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Current Developments in Creative Problem Solving for Organizations: A Focus on Thinking Skills and Styles

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In 1953 advertising executive Alex Osborn disseminated his views on the Creative Problem Solving (CPS) process—an approach he developed for deliberately enhancing creativity in groups and individuals. Since then, scholars and practitioners world-wide have modified, studied and utilized Osborn's process. In this article the authors first present research regarding the effectiveness of CPS in training and then examine the similarities and differences in select modifications of CPS (Basadur, 1994; Isaksen & Treffinger, 1985; Isaksen, Dorval, & Treffinger, 1994, 2000; Miller, Firestien, & Vehar, 2001; Parnes, 1967, 1988, 1992; Puccio, Murdock, & Mance 2005; Vehar, Firestien, & Miller, 1997). We then discuss two current developments in CPS research and practice that are pertinent to instructional use: (a) an overview of *Creative Problem Solving: The Thinking Skills Model*, a teaching/training and learning model of CPS which builds on Osborn's original tradition; and (b) an applied person-process view of styles of CPS found in two instruments—*The Creative Problem Solving Profile* (Basadur, Graen, & Wakabayashi, 1990) and *FourSight* (Puccio, 2002).

INTRODUCTION

After downsizing, reengineering, out-sourcing, mergers and acquisitions, and other methods of reducing costs and enhancing productivity, organizations are again recognizing the importance of tapping into the creativity of their employees. Florida and Goodnight (2005) have maintained that:

> A company's most important asset isn't raw materials, transportation systems, or political influence. It's *creative capital*—simply put, an arsenal of creative thinkers whose ideas can be turned into valuable products and services. Creative employees pioneer new technologies, birth new industries, and power economic growth. (p. 125)

They further commented, "What's less certain is how to manage for maximum creativity. How do you increase efficiency, improve quality, and raise productivity, all while accommodating for the complex and chaotic nature of the creative process?" (p. 125).

If the challenge is, indeed, as Florida and Goodnight (2005) believe—that we have creative capital and that what we need is to figure out how to produce without crushing the very processes that support creative people, then research and practice in the

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discipline of creativity have much to offer organizations. We do, in fact, know something about how to successfully enhance creativity in people and have been teaching and training individuals for many years (see, for example, creativity program reviews by Nickerson, 1999 and Murdock, 2003, as well as the meta-analysis of creativity programs by Scott, Leritz and Mumford, 2004a, 2004b).

In this article we focus on developments in the Creative Problem Solving (CPS) process, a well-known approach that engages people in bringing order to the sometimes chaotic creative process and boosts their creative skills along the way. What we present is an approach to creative process that has a 50-year history of research, use and development, and that can be used with individuals or teams.

With the quest to maximize creativity comes the search for creativity programs, methods and approaches and the field of creativity is replete with books that offer techniques designed to boost an individual's creativity. A number of these books have enjoyed popular success, such as Von Oech's (1998) *A Whack on the Side of the Head*, Cameron's (2002) *The Artist's Way*, Michalko's (1991) *Thinkertoys*, and Siler's (1996) *Think Like a Genius*. One clear benefit of such books is that they help to democratize creativity—that is they challenge the view that creative thinking is the dominion only of those who achieve eminence. Furthermore, these books help promote the notion that the creative-thinking skills of all people can be enhanced. The challenge created by popular creativity books, however, is as Sternberg and Lubart (1999) observed that such materials can give the impression that the field of creativity is overly focused on application and lacks scholarly thought and scientific rigor.

CREATIVE PROBLEM SOLVING: RESEARCH EFFICACY AND MODEL DEVELOPMENT

In her review of creativity programs, Murdock (2003) maintained the body of work in CPS, beginning with Osborn's (1942, 1952) initial applied work to maximize the creativity of his employees, was an example of a balance of application and research. The foundation of this dual focus began shortly after Sidney Parnes and Alex Osborn became collaborators in the mid-1950s.

Theory and Practice in the Creative Studies Project

Parnes, along with his academic colleagues, carried out a series of studies that examined the benefits of the tool brainstorming and instruction in CPS (Meadow & Parnes, 1959; Meadow, Parnes & Reese, 1959; Parnes & Meadow, 1959, 1960). The most comprehensive examination of the impact of CPS was conducted between 1969 and 1972. This study, referred to as the Creative Studies Project, used a quasi-experimental design to test the effects of creativity courses on college students (Parnes, 1987; Parnes & Noller, 1972a, 1972b, 1973). Participants in this study, freshman college students at Buffalo State, State University of New York, were randomly assigned to either an experimental or control group. Students in the experimental group were enrolled in a series of four consecutive semester-long creativity courses delivered over a two-year period. Though the courses surveyed a number of creativity models and theories available at that time, the main model featured in this curriculum was CPS.

Students in both the experimental and control groups completed a battery of paper-and-pencil tests before, during and after the sequence of creativity courses. Among the measures included in this battery were tests drawn from Guilford's Structure-of-

the-Intellect (SOI) model, personality measures, tests of problem solving and decision-making skills, and college English tests. In describing the selection of measures included in their study Parnes and Noller (1972b) noted that, "The tests called for *utilization* of knowledge in a wide variety of increasingly difficult tasks, none of which had been specifically presented anywhere in the courses" (p. 183). Analysis of the results showed numerous statistically significant gains for students in the experimental group. For instance, students enrolled in the creativity courses out performed the control group on 16 out of 27 semantic tests, 7 of 10 cognition tests, 9 of 14 divergent production tests, and 4 of 8 convergent production tests. The experimental group also did better on creativity-related tests given as part of their English courses.

Later Research on Creativity Training and Programs

Since its inception the CPS process has been widely diffused. Many educators and researchers outside of Buffalo State have used CPS in their work. As a result, a number of comprehensive reviews and meta-analytic studies have been published that cast some light on the efficacy of CPS. Torrance (1972) and Torrance and Presbury (1984) reviewed the impact of creativity training programs and found CPS to be among the most effective. Rose and Lin (1984) carried out a meta-analytic evaluation of creativity-training programs. Rose and Lin used a set of three criteria to select studies for their analysis. They included only studies that involved a series of lessons or a training program, used the *Torrance Tests of Creative Thinking* (or variations of the TTCT) as the dependent measure, and provided sufficient information to carry out the effect size statistic. Forty-six studies were found that matched these criteria. These studies featured such creativity-training programs as CPS, Covington's *Productive Thinking Program,* and the *Purdue Creative Thinking Program*. Rose and Lin reported that the CPS program had the most consistent positive effect on TTCT scores. They noted that:

> The substantial impact of Osborn and Parnes CPS on verbal creativity combined with the conclusions from both Torrance's (1972) and Parnes and Brunelle's (1967) reviews provide strong evidence to support the effectiveness of this program. The use of CPS in education and business should foster more original thinking among practitioners. (p. 21)

More recently Scott, Leritz and Mumford (2004a, 2004b) published two articles based on their meta-analysis of creativity training programs. In one study, they reviewed 156 training programs to identify the most effective approaches for enhancing creative capacities (2004b). One of the conclusions drawn from this review was that creative process training programs that took a cognitive approach, such as CPS, were shown to be among the most effective. From their broader investigation Scott et al. (2004a) reported that creativity training programs had positive effects on divergent thinking, problem solving, attitudes, and behavior. They concluded that the most successful creativity training programs met the following characteristics: founded on sound and valid conceptions of cognitive processes related to creative effort; provided sustained training that involved participants in discrete cognitive skills; presented principles that were demonstrated through "real-world' cases or cooperative exercises; and engaged students in instruction that is followed by opportunities to apply and practice strategies on increasingly complex and realistic challenges. According to Scott et al. (2004a) these characteristics were found in the more successful training programs, among which they cited CPS.

Table 1

Impact of Creative Problem Solving: Unpublished Master's Degree Research

Author (date)	Nature of Study	Key Outcomes
Bruce (1991)	Investigation of the impact of CPS training on managers within a large food store chain. The study focused on ways in which CPS was used at work and in participants' personal lives.	Survey results and interviews conducted several months after training showed the application of CPS tools, development of new ideas, greater open-mindedness, and the application of CPS to both departmental functions and day-to-day operations.
Danforth (1998)	Part two of a study of the impact of CPS training provided to professionals in higher education. Examination of the short-term impact of training.	Interviews showed transfer of training to instruction, as well as faculty members' personal lives.
DeSchryver (1992)	Interviews of CPS trained facilitators with a large multi-national corporation. Interviews conducted eight months after the initial training program.	Employees trained as a CPS facilitator highlighted use within work groups, departments and across the organization. Facilitators reported many positive benefits of the application of CPS, including cost savings, improved decision-making, and enhanced working climate. Participants also reported using CPS outside their company.
Hurley (1993)	Examined the relationship between long-term use of CPS after training and the cognitive styles of participants. Training delivered as part of a graduate-level course.	Cognitive styles, measured through Kirton's Adaption-Innovation Inventory, showed differences with regard to the kinds of tools used after CPS training.
Keller-Mathers (1990)	Examined the long-term impact of an introductory graduate course in CPS.	Pre and post-instruction assessment showed that students applied the CPS tools up to one-year after training.
Labno (2000)	Phase one of a three-part project. Purpose of the first phase was to document a	Case study method used to document the program designed to infuse creative

	small liberal arts college's attempt to infuse creative thinking into their curriculum.	thinking and problem solving into the lives of professionals in higher education.
Miller (1992)	Documented the benefits of integrating outdoor-based experiential activities within CPS training.	Participants' reaction illustrated the beneficial effects of the use of outdoor-based activities within a five-day CPS workshop. The experiential activities helped to deepen participants' learning.
Muneyoshi (2004)	Study examined three questions: what CPS tools, principles, and concepts are used most often by teachers; how have they used various aspects of CPS in their work; and what impact do teachers believe the use of CPS has had on their students. Teachers involved in this study were graduates of a Master of Science degree program in creativity.	The aspects of CPS most often used by teachers related to principles and tools associated with idea generation. CPS had been applied to project work, writing activities, lesson planning, student evaluation, and questioning strategies. Teachers believed the use of CPS had a positive impact on students' attitude toward learning, students' attitude toward problem solving, and students' motivation.
Neilson (1990)	Evaluated the extent to which graduate students transferred training after an introductory CPS course.	Follow-up surveys showed the application of CPS tools six months after training.
Pinker (2002)	In-depth interviews of five graduates of the MS degree program at Buffalo State.	Analysis of the qualitative data highlighted several key themes: enhanced leadership capabilities, improved relationships, greater willingness to take risks, etc.
Reid (1997)	Study of CPS facilitators carried out as part of a two-year internship with a creativity consulting firm.	Participants trained as CPS facilitators reported on the aspects of CPS most used after training (e.g., Task Appriasal, Generating Ideas, etc.), as well as factors that most inhibited their use of CPS.
Scritchfield (1999)	Part three of a series of studies carried out in relationship to CPS training	Interviews reflected the integration of CPS, and other creativity principles, into

	delivered to professionals in higher education. In-depth interviews used to examine the long-term benefits of training for these professionals. Analysis also compared students' reactions to courses offered by those who received CPS training against faculty who had not received such training.	individuals' professional and personal lives. Analysis of students' reactions to their courses, both quantitative and qualitative, highlighted a large number of differences. For instance, students enrolled in courses taught by professors trained in creativity were more likely to say they were engaged in the learning process.
Vehar (1994)	Evaluation of participants' reactions to a five-day CPS workshop. Participants represented a diverse set of organizations.	Participants' overall reactions to the workshop were very positive. Feedback was useful in identifying ways to improve the course and to create follow-up activities for on-going learning.

CPS Impact: A Focus on Training in Organizational Contexts

Much of the research on the impact of CPS training has occurred in the classroom, particularly the early research. Over the last several decades researchers have focused more attention of the impact of training with adult professionals, and often this research has been carried out within organizational contexts (i.e., employee training and development). If organizations wish to enhance employees' creativity, then it is imperative for re-searchers to test whether training programs based on CPS have an appreciable impact on participants.

Because CPS remains a core feature of the courses and research carried out at Buffalo State, a number of unpublished master's theses and projects have examined the impact of CPS. Table 1 presents a summary of only those studies that investigated the effectiveness of CPS with adults from a variety of organizational settings. Some of these studies examined the transfer of CPS training to participants' professional and personal lives (e.g., Bruce, 1991; Hurley, 1993; Keller-Mathers, 1990; Muneyoshi, 2004; Neilson, 1990), while others examined the application of CPS within organizational settings (e.g., DeSchryver, 1992; Reid, 1997).

Where Table 1 summarizes unpublished CPS research, Table 2 provides a summary of published research. The studies featured in this table were focused on empirical evaluation of the impact of CPS training with employees. The main impact of CPS on employees can be organized into two categories: (a) change in attitudes pertinent to creativity; and (b) change in problem-solving behaviors. Basadur, for example, has conducted a series of studies in which he has consistently demonstrated that CPS training improves participants' attitude towards the value of active divergence when solving problems and reduces the tendency to prematurely evaluate ideas (Basadur, Graen & Green, 1982; Basadur, Graen & Scandura, 1986; Basadur & Hausdorf, 1996; Basadur, Taggar & Pringle; 1999). In regard to changes in behavior that relate to pro-

Table 2
Published Studies on the Impact of CPS Training in Organizations

Author (date)	Duration of Training Program or Nature of Application	Participants	Key Outcomes
Basadur, Graen, and Green (1982)	Trained group received two days of CPS training. Study involved placebo and control groups.	45 engineers, engineering managers and technicians	Trained participants showed significant improvement in preferences for ideation, practice of ideation and performance in problem finding.
Basadur, Graen, and Scandura (1986)	24 hours	112 manufacturing engineers (65 from diverse locations and 47 from intact work groups)	Training improved attitudes towards divergent thinking. Impact higher for participants from intact groups.
Basadur and Hausdorf (1996)	3 days	Business students (n=522) Middle and lower management (n=218)	Training significantly enhanced preference for ideation. (DV measured before and after training.)
Basadur, Pringle, and Kirkland (2002)	Experimental group received half-day training in CPS. Placebo group received half-day training. Control group received no training.	Spanish-speaking South American managers. Experimental group (n=149). Placebo group (n=19). No-training control group (n=68).	Training participants showed a significant increase in preference for ideation and decrease in tendency toward premature critical evaluation.
Basadur, Pringle, Speranzini, and Bacot (2000)	12 days	Union-management bargaining team (7 management	Before and after training measures showed positive shift in attitude

		representatives and 7 union representatives).	towards divergence. Case study showed the application of CPS to the negotiation process enhanced trust and collaboration.
Basadur, Runco, and Vega (2000)	20 hours	112 managers from a large international consumer goods manufacturer	Skill in generating options was shown to contribute to generating higher quality options and evaluating options.
Basadur, Taggar, and Pringle (1999)	Experimental group participated in a two-day CPS workshop. Placebo groups participated in experiences of similar length.	Experimental group (36 managers). Two placebo control groups (11 managers, 35 business students).	Training significantly enhanced attitudes towards openness to new ideas, the value of creativity, and not feeling too busy for new ideas.
Basadur, Wakabayashi, and Graen (1990)	3 days	90 managers and 66 non-managers	The Optimizer style of problem solving demonstrated strongest positive change in attitudes towards divergent thinking.
Basadur, Wakabayashi, and Takai (1992)	CPS training conducted over 4 hours. Placebo groups participated in experiences of the same duration.	Experimental group (60 Japanese managers). Two placebo groups (47 Japanese managers; 15 faculty members and university students).	Training significantly increased preference for active divergence and decreased preference for premature convergence.

Fontenot (1993)	8 hours	Business people whose jobs required creative thinking and problem solving (34 participants in experimental group and 28 participants in control group)	Trained participants generated a significantly larger set of data when examining a problem situation, and they generated significantly better problem statements.
Kabanoff and Bottger (1991)	Two 80 minute session per week over a period of 10 weeks.	MBA students (32 in trained group and 44 in control group)	Trained participants experienced significant gains in originality.
Runco and Basadur (1993)	20 hours	35 managers	Post-training gains showed significant increases in fluency and originality in producing solutions, and improved ability in judgments about original ideas.
Wang and Horng (2002)	18 hours of CPS training spread over a year-long period	R&D workers (102 in experimental group; 35 in control group)	Fluency and flexibility and the number of co-authored service projects. increased significantly,
Wang, Horng, Hung, and Huang (2004)	12 hours of CPS training over two consecutive days	Managers across departments (23 in experimental group; 21 in control group)	Managers trained in CPS used more inference behaviors, provided less justification for solutions, and were more likely to define the problem before selecting solutions.

blem-solving effectiveness, various studies demonstrated that CPS training significantly improved individuals' ability to generate many original solutions to problems (Basadur, Runco & Vega, 2000), accuracy in evaluating original ideas (Basadur, Runco & Vega, 2000; Runco & Basadur, 1993), fluency in generating solutions to problems (Kabanoff & Bottger 1991; Runco & Basadur, 1993; Wang & Horng, 2002), enhanced ideation in problem finding (Basadur, Graen & Green, 1982; Fontenot, 1993), and improved problem-finding performance (Basadur, Graen & Green, 1982; Fontenot, 1993; Wang, Horng, Hung & Huang, 2004). For a detailed review of research into the impact of CPS in organizational settings see Puccio, Firestien, Coyle and Masucci (in press) and Puccio (2004).

Where most studies have used paper-and-pencil measures to assess changes in attitude and problem-solving performance, one study, carried out by Wang and Horng (2002), investigated the degree to which CPS training directly impacted employees' performance at work. Wang and Horng (2002) studied CPS training within the research and development (R&D) function. These researchers examined the effects of a CPS course on R&D performance up to 11 months after training. Among other findings, Wang and Horng's research yielded one significant difference between employees who received training and those in the control group. Specifically, using R&D workers' performance over the past three-years as the pre-test baseline, those who participated in CPS training showed a significant increase in the main work responsibility, namely co-authored service projects. Service projects are initiatives undertaken in response to customer complaints and technical problems related to work carried out in the field.

Future Research Directions

Although much work has been carried out in the development of CPS theory and practice, there is a need to continue investigations into CPS training. In particular, there is a need to build on Wang and Horng's (2002) research and carry out more studies that examine the specific ways in which CPS training impacts employees' performance or work experience. Future research might also focus on the long-term effects of CPS training. For instance, it would be useful to explore how more sustained training programs, such as a year or more, impact participants' lives. Firestien and Lunken (1993) conducted an initial investigation in this area, but more research is needed.

Research on CPS needs to be broadened beyond the fairly exclusive focus on the impact of training at the individual level and begin to examine how CPS impacts teamwork. Problem solving at work is often carried out in teams, and it would be useful to have more studies examine how training in CPS is beneficial to teams. Firestien and McCowan's (1988) study of the effects of CPS training on communication behaviors in small groups is one such study currently available.

Finally, given the number of organizational consultants who use CPS, it would be useful to begin to systematically collect more cases that describe, in detail, the application of CPS to real organizational problems. How was CPS employed? What were the direct and indirect benefits? What led to success or failure? Thompson's (2001) case summary of the application of CPS on plant maintenance issues provides an excellent example of how the use of CPS in organizations might be documented.

CPS MODEL DEVELOPMENT

From the published studies on the impact of CPS training and meta-analytic studies of creativity training in general, it would seem there is good evidence that CPS training can help maximize the "creative capital" of both students and employees, which Florida and Goodnight (2005) describe. Just as there has been a significant amount of research on CPS over the past 50 years, there has also been development in the CPS model first presented by Alex Osborn in the 1950's. This development is a direct result of both research and practice in CPS. Here we present an overview of some of the key developments to the CPS model, several of which lead directly to our current view which we refer to as *CPS: The Thinking Skills Model.*

Creative Problem Solving—The Original Model

Alex Osborn first captured his views on creativity and creative thinking in *How to Think Up* (Osborn, 1942), and as Parnes (1992) noted, "This unassuming mini-book was the seed from which most of today's applications of creative thinking and problem-solving germinated" (p. 4). Osborn continued to apply creative thinking to his work in the advertising field and published, *Wake Up Your Mind* (Osborn, 1952) and *Applied Imagination* (Osborn, 1953) in which he outlined his perspective on the CPS process. Osborn's original model included seven steps: (1) **Orientation**—pointing up the problem; (2) **Preparation**—gathering pertinent data; (3) **Analysis**—breaking down the relevant material; (4) **Hypothesis**—piling up alternatives by way of ideas, (5) **Incubation**—letting up to invite illumination; (6) **Synthesis**—putting the pieces together; and (7) **Verification**—judging the resultant ideas. As a result of ongoing use, he later modified this model and collapsed the seven steps into three: (1) **Fact-Finding** which included problem definition, data gathering and analyzing; (2) **Idea-Finding** which included idea production and idea development; and (3) **Solution-Finding** which included evaluation and adoption (Osborn, 1963).

Creative Problem Solving Modifications

Over the years a number of modifications were made to Osborn's CPS model, beginning with Parnes (1967), who expanded from Osborn's three-step approach to a five-step model commonly known as the Osborn-Parnes CPS model. Others followed with modifications based on their own research and practice. For purposes of this article, we will focus on select models that exemplify key developments and shifts in thinking of various researchers and practitioners (see Table 3). For a chronological review of CPS refer to Isaksen and Treffinger (2004). Table 3 contains an overview of ten models that includes the following information: the name of the developer(s); the date and a published source for the model (often the first time the model was presented); a descriptive name for the model; and the elements (components, steps or stages) of the model. As much as possible, similar elements are aligned horizontally for easier comparison.

Similarities in the Models

A review of Table 3 illustrates many similarities among the models. Just as you would expect to see a family resemblance among relatives, each of these models shares some basic commonalities because of their origins with Osborn's (1953, 1963) CPS model. For example, each model includes an examination of the problem or challenge to better understand its nature (i.e., Preparation, Analysis, Fact-Finding, Data-

Table 3

Creative Problem Solving Models: Developments and Spin-offs

Osborn (1953) *Applied Imagination*	Osborn (1963) *Applied Imagination 3rd edition*	Parnes (1967) *Creative Behavior Workbook*	Isaksen & Treffinger (1985) *CPS: The Basic Course*	Isaksen & Treffinger (1994) *Creative Approaches to Problem Solving*	Parnes (1988,1992) Visionizing, *CPS and Visionizing*	Basadur (1994) *Simplex®: A Flight to Creativity*	Vehar, Firestien, & Miller (1997) *Creativity Unbound*	Isaksen, Dorval & Treffinger (2000) *Creative Approaches to ProblemSolving*	Puccio, Murdock, & Mance (2005)
The Original Model	**CPS Stream Lined Model**	**Osborn-Parnes Model**	**Basic Course Model**	**Componential Model**	**Visionizing Model**	**Simplex® Model**	**Plain Language Model**	**CPS v6.1 ™ Model**	**Thinking Skills Model**
								Planning your approach Appraising Tasks, Designing Process Stages	Assessing the Situation
Orientation			Mess-Finding	Understanding the Problem Mess-Finding	Desires (1988) Objective-Finding (1992)	Problem Finding Problem Finding	Explore the Challenge Identify the Goal Wish, Challenge	Understanding the Challenge Constructing Opportunities	Clarification Exploring the Vision
Preparation	Fact-Finding (Problem Definition, Data gathering and analyzing	Fact-Finding	Data-Finding	Understanding the Problem Data-Finding	Fact-Finding	Problem Finding Fact-Finding	Explore the Challenge Gather Data	Understanding the Challenge Exploring Data	(In Assessing the Situation)
Analysis		Problem-Finding	Problem-Finding	Understanding the Problem Problem-Finding	Problem-Finding	Problem Finding Problem-Definition	Explore the Challenge Clarify the Problem	Understanding the Challenge Framing Problems	Clarification Formulating Challenges
Hypothesis	Idea-Finding (Idea production & Idea development)	Idea-Finding	Idea-Finding	Generating Ideas Idea-Finding	Idea-Finding	Problem Solving Idea-Finding	Generate Ideas Generate Ideas	Generating Ideas Generating Ideas	Transformation Exploring Ideas
Incubation									
Synthesis									
Verification	Solution-Finding (Evaluation & Adoption)	Solution-Finding	Solution-Finding	Planning for Action Solution-Finding	Solution-Finding	Problem Solving Evaluate & Select	Prepare for Action Select & Strengthen Solutions	Preparing for Action Developing Solutions	Transformation Formulating Solutions
						Solution Implementation Plan			
		Acceptance-Finding	Acceptance-Finding	Planning for Action Acceptance-Finding	Acceptance-Finding	Solution Implementation Acceptance "Sell" Idea	Prepare for Action Plan for Action	Preparing for Action Building Acceptance	Implementation Exploring Acceptance
						Solution Implementation Action			Implementation Formulating a Plan

Finding, Problem-Finding, Framing Problems, Clarify the Problem, Problem Definition, Formulating Challenges); an idea generation step (i.e., Hypothesis, Idea-Finding, Generating Ideas, Exploring Ideas); the evaluation of ideas (i.e., Verification, Solution-Finding, Evaluate and Select, Select and Strengthen Solutions, Developing Solutions, Formulating Solutions) and a movement toward action within a context (Acceptance-Finding, Acceptance "sell" Idea, Exploring Acceptance, Action, Plan for Action, Formulating a Plan). Even Osborn's (1963) model, which appears to only have three steps, includes all of these functions.

An important similarity, not apparent from the written descriptions of the CPS models (though generally shown in some way visually in most models), is the presence of the divergent and convergent phases of the CPS process. Regardless of the model and the language used to describe it, each step/stage does contain an initial divergent phase when many options are generated using deferral of judgment, followed by a convergent phase in which affirmative judgment is applied to select the most promising of the options. This deliberate separation and repetition of divergence and convergence is at the core of CPS and occurs in each of these models in some way.

Language Variations

One of the most readily observable differences is the terminology used in the various models. In addition to condensing his original model, Osborn changed the language, naming the three steps, **Fact-finding**, **Idea-Finding** and **Solution-Finding** (Osborn, 1963). This language is still used today in a number of models (e.g., Osborn-Parnes, Visionizing, Simplex®).

In the Basic Course Model, Isaksen, and Treffinger (1985) made a shift in terminology for one of the steps, changing Fact-Finding to Data-Finding. They noted:

> Effective problem solving requires people to consider more than facts when they are defining and solving problems. We recognized, for example, that feelings, impressions, observations, and questions were also important; often, the creative opportunity or challenge in a task pertains as much or more to what might be unknown, uncertain, or unclear than to the agreeable facts of the situation. We concluded that strong emotional issues, concerns and needs should be an explicit dimension of this CPS stage. (Isaksen & Treffinger, 2004, p. 82)

Another departure from Osborn's (1963) terminology is the Plain Language Model of Vehar, Firestien, and Miller (1997). This model uses functional descriptions of what the problem solver does in each stage of the process (e.g., Identify the Goal, Wish or Challenge; Gather Data; etc.).

Explicitness in the "Front-end" of CPS

Another variation in models is the explicit starting point, or "front-end" of the process. In his original model Osborn (1953) included the step of "Orientation" which he defined as "pointing up the problem". While this was not a part of his next model (Osborn, 1963), which began with Fact-Finding, he did indicate another potential beginning of the creative process when he noted, "Sensitivity to problems is a valuable trait" (Osborn, 1963, p. 87).

Parnes (1967) started his 5-step CPS model with Fact-finding, although his spiral, graphic depiction of the model at that time showed "mess" at the beginning. There is, however, no mention of "mess" as a formal part of the model. Noller, Parnes and

Biondi (1976) also described a 5-step model beginning with Fact-Finding; their graphic representation of the model included "Problem Sensitivity" leading to "Mess or Objective". Parnes later added a more explicit step at the front-end of CPS in his Visionizing Model (1992). He noted, "Visionizing makes explicit and expands 'opportunity-finding' processes which are largely implicit in general CPS programs—in what is termed in the Osborn-Parnes model, 'sensitivity to objectives or messes'" (Parnes, 1988, p. *ii*). He included "Desires" in his early Visionizing Model (Parnes, 1988) and then added "Opportunity-Finding" (Parnes, 1992). He further described his thinking as follows:

> I call my present approaches "Third Generation" because they blend the so-called "Second Generation" non-verbal (imagery) processes with the verbally-emphatic Osborn-Parnes "First generation" model of Creative Problem Solving. The earlier model stresses verbal processes explicitly while implicitly dealing with imagery. The new emphases deal explicitly with imagery. Thus, a more intuitive, imagery-driven approach is overlaid on our earlier more verbally driven CPS model. The research based CPS model thus provides a firm foundation for expansion into imagery processes. This, in turn, allows an increased psychological stretch within the sound logic of the tested CPS process. (Parnes, 1992, p. 15)

Isaksen and Treffinger (1985) also expanded the "front-end" of CPS by adding "Mess-Finding" as an explicit step to the Osborn-Parnes model. They suggested:

> Before submitting a challenge to deliberate problem-solving efforts, it is essential to put off the natural tendency to "leap for a solution". A more productive way to get started involves "massaging" the situation: examining it and uncovering its elements. This permits you to choose the most promising avenues to investigate. Mess-Finding sets the scope for your efforts; it is the stage of CPS during which deliberate effort is extended to identify the significant elements or components of the challenge you are attempting to meet. (Isaksen & Treffinger, 1985, p. 3-1)

Emphasis on the "Back-end" of CPS

Rather than modifying the "front-end" of the process, Simplex® (Basadur, 1994) is a modification of the Osborn-Parnes CPS model that expands the "back-end". While the name is different, Simplex® grew out of an organizational application of the Osborn-Parnes model. In reflecting on the name Basadur (1994) noted, "As I helped people move through this process, the key word seemed to be 'simplicity'. In fact, that's where the name Simplex® came from" (p. *xx*).

Basadur was introduced to CPS when he attended the Creative Education Foundation's Creative Problem Solving Institute in the early 1970's and when he returned to his employer, he integrated what he learned into his professional work. Basadur's model contained three steps in the final component, called **Solution Implementation**. He described this component in the following way:

> The final three steps of the process included developing a creative plan, selling the idea to the people you need to make it work, and taking the action necessary to make it work. A surprising number of people assume that the problem solving process ends with a solution. But it only ends

> when you have implemented the solution and have made a valuable change in procedures or a new product. (Basadur, 1994, p. *xx*)

Another variation in Basadur's view of CPS is that unlike other models, Basadur put creating a plan before acceptance.

Step-by-Step or Components

A major modification of the Osborn-Parnes model of CPS was the Componential Model formally presented by Isaksen, Dorval, and Treffinger in 1994. The componential approach highlighted the ability to use the CPS process flexibly. This model organized the CPS model into three components, **Understanding the Problem** (Mess-Finding, Data-Finding, Problem-Finding), **Generating Ideas** (Idea-Finding), and **Planning for Action** (Solution-Finding, Acceptance-Finding). In their later work in 2004, Isaksen and Treffinger explained their thinking as follows:

> When we examined numerous case studies of CPS application we observed that people commonly used CPS to clarify their understanding of problems, to generate ideas, and/or to plan for taking action. We concluded that the six stages of CPS could be clustered into three main sections or components. Put simply, people often chose to apply parts of CPS that met their needs. (p. 89)

Each of the models presented after 1994 included a componential framework and moved away from the step-by-step approach of Osborn-Parnes (underlined titles in Table 3 refer to components within a given model), with the exception of Simplex® which contained components but maintained a step-by-step approach.

Metacognitive Approach

With a shift away from a CPS process in which the problem solver follows a prescribed step-by-step process, Isaksen, Dorval, and Treffinger (1994, 2000) added a meta-component to their CPS model, "Planning Your Approach" which contains **Appraising Tasks** and **Designing Process**. A step-by-step model does not allow individuals and teams to tailor their use of CPS to fit their needs. However, for individuals and teams to use CPS in a way that matches their needs requires them to be able to engage in metacognition. As Isaksen and Treffinger (2004) explained:

> Meta-components involve continuous planning, monitoring, managing, and modifying behavior during CPS. Task appraisal involves determineing whether or not CPS is appropriate for a given task or whether modifications of one's approach might be necessary (Isaksen, 1995)... Process planning enabled problem solvers to identify their entry point into the framework, their pathway through the framework, and an appropriate exit point from the framework. These metacognitive tools helped problem solvers to manage a number of important choices and decisions about their CPS applications. (p. 92)

Conclusion: Different Models from the Same Genetic Stock

As you can see from Table 3, there is both coherence and stability in the basic "bones" of the CPS model across time in its development. This stability and coherence demonstrate that CPS is seasoned and tested. The recurring elements and patterns of development show an orderly progression of both research and practice that, in a disciplinary sense, support what Phenix (1962) called "synthetic coordination".

Language and terminology does vary, but not to the degree that one cannot understand or follow the thread of concepts. The language variation is a bit like using a synonym for another word—the color blue for example. "Blue" is the basic descriptor for a particular primary color, but azure, sapphire or turquoise can also be used to show variations, as might light blue, medium blue or dark blue; regardless of the words, we still know the basic color is blue and we understand the reason for distinctions in hue or intensity.

CPS model developments illustrate that there have been useful incremental changes in both theory and practice over time. These developments are in line with what Sternberg and Lubart (1999) called for in rigor within practice. Both the historical and current research and model development show how the CPS process has been a major, consistent vehicle for people to use their creative skills and ideas.

An Introduction to Creative Problem Solving: The Thinking Skills Model

The approach we are presenting here—*Creative Problem Solving: The Thinking Skills Model*—builds on the research and practice we discussed earlier and extends to connect with the cognitive skills that help to make the CPS process so powerful in working with the kinds of ill-structured, complex and novel situations described by Mumford, Zaccaro, Harding, Jacobs, and Fleishman (2000). In this context we considered thinking skills to be (a) elements that were necessary for basic performance in each step of CPS and (b) learnable elements that could be developed through practice.

Ruggierro (1998) defined thinking as "Any mental activity that helps formulate or solve a problem, make a decision, or fulfill a desire to understand. It is a searching for answers, or reaching for meaning" (p. 2). He further maintained that if we are actively directing our minds toward something, we are, in fact, thinking. Clearly, this aligns with basic functions of CPS as a process and model, namely to (a) deliberately channel people's mental efforts into resolving problems creatively; and (b) provide a structure for complex thinking that can help simplify its elements.

Background and Context to the Thinking Skills Model

CPS: The Thinking Skills Model was developed primarily to facilitate more explicit teaching and learning of the CPS process, and to make these teaching and learning processes more generally accessible to different audiences. As a theoretical model, it originates not only from the CPS literature documented here, but from the thinking skills literature as well (Barbero-Switalski, 2003; Beyer, 2001; Costa, 2001; Dewey, 1910; Perkins, 1995; Resnick, 1987; Marzano, 1992; Marzano, et al. 1988). These theoretical perspectives are supplemented with experience from our practice, which has involved training and teaching the CPS process to individuals on a regular basis for many years.

In our applied work and commensurate supporting research (e.g., Keller-Mathers, 1990; Lunken, 1990; Neilson, 1990; Pinker, 2002) in teaching and training CPS, we have consistently run across a response to the impact of using CPS wherein learners say such things as "CPS changed my life! I don't think about problems or opportunities in the same way now! My way of doing things is different!"

These comments and the intensity that accompanied them made us—as Alice noted of events in *Through the Looking Glass,* "curiousier and curiousier" about what went on in people's heads to initiate such a reaction. Their responses, in conjunction with the responsibility of actually teaching CPS language and concepts to adults, led us to explore how CPS worked in the service of teaching, training, and learning.

In developing the model we were also responding to what Torrance in his well-known process definition of creativity, observed as "...becoming sensitive to or aware of gaps, deficiencies or disharmonies" (Torrance & Myers, 1970, p. 22) in versions of the CPS process that we had used previously. For example, in teaching and training we experienced frustration in articulating the practical relationship between ideas and solutions. Conceptually in most versions of the CPS model, idea generation stands alone as a step or component to itself. What this means in teaching/training is that explaining the connection from ideas to solutions is neither clear in language nor conceptually smooth. You enter this component or step to get ideas, but after you get them, are they still ideas or have they magically turned into solutions (albeit potential ones)? And after you arrive at the step that is intended to develop solutions, you are suddenly faced with an array of tools without much conceptual support for the subtleties of development. As Isaksen and Treffinger (1985) noted earlier in their reasons for making Mess-Finding an explicit step early on in problem solving efforts, people tend to rush to solution and deliberate Mess-Finding helped to mitigate this kind of "quick-draw" thinking. We would maintain from our experience in teaching and training that this is also true in a subtle way when people reach the solution development step, there is a tendency to want to rush past development and head straight to action. The solution step not only "feels" different from the wildness of idea generation, its dynamic balance between divergence and convergence changes. The traditional tools most often used in this step to strengthen solutions, such as the Evaluation Matrix and itemized evaluation tools (i.e., PPCO–Plusses, Potentials, Concerns; PMI–Plusses, Minuses, Interesting), are combinations of divergence and convergence in tandem. It seemed to us that the natural thinking occurring here was, as with idea generation, still focused on transforming initial concepts into proposed solutions. Therefore we moved Formulating Solutions closer to what we thought was its natural CPS partner—Exploring Ideas.

Different CPS models have different purposes and there is no "best" one to use, selection among the various models should be based on the circumstances within which the model is being applied. For teaching and training overall, we believed for a variety of reasons that the CPS model could benefit from more deliberate connections to both cognitive and affective skills (see Tables 4 and 5).

1. The use of thinking skills provides an additional way to differentiate one CPS step from another, which helps learners be more independent in their decisions about which step(s) to use and more successful in actual application. When students and training participants work through various CPS steps, they often report how different each step feels when it is applied. By identifying the core thinking skills associated with the steps of the CPS process, we wanted to unearth the mental processes that lead to qualitatively unique experiences as individuals work through CPS and to make them more explicit.
2. Thinking skills are the fundamental building blocks of teaching and learning and connecting them directly into CPS links the teaching and learning of CPS to thinking in concrete ways.
3. The CPS process, in turn, provide teachers, trainers, and learners with a cognitive "mind map" of how the creative process works. It is

a mental "Rosetta Stone" for translating some basic tacit learning processes inherent in creativity and for identifying the creative process in other content areas.

4. A connection to thinking skills helps the basic concepts of CPS to be more explicitly transferable to other contexts. Byer (2001) noted that in teaching for transfer, it is necessary for learners to understand and practice concepts and implications in more than one context. We posited that more deliberateness in articulation and the ability to connect to a broader thinking skills framework would increase the potential for transfer of learning to organizations and educational institutions.
5. Models of CPS (and in fact, most models) are generally theoretical rather than operational and require articulation to explain or teach. Using a thinking skills framework adds a layer of language that is more actionable than using CPS concepts alone. The deliberate addition of thinking skills as an integral part of CPS creates an additional set of rubrics to describe and explain CPS steps. It also opens up an additional area of potentially overlapping theoretical and practical information to use in articulating what CPS does and how it functions.
6. Problem solving tools are critical in helping to support the operation of CPS. From a pragmatic standpoint, the identification of thinking skills in association with the steps of the CPS process allows users to draw more tools into the model. There are numerous problem solving, creativity, decision-making, quality management and other business tools that can be organized within the CPS framework. Articulation of a main thinking skill for each step of the process makes it much easier to identify tools that align with a particular thinking skill and thus a specific step in the CPS process (Barbero-Switalski, 2003).

CPS and Thinking Skills: Some Connections

Mumford et al. (2000) suggested that the thinking required in problem-focused cognition is neither simple nor obvious, but rather, complex. In these situations people are attempting to solve novel, ill-defined problems which cannot be solved through the routine use of existing knowledge.

The skills associated with thinking in general also have complex levels and can be organized according to their complexity as illustrated by Bloom's taxonomy—one of the first structured models for sorting thinking skills (Bloom, Englehart, Furst, Hill & Krathwohl, 1956). See Marzano (2000) for a more recent taxonomy of thinking skills. Complex thinking processes are complemented by so called basic ones. According to Presseisen (2001) the main differences between basic and complex thinking processes lie in the transition from "simple to more complex operations, from observable to abstract dimensions, and from an emphasis on working with known materials toward an emphasis on creating or inventing new, previously unknown approaches or materials" (p. 48).

Thus, complex thinking is integral to the function of CPS, which focuses on creating new approaches and working with unknown elements. Mumford et al. (2000) described the skills of problem-focused cognition and their relationship to creative pro-

blem solving and leadership. They deliberately connect the kinds of thinking that are needed to manage novel and ill-structured situations to creative problem solving in general. They noted that in problem-focused cognition, "...relevant knowledge, particularly representations derived from prior experience and knowledge of one's job, must be reshaped and reformed to generate new solutions. These observations, in turn, suggest that the skills involved in creative problem solving influence leader performance" (p.17).

Treffinger (1996) identified the use of CPS process as a complex level of thinking within what he called a descriptive model of productive thinking. He included in this complex level both creative thinking and decision making, which are indeed functions which the divergent and convergent phases of CPS require.

The work of Cohen (1971) and Presseisen (2001) further supports Treffinger's CPS connections to complex thinking skills. Presseisen elaborated on Cohen's four complex thinking processes all of which are elements of the CPS process: (a) **problem solving** (resolving a known difficulty); (b) **decision making** (choosing the best alternative); (c) **critical thinking** (understanding particular meaning); and (d) **creative thinking** (i.e., creating novel or aesthetic ideas or products).

Because creative thinking and problem solving are characterized by the need for higher order thinking skills that address complex thinking tasks (Marzano, et al., 1988; Mumford, et al., 2000; Treffinger, 1996), the framework of the CPS process is useful in helping people organize and articulate their thinking skills and problem solving at the same time. In this sense, the CPS process is like a macro thinking process that can contain and use a variety of processes, skills or tools. From this perspective, discrete and definable thinking skills can be sufficiently isolated within the framework of the CPS model to provide additional rubrics for people to identify and choose kinds of thinking that will help them operate more effectively.

The Thinking Skills Approach: Key Cognitive and Affective Skills

Although a variety of thinking skills may come into play when applying CPS (and additional specific ones with the iterative use of divergent and convergent thinking), there are a number of discrete thinking skills people use as they engage in the CPS process. These thinking skills vary from one step to another based on the macro-function of the step. The nature, purpose, and operation of each of the seven steps in CPS are different. Therefore, people use different thinking skills in each step.

Table 4 contains some specific thinking skills associated with the seven steps of the CPS process in the Thinking Skills Model that were identified when we first examined the nature and purpose of each of the CPS steps and matched skills to our working definitions. Barbero-Switalski (2003) tested these proposed thinking skills through an analysis of the literature and feedback from a focus group of CPS experts. She used this information to modify the initial set of thinking skills and their accompanying definitions. The final definitions were based on dictionary and literature sources (i.e., Costa, 2001; González, 2002; Isaksen, Dorval & Treffinger, 1994; Marzano, et al., 1988; Morrisey, 1996; Sternberg, 1985). For other thinking skills related to creativity and CPS see Puccio and Murdock (2001).

Because problem solving is a mental process, people need certain thinking skills to be effective in using it, especially those thinking skills that support creativity in general. To our way of thinking, it is therefore reasonable to assume that some thinking skills will match better with the CPS process than others, and that awareness of such

Table 4
Major Thinking Skills Associated with CPS

Step	Assessing the Situation (executive step)	Exploring the Vision	Formulating Challenges	Exploring Ideas	Formulating Solutions	Exploring Acceptance	Formulating a Plan
Purpose	1. To describe and identify relevant data 2. To determine next process step	To develop a vision of a desired outcome	To identify the gaps that must be closed to achieve the desired outcome	To generate novel ideas that address important challenges	To move from ideas to solutions	To increase the likelihood of success	To develop an implementation plan
Thinking Skill	**Diagnostic Thinking** Making a careful examination of a situation, describing the nature of a problem and making decisions about appropriate process steps to be taken.	**Visionary Thinking** Articulating a vivid image of what you desire to create.	**Strategic Thinking** Identifying the critical issues that must be addressed and pathways needed to move towards the desired future.	**Ideational Thinking** Producing original mental images and thoughts that respond to important challenges.	**Evaluative Thinking** Assessing the reasonable-ness and quality of ideas in order to develop workable solutions.	**Contextual Thinking** Under-standing the interrelated conditions and circum-stances that will support or hinder success.	**Tactical Thinking** Devising a plan that includes specific and measurable steps for attaining a desired end and methods for monitoring its effectiveness.

skills can support the understanding and use of it. In addition, because CPS takes place in a social context and involves the interaction of people with process and environment, it relates to emotions and feelings as well as thinking. Although most people think of CPS primarily as a cognitive process, deliberate creativity does not rely on thought processes alone. Creativity and the production of change that it engenders involve both thinking and emotion. To create positive change, you need clear thinking in conjunction with such emotional states as risk taking, courage, and tolerance for ambiguity. Discounting the effects of affective states, such as motivation and passion to create (Amabile, 1987; Torrance, 1972), would be like showing up for car race with half an engine. Current research demonstrates how strongly our thinking is influenced by our emotions. In fact, Goleman, Boyatzis, and McKee (2002) go so far as to assert that the key to learning that lasts is linked to our emotional intelligence, which involves hard wiring between the prefrontal lobes and the limbic system. Skills based in the limbic system are more easily learned through motivation, practice, and feedback. Strong emotions, such as fear, love, distrust or joy influence our thinking—both in positive and negative ways.

Consequently, the underpinnings of *CPS: The Thinking Skills Model* also contain some key affective skills that we believe support the CPS process in general and the main thinking skills associated with each step of the model. Table 5 contains an initial list of affective skills based in the creativity literature (Davis, 1998; Torrance 1979; Torrance & Safter, 1999; Williams, 1970) and other related sources (Goleman, 1998; Goleman, Boyatzis, & McKee, 2002; Krathwohl, Bloom, & Masia, 1964). Our initial list of affective skills was presented to more than 20 members of our creativity community, individuals with many years of experience in both teaching and applying CPS (Puccio, Murdock, & Mance, 2005). Feedback received from this group reduced the list of affective skills to those presented in Table 5 (i.e., those skills which received more than 80% agreement among these CPS experts).

THE THINKING SKILLS MODEL: STRUCTURE AND FUNCTION

The Thinking Skills Model has both cognitive and metacognitive elements, beginning with three stages which describe the beginning, middle and end of people's natural creative thinking processes: **Clarification, Transformation, and Implementation**. These three stages provide a cognitive organizer of intuitive process that generally occur in order, even though they may sometimes happen so quickly that we do not realize that one preceded the other. Practically speaking, we may spend more time in one stage than another, depending on how complex, ill-structured or novel the situation may be, but we still will have done a bit of each kind of thinking tacitly to get out of the tangle of complexity that is common to creative problem solving concerns. The intuitive or natural process stages function like a mental compass to help us locate our position if we get temporarily disoriented in the complexity of deliberate thinking.

Parallel to the intuitive thinking process are six pairs of descriptors of deliberate functions of CPS process that correspond in function to the three natural process stages. **Clarification** consists of two basic CPS steps—**Exploring the Vision** and **Formulating Challenges**; **Transformation** requires thinking that goes with **Exploring Ideas** and **Formulating Solutions**; and **Implementation** involves natural thinking that goes with both **Exploring Acceptance** and **Formulating a Plan**. As with other CPS models, each step begins with a divergent phase, a search for options, which is

Table 5

Selected Affective Skills that Support CPS

Step	Assessing the Situation (executive step)	Exploring the Vision	Formulating Challenges	Exploring Ideas	Formulating Solutions	Exploring Acceptance	Formulating a Plan
Purpose	1. To describe and identify relevant data 2. To determine next process step	To develop a vision of a desired outcome	To identify the gaps that must be closed to achieve the desired outcome	To generate novel ideas that address important challenges	To move from ideas to solutions	To increase the likelihood of success	To develop an implementation plan
Affective Skills	**Curiosity** A desire to learn or know; inquisitive	**Dreaming** To imagine as possible your desires and hopes	**Sensing Gaps** To become consciously aware of discrepancies between what currently exists and is desired or required	**Playfulness** Freely toying with ideas	**Avoiding Pre-mature Closure** Resisting the urge to push for a decision	**Sensitivity to Environment** The degree to which people are aware of their physical and psychological surroundings	**Tolerance for Risks** Not allowing yourself to be shaken or unnerved by the possibility of failure or setbacks

Affective Skills that Underlie All Steps of CPS

Openness to Novelty: Ability to entertain ideas that at first seem outlandish and risky.
Tolerance for Ambiguity: to be able to deal with uncertainty and to avoid leaping to conclusions.
Tolerance for Complexity: Ability to stay open and persevere without being overwhelmed by large amounts of information, Interrelated and complex issues and competing perspectives.

followed by a convergent phase, the narrowing down of options through screening, selecting and prioritizing. These six steps are much like what you will see in many CPS models. Although you may use any of these CPS steps separately or in any order, they do have a conceptual relationship to each other as ways of thinking deliberately about opportunities or predicaments. We selected the recurring terms of "exploring" and "formulating" for each pair to represent a movement from more abstract thinking to more concrete thinking within each of the three fundamental stages.

Each of the previous six deliberate CPS steps is driven by the need for data or information; thus, **Assessing the Situation** is the executive step that guides decisions about both content and process, making seven steps in all. This step is a bit like a double decker bus in that it contains the traditional CPS cognitive "data" function on one level (generating and selecting facts, information, hunches, nags, etc. that are pertinent to the situation) and higher metacognitive functions on the other level (What step should I begin with? What fits my purpose?). Thus, if the situation calls for information on a particular content, the user can, if needed, generate and select data only for that content as needed. Conversely, if the situation calls for information about which step of the CPS process to use to work on a specific predicament or opportunity, the same step of Assessing the Situation may be used metacognitively to guide users in determining the information needed to operate deliberately between or within the steps of the CPS process itself.

Implications and Uses of a Thinking Skills Approach

What are some practical implications of a thinking skills approach for organizations? The work of Mumford et al. (2000), who suggested that creative problem solving is a key competency in leadership, brings out several useful points. They maintain, "Effective leadership behavior fundamentally depends upon the leader's ability to solve the kind of complex social problems that arise in organizations" (p. 11). By focusing their work on a "capacity" model of leadership (i.e., theories that articulate the knowledge and skills required for effective leadership performance) these authors articulated the kinds of skills and knowledge necessary for leaders to successfully resolve complex social problems—skills and knowledge that can be developed. We would argue that a macro-creative process model, such as CPS, embodies many of the kinds of skills called for by Mumford et al. (2000). Thus, practice and use of this creative process should have a positive effect on individuals' capacity to manage ambiguous, ill-defined, and novel problems, and as a consequence improve their leadership performance. One of the main benefits to the version of the CPS model presented in this paper, the Thinking Skills Model, is that it explicates the skills involved in creative problem solving. The delineation of these skills makes it much easier for individuals to draw on strategies, tools, and methods that can be used to build and leverage these creative problem-solving capacities.

At the heart of leader performance, Mumford et al. (2000) further maintain, is the question, "What must a leader do to facilitate group maintenance and task accomplishment?" (p. 13). Again CPS as a macro-model and process can provide an organizing structure that is amenable to maximizing the creativity of people in the workforce; therefore, using it effectively can help organizations "manage" people to accomplish tasks. That is, an explicit CPS framework can be used to guide groups through complex problems thereby enhancing efficiency and effectiveness.

PERSON-PROCESS INTERACTION: DEVELOPMENTS IN IDENTIFYING AND USING CREATIVE PROBLEM SOLVING STYLES

We close our paper by describing research that has linked the CPS model to individual preferences. Mumford et al. (2000) emphasized that leadership occurs within a social setting. That is the kinds of complex problems addressed by leaders involve the input and acceptance of others. Thus creative problem solving efforts in organizations often involve many group members and not just a single person. When individuals come together to solve complex problems it may be that their individual preferences may influence how they engage in creative problem solving. A recent trend in CPS research has focused on how this process model can be used to help us understand individual differences in regard to how people engage in the creative process (Basadur, Graen, & Wakabayashi 1990; Puccio, 1999, 2002). This line of research reflects the multi-dimensional facets of creativity described by Rhodes (1961), Stein (1968), and MacKinnon (1978). Each of these early creativity researchers described four basic domains within the study of creativity: aspects of the person; steps, stages and mental activities associated with the process; qualities of creative products; and environmental conditions conducive to creativity. Within this larger framework, the use of the CPS process as a lens to identify individual preferences illustrates a practical application of the importance of process-person interaction.

The Creative Problem Solving Profile: How People Gain and Use Knowledge

Basadur was the first to initiate the process-person research in CPS. In 1990 Basadur et al. published a detailed description of a paper-and-pencil inventory called the *Creative Problem-Solving Profile* (CPSP). They based the CPSP on the Osborn-Parnes CPS model. According to Basadur et al., there are two opposing information-processing dimensions—how people gain knowledge and how people use knowledge—underlying the CPS process. One end of the gaining knowledge continuum represents direct ways of acquiring knowledge and the other end represents abstract ways of gaining knowledge. The continuum for how people use knowledge ranges from a preference for ideation (i.e., divergent thinking) to one for evaluation (i.e., convergent thinking). According to Basadur et al. (1990):

> Each individual could thus be characterized as having a unique set of relative preferences on these two information processing dimensions... Considering these two dimensions makes it possible to create four quadrants of different combinations of gaining and using knowledge. (p. 113)

The orthogonal nature of the two dimensions creates the four quadrants, each of which represents a different CPS preference. The four preferences measured by the CPSP correspond to the steps found within Basadur's CPS process, called SIMPLEX® (see Table 3). High preferences for gaining knowledge through direct experience and using knowledge for ideation is called the **Generator**. The Generator style relates to the Problem-Finding and Fact-Finding steps of the process. The combination of the acquisition of knowledge through abstract thought and a preference to use information for ideation is called the **Conceptualizer** style and is associated with the Problem-Definition and Idea-Finding steps of Basadur's CPS model. The Evaluate and Select step, along with the Plan step, correspond to the **Optimizer** style, which combines a preference for knowledge brought about by abstract thinking and a pre-

ference to use knowledge for convergence. Finally, the **Implementor** style, which brings together a preference for knowledge acquisition through concrete experiences and the use of this knowledge for convergent thinking, is associated with the Gain Acceptance and Action steps of Simplex®.

Basadur's measure, the CPSP, uses twelve sets of four words to identify individuals' preferences. Each word in the set relates to one of the four poles on the two underlying dimensions (i.e., knowledge through either direct or abstract experience, and the use of knowledge for either divergent or convergent thinking). A respondent examines the set of words and ranks them in terms of how descriptive they are of his or her "problem solving style". Scores for these four preferences are then graphed and the shape of the graph determines the respondent's CPS profile. Some individuals, for instance might have a balanced profile, the shape is evenly distributed across the four styles (i.e., Generator, Conceptualizer, Optimizer, and Implementor). In other cases, individuals might express a clear preference for one style or combination of styles.

The CPSP has been examined for both test-retest and internal reliability. Basadur et al. (1990) reported test-retest correlations that ranged between .58 and .67 for individuals who completed the CPSP over a two-week period. Basadur et al. (1990) reported Spearman-Brown reliability estimates that ranged between .62 and .65 for the four style scales.

Using the CPSP in Training

In applying the CPSP, Basadur examined the impact of CPS training on individuals with different style preferences. Basadur, Wakabayashi, and Graen (1990) hypothesized that individuals with an Optimizer preference would gain the most from CPS training. The authors argued that Optimizers, individuals with a proclivity towards convergent thinking and who learn through abstract discussion, would benefit most from CPS because the training had a heavy emphasis on divergent thinking and was taught through direct experience. The results of this investigation supported the authors' contention as Optimizers showed the greatest positive post-training shift on two different creative attitudes, preference for ideation and premature critical evaluation.

In a more recent study Basadur and Head (2001) examined the problem-solving performance of teams comprised of members with homogenous CPS styles (i.e., all of one CPSP style), moderate homogeneity (i.e., members represented two of the four CPSP styles), and heterogeneous blends (i.e., members represent all four CPSP styles). The teams with the greatest mix of CPS process styles significantly outperformed the homogenous groups on three of five measures of innovative performance. In contrast, team members' level of satisfaction was found to be inversely related to the amount of CPS style diversity found in the team. Individuals in homogeneous and moderately homogeneous teams were more likely to say that they enjoyed working together and that they would be willing to work together again.

Understanding Creative Problem Solving Styles: FourSight

Puccio (1999; 2002) also developed a measure to identify individuals' preferences for aspects of the CPS process. Both Puccio and Basadur's work is designed to achieve the same conceptual end—the identification of creative process preferences that can be related to the CPS model. However, their approach to the identification of these process preferences is different. There are two main points of differentiation. First, where Basadur uses two underlying information-processing dimensions as the basis to his four process preferences (i.e., how people acquire knowledge and how they apply

knowledge), Puccio (1999) focuses on the unique mental activities directly associated with each of the six CPS steps described by Isaksen, Dorval, and Treffinger (1994). Second, related to the conceptual underpinnings of their respective measures, Basadur and Puccio use different formats to assess the process preferences. Where Basadur has respondents rank order a set of four words that represent the four poles of his information processing dimensions, Puccio's measure, called *FourSight* (originally named the *Buffalo Creative Process Inventory*), uses statements that describe the kinds of activities associated with the CPS process. For instance, the statement "I like to work with unique ideas" relates to the idea generation step of CPS, while "I like to generate all of the plusses and minuses of a potential solution" is an example of a statement that relates to the solution development step. Thus, when individuals complete *FourSight* they are asked to indicate how descriptive each process statement is of them. In this sense, *FourSight* has individuals respond directly to the mental activities that comprise the CPS process.

Though Puccio (1999; 2002) originally set out to identify a preference for each of the six CPS steps, he found through factor analysis of different versions of his measure that four main styles emerged. These four preferences were labeled **Clarifier** (the merger of Data-Finding and Problem-Finding statements), **Ideator** (the combination of Mess-Finding and Idea-Finding items), **Developer** (statements associated with Solution-Finding and the planning aspect of Acceptance-Finding), and **Implementer** (the aspect of Acceptance-Finding that focuses on taking action). Puccio (2002) reported Cronbach alpha coefficients for an earlier version of FourSight that ranged from .78 to .81. Chan (2004) reported internal reliability coefficients for the current version of *FourSight* as follows: Clarifier = .79; Ideator = .75; Developer =. 83; and Implementer = .86.

FourSight and CPS Training

Puccio, Wheeler, and Cassandro (2004) used *FourSight* to assess students' reaction to CPS training. They wanted to know whether individuals with different process preferences would respond differently to the same CPS training experience. Undergraduate and graduate students enrolled in CPS courses completed *FourSight* at the beginning of the semester and then responded to a survey of their reactions to the course at the end of the semester. The results of regression analysis indicated that individuals with different process preferences had the exact opposite reaction to the very same aspect of CPS. For instance where high Clarifiers said they did not enjoy learning the Plan for Action step of CPS, high Implementers reported high levels of enjoyment. And where high Developers believed that the principle "Defer Judgment" would be valuable for them in the future, both high Clarifiers and Ideators were more likely to see little future benefit to this divergent-thinking principle. The results of this study highlighted the fact that learners with different process preferences could interact with the same instructional content in CPS in very different ways.

FourSight Research Beyond CPS Training

The process preferences measured by *FourSight* have also been used in studies that did not involve CPS training. Chan (2004), for instance, investigated the relationship between knowledge workers' creative process preferences and the type of knowledge they were most likely to utilize. Chan found that Clarifiers and Developers showed no specific preference for one form of knowledge over another. Ideators, however, had a clear tendency to use tacit and self-transcending knowledge and Implementers were

strongly associated with explicit and self-transcending forms of knowledge. McClean (2004) compared judges' evaluations of the creativity of college students artistic work against the *FourSight* preferences of the students. Using Amabile's (1982) Consensual Assessment Technique, McClean had domain-expert judges evaluate the creativity level of student collages without knowing the creative process preferences of the students. Regression analysis of the judges' evaluation of the collages revealed a striking pattern. There was a positive linear relationship between all 20 judging criteria and the Ideator preference. In contrast, McClean found a negative linear relationship between the judges' evaluation of the 20 criteria and the Clarifier preference. These results raise at least two intriguing questions. First, are domain experts biased towards the creative products created by individuals with certain CPS process preferences? Second, contrary to Kirton's (1976; 1994) contention that creativity style and level are unrelated constructs, is it possible that individuals with certain creativity styles are indeed more creative, at least on certain tasks or in particular domains?

CPS Style Implications for Practice

The extension of the CPS model into the examination of individual preferences has effectively linked two domains of creativity research, namely the process and person. The identification of individuals' CPS process preferences promotes the kind of multi-dimensional research called for by Amabile (1990), Murdock and Puccio (1993), Harrington (1990), and others. The insights gained from these multi-dimensional investigations, such as those studies that examine the interaction between the content of a CPS course and the process preferences of the participants, can help CPS practitioners enhance the impact of their training programs. Recall that Basadur et al. (1990) carried out a study that showed that individuals whose problem-solving preferences were most unlike the content found in CPS training gained the most from the experience. Puccio et al. (2004) discovered in some cases participants associated the greatest future value with those aspects of CPS that were most like themselves, while some participants reported the greatest potential value for those tools and concepts that departed from their own natural tendencies. Those who design CPS training might use these findings to expand the content and instructional methods found in their programs to insure that the impact of training is maximized across people with different personalities and preferences.

Another area of implication of process preferences relates to research focused on teams. If one assumes that a critical aspect to team success is the ability to effectively solve complex problems and that individual members' creative process preferences will influence how they interact with others while working to resolve complex problems, then the identification of process preferences through such tools as the CPSP and *FourSight* might help organizations better understand what leads to effective work in teams. Hammerschmidt's (1996) study into the problem solving success rates of teams that were either high or low in style diversity and that had members who were either in style consistent or inconsistent roles, is an excellent example of this kind of research. Basadur and Head (2001) provide yet another example of how understanding the composition of preferences found among group members is related to overall performance and individuals' satisfaction with their experience in the team.

CONCLUSION

Brandt (2001) maintained that the teaching of thinking can be divided into three areas: (a) teaching for thinking (the identification and use of practices that will help learners think better); (b) teaching about thinking (helping people to become conscious of their own thought processes and to improve their ability to control them); and (c) teaching of thinking (thinking as a subject).

CPS falls into all three of these categories. We described *CPS: The Thinking Skills Model* as a cognitive model because one of its functions is to improve people's thought processes so that they are better able to resolve predicaments or pursue opportunities that bring about productive change. Using it also causes people to practice the kinds of thinking skills that they need to resolve complex problems and because it fulfills these two functions, it can illuminate the teaching of thinking itself.

With these characteristics in mind and with the 50-plus years of developmental research and practice, it would seem that CPS could be a viable alternative to "flavor-of-the month" approaches to enhancing creativity. Its process functions have the potential to manage the chaos of creativity and to guide the thinking and acting of creative people; its content functions have the potential to help people clarify opportunities or predicaments, transform ideas into solutions and implement change. If creative people are the "creative capital" that Florida and Goodnight (2005) believe can make things happen in today's organizations, then CPS is a creativity currency that with a little effort can be used to promote thinking skills and thus maximize creativity in organizations. These skills in turn, can impact the bottom line of leader and follower performance for the better.

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