exploring the framing effects of emotion: Do discrete emotions differentially influence information accessibility, information seeking and policy preference? *Communication Research*, *30*, 224–247.

Nonaka, I. (1994). A dynamic theory of organizational knowledge creation. *Organization Science*, *5*, 14–37.

Okuda, S. M., Runco, M. A., & Berger, D. E. (1991). Creativity and the finding and solving of real-world problems. *Journal of Psychoeducational Assessment*, *9*, 45–53.

Paulus, P. B., & Paulus, L. E. (1997). Implications of research on group brainstorming for gifted education. *Roeper Review*, *19*, 225–229.

Perkins, D. N. (1992). The topography of invention. In R. J. Weber, & D. N. Perkins (Eds.), *Inventive minds: Creativity in technology* (pp. 238–250). London: Oxford University Press.

Pitz, G. F., Sacks, N. J., & Heerboth, J. (1980). Procedures for eliciting choices in the analysis of individual decisions. *Organizational Behavior and Human Decision Processes*, *26*, 396–408.

Plucker, J. A. (1999). Is the proof in the pudding? Reanalyses of Torrance's (1958 to present) longitudinal data. *Creativity Research Journal*, *12*, 103–114.

Plucker, J. A., & Runco, M. A. (1998). The death of creativity measurement has been greatly exaggerated: Current issues, recent advances, and future directions in creativity assessment. *Roeper Review*, *21*, 36–39.

Qin, Y., & Simon, H. A. (1990). Laboratory replication of scientific discovery processes. *Cognitive Science*, *4*, 281–312.

Quintas, J. B., Anderson, P., & Finkelstein, S. (1996, March–April). Managing professional intellect: Making the most of the best. *Harvard Business Review*, *74*, 71–80.

Redmond, M. R., Mumford, M. D., & Teach, R. (1993). Putting creativity to work: Effects of leader behavior on subordinate creativity. *Organizational Behavior and Human Decision Processes*, *55*, 120–151.

Reeves, L., & Weisberg, R. W. (1994). The role of content and abstract information in analogical transfer. *Psychological Bulletin*, *115*, 381–400.

Reiter-Palmon, R., Mumford, M. D., O'Connor Boes, J., & Runco, M. A. (1997). Problem construction and creativity: The role of ability, cue consistency, and active processing. *Creativity Research Journal*, *10*, 9–23.

Reiter-Palmon, R., Mumford, M. D., & Threlfall, K. V. (1998). Solving everyday problems creatively: The role of problem construction and personality type. *Creativity Research Journal*, *11*, 187–197.

Rickards, T. (1999). Brainstorming. In M. A. Runco, & S. R. Pritzker (Eds.), *Encyclopedia of creativity, vol. 1* (pp. 219–228). San Diego, CA: Academic Press.

Rostan, S. M. (1994). Problem finding, problem solving, and cognitive controls: An empirical investigation of critically acclaimed productivity. *Creativity Research Journal*, *7*, 97–110.

Runco, M. A. (1986). Maximal performance on divergent thinking tests by gifted, talented, and nongifted children. *Psychology in the Schools*, *23*, 308–315.

Runco, M. A. (1991). *Divergent thinking*. Westport, CT: Ablex.

Runco, M. A. (1999). Divergent thinking. In M. A. Runco, & S. R. Pritzker (Eds.), *Encyclopedia of creativity, vol. 1* (pp. 577–582). San Diego, CA: Academic Press.

Runco, M. A., & Chand, I. (1995). Cognition and creativity. *Educational Psychology Review*, *7*, 243–267.

Runco, M. A., & Charles, R. E. (1993). Judgments of originality and appropriateness as predictors of creativity. *Personality and Individual Differences*, *15*, 537–546.

Runco, M. A., & Marz, W. (1992). Scoring divergent thinking tests using total ideational output and a creativity index. *Educational and Psychological Measurement*, *52*, 213–221.

Runco, M. A., & Nemiro, J. (1994). Problem finding, creativity, and giftedness. *Roeper Review*, *16*, 235–241.

Runco, M. A., & Okuda, S. M. (1988). Problem discovery, divergent thinking, and the creative process. *Journal of Youth & Adolescence*, *17*, 211–220.

Runco, M. A., & Okuda, S. M. (1991). The instructional enhancement of the flexibility and originality scores of divergent thinking tests. *Applied Cognitive Psychology*, *5*, 435–441.

Runco, M. A., Okuda, S. M., & Thurston, B. J. (1987). The psychometric properties of four systems for scoring divergent thinking tests. *Journal of Psychoeducational Assessment*, *5*, 149–156.

Schraw, G., Dunkle, M. E., & Bendixen, L. D. (1995). Cognitive processes in well-defined and ill-defined problem solving. *Applied Cognitive Psychology*, *9*, 523–538.

Schulz-Hardt, S., Jochims, M., & Frey, D. (2002). Productive conflict in group decision making: Genuine and contrived dissent as strategies to counteract biased information seeking. *Organizational Behavior and Human Decision Processes*, *88*, 563–586.

Scott, S. G., & Bruce, R. A. (1994). Determinants of innovative behavior: A path model of individual innovation in the workplace. *Academy of Management Journal*, *37*, 580–607.

Scratchley, L. S., & Hakstian, R. A. (2001). The measurement and prediction of managerial creativity. *Creativity Research Journal*, *13*, 367–384.

Shalley, C. E. (1995). Effects of coaction, expected evaluation, and goal setting on creativity and productivity. *Academy of Management Journal*, *38*, 483–503.

Shalley, C. E., & Perry-Smith, J. E. (2001). Effects of social–psychological factors on creative performance: The role of informational and controlling expected evaluation and modeling experience. *Organizational Behavior and Human Decision Processes*, *84*, 1–22.

Simon, H. A. (1978). Information-processing theory of human problem solving. In W. K. Estes (Ed.), *Handbook of learning and cognitive processes: V. Human information* (pp. 271–295). Oxford: Erlbaum.

Smilansky, J. (1984). Problem solving and the quality of invention: An empirical investigation. *Journal of Educational Psychology*, *76*, 377–386.

Smith, G. F. (1989). Representational effects on the solving of an unstructured decision problem. *IEEE Transactions on Systems, Man, and Cybernetics*, *19*, 1083–1090.

Smith, G. J. (1998). Idea-generation techniques: A formulary of active ingredients. *Journal of Creative Behavior*, *32*, 107–133.

Smith, S. M., & Blankenship, S. E. (1989). Incubation effects. *Bulletin of the Psychonomic Society*, *27*, 311–314.

Sternberg, R. J., & Lubart, T. I. (1991). An investment theory of creativity and its development. *Human Development*, *34*, 1–31.

Stokes, P. D. (1999). Learned variability levels: Implications for creativity. *Creativity Research Journal*, *12*, 37–45.

Swan, J., Newell, S., Scarbrough, H., & Hislop, D. (1999). Knowledge management and innovation: Networks and networking. *Journal of Knowledge Management*, *4*, 262–275.

Van Beveren, J. (2002). A model of knowledge acquisition that refocuses knowledge management. *Journal of Knowledge Management*, *6*, 18–22.

Vincent, A. S., Decker, B. P., & Mumford, M. D. (2002). Divergent thinking, intelligence, and expertise: A test of alternative models. *Creativity Research Journal*, *14*, 163–178.

Voss, J. F., & Post, T. A. (1988). On the solving of ill-structured problems. In M. T. H. Chi, R. Glaser, & M. J. Farr (Eds.), *The nature of expertise* (pp. 261–285). Hillsdale, NJ: Erlbaum.

Voss, J. F., Wolfe, C. R., Lawrence, J. A., & Engle, R. A. (1991). From representation to decision: An analysis of problem solving in international relations. In R. J. Sternberg, & P. S. Frensch (Eds.), *Complex problem solving: Principles and mechanisms* (pp. 119–158). Hillsdale, NJ: Erlbaum.

Ward, T. B., & Sifonis, C. M. (1997). Task demands and generative thinking: What changes and what remains the same? *Journal of Creative Behavior*, *31*, 245–259.

Ward, T. B., Smith, S. M., & Finke, R. A. (1999). Creative cognition. In R. J. Sternberg (Ed.), *Handbook of creativity* (pp. 189–212). New York: Cambridge University Press.

Ward, T. B., Smith, S. M., & Vaid, J. (1997). Conceptual structures and processes in creative thought. In T. B. Ward, S. M. Vaid, & J. Vaid (Eds.), *Creative thought: An investigation of conceptual structures and processes* (pp. 1–27). Washington, DC: American Psychological Association.

Weenig, M., & Maarleveld, M. (2002). The impact of time constraint on information search strategies in complex choice tasks. *Journal of Economic Psychology*, *23*, 689–702.

Weisberg, R. W. (1988). Problem solving and creativity. In R. J. Sternberg (Ed.), *The nature of creativity: Contemporary psychological perspectives* (pp. 148–176). New York: Cambridge.

Weisberg, R. W. (1999). Creativity and knowledge: A challenge to theories. In R. J. Sternberg (Ed.), *Handbook of creativity* (pp. 226–250). New York: Cambridge.

West, M. A. (2002). Sparkling fountains or stagnant ponds: An integrative model of creativity and innovation implementation in work groups. *Applied Psychology: An International Review*, *51*, 355–387.

Woodman, R. W., Sawyer, J. E., & Griffin, R. W. (1993). Toward a theory of organizational creativity. *Academy of Management Review*, *18*, 293–321.

Yuan, R., & Zhou, J. (2002). Expected evaluations and creativity: New answers to an old question. Presented at the Annual Conference of the Academy of Management, Denver, CO.

Zhou, J., & Shalley, C. E. (in press). Research on employee creativity: A critical review and directions for future research. *Research in Personnel and Human Resources Management.*