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# **NATURE OR NURTURE: CAN PSYCHOMETRIC TOOLS HELP TO FOSTER CREATIVITY IN ORGANIZATIONS?**

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## Executive Summary

Broadly defined, there are three main research approaches to the measurement of creativity in organizations. The first (and the oldest of the three) measures *individual outputs* directly on a number of dimensions (e.g., divergent thinking) and tries to identify creative individuals based on those measurements. The most famous and statistically supported scales in this category are the Guilford Battery Test (1959) and Torrance Tests of Creative Thinking (Torrance, 1962). The second area, where the majority of research in creativity has been done so far, is the one that attempts to identify *individual creative potential* based on the personality traits. The most frequently used scales in this research stream are the Myers-Briggs Indicator (Myers & Briggs, 1962) and Kirton Adaptation Inventory (Kirton, 1976). Both, divergent thinking and personality traits tests have been found relatively successful and useful for identifying gifted individuals and creative employees at work.

However, decades of research demonstrated that individual creative potential or creative output alone is not necessarily predictive of (or leads to) efficient creative performance. Therefore, the third (and more recent) stream of research in this area has focused on identifying *organizational environments* that foster creativity. The scales that showed the most promise and statistical support so far are the Creative Climate Questionnaire (Amabile, Conti, Coon, Lazenby & Heron, 1996), the Team Climate Inventory (Anderson & West, 1998) and the Situational Outlook Questionnaire (Isaksen, Lauer, Ekvall, & Britz, 2001). Nevertheless, as with scales that measure one's creative potential or a creative output as a sole main predictor of individual creativity in organizations, the scales that measure organizational climate that facilitates individual and organizational creativity fail to fully address the issue when used alone.

Recent studies in this area suggest that in order to foster creativity in organizations, companies must identify creative individuals based on both, their creative potential and the actual output measurements, as well as ensure organizational working climate to be conducive of creativity.

Specifically, studies show that both, individual and organizational level characteristics play a relatively important role in the process of assessment of individual potential and the development of creative organizational climate. Alternatively, organizational climate has been proven as a primary factor stimulating and ensuring successful use of organizational creative resources in the process of nurturing and sustaining creativity.

Based on the review of existing research, in this paper we propose the following steps organizations must take in order to select creative individuals and attempt to develop, nurture and sustain creativity in their companies. First, using the examples of valid and reliable scales, we argue that companies need to ensure that they attract and select individuals possessing both, creative personality traits and cognitive abilities (e.g., divergent thinking or creative problem-solving skills) that are conducive to creativity. Second, we urge managers to carefully develop training programs that enhance individual creative cognitive abilities and propensity to innovation. Furthermore, we emphasize that in addition to having a goal of enhancing individual creative abilities and skills, the creativity training programs need to focus on improving individual motivation to be creative, as well as on developing a group and/or an organizational climate that supports individual-level creativity. Finally, in this paper we highlight the role of organizational leadership and team/group dynamics in the process of development and nurturing creativity on both, individual and organizational levels. The brief summary of key recommendations for managers for development, nurturing and sustaining creativity in their organizations is attached at the end of the paper.



## NATURE OR NURTURE:

### CAN PSYCHOMETRIC TOOLS HELP TO FOSTER CREATVITY IN ORGANIZATIONS?

In today's fast moving business environment creative thinking is essential, and new and useful ideas are critical. Many psychometric tools have been developed to assess creative potential and with the hope that they can be used effectively to select creative individuals, form creative teams, establish creative organizational climates, and ultimately to foster creativity in organizations. This paper reviews the recent literature on psychometric tools and on creativity in organizations. It addresses two broad questions: (1) What are the strengths and weaknesses of available tools for measuring creativity? And (2) Based on the literature, what do we know about how to select, develop, and nurture creativity in organizations?

Creativity can be defined as the ability to produce work that is both novel and appropriate (Sternberg, 1999). Researchers have defined novel as original or unexpected, while defining appropriate as useful and adaptive to task restraints (Lubart, 1994). However, due to the perceived complex nature of creativity, only in the past sixty years have researchers attempted to scientifically study this phenomenon, and the majority of creativity scholars today believe that creativity can be measured only to some degree (Sternberg, 2006). Taking into account the complex and ambiguous nature of the topic, it comes as no surprise that there is no unified theory in the field regarding the measurement and the selection of individual creativity and individual creative potential, or the development and the maintenance of a creative climate in the organizational environment. In this paper we attempt to not only review and reconcile together different streams of research that exist in this area, but also to come up with a comprehensive set of steps that need to be taken by modern organizations in order to select creative employees and develop and nurture creativity in work settings.

In the past, creativity has been described by a majority of researchers as a personality trait or a combination of personality traits (Plucker & Renzuli, 1999). Personality traits are defined as the pattern

of relatively enduring ways in which a person feels, thinks, and behaves (Staw, 2001). In the past decades, researchers also came to the conclusion that creativity is influenced by an individual's context (or an environment one works in – (Mayer, 1999)). Context has been defined as the interrelated conditions in which something exists or occurs (Mish, 1997). Thus, it has been general consensus in the field that creativity of an individual is related to one's propensity for creativity coupled with the surrounding context or work environment.

Most research in the past has concentrated on the psychometric measures of creativity. These were the first attempts at measuring creative potential because the tests were normally brief and easy to administer (Sternberg & Lubert, 1999). Over time psychometric approaches to the study of creativity have become incredibly diverse in nature and are not easily characterized as a group (Plucker & Renzulli, 1999). What began as attempts at measuring thoughts and actions that were unique now includes studying many different personality traits in various combinations. Recent approaches have also included the psychometrics studies of the context or work environment.

In the next two sections we will follow the history of measuring both the individuals' propensity for creative thought and the potential for creativity in a given work environment. We will present the major tests and scales used for this measurement and we will address their strengths and weaknesses. We then follow with potential applications of the described measures and scales for the purposes of selection, nurturing and sustaining of creativity in organizations. Finally, we will conclude with a summary of things managers can do to enhance creativity in their organizations.

## PSYCHOMETRIC MEASURES OF CREATIVITY

“Psychometrics is the field of study concerned with the theory and technique of [educational](#) and [psychological measurement](#), which includes the measurement of knowledge, abilities, attitudes, and [personality](#) traits” (www.wikipedia.org). The two main dimensions of psychometric quality are validity and reliability scales. In the creativity field, psychometric measurement has been defined as the direct measurement of creativity and/or its perceived correlates in individuals (Plucker & Renzulli, 1999). Therefore, with respect to creativity measures, validity of scales relates to whether or not the test is truly measuring the creative potential of an individual. Validity can be tested by comparing different creativity measurement tests and seeing if they predict whether the same individuals are indeed creative. Reliability, on the other hand, relates to whether or not the test produces stable, consistent results across different settings. As such, reliability is negatively affected by an inconsistent testing environment.

### **Divergent Thinking Scales (Measuring Direct Outputs)**

The earliest approaches to measurement of creativity focused on measuring direct outputs. Specifically, one of the first tests that appeared in the field were divergent thinking scales, with the Guilford Battery (Guilford, 1957) and Torrance Tests of Creative Thinking (TTCT – Torrance, 1962), as the most known and widely used scales. For example, in Guilford test, individuals are asked to produce words that are similar or different to two double words (or have to construct words from a group of letters), and they are evaluated on the bases of fluency (number of responses) and originality (the uniqueness of the answer). In TTCT test individuals produce words and draw pictures on four sets of tests. The evaluation technique is similar to the one in Guilford test, but it is more sophisticated, as individuals are evaluated on the basis of fluency, originality, elaboration, abstractness and resistance to premature closure. Both types of tests are relatively easy to administer and interpret. The TTCT test has been especially widely researched in the literature and has been proven by researchers as a successful tool in identifying highly gifted individuals, predicting creativity in students (Kim, 2006) and is capable of predicting creative

achievement three times better than intelligence tests (Plucker, 1999). An example of a shorter version of TTCT is the Abedi-Schumacher Creativity Test (CT). The authors also suggest measuring individual creative thinking by fluency, flexibility, originality and elaboration of individual ideas. This test as well has showed an adequate validity and reliability (Abedi, 2002).

Despite the proven psychometric qualities, the validity and reliability of the TTCT scales are still a subject of controversy and may lack support when are not administered properly (Cropley, 2000). Later, TTCT have been altered to take into account not only the quantity but also the quality of responses (Runco, 1986). However, even with these improvements divergent thinking tests do not take into account the usefulness of ideas, the demographics and personality of respondents and contextual factors. Thus, some key factors of the development and nurture of creativity are not adequately addressed in those tests (Sternberb & Lubart, 1999).

### **Personality Trait Scales (Measuring Creative Potential)**

As was mentioned above, the majority of research in the field to this date has focused on measuring creative potential of individuals by looking at their personality traits. In particular, Myers-Briggs Type Indicator (MBTI - Myers & Briggs, 1962), is one of the earliest, but still widely recognized and used scales among practitioners. In this test individuals respond to various questions and their answers are evaluated on four dimensions: Introversion-Extraversion; Intuitive-Sensing, Thinking-Feeling, & Perceiving-Judging. Based on those four dimensions, individuals are grouped into 16 different categories with various traits attached to each. The Myers-Briggs Indicator is easy to administer and has relatively acceptable validity and reliability scores. For example, it has been useful in identifying individuals who are effective in early development of products in organizational settings (Stevens, Burley, & Divine, 1999), as well as predicting creative performance of executives (Ford, 1999). Recent research indicates that the Intuitive-Sensing scale may be predictive of creative thought by indicating whether an individual has the right balance between the courage to champion their creative idea and the willingness to champion an idea presented by a

coworker (Cramer, 2006). However, there are several major shortcomings to this test, including the self-report bias (e.g., the individual tendency to answer questions in a way that supports their self image, but not necessarily is reflective of an actual behavior). There are also some concerns about the lack of statistical difference between 16 categories of the indicator (Cramer, 2006; Pittenger, 1993). In addition, the MBTI tests have also been criticized for not taking into account surrounding contexts, a major criticism common to quite a few scales and tests that have been solely focused on individual dimensions.

Another major test in this category is the Kirton Adaptation Inventory (KAI – Kirton, 1976). In this test, answers of respondents are scored on the four scales: Originality, Efficiency, Rule/Group and Conforming. The main goal of this scale is to identify two basic types of individuals – those who tend to *innovate* in a creative problem-solving context and those who tend to *adapt* in a creative problem-solving situation. Originality is the inclination for adaptors to offer many implementable solutions while innovators present many possible solutions. Efficiency is the inclination for adaptors to proceed linearly in creative problem solving while innovators disdain too much attention to detail. Rule/Group is the tendency for adaptors to follow social norms, while innovators have a tendency to think unconventionally. Finally, conforming is the tendency for adaptors to take a more accepted route.

This is one of the first scales to differentiate between the ability to do a task better and the courage to do it differently. In other words, the KAI scale measures not only whether a respondent has a capacity to be creative, but whether a respondent has the self confidence to deviate from conventional thought. The KAI scale has been used in a number of studies and has a proven reliability and validity record. For example, it is widely used for identifying innovators and adaptors in organizational settings (Garfield et al, 2001; Skinner & Drake, 2003), as well as considered to be a good predictor of employee creativity (Emsley, Nevicky, & Harrison, 2006; Jaskyte, Kisielienc, & Audrone, 2006; Miron, Erez, & Naveh, 2004). As with other scales that measure only creative potential of an individual, the major weakness of this scale is that it does not take into account other factors, such as team/group climate, task characteristics and individual behaviors. In addition the KAI scale assumes that respondents will be working individually; therefore, it

has difficulty predicting creativity in work groups. The KAI scale also assumes that individual creativity will not vary depending on different types of tasks and behaviors. Therefore the KAI scale is less effective measuring respondent creativity when the respondent works on varied tasks in a group setting.

Other personality trait scales, such as the Adjective Check List (Gough, 1979; Gough & Heilbrun, 1983); What Kind of Person Are You (WKOPAY – Torrance & Khatena, 1970); and Runco Ideational Behavior Scale (RIBS – Runco, Plucker, & Lim, 2001) have also been used in some studies, but not as many as the MBTI or KAI scales. Specifically, the Adjective Check List (the scale that was used the most and received the most support out of the three above was used in studies as a general predictor of individual creativity and innovation in organizational context (Craik, Ware, Kamp, O'Reilly, Straw, & Zedeck, 2002; Domino, Schmuck, & Schneider, 2002; Unsworth, Brown, & McGuire, 2000), and was successfully used to identify top software developers (Wynekoop & Waltz, 2000). WKOPAY has been used along other creativity personality traits scales (such as KAI & MBTI) in several studies and showed satisfactory reliability ratings (Houtz, Selby, Esquivel, Okoye, & Peters, 2003; Kwang, 2001). Finally, Runco Ideational Behavior Scale was shown in some studies to be a good instrument for measurement of creative potential and originality and useful in different cultural contexts (Ames & Runco, 2005; Plucker, Runco, & Lim, 2006). Specifically, by combining personality characteristics and individual cognitive abilities, Runco (1992) identified and extracted personality traits of those people who have high ideational skills such as divergent thinking and elaboration. These traits are internal locus of control, nonconformance, independence, playfulness, and cognitive tempo. These personality traits are believed to be useful for guiding the development of creative thinking processes (the cognitive processes).

### **Situational Variables (Measuring the Role of Context)**

Recent creativity research has explored the possibility that creative thought is more closely related to situational variables, such as organizational context (Bauer, 1993), as individuals have been found to have greater creative capacity under certain conditions (Nickerson, 1999). These conditions are related to

the degree to which the following attributes are present at work: challenge (e.g., time pressures at work), freedom (e.g., high autonomy in day to day operations), resources (e.g., availability of the tools needed to perform the required tasks), organizational support (e.g., organizations that value innovation), supervisory encouragement (e.g., goal clarity, open interactions and perceived support), and work group support (e.g., intrinsic and extrinsic motivation) (Amabile, 1996).

Alternatively, Csikszentmihalyi introduced the concept of “flow” where the context assists an individual in entering a highly creative state where time and place seems to fade away (Csikszentmihalyi, 1997). Csikszentmihalyi understands creativity as “a phenomenon that is constructed through an interaction between producer and audience.” (Csikszentmihalyi, 1999: 314). Creativity involves the interplay of the domain (e.g., surrounding context), the field (e.g., the society), and the individual (Csikszentmihalyi, 1999). Creative people seek out domains and fields where they can be the most creative (Csikszentmihalyi, 1999). A good example would be a professional baseball player who is so focused on hitting a pitch that everything else fades and slows down so he only sees the rotating ball coming at him. Csikszentmihalyi believes this state of “flow” is the epitome of most creative moments in individual’s lives and emphasizes the role of the context in helping individuals to achieve this state.

Other research has found that creative thought can be enhanced with the presence in the environment of elements, such as empathy and compassion (Gruber & Wallace, 1999). Specifically, Gruber and Wallace found that employees that work in a nurturing, caring environment are more creative. Runco and Sakamoto (1999) found that fun and playfulness in the work environment can lead to more experimentation and willingness to “just give it a try”. In turn this willingness to try something new just for the fun of it leads to more creative thought (Runco & Sakamoto, 1999). Simonton (1999) found that a sense of danger and adventure in the work environment can lead to more creative ideas. In light of this research, more recent scales also include contextual measures that either facilitate or inhibit individual or group creativity. An overview of these scales will be addressed in the next section.

Even though this area has not been yet explored well, several scales that assess organizational climate have been developed and validated by researchers. Specifically, the Siegel Scale for Innovation Support (SSSI – Siegel & Kaemmerer, 1978) was the first measure that took into account the contextual nature of creativity. In this instrument the creative climate is assessed by the workers themselves. Individuals are asked a number of questions related to the leadership, ownership, norms for diversity, continuous development of an organization and consistency of the development. To date there is no strong support for the psychometric properties and the structure of this scale, though its validity appears to be acceptable (Orpen, 1990). Some subscales of SSSI have been used elsewhere (Howell & Avolio, 1993; Scott & Bruce, 1994), but the psychometric characteristics of those are seldom reported.

The Creative Climate Questionnaire (KEYS – Amabile, Conti, Coon, Lazenby, & Heron, 1996) is one of the most widely used scales in the organizational climate assessment category. In KEYS individuals are asked a number of questions related to the categories of: organizational support, supervisory encouragement, work group support, freedom, resources, and challenge<sup>1</sup>. Each of those categories is ranked as either a stimulant or an obstacle for creativity. Organizational support, supervisory encouragement, and work group support all work as a stimulant for creativity, while results for freedom, resources, and challenge depend on the indicated range. In particular, freedom was found to enhance creativity, but too much freedom negatively influences the boundaries important to maintaining creative focus. Access to adequate resources stimulates creative thought, while limited resources represent an obstacle. In a similar fashion, challenge is found to be important for stimulating creative thought, while too much challenge leads to work pressures which can be an obstacle to creative thought. This scale was used in several studies and has been validated as a good measure of the perceived creative climate in various organizations (Arvidsson, Johansson, Ek, & Akselsson, 2006; Bommer & Jalajas, 2002; Zain, Richardson, & Adam, 2002), as well as the predictor of organizational creative outcome (Ekvall & Ryhammar, 1998).

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<sup>1</sup> For the description of those categories, see Amabile, et al., 1996 pages 1158-1162.

The Team Climate Inventory (TCI – Anderson & West, 1998) is a self-report measure of creativity climate that showed good reliability and validity in some studies (Anderson & West, 1998; Pirola & Mann, 2004). This measure is used to demonstrate that creative climate can have a positive impact on team creativity. TCI is used to assess team environment as it relates thirteen sub scales. These subscales include categories such as Social Desirability and Shared Perceptions.

Studies by Isaksen, Lauer, Ekvall, & Britz (2000) and Isaksen & Lauer (2002) also showed the validity of a Situational Outlook Questionnaire (SOQ) (developed by Scott et al., 2001; 2002) that is used to measure organizational climate as an enhancer or inhibitor of creativity and change in teams. SOQ measures whether the work environment is conducive or detrimental to creativity. It measures numerous variables related to problem solving, decision making, communicating and coordinating. Similarly to TCI scale, SOQ is also a self-report measure.

As with the outcome or personality trait scales described earlier, the instruments assessing creative climate as a main predictor of creativity in organizations fail to uncover a complete picture when used alone. Joy (2004) argued that innovative behavior is influenced by both, individual traits (e.g., the need to be different) and environment (e.g., one's expectancy that innovative behavior will lead to a desirable outcome). Therefore, coupled together, individual ability and work environment, may predict innovative behavior (Joy, 2004). Similarly, Ford (1999) looked at how individual creative ability, style, motivation and work environment can predict one's creative performance. Using sample of executives he found that taken together, problem-finding interpretive style, motivation towards creative goals and context that supports creativity, contribute to higher creative work performance of executives. Thus, a combination of factors, such as individual traits or behaviors, individual motivation, and surrounding context can all contribute to enhanced creativity at work.

In addition, some researchers recently started combining both, creative potential and actual output measurements in an attempt to improve the reliability of tests (e.g., Miller et al, 1996). These hybrid scales are relatively new and have limited research to reinforce their predictive claims. The premise behind this

line of inquiry is that divergent thought, personality trait and context related scales each holds only one piece to the puzzle. By using multiple scales and statistically combining these scales a more predictive index can be produced.

### **HOW TO SELECT, DEVELOP AND NURTURE CREATIVITY IN FIRMS**

The first step in building a creative organization is the process of selecting individuals who have creative potential and fit well in their organizational environments. The psychometric tests of creativity reviewed above can be helpful with this process, despite their limitations. Other research indicates that creative behavior in organizations can be increased through selection based on overall personality traits, development of abilities and behaviors associated with creativity through training programs, and nurturing creative behavior in the workplace by establishing creative work environments or climates. .

#### **Selection of “Creative Personalities”**

The process of selection, development and nurturing should focus on one or several of the following aspects: personality factors, motivation, cognitive styles and skills, metacognitive skills and environmental conditions (Feldhusen & Goh, 1995). An individual’s level of creativity has long been believed to be a function of both personality traits and cognitive abilities (Ocker, 2005). Thus, researchers and practitioners have studied both creative personality potential and creative cognitive styles (skills) of job applicants. Creative personality is usually defined as one’s desire to think and behave differently from the norm, coupled with the talent for originality (i.e., generating more numerous original alternative solutions and application of solutions and methods to different problems or contexts – Davis, 1992; Wynekoop & Walz, 2000). The “Creativity Personality” sub-scale of the ACL (Adjective Check List) scale (Gough, 1979) is a useful tool for selecting people with creative personality in the workplace, as mentioned above (e.g., Wynekoop & Walz, 2000; Kletke et al, 2001; Craik et al, 2002). This subscale mainly focuses on a person’s desire to be original and different from others. For instance, by using the

“creativity personality” part of the ACL scale, Wynekoop and Walz (2000) found that software developers who are identified as creative problem solvers could think out more ways/solutions in translating abstract business problems into a concrete system, and could be distinguished statistically significantly from those who do NOT have a strong creative personality. Their study also showed that IT personnel can benefit from training in creative problem solving.

Creative personality assessments can also be used as a selection tool. In a combined managerial and personality assessment program, Craik et al (2002) used ACL to predict MBA candidates’ managerial styles and found that a manager’s creativity personality is significantly associated with his/her decision-making and fact finding (identified as Strategic Managerial Style), as well as oral communication and initiative (identified as Interpersonal managerial style). Furthermore, managers’ creativity personalities were found to be related to their managerial potential. Thus, creativity instruments such as the ACL can be used to help place a creative person into his/her most appropriate managerial position by distinguishing his/her managerial styles. Other personality characteristics have also been found to be positively related to a person’s creativity. For example, openness to experience was found to be positively related to divergent thinking and cognitive fluency (Wolfradt & Pretz, 2001). Furthermore, some studies (Gotz & Gotz, 1979; MacKinnon, 1975) showed that creative people tend to be more introverted as measured by the Myers-Briggs Type Indicator, described in previous section. However, caution should be exercised in applying this finding, since a large part of creativity is domain-specific. A creative architect and a creative manager may not share the same personality characteristics.

Woodman and Schoenfeldt (1989) pay special attention to personality variables such as locus of control, dogmatism, and autonomy. Locus of control defines whether a person places the primary responsibility for an event on internal or external forces. People who believe their own actions determine what happens to them have a high **internal** locus of control, and they are more likely to be creative, self-motivated, actively searching for more information and solutions; while those who believe outside forces

determine what happens to them have a high *external* locus of control, and they are likely to be more compliant, and not effective in situations that require initiative and creativity. Dogmatism refers to a person's receptiveness to others' ideas and opinions. Individuals who are highly dogmatic appear to be "closed-minded" and not very receptive to the ideas of other, which results in lower creativity. Autonomy refers to the extent to which a person can control his/her own work, job or action without being supervised by others. Higher autonomy is linked to higher individual self-motivation and creativity.

Other personality factors for the purposes of the selection process, such as agreeableness and conscientiousness, resulted in mixed conclusions and further studies are required. Specifically, some researchers have suggested that creative individuals are more likely to be less agreeable and more independent (Guncer & Oral, 1993), but other studies failed to notice any difference in the agreeableness of creatively successful individuals (King et al, 1996). Still other studies reported that creative individuals actually have stronger tendencies of being agreeable compared with non-creative individuals (Walker et al, 1995). The mixed result of research on the relationship between agreeableness and creativity may be due to one or more of several possibilities 1) contextual or other personal characteristics may have affected results. For example, less agreeable people may appear to be more creative by arguing forcefully for their own ideas in more competitive environments; whereas the more agreeable individuals may appear more creative in cooperative environments by adopting new ideas to come up with new solutions. 2) It is possible that the research did not distinguish between an individual's creativity potential vs. creative output. Thus, less agreeable individuals may have shown more creative output by making independent thinking more salient, but more agreeable individuals may actually have more creative potential. Therefore, managers should be cautious about a candidate's personality of agreeableness and take other factors into consideration.

The same issue also happens to conscientious. For instance, McCrae (1987) reasoned that conscientious individuals are more likely to follow through with creative undertakings, and found a strong *positive* correlation between conscientiousness and creativity. However, King et al (1996) found a *negative*

relation between conscientiousness and creativity and creativity achievements. The reason for such mixed result of research might lie in omitting of other significant variables. For example, a conscientious person who has more openness to experience or less dogmatism may have more creative potential than one who has less openness to experience. As a result, managers should not judge a candidate's creativity by only one or two personality traits; furthermore, the interaction between different personality traits should be fully considered.

Ocker (2005) concluded that one's creative personality includes the following characteristics: independent thought processes (e.g., both an individual's originality in thinking and ability to think without others' influence), persistence and self-confidence (which mainly relates to the creative achievement an individual could obtain and an ability of keeping a high degree of psychological openness), internal locus of control and intellectual honesty (which influence an individual's motivational potential to 1) control his/her surrounding environment; 2) be creative within his/her specific domains; and 3) guarantee his/her job competence in the workplace, especially in such areas as R&D, academic research, or knowledge work). Selecting people with these creative personalities may significantly enhance the probability that they will do their job creatively in a work place.

As research evidence points out, creative personality, combined with creative motivation and idea generation (divergent thinking), can have positive effects on innovation which is the ideal and desired result of creativity (Unsworth et al, 2000). Moreover, research shows that individual cognitive skills are behaviorally defined, i.e., these skills can be taught and learned by well-designed creativity training and thus be turned into concrete behaviors of an individual.

### **Creativity Training**

Selecting individuals who possess a creative personality or creative cognition abilities is only the first step of enhancing creativity at work. The next step is to find ways to develop and nurture creativity. Fortunately, a number of researchers in the field of creativity have found that creativity can be taught and enhanced through creativity training programs.

The majority of creativity training programs have been developed by researchers and practitioners on the basis of creativity theories or models of divergent thinking, productive thinking, or creative problem solving. One important characteristic of these training programs is that they aim to improve individual creativity in different *constructs* or *dimensions* identified in creativity instruments such as TTCT. Theory-driven creativity training can be categorized into four categories as enhancing: 1) creative personality, 2) cognitive factors, 3) a combination of personality and cognitive abilities, and 4) motivation to be creative.

Researchers suggest that there are aspects of personality that may be modified or taught by creativity training. For example, Dacey (1989) identified nine personality factors predictive of creativity – tolerance of ambiguity, stimulus freedom, functional freedom, flexibility, risk taking, preference for complexity and disorder, positive attitude toward work, androgyny, and acceptance of being different. According to Dacey, tolerance of ambiguity refers to one's ability to tolerate uncertainty, stimulus freedom refers to one's ability and desire to break or change the existent (social, organizational, etc.) norms which prevent creative problem solving, function freedom refers to one's ability to break the existent psychic or cognitive habits (i.e., the so-called functional fixity) and come up with new solutions, and androgyny refers to one's ability of NOT possessing stereotyped gender character. These personality factors are regarded as malleable and can be taught and trained with an eye towards developing one's creative potential.

In addition, Speedie et al (1973) and Feldhusen (1993) found a number of cognitive skills and strategies that are components of creative thinking and problem solving. According to them, the most important components include: an ability to sense a problem existence, an ability to formulate questions to clarify the problem and determine the causes of the problem, clarification of the goal or desired solution, specific problem determination, redefine or create a new use for a familiar concept or object, see implications of a possible action, selection of the best or most unusual solution from several possibilities, and an ability to sense what follows problem solution. The so-called ability to sense what follows problem

solution means that one has an intuition of sensing the consequence of the creative problem solving and what will follow up after the problem is solved.

A large number of researchers in the field believe that creative cognition, i.e., the thinking process (divergent thinking, convergent thinking, critical thinking, and so on) can actually be taught (Feldhusen & Goh, 1995), so there are some training programs that have been developed in the field that focus on enhancing such cognitive abilities. Perhaps, one of the most famous is the Purdue Creative Thinking Program which will be discussed in later paragraphs.

Creativity training that focuses on cognitive factors emphasizes either Divergent Thinking or Problem Solving abilities across a range of general situations, which requires little modification to account for different work domains and population differences (Basadur, 1997; Isaksen & Dorval, 1992). For example, one of the most famous “general” creativity training might be the Osborn-Parnes Creative Problem-Solving Program (CPS) as described by Parnes et al (1977). The CPS has been developed over past three decades at the State College of New York, Buffalo, in cooperation with the Creativity Education Foundation. The CPS program, based upon a five-step model of creative problem solving process (i.e., fact finding, problem finding, idea finding, solution finding, and action finding), provides participants with lectures and exercises which can potentially enhance participants’ creative thinking process, creative problem solving skills, and develop positive attitudes toward creativity problem solving in participants’ both work and non-work life. On the other hand, some training programs in creativity focus on specific domains. For example, Baer (1996) developed creative thinking exercises specific to poetry writing and found that this domain-specific training appeared to result in more creative products for poems, but not stories.

Creativity training that focuses on divergent thinking models have also provided a basis for the development of some systematic and widely applied training programs such as Purdue Creative Thinking Program (Feldhusen, 1983). Specifically, the Purdue Creative Thinking program consists of 28 audio taped lessons. These 14-minute instructional sessions represent a key element for enhancing individual

capability of fluency, flexibility, originality, and elaboration of ideas. Some researchers have evidence to prove the effectiveness of the Purdue Creative Thinking program (e.g., Alencar, Feldhusen, & Widlak, 1976; Speedie, Treffinger, & Feldhusen, 1971).

Another branch of creativity training focuses attention on problem solving aspect of cognition by identifying several processes which are imperative in creative problem solving. Except for the above-mentioned CPS program, Mumford and his colleagues (Mumford, Peterson, & Childs, 1999; Mumford et al, 2006) proposed eight core cognitive processing operations: 1) problem construction or problem finding, 2) information gathering, 3) concept search and selection, 4) conceptual combination, 5) idea generation, 6) idea evaluation, 7) implementation planning, and 8) action monitoring. Problem construction or problem finding refers to understanding of the complex and ill-defined situations in which a creative problem solution must be figured out, and a structure—a framework for interpreting the problem—is critical for creative thinking. Thus, problem construction is essentially an initial stage of creative problem solving, and it provides the bases for later steps of creative problem solving. After figuring out the nature of the problem, information gathering is suggested as the second cognitive step which helps people to gather information relevant to the situation at hand and discard irrelevant information. The concept search and selection refers to turning the problem-solving relevant information to useful and understandable ideas or concepts, which are most pertinent to the current situation. The conceptual combination process involves taking the relevant notions from the concept selection stage and combining them in new unique ways. During the conceptual combination stage, individuals attempt to combine previously unrelated concepts to get a feel for how some broad ideas may be placed together. An idea generation stage involves training of the ability to formally generate ideas derived from the new combination and reorganization of concepts. Idea evaluation involves the consideration of ideas in light of potential outcomes deriving from, and resources needed for, its implementation. This stage is critical because it helps people to focus resources on ideas that are most likely to be useful for the situation at hand. Once ideas have been properly identified, they must be implemented. And implementation planning

helps to guide and maximize creative efforts, and sustain organizational innovation. Finally, action monitor makes sure that feedback of the implementation, whether good or bad, can be obtained. Action monitor can be used in nearly all stages in the creative process and make changes, adjustments, or alterations to creative ideas or processes, which guarantees a continuous improvement in creative problem solving. Several studies have identified the effectiveness of the Creative Problem Solving program (i.e., Fontenot, 1993; Basadur & Hausdorf, 1996). And according to Scott et al (2004), creativity training has tangible effects on divergent thinking, problem solving, creative performance and attitudes.

In addition to training people's creative personality or creative cognitive style/skill, researchers also tried to combine those dimensions separately and come up with a unified scale (e.g., Runco, 1992; Woodman & Schoenfeldt, 1989). For example, Woodman and Schoenfeldt (1989) presented a combination model of personality and cognitive factors related to creativity. The most interesting part of their model was the finding that some attitudinal and motivational characteristics of individuals are involved in the training program such as locus of control, dogmatism, and autonomy.

Creative motivation is another aspect of creativity training; however, one should be very careful in drawing preliminary conclusions from training to enhance people's motivation to be creative, even if an individual's intrinsic motivation toward a work task has been found to have an impact on creativity (Barron & Harrington, 1981; Amabile, 1988). Such motivation is highly related to the creative climate in a team or a group, such that a creative person may not be acting creatively in a team or a group which has a creativity-inhibiting climate.

Building on the arguments above, creativity training has been shown to be an effective tool for enhancing individual and group creativity. To sum up this discussion, we look at the recent meta-review of the effectiveness of creativity training in organizations (Scott, Leritz, & Mumford, 2004), which examined how successful programs are able to sustain and enhance creativity in the workplace. In this meta-analysis based on 70 prior studies, Scott et al found that creativity training that uses divergent thinking and problem solving approaches, if designed well, have both high external and internal validity. The meta-

analysis found at least the following favorable effects in the creative training: First, creativity training in general, has a particularly strong influence on divergent thinking and problem solving, and noteworthy effects on people's performance, attitudes and behavior. Second, the positive effects of creativity training can be generalized across people and settings, as the evidence accrued in the meta-analysis indicates that creativity training was effective in both academic and organizational settings. Third, the positive effects of creativity training can also be identified among people who differ in their intellectual capabilities, i.e., creativity cannot be fully measured by intelligence and has its own characteristics, which can be emphasized by creativity training. Fourth, the meta-analysis shows that the stability of the creativity training effects over time is also acceptable. In other words, the training based upon more recent creativity research has been proven as effective as earlier divergent thinking based approaches.

Fifth, the meta-analysis showed that the extant theoretical research in creativity field is qualified to serve as a guide for creativity training. In fact, the content of most creativity training efforts is typically based upon some meta-theoretical model concerning the kinds of variables shaping creativity achievement. As mentioned below in detail, the design of the training contents is evaluated as to whether or not they stress cognitive, social, personality, motivational, or confluence frameworks (i.e., whether the training is theory-driven). The meta-analysis found that *cognitive framework oriented* training (e.g., the training focusing on divergent/convergent thinking, etc) has apparently positive effects.

Sixth, among the *cognitive framework oriented* training courses, it was found that the courses focusing on problem identification, idea generation, solution monitoring, and concept combination were positively related to the training success. Further, problem ideation and idea generation made the strongest unique contribution to training effects. Moreover, these *cognitive framework oriented* training courses, which have a common characteristic of focusing on peoples' cognition processing, strongly related to trainees' improvement in problem solving skills, performance, and attitudes and behavior.

In addition, the meta-analysis showed that various creativity training techniques have differential effects on success of the training. More specifically, the meta-analysis demonstrated that training

techniques stressing the analysis of novel, ill-defined problems contribute to the success of a training course, and these techniques include critical thinking, convergent thinking, and constraint identification. On the contrary, techniques such as imagery, metaphor, elaboration, and illumination, which focus on unconstrained idea exploration, are *less* conducive to the success of creativity training. The reason for such differences lies in the fact that the former techniques give trainees more structure for analyzing problems, providing more relevant strategies or heuristics. On the other hand, the latter techniques, i.e., those focusing more on open exploration, provide less guidance in strategic techniques, and have less impact on training outcomes. However, caution must be exercised with these findings, as the latter techniques are still useful in encouraging individual engagement in creative efforts.

Moreover, the meta-analysis found that the design of the course also influences the success of a creativity training course. For example, the meta-analysis strongly recommended that there should be an overall academic-research-based model that underlies the whole design of the creativity course. Such a theory-driven course can be much more effective than an ad hoc assembly of some creativity techniques. The meta-analysis also emphasizes the importance of an inclusion of practical (or “real life”) experience in creativity training programs. Such realistic practice helps trainees to “map” what they learn from the course to the “real world” domains, sharpening their creative problem solving skills, making the creativity concrete and interesting, and enhancing their attitudes toward creativity.

In addition, the meta-analysis indicates that creative training instructors should be careful in selecting the media used in training. More specifically, it is found that the instructor’s lecturing and audio/video are conducive to success of creativity training, but computer-aided training style and discussions do NOT contribute to the success of a training program. The reason is that lecture and audio/video can provide the most relevant information about creativity, but computer-assistance and discussion can easily stray from the main topic and lead to focus shifting. Further, the use of media that encourage knowledge application was found to be positively related to the success of creativity training.

Specifically, use of social modeling, cooperative learning, and case-based learning contribute to the success of training courses.

Finally, the type of practices and exercises studied by the meta-analysis clearly indicate that the use of domain-based performance exercises is conducive to the success of training, especially in improving trainees' creative problem solving skills, performance, attitudes and behavior. However, it should be noted that the use of imaginative exercises does not contribute to the success of creativity training. The results of studies of practice exercises further confirm that creativity training courses should be structured and directed toward practice in application of creativity techniques and theories.

Scott et al (2004) suggested that creativity training should not be viewed as simply a particular program or the result of applying a fixed set of techniques. Rather, the following rules should be followed: First, training should be based on a sound and valid, conception of cognitive activities underlying creative efforts. In other words, the cognitive steps such as mentioned above by Mumford and his colleges (1999; 2006) or the five-step model in the CPS program can be used as reference for future training programs. Second, this training should be lengthy and relatively challenging with emphasis on various discrete cognitive skills. For example, the Purdue program was designed in such a way as to challenge participants (late elementary and middle school students) in terms of the depth of topic coverage and the difficulty of the training materials. The presentation of the training materials should facilitate the initial acquisition of relevant concepts or procedures.

Third, articulation of creative principles should be followed by illustrations of their application using material based on "real-world" cases or other contextual approaches (e.g. cooperative learning). In this sense, training techniques such as field exercises and case based instructions should be favorably considered in training programs. Fourth, presentation of material should be followed by a series of exercises appropriate to the domain at hand (e. g., creativity practice in the domain of software development). These provide practice in applying relevant strategies and heuristics in a more complex, and more realistic context. The exercises help participants to consolidate their understanding of the basic

creativity ideas, techniques, steps and the whole procedures used in creative problem solving.

Furthermore, exercises help participants to sustain their positive attitude towards creative problem solving and creative cognition process

### **Nurturing and Sustaining Creativity**

The goal of nurturing and sustaining creativity is especially relevant on the group and organizational levels. Team or group creativity at a particular point in time can be measured as either the average or a weighted average of team member creativity (Pirola-Merlo & Mann, 2004). In other words, both individual creativity of organizational members and a team/group creativity contribute to creative success of an organization as a whole. In this sense, a creative climate in which an individual creativity is promoted or inhibited becomes a key variable for nurturing and sustaining organizational creativity. Specifically, Pirola-Merlo and Mann (2004) have found that aggregated team creativity is strongly related to: 1) team members' average creativity, 2) the maximum of the team members' recent creativity, and 3) the minimum recent team member creativity. This finding indicates that individual creativity is necessary for group creativity. In other words, without individuals who have both creative personality/cognitive skills and creative motivation, group creativity is impossible.

Recently, researchers started to investigate how a changing work environment (i.e. high technology) affects individual creativity. For example, Lapierre and Giroux (2003) suggested six dimensions that can help managers to improve work environment in high tech companies in order to enhance individual creativity. Those dimensions include: the work atmosphere, the degree of vertical and lateral collaboration between employees and their superiors, employee autonomy and freedom, respect, and clear goal alignment. In a positive work atmosphere that is conducive to creativity, people should feel that they belong to their organization, they have a role to play, and their ideas will be listened to and supported in a non-critical environment. Moreover, people can sense an enthusiasm of the whole organization, be stimulated by it and enjoy working in it (Lucas, 2000). The degree of vertical and lateral

collaboration between employees and their superiors, indicates whether employees feel free to discuss their ideas with their bosses without judgment and whether superiors trust employees' viewpoints and allow employees' participation in decision-making. In addition, Ocker (2005) identified the following characteristics that stimulate a creative climate: democratic leadership, which should be oriented toward participative decision making, organizational climate/atmosphere, which should enhance participation safety by encouraging high participation without judgments, and communication, which should allow free flow of information between teammates. A thorough literature review revealed that leadership and group dynamics are the two key issues for nurturing, facilitating and enhancing creativity in the workplace because these two factors are the two backbones of the group context, which can either foster or hinder creativity. As groups are made up of individuals, group creativity is influenced by creativity of individuals comprising the group (Ocker, 2005). Thus, understanding how leadership and group dynamics influence individual and group creativity plays a key role in identifying strategies to nurture, to sustain and to facilitate creativity in modern organizations.

### **Leadership Role in Nurturing and Facilitation of Organizational Creativity**

Generally speaking, contextual factors in a workplace such as leadership and group dynamics affect creativity via influence on employees' intrinsic motivation to perform a work assignment (Shalley, Zhou, & Oldham, 2004). Intrinsic motivation refers to the extent to which an individual is excited about a work activity and engages in it for the sake of the activity itself (Utman, 1997). Researchers have long argued that individuals are likely to be most creative when they experience high levels of intrinsic motivation since such motivation increases their tendency to be curious, cognitively flexible, risk taking, and persistent in the face of barriers (Utman, 1997; Zhou & Shalley, 2003), all of which should facilitate the development of creative ideas (Shalley, Zhou, & Oldham, 2004).

A supervisor's leadership style is proved to influence an individual employee's creativity via enhancing or inhibiting the employee's intrinsic motivation. Specifically, supportive leadership styles are expected to boost intrinsic motivation (Shalley, Zhou, & Oldham, 2004). When a supervisor is supportive,

s/he shows empathy for the employee's feelings, provides nonjudgmental informational feedback about the employee's work, and encourages the employee to voice his/her concerns (Deci, Connell, & Ryan, 1989). Such support from immediate supervisors exerts an influence on subordinates creativity through direct help with the project on which they are working, the development of subordinate expertise, and enhancement of subordinate intrinsic motivation (Amabile et al, 2004). In a study examining 191 R&D employees of a large chemical company, Tierney et al (1999) found that effective exchange relationships between supervisors and subordinates showed a strong association with not only employees' creativity, but also their intrinsic motivation to be creative. Another study by Cummings and Oldham (1997) also found that supervisory support for new ideas is related to inclination toward creativity of those employees who possess strong creative personalities.

In addition, along with an encouragement, the team leader should act as a role model him/herself. One study (Jaussi & Dionne, 2003) showed that employees not only hear what a leader says about creativity, but more importantly watch whether a leader behaves him/herself in a creative way (e.g., the leader is able to "walk the talk"). Thus, a leader should grasp opportunities to behave unconventionally and creatively in a constructive and supportive way if s/he wants the subordinates to also be creative.

Leadership is also found to be associated with a work team's success in creative endeavors (e. g. Amabile & Conti, 1999; Amabile et al, 1996; Andrews & Farris, 1976). For example, Farris (1974) found that, compared to less creative groups, the supervisors of the more creative groups played a role of an integrator by receiving information, facilitating communication among group members, relaying messages, and integrating ideas so that a single unified solution can occur. Further, supervisors in more creative groups were more supportive in facilitating group members' thinking and providing critical idea evaluations. On the contrary, supervisors in less creative groups seemed to give their own ideas to the group rather than helping group members to generate their ideas, which turned out to be ultimately detrimental to group creativity. Moreover, research indicates that intrinsic motivation is conducive to employees' creativity, and creative subordinates are more willing to communicate with their leader if they

are motivated to seek evaluative feedback about their work and its implementation, and when they try to initially define or construct a problem (Farris, 1972). Thus, leaders should try to both motivate employees to be more creative and make creative employees more motivated.

To sum up, creativity researchers advise that leaders and managers should: a) serve as a good work model for employees, value individual contributions, show confidence in the work group (Amabile, 1997); b) help creative employees to define problems and set appropriate goals for them (Mumford, 2000a, 2000b); c) encourage employees to participate in important decisions, allow employees to make decisions about work on their own, help employees solve work-related problems, encourage them to develop new ideas and skills (Cummings & Oldham, 1997); d) help to alleviate stressful situations for subordinates, provide constructive positive feedback on work, act on subordinates' ideas or wishes, ask for team members' ideas and opinions (Amabile et al, 2004); and f) not punish employees for their failures, if it is a results of their intentions to meet work objectives (Scott, 1995).

Even if intrinsic motivation is proved to enhance employee creativity, managers must be very careful to concentrate their efforts on intrinsic motivation only at the expense of offering some extrinsic rewards. For example, research has shown that those extrinsic motivation which may combine synergistically with intrinsic motivation include rewards and recognitions for employees' creative ideas, clearly defined project goals, feedback that confirms employees' competent, rewards that involve more time or freedom for employees to pursue exciting ideas, feedback that provides more information on how to improve employees' work, etc. Furthermore, if leaders truly desire to enhance creativity among subordinates, they need to communicate this to subordinates, and when leaders reward employees that are creative, this can send a powerful message that creativity is indeed a desirable goal (Shalley & Gilson, 2004).

Some of the potential avenues for stimulating organizational creativity can be establishing idea generation contests that offer rewards for useful ideas that are also new, award competitive internal grants for further development of ideas judged as creative by one's team members; or conduct between-

team competitions for product development bonuses based upon improvement suggestions (Cummings & Oldham, 1997).

However, not all aspects of extrinsic motivation may enhance employees' creativity. In fact, some extrinsic rewards may be detrimental to creativity and managers should pay special attention to this fact. Specifically, research shows that rewards, recognitions, or evaluations that lead employees to feel controlled by the supervisor or the work context will hinder creativity. For example, Amabile et al (1993) found that professional artists who work under commission which indicates how the work should be done are significantly less creative than those working in a non-commissioned situation.

In addition, we believe that managers should also be aware of the leadership factors or behaviors that may directly hinder subordinates' creativity. For example, extreme time pressure on employees (Amabile, 1997), giving assignments that are not appropriate for subordinates, providing non-constructive negative feedback on employees work, inadequate understanding of subordinates' capabilities or their work, lack of interest in subordinates' ideas or work, assigning unclear or conflicting goals to subordinates, and micromanaging the details of high-level subordinates' work (Amabile et al, 2004), etc., all of these could be detrimental to creativity.

### **Group climate/group dynamics**

In addition to leadership, group dynamics also play important roles in enhancing or inhibiting employees' creativity. One common theme of group dynamics is that individuals need to feel that they are working in a supportive work context (Shalley & Gilson, 2004). This applies to how coworkers and team members interact with employees, whether or not sufficient resources are available, and whether team or organizational climate is perceived to be supportive by employees. For example, employees are expected to exhibit high levels of creativity when their coworkers are nurturing and supportive, because such behavior enhances employee intrinsic motivation, while non-supportive coworkers undermine intrinsic motivation and lower individual creativity (Shalley, Zhou, & Oldham, 2004). For example, Zhou and George

(2001) have found positive relationship between employee creativity, coworker support and informational feedback. Woodman and colleagues (1993) proposed that individual creative performance can be increased by group behavior that facilitates the open sharing of information. Group creativity is enhanced through effective communication among group members (Taggar, 2002), because good interaction and integration of group members can result in motivational enhancement. Thus, it appears that an employee possessing a creative personality and cognitive skills will be more creative if she is intrinsically motivated by the work context to be creative.

Thus, group creativity is not completely determined by the creativity of its individual members, but rather, group creativity might emerge synergistically when group members interact in certain ways (Taggar, 2002). This evidence suggests that individual creativity can provide “the raw material” for novel and useful ideas, but that team member interaction and team processes play an important role in determining how these raw materials are developed into group-level creativity (Pirola-Merlo & Mann, 2004). As noted by Woodman et al (1993), group creativity is influenced by group characteristics, group processes and contextual influence.

A group that fosters creativity has a collaborative, team-based structure where the leadership is democratic, and where unobstructed lateral communication exists among all members (Meadows, 1980). Equally important is *participative safety*, which refers to an atmosphere where work is accomplished in a nonjudgmental and supportive team environment (West, 1990). West and Wallace (1988) argue that this atmosphere is likely to increase team member participation, leading to increased levels of information sharing and, in turn, increasing the amount of ideas offered. Moreover, if a manager does not punish employee failures for the sake of creativity, it will send employees a strong signal that the risk of being punished for being creative in their team is low. Furthermore, West (1990) argues that if, in a group, the underlying assumptions are challenged, opposing opinions are encouraged and explored, ideas and practices are appraised, it is likely that flawed creative ideas will be rejected prior to their application.

Another suggestion for group characteristics is that work groups should be constituted of diversely skilled

individuals with a shared intrinsic motivation for their work and willingness to both share and constructively criticize each other's ideas. Jaussi and Dionne (2003) have found that a group high in intrinsic motivation to be creative tends to be more cohesive and create a warm and benign climate for creativity. As was argued in the previous section, leaders in such group should also behave in a creative way.

Task-related processes also influence the creative performance of teams. Effective task allocation and coordination among team members can increase the likelihood of a creative response (Brophy, 1998). Improvement in creative performance is more likely when team members are task-motivated and involved (Taggar, 2002). Gilson and Shalley (2004) found that more creative teams were those that perceived that they were working on jobs with high task interdependence and that their tasks required high level of creativity. Further, teams high on shared goals that valued participative problem solving, and had a climate supportive of creativity were more creative. Also, members of the more creative teams spent more time socializing with each other, inside and outside of work.

Support for innovation and organizational encouragement together account for group creativity (Pirola-Merlo & Mann, 2004), even after taking individual creativity into account. This indicates that team creativity is not simply the aggregated team member creativity. Group leaders must also establish a work environment which supports creativity.

### Summary: Key Recommendations for Managers

Several suggestions and recommendations for managers were made throughout this paper, and it will be helpful to summarize some of the key recommendations here. Each recommendation is supported by research which we reviewed.

- Since creativity is a function of both nature and nurture, we recommend using at least two measurement tools. Our personal favorites are the KAI measurement tool for personal propensity to be creative and the KEYS measurement tool for assessing the workplace for creativity. Both have demonstrated the higher levels of reliability and validity than the other tools we reviewed. Since each measurement tool has its own strengths and weaknesses, it could easily make sense to employ different tools depending on the needs of the situation.
- Building creative groups requires a balance between highly diverse individuals and individuals with similar personality traits. An ideal group would be diverse in terms of personality traits, but each member would have one partner who is similar and thus provides a source of security.
- The training programs we described in this paper can enhance creativity. Our personal favorites are the Buffalo (Osborn-Parnes Creative Problem-Solving Program) and the Purdue (Purdue Creative Thinking) programs. Studies have supported the effectiveness of each.
- Creativity training should be based upon creativity theories, and the training should include relevant “real-world” exercises and cases to increase its applicability in the workplace. Creative output is both novel and useful.

Managers also play an important role in stimulating creativity in their organizations:

- Managers should attempt to foster intrinsic motivation in the workplace and use appropriate extrinsic motivation methods when needed. By doing so, managers should try to send clear signals to individuals that creativity is both encouraged and valued. Rewarding creativity of both

individuals and groups, showing interest in new directions, and taking action on new and useful ideas can all foster creativity.

- Managers should devote themselves to the growth and maintenance of creativity in their work groups by exerting democratic and supportive leadership styles. Managers should try to model desired behaviors for their employees, communicate clear goals and visions, encourage member participation and communication toward a shared team task or goal, and give constructive feedback and critical evaluation to member's creative ideas.
- Managers should try to enhance creativity by guaranteeing participatory safety in the work groups by not punishing "honest failure". Managers should be creativity-oriented as well as task-oriented, encourage constructive frame-breaking opinions from subordinates, involve diversely skilled, intrinsically motivated individuals in their work groups, and support group members to challenge others' creative ideas in a benevolent manner.
- Managers should try to nurture and facilitate *group intuition* by building trust among group members. Work group trust can be facilitated through sharing work stories, communicating information, and nourishing small and subtle successes in an evolutionary way. . Mutual trust among peers will enhance a creative climate in which everyone can make full use of there creative capacity in a consistent, sustainable way.

The above are some brief recommendations for managers to enhance both individual and group creativity in their teams or work groups. Of course, these recommendations are not exhaustive, and practicing supportive leadership according to each team's specific characteristics and needs, coupled with careful employee selection and training practices, is what managers really should really strive for in order to develop, nurture and sustain creativity in organizational settings. Nature and nurture are both

important for creativity, but our review of psychometric methods suggests that managers will have more effect on creativity by emphasizing nurture.

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