The Pennsylvania State University

The Graduate School

College of the Liberal Arts

WEB-BASED TRAINING FOR INNOVATION: AN EXAMINATION OF TRAINING REGIMENS, TRAINING ENVIRONMENT AND THE MODERATING INFLUENCE OF CREATIVE PERSONAL IDENTITY AND INTRINSIC MOTIVATION

A Dissertation in

Psychology

by

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Submitted in Partial Fulfillment
of the Requirements
for the Degree of

Doctor of Philosophy

August 2011

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ABSTRACT

The ability to enhance innovation is crucial for organizational success in today's rapidly changing and technologically-driven workplace and, in order for employees to contribute to organizational innovation in the modern workplace, online training has emerged as a significant trend for organizational training and development. Little research, however, has been conducted on how to best design and implement such training to enhance innovation among employees. With the Osborn-Parnes Creative Problem Solving (CPS) program as the conceptual framework, three online training programs were developed, implemented, and evaluated for their relative effectiveness for enhancing innovative performance. Innovative performance was conceptualized as having two dimensions, creativity and implementation planning, each consisting of two facets (quality and originality and penetration and forecasting, respectively). It was hypothesized that a full CPS training program would have the greatest impact on innovative performance, both at the dimension and facet levels, and that creative personal identity and intrinsic motivation would exhibit moderating, interactive influences. Three hundred and eighty-six participants completed one of three different training regimens (full CPS, ideational skills training only, or control training). An additional experimental condition involving training environment was also tested, creating a repeated measures, 3 X 2 factorial study design whereby training type and training environment functioned as between-subjects factors and pre and post-training innovative performance functioned as the within-subjects dependent variable. Hypotheses were partially supported and two consistent findings emerged: 1) a distinct positive trend for the IDS only condition indicating that online IDS only training may be more effective for enhancing innovative performance, as compared to full CPS or control

training, and 2) a strong environment effect indicating that the provision of online creative problem solving training in a more formal, controlled setting results in higher overall innovative performance than does the identical training in a non-lab setting. Theoretical and practical contributions, study limitations, and future research areas are also discussed.

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ACKNOWLEDGEMENTS

Over the past several years, I have had the fortune of being surrounded by a network of colleagues, family, and friends whose patience, enthusiasm, and support I would like to recognize. I would like to begin by expressing my sincere thanks to my advisor and committee chair, Sam Hunter, for his constant encouragement, mentoring, and support. To say that there were some ups and downs before crossing the finish line would be an understatement, but your guidance made all the difference in the world; I am honored that I will forever hold the title of being your first Ph.D. I would also like to thank my committee members, Jim Farr, Rick Jacobs, and John Messner for their feedback and input. I am also grateful to Andrea Hetrick, Neena Kaur, Brittany Opdyke, and Brendan Saller for serving as coders/judges and, especially, for pulling through for me at the end despite the tight deadlines – perhaps $10 coffee cards would have been more appropriate.

I am blessed to have such a wonderful network of people who have made my time in Happy Valley so memorable. Little did I know when we moved to State College that I would leave with so many wonderful friends and colleagues. A special thank you to Adam Myer, Christian Thoroughgood, and Katina Sawyer for their friendship during my time here – your senses of humor and willingness to listen were critical to my success. I would also like to thank the Sam Elliot/GWAR/910/trivia crowd – you know who you are and you have, in large part, made my experience at Penn State what it was. Thank you for the laughs and for our unspoken "no shop talk" code, both of which were absolutely instrumental to maintaining my sanity and keeping my engine going.

I would like to thank my family, especially my Mom and Dad, for their unconditional love and support. You taught me the value of education and have always believed in me. This accomplishment is a testament to your own examples of dedication, hard work, and refusal to quit.

I would especially like to thank George Mitchell for his encouragement and advice during my time in State College. I'm not sure how, but I did it.

Finally, I would like to acknowledge my wife, Lauren, whose unconditional patience and support has truly been the cornerstone of this effort. You have been there every step of the way since we met while I was taking my first prerequisite course for graduate school. Indeed, it is hard to believe that this is where we would be almost nine years later. This dissertation, and what it represents for us more broadly, is as much yours as it is mine. It has been a long, long journey to get here and I look forward to our post-graduate life together. Even though you will likely never read what follows in its entirety, it is dedicated to you.

Chapter 1

Introduction

Current figures show that U.S. companies are spending more money than ever on training and development. The American Society for Training and Development (ASTD) estimates that U.S. organizations spent $134.07 billion on employee learning and development in 2008 (ASTD, 2009) and that there has been a sharp increase in the use of new web-based and collaborative learning resources, including podcasts, blogs and wikis to help cut costs and streamline training. The percentage of companies using technology-delivered training increased from 8% in 1999 to 27% in 2004, and that roughly 75% of the technology-delivered courses in 2004 were online (Sugrue & Rivera, 2005). In conjunction with the rapid growth of computer-based training in modern organizations, jobs in virtually every sector of today's rapidly changing, information-based business environment, require or emphasize creativity and innovation (e.g., Galunic & Eisenhardt, 2001; Lichtenberg, Woock, & Wright, 2008). However, given the increasing emphasis on both training (particularly streamlined, computer-based training) and creativity/innovation within organizations, these two important growth areas have yet to be effectively unified.

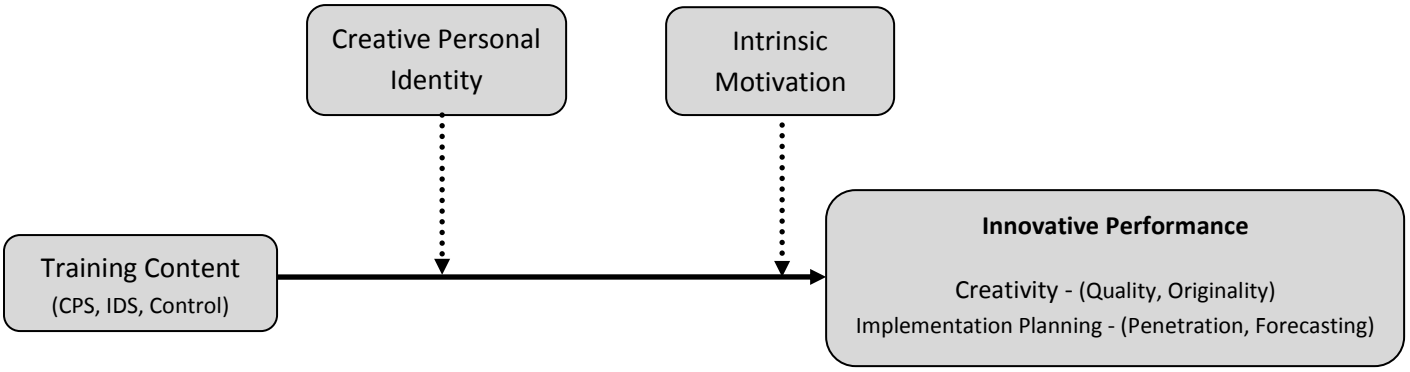
As part of a recent study conducted by The Conference Board, Corporate Voices for Working Families, ASTD, and the Society for Human Resource Management, over 200 employers were surveyed to examine corporate practices for training newly hired employees. Included among the key findings from this joint effort report was that the majority of respondents (68.6%) reported a “high need” for training programs in creativity and innovation

that teach new entrants how to "demonstrate originality and inventiveness in work, communicate new ideas to others, and integrate knowledge across disciplines" (Casner-Lotto, Rosenblum, & Wright, 2009, p. 10). However, among respondents indicating a "high need," less than a third (31.4%) offered such training, leaving a distinct, and unfortunate, gap of more than two-thirds not offering the very training programs needed to enhance the skills that cultivate creativity and innovation that are in such high demand.

Clearly, there is a need for training programs that can not only effectively enhance organizational creativity and innovation, but that can also be delivered in a cost-effective, practical manner. In an attempt to address this need, the proposed study has multiple purposes. First, this study will assess the overall effectiveness of an online training program for enhancing innovative performance. The training program to be evaluated was developed specifically for the current study and is based on the well-supported Osborn-Parnes Creative Problem Solving (OP-CPS) program (e.g., Noller & Parnes, 1972). Second, this study will address the need to determine if specific training elements are more critical for success by comparing the relative impact of the full training regimen with a training regimen that includes only the ideational skills training elements. Third, this study investigates the often-neglected importance of planning as part of the innovation process by 1) introducing a measure of innovative performance that includes creativity and implementation planning dimensions, and 2) testing a series of hypotheses comparing the relative impact of the full and partial training regimens on these two dimensions in addition to the overall measure of innovative performance. Finally, this study investigates the moderating influence of creative personal identity and intrinsic motivation on the relationship between the training programs and

subsequent innovative performance. Figure 1 presents a conceptual model showing the proposed relationships to be tested.

Figure 1. Conceptual model showing relationships to be tested.



The literature review that follows will be organized in the following manner. First, the literature on the importance of creativity, the distinction between creativity and innovation, and the effectiveness of training for creativity/innovation will be reviewed. This will be followed by discussions of the Osborn-Parnes CPS program and computer-based training. After a review of the literature comparing full versus partial CPS training, creative personal identity, and intrinsic motivation, a summary of the hypotheses predicting the relationships between the training programs, moderators, and the innovative performance outcome variables will be presented.

What is Creativity and Why is it Important?

Although the definition of creativity has been debated for decades, it is generally agreed upon today that it can be defined as the ability to produce work that is both novel (i.e., original, unexpected) and appropriate (i.e., useful, adaptive concerning task constraints) (e.g., Amabile,

1983, 1996; Barron, 1970; Mumford & Gustafson, 1988; Sternberg, 1988; Sternberg & Lubart, 1991, 1995, 1999). There is also general consensus among scholars that creativity is a process – a sequence of thoughts and actions that leads to creative performance. While the debate continues regarding the true nature of this process, most current research incorporates variations of the original process model put forth by Wallas (1926), whereby the complete creative act involves four several steps traditionally identified as preparation, incubation, illumination, and verification. More recent process models include the eight-stage general model of core creative problem solving proposed by Mumford and colleagues (Mumford, Mobley, Reiter-Palmon, Uhlman, Doares, 1991) and Finke, Ward and Smith's (1992) Geneplore model which distinguishes between generative and explorative processes during creative cognition to identify the cognitive processes and structures involved in creative thinking.

Creativity is an intriguing and complex construct that, as a research area, has its roots firmly embedded within the discipline of psychology. Beginning with Guilford's (1950) call for increased exploration, creativity has received a substantial amount of attention in the literature, resulting in a rich foundation of knowledge. While much is known about creativity in general, organizational creativity represents a relatively new and emerging area of research focused primarily on the factors that can enhance or impede creativity within organizations or the work context more broadly (Shalley & Zhou, 2008). As Shalley, Gilson, and Blum (2000) suggest, creativity is possible in any job or by any employee, given the appropriate conditions, and while creative work is typically associated with scientists and artists, creative work is not tied to or defined by a particular occupational field(s) (Mumford, Whetzel, & Reiter-Palmon, 1997). Indeed, if asked to identify the best scientists, artists, writers, musicians, teachers,

entrepreneurs, or business executives, one would most likely select individuals who are creative.

Organizational creativity is a far-reaching and truly multi-level construct with important implications not only for individuals, teams, and organizations, but for society as a whole. At the individual level, creativity has been linked to overall health and well-being, decreased stress, and successful adaptation to the demands of daily life (e.g., Cropley, 1990; Reiter-Palmon, Mumford, & Threlfall, 1998), as well as increased work success and employer demand (e.g., Frymire, 2006; Runco, 1997; Stokols, Clithertoe, & Zmundzinas, 2002). At the group or team level, it has been demonstrated that creativity is a vital component of team effectiveness and vitality (e.g., Taggar 2002; Tesluk, Farr, & Klein, 1997). At the organizational level, creativity has been shown to play a key role in entrepreneurial activities and long-term economic growth (Amabile, 1997; Simonton, 1999). Finally, at the societal level, creativity leads to innovation and the development of new scientific findings, artistic movements, and social programs that cure disease, create new jobs, and enlighten perspective (e.g., Mumford, 2002).

In today's today's rapidly changing, information-based business environment, highly desirable jobs often require or emphasize creative thinking ability (Mumford, Peterson, & Childs, 1999). Globalization, new consumer expectations, changes in production technology, and the increased rate of technological change, have created conditions where organizational success often depends on creativity and innovation (Florida, 2002). As Tushman and O'Reilly (1997) point out: organizations must create and implement innovative new products and services to not only survive, but thrive in the modern economic context. Indeed, innovation has

become a critical means of competitive advantage for organizations in a variety of industries because it allows them to adapt, diversify, and even reinvent themselves to keep up with evolving conditions (Gibson & Gibbs, 2006). In fact, creativity (and its counterpart innovation) has been characterized as the "cornerstone of organizational effectiveness" (Gilson, 2008, p. 306). Accordingly, the benefits of innovation do not appear to be industry specific, but rather the positive impact of innovation has been demonstrated across a variety of workplace domains including technology (Galunic & Eisenhardt, 2001), pharmaceuticals (Zellmar-Bruhn & Gibson, 2006), and automotive settings (Clark and Fujimoto, 1991), as well as in multi-industry studies that that have controlled for industry effects such as such as retail, agriculture, aerospace, professional services, medical products, chemicals, telecommunications, and consumer electronics (e.g., Gatignon, Tushman, & Anderson, 2002).

Creativity vs. Innovation

The widespread impact of creativity and innovation are clearly evident in modern society and for the current effort it is important to clarify the difference between these two related, but distinct concepts. As previously noted, modern creativity researchers generally agree that creativity can be thought of as the ability to produce work that is both novel (i.e., original, unexpected) and appropriate (i.e., useful, adaptive concerning task constraints) (e.g., Amabile, 1996; Sternberg & Lubart, 1991, 1995, 1999). Given this conceptualization, creativity can be thought to encompass the processes *leading to* the generation of new and valued ideas (West, 2002). Conversely, innovation concerns the behavioral and social processes whereby individuals, groups, or organizations seek to achieve desired changes, or avoid the penalties of

inaction. While several formal definitions of innovation have been proposed, all revolve around a central theme that includes the successful *implementation of the ideas* generated by creative thought (e.g., Amabile, 1988). One commonly cited definition is provided by West and Farr (1990), who define innovation as: "the intentional introduction and application within a job, work team or organization of ideas, processes, products or procedures which are new to that job, work team or organization and which are designed to benefit the job, the work team or the organization" (p. 9). This often cited definition points to the critical distinction between creativity and innovation, namely that whereas *creativity* involves the process leading to the generation of new ideas, *innovation* is the process of translating these ideas into useful new products (Amabile, 1997; Scott & Bruce, 1994).

For the current effort, creativity and innovation will be assessed using the following four dimensions: quality, originality, penetration, and forecasting. Quality and originality will be used to evaluate creativity, while penetration and forecasting will be used as to evaluate implementation planning, a critical aspect of innovation (e.g., Berger, Guilford, & Christensen, 1997; Obsurn & Mumford, 2006). Hypotheses will be developed using these four dimensions as both a single, continuous dependent measure termed *innovative performance* (see Figure 1), as well as separate dimensions termed *creativity* and *implementation planning*. A more detailed discussion of the dependent measures, to include support for this conceptualization and how it will be assessed, is provided in both the *Importance of Planning* and the *Method* sections.

Can Creativity Be Trained?

Given the ubiquitous impact and importance of creativity and innovation, both within and external to the world of work, as well as the flourishing interest in studying creativity and innovation empirically, one must ask: Can creativity and innovation be enhanced, and if so, how? A number of approaches have been used to encourage creativity, including provisioning of effective incentives, acquisition of requisite expertise, effective structuring of group interactions, optimizing creative climate and culture, identification of requisite career development experiences, and training to foster creativity (Scott, Leritz, & Mumford, 2004a). Of these methods, training has been the preferred approach for enhancing creativity (Montouri, 1992, as cited in Scott et al., 2004).

Accordingly, educational institutions and organizations have invested substantial resources in the development and implementation of creativity training. Solomon (1990) found that among organizations employing more than 100 people, 25% offered some kind of training for creativity. Creativity training has been developed for a wide range of job sectors including marketing (Rickards & Freedman, 1979), business management (Basadur, Wakabayashi, & Takai, 1992), educational administration (Burstiner, 1973), medicine (Estrada, Isen, & Young, 1994), and engineering (Basadur, Graen, & Scandura, 1986). Moreover, creativity training has been widely utilized and implemented in educational settings for virtually every student population, including kindergarten students (Meador, 1994), elementary students (Cropley, 1997), high school students (Fritz, 1993), college students (Daniels, Heath, & Enns, 1985), gifted and talented students (Kay, 1998), disadvantaged students (Jaben, 1983), art students (Rump, 1982), science students (McCormack, 1971), athletes (Kovac, 1998), and engineering students (Cropley & Cropley, 2000).

The widespread application of creativity training has merit. Although there is some debate as to whether training effectively enhances creativity, the belief that creativity can be enhanced through training is supported by many researchers (e.g., Amabile, 1983, 1996; Cropley, 1997; Dominowski, 1995; Guilford & Tenopyr, 1968; Ma, 2006; Rose & Lin, 1984; Scott, Leritz, & Mumford, 2004a, 2004b; Sternberg & Lubart, 1996; Torrance, 1972). Amabile (1983, 1996) suggests that anyone with normal cognitive abilities can aspire to produce work that is creative to some degree in some domain. Similarly, Cropley (1992, 1997) argues that all students, regardless of IQ, are capable of divergent thinking. Divergent thinking refers to the capacity to generate multiple alternative solutions, as opposed to the one correct solution. Divergent thinking models have provided a basis for the development of several systematic and widely applied training programs (e.g., the Purdue Creative Thinking Program and the Osborn-Parnes Creative Problem Solving process). Although the extent to which training can enhance creative performance and the notion that training is transferable are debated, there is general agreement among scholars that creativity *can* be trained and the majority of research supports this view.

How Can Creativity be Trained?

If training can indeed foster creativity, what are the characteristics of training, in terms of content and delivery methods, that influence the relative success of such efforts? Which training programs work the best, and why? Given the expanding market of specific training programs that target creativity and the corresponding body of literature on the effectiveness of these programs, several studies have been conducted in attempts to synthesize the mounting

research. Results from these efforts indicate that, in general, training can be effective in increasing creative performance but that the success of the training depends on several distinct factors. In short, not all creativity training programs are effective, and those that are have commonalities that help explain why and how they are better at fostering creativity. A brief discussion of each of the four major attempts to synthesize this body of research over the past several decades reveals these key characteristics in a historical context.

Torrance – 1972

Torrance's 1972 review, considered the first of its kind, was an initial attempt to provide a more comprehensive assessment of the effectiveness of creativity training programs. Given that most early attempts to understand creativity involved children, this quasi meta-analysis was based on studies involving divergent thinking training with children, particularly in the educational context. In conducting this research, Torrance (1972) reviewed the results of 142 separate studies published between 1960 and 1972. The training interventions examined covered a wide range of programs and techniques. To organize the data, Torrance classified the 142 studies into nine categories of "ways of teaching children to think creatively" (p.117). The categories included: training programs emphasizing the Osborn-Parnes Creative Problem Solving (CPS) procedures; other disciplined approaches (e.g., training in general semantics, creative research, etc.); complex programs involving packages of materials (e.g., the Purdue Creativity Program, Covington, Crutchfield and Davies' Productive Thinking Program, and the Myers and Torrance idea books); the creative arts as vehicles for teaching and practicing creative thinking; media and reading programs designed to teach and give practice in creative

thinking; curricular and administrative arrangements designed to create favorable conditions for learning and practicing creative thinking; teacher-classroom variables (e.g., indirect and direct control, classroom climate, etc.); motivation, reward, and competition; and testing conditions designed to facilitate a higher level of creative functioning or more valid and reliable test performance (Torrance, 1972).

To evaluate the success attained in the studies, Torrance (1972) conducted a judgmental appraisal of whether the study met its initial objectives. More specifically, to judge success, a score of 1 was awarded if all the measured objectives of the experiment were attained. If the experiment had a single objective, such as increasing the degree of originality of thinking, a score of 1 was still assigned. However, if data were presented for fluency, flexibility, originality, and elaboration and the only statistically significant gain over the control group was in originality, a score of .25 was awarded. If 10 of 20 tests of significance reached the .05 level of confidence, a score of .50 was awarded (Torrance, 1972).

Criticism of the analytic methods notwithstanding, the results showed that, overall, 72% of the training interventions were successful, with a range from 55% for curricular and administrative arrangements to 91% for the Osborn-Parnes CPS program. All categories of intervention with 10 or more studies (7 of the 9) had more than a 60% success rate.

While encouraging, this study had several significant drawbacks. Of these, two in particular have received the most critical attention. First, 103 of the 142 studies (~73%) involved the use of the Torrance Tests of Creative Thinking (TTCT) as a criterion. Therefore, the criterion of creative thinking was much the same as the practice exercises, namely scores on

divergent thinking tasks. In fact, in anticipation of being discredited for the inclusion of so many studies that involved performance on the TTCT (a battery that had yet to be convincingly validated), Torrance justified his inclusion of these studies based on what limited validity studies were available at the time. It should be noted that several studies, including a 40-year longitudinal study, have since provided empirical evidence for the TTCT as a valid predictor of adults' creative performance (Cramond, Matthews-Morgan, Bandalos, & Zou, 2005). Second, the analytic methods used by Torrance (1972) have received substantial criticism (e.g., Rose & Lin, 1984, Scott et al., 2004a, 2004b). While straightforward and relatively simple, this kind of judgmental analysis is subject to a number of ambiguities. A more salient criticism of these methods, however, involves the failure of the evaluation to explicitly examine performance gains due to training (Scott et al., 2004a).

Rose & Lin – 1984

Over a decade later, Rose and Lin (1984) conducted the first true quantitative meta-analysis of the effectiveness of creativity training. Their use of effect size (ES) measures to determine the relative magnitude of the effectiveness of treatments was the most critical improvement upon previous attempts to assess the effectiveness of creativity training. To do so, Rose and Lin (1984) initially selected 158 studies involving creativity training, 76 of which were doctoral dissertations. Once identified, the authors applied a set of criteria to determine final inclusion in the meta-analysis.

First, only studies examining the effect of a series of lessons or training treatments were included. This decision was based on evidence at the time indicating that such studies were

typically more long-term, and thus tended to use larger samples, appropriate methodological controls, more logical construction, and were undertaken with a stronger theoretical basis than short-term experiments. Secondly, only those studies using the TTCT as the assessment instrument were included. This approach was done for the purpose of comparability among studies in terms of scoring the traditional set of components of creative performance assessed by the TTCT: fluency (the ability to produce a large number of ideas), flexibility (the ability to produce a variety of kinds of ideas, to shift from one approach to another, or to use a variety of strategies), originality (the ability to produce ideas away from the obvious, commonplace, banal, or established), and elaboration (the ability to develop, embroider, or embellish, carryout or otherwise elaborate on ideas). In this way, restricting studies to only those using the TTCT created a universal operating paradigm across studies on what constituted creativity (Rose & Line, 1984). Finally, every study had to provide sufficient data from which ES could be calculated. Based on these criteria, 46 of the initial 158 studies were included in the analysis (22 doctoral dissertations, 13 journal articles, and 11 unpublished documents).

Once selected, each of the 46 studies was placed into one of six categories based on the type of training program or treatment: CPS (8 studies), Covington's Productive Thinking Program (CPT) (5 studies), Purdue Creative Thinking Program (PCTP) (3 studies), other creative thinking programs (10 studies), school programs via regular classroom arrangements (9 studies), and other long-term programs utilizing special techniques (e.g., creative dramatics) (11 studies). ESs were calculated using Glass's (1978) Delta. Rose and Lin (1984) reported an overall mean ES for creativity training on all creativity components of 0.468 ($\Delta = 0.468$), and that creativity training accounted for 22% of the variance in the overall creative thinking

performance of subjects. Furthermore, originality and fluency emerged as the two components of the TTCT most affected by training (Δ = 0.499 and Δ = 0.455, respectively). When the effects of training were broken down by training type/program, a wide range of effectiveness was found. The program with the most consistent impact on the TTCT scores was the Osborn-Parnes CPS (Δ = 0.629), while the weakest programs were the PTP (Δ = 0.118) and the PCTP (Δ = 0.329).

Based on their findings, Rose & Lin (1984) suggested that training does affect creativity. They concluded, "Creative thinking is at once a skill that can be developed through various teaching methodologies and an innate ability that some individuals have in greater abundance than others" (p.22). In this way, the authors supported the notion that creative potential is, to some extent, flexible and malleable, and that through education and training the innate creative thinking ability of individuals can be stimulated and fostered.

Scott, Leritz, & Mumford – 2004

Two decades after Rose and Lin's (1984) meta-analysis, and nearly 35 years after Torrance's (1972) seminal review, Scott and colleagues (2004a, 2004b) produced two reviews of creativity training that substantially improved upon those that preceded them. In doing so, Scott et al. (2004a, 2004b) both addressed the validity concerns of previous attempts to synthesize the effectiveness of creativity training and provided a far more comprehensive examination of creativity training than had been done previously.

The first of these efforts addressed several aspects of the effectiveness of creative training programs, using quantitative meta-analytic techniques (Scott et al., 2004a). This meta-analysis incorporated 70 studies, and the authors concluded that: 1) overall, training is effective

in enhancing creativity; 2) training is effective in enhancing each of the individual criteria that constitute creativity in general (divergent thinking, problem solving, performance, and attitude/ behavior); 3) creativity training has a particularly strong influence on problem solving and divergent thinking, especially originality; 4) creativity was equally effective in the short-term and long term for enhancing creativity; and 5) training benefited individuals in academic and occupational settings, across all ages, and at different intellectual levels (Scott et al., 2004a).

The overall Delta obtained in aggregating effects across criteria (e.g., divergent thinking, problem solving) was 0.68 (Δ = 0.68). Scott et al. (2004a) obtained similar results when the analyses were replicated eliminating outliers yielding Deltas larger than +2 or –2. Although the expected changes in estimates occurred with the elimination of outliers, the average ES obtained (Δ = 0.64) was similar. In the case of both analyses with and without outliers eliminated, fail-safe N statistics pointed to the robustness of these effects indicating that creativity training does lead to gains in performance. In fact, the fail-safe N statistic indicates that 168 null studies would be required to reduce the overall ES below .20 (Scott et al., 2004a).

Regarding the application of their findings concerning the effectiveness of creativity training to the various criteria of interest, Scott et al. (2004a) obtained Deltas for studies employing divergent thinking, problem solving, performance, and attitudes and behavior criteria. The largest ESs were obtained in studies employing divergent thinking (Δ = 0.75) and problem solving (Δ = 0.84). Studies applying performance criteria yielded smaller, but sizable, effects (Δ = 0.35), while studies employing attitudes and behavior criteria produced weaker effects (Δ = 0.24). It should be noted that this overall pattern of results was maintained when

outliers were eliminated. When ESs in divergent thinking studies were assessed with respect to fluency, flexibility, originality, and elaboration, the results echoed those found by Rose and Lin (1984) two decades earlier. Originality produced the largest ES (Δ = 0.81), followed by flexibility (Δ = 0.75), fluency (Δ = 0.67), and elaboration (Δ = 0.54).

The next set of results presented by Scott et al. (2004a) involved the generalizability of the effectiveness of creativity training across people and settings, as well as criteria. As previously noted, a major criticism concerning the external validity of creativity training derives from the widespread use of elementary school students in early studies (e.g., Torrance, 1972). To address this issue, Scott et al. (2004a) coded all studies by age—those involving people younger than 14 or 14 and older. Their results indicated that similar ESs were obtained for younger (Δ = 0.67) and older (Δ = 0.59) populations, with creativity training proving effective in both age groups. The authors also provided evidence indicating generalizability across settings. Scott et al.'s (2004a) overall analysis indicated that creativity training was effective in both academic (Δ = 0.65) and organizational (Δ = 1.41) settings. Their results suggest that creativity training may be more effective in organizational than academic settings.

Scott et al. (2004a) also investigated whether the effectiveness of creativity training held across time. To address this issue, studies were assigned to a before 1980 or a 1980-and-after category to reflect the emergence of cognitive approaches. In the overall analysis, studies published before 1980 yielded an ES similar to that obtained for later studies (Δ = 0.78 and Δ = 0.64, respectively). Among other things, these effects suggest that more recent training efforts are as effective as earlier divergent thinking based approaches.

Regarding the stability of creativity training, Scott et al. (2004a) addressed the criticism of creativity training studies for failing to implement designs demonstrating the robustness of training effects, as evidenced by the long-term impact of creativity training. Their results support the idea that creativity training does have a long-term effect on performance. Overall, Scott et al. (2004a) found that studies using longer posttest intervals produced ES estimates comparable to those obtained from studies using shorter posttest intervals ($\Delta = 0.65$ and $\Delta = 0.54$, respectively). They also found that studies employing transfer tasks yielded weaker, but sizable, overall ES estimates than studies that did not use transfer tasks ($\Delta = 0.51$ and $\Delta = 0.74$, respectively).

Finally, Scott et al. (2004a) examined course content and course delivery variables. Course content was divided into separate analyses of processes and techniques. Regarding course processes, the authors obtained a multiple correlation for the overall index of .49 and concluded that the development of course content around core processing activities contributes to the success of creativity training. Correlational analysis using the overall index indicated that training that focused on problem identification ($r = .37$), idea generation ($r = .21$), implementation planning ($r = .19$), solution monitoring ($r = .17$), and conceptual combination ($r = .16$) were all positively related to program success. However, regression analysis indicated that problem identification ($\beta = .48$), idea generation ($\beta = .18$), and conceptual combination ($\beta = .14$) made the strongest unique contributions to training effects.

Regarding the analysis of training techniques, the multiple correlation obtained when the overall index of cross-criteria was regressed on technique application ratings was .56, an

indication that training techniques contribute to the success of creativity training. More specifically, the correlations and regression weights indicated that training courses stressing techniques such as critical thinking (r = .22, β = .26), convergent thinking (r = .17, β = .12), and constraint identification (r = .15, β = .07) produced the largest positive relations with ES. Based on these results, Scott et al. (2004a) concluded that the use of techniques that stress analysis of novel, ill-defined problems contribute most to the relative success of creativity training programs.

To examine course delivery methods, Scott et al. (2004) conducted analyses on three different aspects of course delivery: design of the training course, approach used to deliver training (i.e., media), and practice exercises used in training. Overall, when study ESs were correlated with, and regressed on, these course design variables, the results indicated that course design had a sizable impact on the effectiveness of creativity training. The multiple correlation obtained in examining the relation of the course design variables with ES was .55. Regarding course design, Scott et al. (2004a) obtained several interesting results. As expected, the amount of practice provided (*r* = .24, β = .32) along with training time, as assessed in days (*r* = .02, β = .26), was positively related to training effects in the overall analysis. The authors also demonstrated that application of model-based approaches in course design, as opposed to an ad hoc assembly of techniques, was found to be positively related to obtained ESs in both the overall (*r* = .39; β = .46) and the various criterion-specific analyses. Based on their results with regard to the style in which training material is presented, Scott et al. (2004a) suggested that material should be presented in a fashion likely to facilitate the initial acquisition of relevant concepts and procedures. Their claim was based on the negative correlation observed between

practice type and overall ES (r = –.07, β = .10), indicating that it was more effective to distribute than mass learning activities, particularly when the concern at hand was problem solving (r = –.10) and performance (r = –.46). However, Scott et al. (2004a) found that massing was positively related to the effects obtained in divergent thinking training (r = .18) where short courses illustrating easily acquired techniques can be applied.

Similarly, in the overall analysis, Scott et al. (2004a) found that training that presented material in a holistic fashion tended to be negatively related to ES (r = –.18, β = .00), whereas training that focused on the development of component skills (r = .15, β = .05) tended to be positively related to ES with these effects again proving most pronounced for studies using problem solving and performance criteria. Finally, the authors examined the amount of feedback provided by instructors during training. In the case of the problem-solving (r = .25) and performance (r = .25) criteria, instructor feedback was positively related to obtained ES. In the case of the divergent thinking (r = –.28) and attitudes and behavior (r = –.19) criteria, instructor feedback was negatively related to obtained ES. Based on these results, Scott et al. (2004a) suggested that feedback is beneficial when performance shaping is required for product generation. Alternatively, the authors suggest that when the performance is less constrained, as is the case of divergent thinking and attitudes and behavior studies, then the imposition of external standards through feedback may inhibit creativity.

The second facet of study design examined by Scott et al. (2004a) involved the approach used to deliver creativity training, an aspect previously not addressed by other studies of creativity training. When the overall index was regressed on the instructional media variables, a

multiple correlation of .40 was obtained, leading the authors to suggest that instructional media can have an impact on program success. More specifically, Scott et al. (2004a) found that two general media deployment strategies contributed to the success of creativity training. First, the use of media that provide information was found to be positively related to the success of creativity training, including the use of lecture based instructional techniques (r = .20, β = .30), as well as the use of audio-visual media (r = .07, β = .17.). Based on these results, the authors suggested that informing people about the nature of creativity and strategies for creative thinking is an effective, and perhaps necessary, component of creativity training.

Finally, Scott et al. (2004a) examined practice exercises. The authors found that exercise type was related to the success of training, producing a multiple correlation of .42 in the regression analysis examining the overall criterion. The most salient finding to emerge in the overall analysis was that the use of domain-based performance exercises was positively related (r = .31, β = .35) to ES. It should be noted, however, that the use of domain-based performance exercises was more important when the concern at hand was problem solving, performance, and attitudes and behavior criteria as opposed to divergent thinking criteria (Scott et al., 2004a). This pattern of findings is consistent with the other results regarding the value of domain-based practice. Also of note, Scott et al. (2004a) found that the use of field exercises and interactive class exercises were positively related to the ESs obtained in performance and attitudes and behavior studies, and that the use of imaginative exercises (r = –.27, β = –.25) was negatively related to program success. These additional findings led the authors to suggest that creativity training requires structured, directed practice in the application of relevant techniques and principals.

Although the findings obtained in the Scott et al. (2004a) study clearly highlight the value of creativity training, this effort, by virtue of the design applied, did not allow two critical issues to be addressed (Scott et al., 2004b). First, the scrupulous screening of studies, while useful and perhaps necessary to draw strong conclusions in a meta-analysis, prevented the ability to draw any conclusions about the frequency with which different types of training appeared in the literature. Second, training typically operates as a "package" of interventions, and Scott et al.'s (2004a) examination of moderator variables, while providing some information about the components of more successful programs, could not take into account the complex interactions among these variables in shaping program effects (Scott et al., 2004b). Accordingly, the intent of Scott et al.'s second 2004 effort was to apply clustering analysis (using the same 156 studies from Scott et al.'s 2004a initial literature review) to identify types of training, or training packages, with respect to cognitive processes, training techniques, media, and types of practice exercises, to assess the frequency with which each type of training occurred in a larger sample of studies, and finally to address the effectiveness of these training types via meta-analysis. In doing so, Scott et al. (2004b) identified 11 common types of training, all of which appeared to have some value. Furthermore, some types of training, specifically idea production and cognitive training, were found to be particularly effective while some commonly applied training strategies, specifically imagery training, were found to be less effective.

Based on these findings, four general themes emerged regarding the types of creativity training studies: idea production training, imagery training, cognitive training, and thinking skills training (Scott et al., 2004b). The most common approach, idea production training, represents

a more traditional approach to creativity training and resulted in effective training. However, in terms of effectiveness, creative process training, conceptual combination training, and critical/ creative thinking training, while less common than idea production training, all resulted in larger ESs and a higher proportion of successful evaluation efforts than idea production training (Scott et al., 2004b).

Although Scott et al. (2004b) provide compelling evidence to support the effectiveness of creativity training programs, the authors acknowledged several limitations to their study. First, while the ES and judgmental criteria displayed adequate convergent validity, both of these indices examined overall success, and therefore the findings do not speak to specific criteria that would likely be of important in selecting a training program (e.g., instructional intensity, content development difficulty, or program costs). Second, unlike the earlier Scott et al. effort (2004a), no attempt was made to take into account the effect of internal validity considerations on the ES estimates obtained for each training type. Third, due to sample size limitations, Scott et al. (2004b) made no attempt to examine the relative effectiveness of different types of training for different populations and settings. Finally, the findings speak to the effectiveness of instructional packages as opposed to the discrete variables that moderate the effectiveness of training (Scott et al., 2004b).

Ma – 2006

In an effort to address the limitations of previous reviews of the effectiveness of creativity training, Ma (2006) conducted a meta-analysis that classified creativity into two main categories: creativity without evaluation (e.g., brainstorming) and creativity with evaluation

(e.g., problem solving), whereby measurements were independently taken for each category in fluency, flexibility, elaboration, and originality. The results of this study revealed a grand mean ES (Δ = 0.77) of creativity training that is comparable to that found in the previously discussed meta-analyses. However, unlike Scott et al. (2004a), this study found that creativity training programs tended to be more successful with older participants than with younger ones, a result likely due to the fact that Scott et al. (2004a) categorized age into two groups (younger than 14 or 14 and older), whereas Ma's (2006) study contained five groups. With the exception of training programs and age, no significance was found in the effect of moderators, indicating that the kind of instruments measuring creativity, the experimental design, and the duration of training do not necessarily significantly influence the evaluation of the effectiveness of creativity training programs (Ma, 2006).

Conclusions

In conclusion, all five empirical reviews of the literature suggest that, overall; training is an effective method of enhancing creativity. Table 1 presents a summary of the reviews discussed.

Table 1: Summary of Significant Empirical Reviews of Creativity Training Programs

Author(s)	Year	Sample	* Effect Size	Major Findings & Contributions	Major Limitations
Torrance	1972	142 studies	N/A	72% of the training interventions were successful	73% studies used TTCT as DV; poor analytic methods; no E.S. measure; limited to school settings
Rose & Lin	1984	46 studies	Δ = 0.47	Creativity training accounted for 22% of overall variance in creative thinking; originality and fluency components of TTCT most affected by training; program with most	Only TTCT used as DV; limited to school settings; did not include analysis of course content or delivery

				impact on TTCT was Osborn-Parnes CPS.	
Scott, Leritz, & Mumford	2004a	70 studies	Δ = 0.68	Training effective in enhancing divergent thinking, problem solving, performance, and attitude/ behavior; training has particularly strong influence on problem solving and divergent thinking; training equally effective across time, setting, age, and intellectual ability.	Careful screening of studies prevented ability to draw conclusions about frequency of appearance in the literature; examination of moderator variables did not take into account complex interactions among these variables in shaping specific program effects
Scott, Leritz, & Mumford	2004b	156 studies	Δ = 0.78	Provided first systematic categorization of training into 11 types/packages via cluster analysis; provided general framework point to a general framework for classifying and appraising creativity training (idea production training, imagery training, cognitive training, and thinking skills training).	Findings do not consider specific criteria of importance in selecting training program; effect of internal validity considerations on the effect size estimates not taken into account; no attempt to examine relative effectiveness of different types of training for different populations and settings; discrete variables that moderate the effectiveness of training not taken into account
Ma	2006	34 studies	Δ = 0.77	Training programs more successful with older participants; no effect for moderators (i.e., instrument of measurement, experimental design, and duration of training do not influence effectiveness of creativity training programs.	Limited number of studies evaluated; limited # of single techniques of creativity training investigated (i.e., not enough to form a category).

*Denotes overall measure of effect size across training programs

Although specific findings vary among the five studies, several general conclusions emerge regarding the nature of creativity training. First, creativity can be enhanced by training. Grand mean ESs across all five investigations range from 0.47 to 0.78, a strong indication that training can effectively enhance creativity. Second, creativity training seems to be particularly effective in enhancing divergent thinking and problem solving. Third, training appears to be equally effective across time, setting (academic and organizational), age, and intellectual ability.

Fourth, feedback during training can be beneficial when performance shaping is required for product generation. Fifth, the use of media that provide information (e.g., lecture-based and audio-visual media) and encourage knowledge application (e.g., social modeling, cooperative learning, and case-based learning) appear to be the most useful methods of training delivery. Sixth, practice exercises, particularly the use of domain-based performance exercises, are positively related to training effectiveness, an indication that creativity training requires structured, directed practice in the application of relevant techniques and principles. Finally, it is possible to form a stable, robust typology of creativity training programs, such that a general framework for classifying and appraising creativity training can be obtained.

The Osborn-Parnes CPS Process

The findings above provide compelling evidence to suggest that creativity can indeed be enhanced through training and that, while a wide variety of training programs have been developed to enhance creativity (e.g., Feldhusen, Treffinger, & Bahlke, 1970; Torrance, 1972), certain training regimens appear to be more effective than others. Among the most well documented, and well known, are the process-based training approaches which include the Creative Problem Solving (CPS) program introduced by Osborn (1953) and most famously refined by Parnes and colleagues (Noller & Parnes, 1972; Noller, Parnes, & Biondi, 1976). This popular training program is referred to by scholars and practitioners alike as the Osborn-Parnes (OP) CPS process.

The origins of the CPS process can be traced back to Alex Osborn (1953), an advertising executive who developed tools such as brainstorming to aid in the generation of creative ideas.

Beginning with Osborn's (1953) seminal book, *Applied Imagination*, CPS has emerged through several decades of work, as it has been developed continuously for nearly 50 years at the State College of New York, Buffalo, in cooperation with the Creative Education Foundation (Kabanoff & Bottger, 1991). A number of researchers have refined and individualized the process over the years, but two fundamental characteristics remain the same. First, OP-CPS involves guiding users through a series of steps associated with the creative act which include: mess-finding, fact-finding, problem-finding, idea-finding, solution finding, and acceptance-finding (see Table 2). This focus on appropriate problem definition, the incorporation of both creative and analytical thinking, and planning for implementation of the final solution are just some of the reasons why OP-CPS has been an attractive model for both academic and organizational settings (Puccio et al., 2006). The second distinguishing feature of CPS is the use of divergent (i.e., generating a diverse set of alternatives) and convergent thinking (i.e., screening, selecting and evaluating alternatives) at each of these stages (Lim, Park, & Hong, 2010). The dynamic balance between these two kinds of thinking in every step of the problem solving process is the hallmark of the OP-CPS process (Puccio et al., 2006).

Table 2: Conceptual Overlap among OP-CPS Stages and CPS Plain Language and Process Models

Osborn-Parnes Stage (Noller & Parnes, 1972)	**Plain language** (Miller et al., 2001)	**General model of core creative problem-solving processes** (Mumford et al., 1991, 1999)	
Mess-finding	Identify the Goal or Challenge	Problem Definition	*Identification of a broad, often ambiguous problem to address*
Fact-finding	Gather Data	Information Gathering	*Assembly of a general body of information, to be used in formulation of a solution*
Problem-Finding	Clarify the Problem	Concept Selection	*Identification of most useful information; sorting into categories relevant to the problem*
Idea-finding	Generate Ideas	Conceptual Combination	*Combination of groups of ideas in novel ways, in order to address the problem at hand*
Idea evaluation	Select & Strengthen Solutions	Idea Generation	*Shaping and integration of concepts into specific potential solutions*
		Idea Evaluation	*Examination of the costs, benefits, potential merits and pitfalls of ideas, and selection of those that are likely to be successful*
Acceptance-finding	Plan for Action	Implementation Planning	*Identification of design details, and determination of how to best enact them*
		Monitoring	*Systematic examination of a solution's success, following implementation*

In this way, OP-CPS can be viewed as a structured methodology that is used to enhance creative thinking, both in individuals and teams. Before discussing the evidence supporting the use of OP-CPS for the current study, it is important to make a distinction between OP-CPS and brainstorming. OP-CPS is a process-based model designed to guide trainees through the series of steps involved in the creative process. Brainstorming, on the other hand, is a *specific tool* designed to enhance divergent thinking and effective idea generation in group settings (e.g., Puccio et al. 2006). It is only one of several divergent thinking-based tools that are incorporated into an appropriately designed OP-CPS training regimen. In this way, OP-CPS can be thought of as a framework for using specific tools, such as brainstorming, to enhance creativity, along with other divergent and convergent thinking tools.

Over the past five decades, OP-CPS has been continually developed, implemented, and evaluated by researchers and, during this time, substantial empirical evidence has emerged to support the OP-CPS process as one of the most effective methods of training for creativity. Among the most compelling findings that support the use of OP-CPS as a training framework include those found in the various reviews and meta-analyses discussed previously. In what is considered the first comprehensive review of creativity training effectiveness, Torrance (1972) concluded that training programs having the highest percentage of success in teaching children to think creatively (over 90%) were those that contained procedures or variations of the procedures developed by Osborn (1963) and Parnes (1966; 1967). Similarly, in the first true meta-analysis of the effectiveness of creativity training programs, Rose and Lin (1984) concluded that the OP-CPS program had the largest effect size (.629) among all creativity training regimens across six different categories. In a more recent meta-analysis, Scott et al.

(2004) examined the effect sizes for different types of training outcome criteria and found that training which focused on teaching divergent thinking and creative problem solving skills, both hallmarks of the OP-CPS program, showed the strongest effects. Similarly, Ma's (2006) recent meta-analysis reported an overall effect size of .82 for the OP-CPS program, the largest effect size for any single creativity training program for which 10 or more studies were included in the analysis. In terms of popularity, it should also be noted that of the 268 effect sizes included in the Ma (2006) meta-analysis, 60 (22%) of them were for the OP-CPS program. Taken together, the evidence from these efforts provides compelling evidence to support both the effectiveness and widespread use of the OP-CPS program to enhance creativity.

The effectiveness of OP-CPS program in enhancing creativity has been supported by a number of studies in addition to the reviews discussed above. To date, the most comprehensive examination of the efficacy of OP-CPS was the Creative Studies project conducted by Parnes and Noller (Parnes, 1987; Parnes & Noller, 1972; Parnes & Noller, 1973). In this study, college freshman were randomly assigned to one of two conditions: an experimental condition in which participants completed four college-level creativity courses over a two-year period, where CPS was used as the primary framework, or a control condition. These researchers found that students who participated in the CPS courses showed significantly higher levels of performance across a large number of the measures to include significant gains on tests of cognition, divergent production, and convergent production. Furthermore, participants in the experimental group also outperformed the control group on creativity-related tests given as part of their English courses and showed greater levels of coping and problem-solving skills.

More recently, a review by Puccio et al. (2006) provides a comprehensive examination of CPS training in organizational settings, describing how CPS has been used effectively in multiple domains to change attitudes, behavior and group processes as they relate to creativity. Controlled studies included among those reviewed demonstrate that CPS training can improve attitudes toward creativity (Basadur, Wakabayahshi, & Graen, 1990; Basadur, Wakabayashi, & Takai, 1992), as well as creative performance (e.g., Basadur, Graen, & Green, 1982). More specifically, Basadur and colleagues (e.g. Basadur & Finkbeiner, 1985; Basadur & Hausdorf, 1996) demonstrated that CPS is effective in changing employees' preference for acceptance of active divergence (entertaining multiple possibilities) and premature convergence (narrowing on one solution early on) and. A quasi-experiment by Basadur, Taggar, and Pringle (1999) demonstrated that managers who completed a two-day CPS training program were more appreciative of new ideas and acknowledged the time required to develop novel ideas. Researchers have also demonstrated that CPS is effective for changing behavior to include improving fluency and flexibility of ideas, as well as idea evaluation and problem finding behavior (e.g. Basadur, Graen & Green, 1982; Kabanoff & Bottger, 1991; Runco & Basadur, 1993; Wang & Horng, 2002). Wang and Horng found that CPS training led to a significant increase in work-related performance projects in a group of Research & Development scientists and technicians. Keller-Mathers (1990) demonstrated that participants continued to use a number of CPS tools in their personal and professional lives up to a year after the training.

The OP-CPS program has also been shown to effectively increase group processing. More specifically, Firestien and colleagues (Firestien, 1990; Firestien & McCowan, 1988) found that groups that participated in CPS training over the course of a semester were more involved

in the problem-solving process, were less critical of ideas, and laughed and smiled more than those groups who did not participate. Additionally, these researchers found that OP-CPS-trained groups produced ideas that were significantly higher in terms of both quantity and quality than non-trained groups. In a similar fashion, Basadur, Pringle, Speranzini, and Bacot (2002) described how application of the OP-CPS process to a union-management negotiation led to greater levels of trust, cooperation, and more creative solutions.

Taken together, the research presented provides compelling support for the effectiveness of CPS training regimens, and the OP-CPS program in particular. OP-CPS training produces clear benefits for creativity-related attitudes, behavior, and group processes and has been shown to be effective across a variety of populations and domains with sustained effects measured over one year after training. The OP-CPS approach was identified, either directly or indirectly, by each of the four major reviews from the past four decades as being the most, or among the most, effective training techniques for enhancing creativity. Based on the evidence presented, the OP-CPS program was chosen as the framework for creativity training in the current study. A more detailed description of the training content is provided in the *Method* section. What follows is discussion of the emerging merits of computer-based creativity training.

Computer-based Creativity Training

It comes as little surprise in today's rapidly evolving technological world, that computer-based training is a popular trend in most organizations (Paradise, 2007). However, despite the growing popularity of this training medium, to date there have been surprisingly few attempts

to develop, implement, and evaluate computer-based forms of creativity training (Benedek, Fink & Neubauer, 2006). One line of reasoning for the lack of computer-based creativity training is that computers are too analytical and rigid to produce anything other than noncreative thinking (Clements, 1991). Yet another barrier involves the manner in which creativity itself has often been conceptualized. In many ways, creativity has traditionally been viewed as a 'magical' occurrence, a phenomenon with a mystical quality that, like love, doesn't readily lend itself to scientific study because it is more of a spiritual process (Sternberg & Lubart, 1999). With this line of thought in mind, many training designers may be reluctant to remove the 'magic' from creativity training, as many of the popular workshops offered to organizations focus on producing "ah-ha" moments and using improvisation training to help employees access their internal creativity (Conlin, 2006; Polewsky & Will, 1996). While these workshops may serve as enjoyable team-building experiences, there has been little systematic evaluation of the effectiveness of such training initiatives (Polewsky & Will, 1996). Regardless, it is plausible to assume that training designers may perceive that these unique experiences would be lost in translating creativity training into a computer-based training format.

Alternatively, the computer offers a potentially powerful tool for users to develop creativity training (Clements, 1991). Lubart (2005) provided a framework for the potential contributions of computers to creative performance, outlining four roles that a computer might play to facilitate creativity: computer as nanny, computer as pen-pal, computer as coach and computer as colleague. A computer acts as a nanny when used to alert the user of approaching deadlines or by reducing the cognitive load on the user by taking over menial tasks such as auto-saving files. A computer can act as pen-pal through electronic emailing and conferencing

systems that allow long-distance collaboration between individuals. A computer can act as coach by providing tutorials to learn a new process, or by providing a database of potential sources of inspiration. Finally, a computer can act as a colleague through actively contributing to the creative dialogue with the user, and by learning and modifying ideas or providing random stimuli to facilitate further user generation. Lubart's (2005) clever framework suggests that, rather than dismissing technological innovations such as the computer for training creativity, such advancements should be embraced and the utility explored.

Although there is limited empirical research, there is some preliminary evidence that computer-based training is an effective way of teaching divergent thinking skills. Benedek, Fink, and Neubauer (2006) found that a computer-based training program that involved practicing divergent thinking exercises increased ideational fluency (number of ideas generated) in participants. While limited to three studies involving training for school children, Scott et al.'s (2004) meta-analysis found an effect size of .77 for computer-based creativity training. In fact, among these author's concluding remarks was specific call for more research on computer-based creativity training, given the obvious potential for teaching creativity skills. As evidenced by the Scott et al. (2004) study, most of the extant research on computer-based creativity training involves children, and overwhelmingly indicates that computer programs can aid children in the development of creativity thinking abilities, to include mathematical creativity (Davis, 1984), creative writing (Carey & Flower, 1989), figural creativity (e.g. Clements & Gullo, 1984), and musical composition (Holland, 1989). Clements (1995) suggested that computer-based training was successful because children are allowed to 'play' with concepts as opposed to concerning themselves with arriving at a correct answer on the first try.

Despite the notion that the vast majority of creativity training programs traditionally examined in the literature represent face-to-face formats, there has been a dramatic trend among organizations in recent years toward implementing online versions of training (Aguinis & Kraiger, 2009), which provide obvious benefits in terms of both cost and convenience for the employee and the employer (Brown & Ford, 2002). One specific area of research that points to a merging of technology and creativity training in organizational settings is electronic brainstorming. Electronic brainstorming research emerged from the need to avoid the evaluation apprehension that can hinder full participation in group discussions. DeRosa, Smith, and Hantula (2007) conducted a meta-analysis of the electronic brainstorming literature and found that electronic group brainstorming resulted in increased quantity and quality of ideas as well as increased group member satisfaction than did traditional face-to-face brainstorming groups. These researchers also found that electronic brainstorming is a better method for creative idea generation than nominal group brainstorming under certain conditions. More specifically, DeRosa and colleagues (2007) found an interaction for group size such that electronic brainstorming groups outperformed nominal groups (i.e., those formed by aggregating the output of a comparable number of individuals working separately) in terms of both quantity and quality of ideas generated when the group size was large, whereas small nominal groups outperformed electronic groups. Taken together, these findings indicate that interaction with group members is not necessary for creativity, and that in some cases individuals are more creative when working alone.

DeRosa et al. (2007) posit that electronic brainstorming is more effective than face-to-face brainstorming because certain social psychological group interferences are reduced. For

example, production blocking (i.e., the phenomenon whereby during the time that one group member provides suggestions, another group member is unable to use that same time period to provide a suggestion) is drastically reduced in an electronic format. Furthermore, conceptual combination is also facilitated by electronic brainstorming, such that all group members have visual access to all ideas generated and, therefore, can more easily build off of previous suggestions. DeRosa et al. (2007) also suggest that the anonymity permitted by electronic brainstorming reduces evaluation apprehension while generating ideas. Taken together, such findings lend support to the notion that training creative problem solving skills may, in fact, be more appropriate in a computer-based setting than in a traditional group training environment, where various social psychological may impede maximum effective participation.

Part and parcel with computer-based training is the dramatic increase in the use of web-based training and instruction by modern organizations. Indeed, web-based instruction is rapidly becoming a favored training option in industry, government, and higher education. By definition, web-based instruction (heretofore used synonymously with web-based training) is a "hypermediabased instructional program, which utilizes the attributes and resources of the World Wide Web to create a meaningful learning environment where learning is fostered and supported" (Khan, 1997, p. 6). Web-based training is delivered via a computer using the Internet, enabling instant updating, distribution, and sharing of information (Rosenberg, 2001). A recent benchmarking survey of organizations by ASTD found that the percentage of companies using technology-delivered training increased from 8% in 1999 to 27% in 2004, and that roughly 75% of the technology-delivered courses in 2004 were online (Sugrue & Rivera, 2005). Newman and Scurry (2001) found that over 1,100 institutions of higher education in the

United States offer online courses, while Symonds (2003) found that the US Army uses online instruction as a retention tool, with over 40,000 soldiers in 50 countries pursuing advanced degrees online.

Given its growing popularity, Sitzmann, Kraiger, Stewart, and Wisher (2006) conducted a meta-analysis in an effort to better understand whether or not this delivery medium is effective, whether web-based instruction is more effective than other delivery media, and what contextual or methodological factors moderate its effectiveness. In this study, effectiveness was operationalized as both learning from and reactions to delivery media. Overall, Sitzmann et al.'s (2006) results indicate that web-based instruction was 6%more effective than classroom instruction for teaching declarative knowledge, while the two delivery media were equally effective for teaching procedural knowledge and trainees were equally satisfied with web-based instruction and classroom instruction. Additionally, these same researchers found that web-based instruction was 19% more effective than face-to-face instruction for teaching declarative knowledge when web-based trainees were provided with control in long courses and when trainees practiced the training material and received feedback during training. Accordingly, the current study utilizes a web/computer-based OP-CPS training program that includes both practice exercises and feedback. A more detailed description of the training program developed for this study is included in the *Method* section.

Full vs. Partial CPS Training

As previously noted, the complete OP-CPS program involves guiding users through a series of divergent and convergent thinking exercises at each stage of the creative process. Most modern versions of the OP-CPS program include the following six stages: mess-finding,

fact-finding, problem-finding, idea-finding, solution finding, and acceptance-finding (Miller, Vehar, & Firestien, 2001; 2002). Despite the fact that modern theory calls for the use, and highlights the importance, of all six stages in OP-CPS training programs, the approach to the empirical investigation of OP-CPS training has been a considerably narrow one, with a focus on evaluating only certain components of the CPS process (e.g., those involving ideational skills training) and using divergent thinking as a measure of creative performance. Two notable examples are discussed below.

Basadur, Graen, and Green (1982) tested what they termed a "complete process" (p. 41) model of creativity, which the authors identified as containing three main stages: problem finding, problem solving, and solution implementation. Basadur et al. (1982) proposed that training the ideation-evaluation process at each of these stages would lead to increased preference for ideation, increased practice of ideation, improved performance in problem finding, and increased performance in problem solving. What should be noted is that, despite their claim of investigating the complete CPS process, Basadur et al. (1982) examined the problem finding and problem solving stages only, ignoring solution implementation on the premise that the ideation portion of CPS is the most difficult to train and, therefore, focused their efforts on these phases.

The authors assessed time-spent on ideation during the problem-finding and solution-finding stages, the number of ideas generated during both stages, the number of evaluations made during generation, and the rated the quality of ideas generated. Using self-reported and other-reported accounts of creative performance at work, the results demonstrated that

participants who received ideation-evaluation training spent more time generating ideas and made fewer negative judgments while generating ideas and that performance in problem finding significantly improved with training whereas performance in problem solving improved marginally. More specifically, trainees in the ideation-evaluation process received higher quality ratings, produced more statements, and spent more time working on the problem than did the untrained and control groups. Taken together, the Basadur et al. (1982) study demonstrates that training ideation-evaluation skills leads to more proficient ideation and more creative solutions within the problem finding and problem solving stages. This study also lends support to the general notion that creativity (or at least some aspects of creativity) can be trained and generally supports the assertion that repeated cycles of divergent and convergent thinking are important components of training creativity (e.g., Mumford et al., 1991).

In another highly cited study, Fontenot (1993) examined the effect of OP-CPS training on two characteristics of divergent thinking, fluency and flexibility. In this study, participants were randomly assigned either to a control or to an experimental group, where the control group received no training and the experimental group received an eight-hour training session. The training was a modified version of the OP-CPS program and included a series of lectures and practice exercises in the following areas: defining creativity, outlining what is meant by a "problem," relating creativity and problem solving, explaining the creative problem-solving model, discussing what blocks creativity, suggesting how to remove the blocks, and introducing specific techniques to implement during the problem-finding phase. To assess creative performance, both the control and experimental groups were asked to read a business case

study, outline a plan or procedure that included all steps to be used in defining the problem in the case study, and to follow through with the established plan.

The results from the Fontenot (1993) study indicated that the training effectively increased participants' fluency and flexibility during both the problem finding and problem solving phases. However, several shortcomings should be noted. First, the control condition received no training and, thus, the impact of eight hours worth of training for the experimental group (in terms of fatigue, mood changes, motivation, etc.) was not truly controlled for. A more methodologically sound approach would have been to subject the control group to eight hours worth of training unrelated to creativity enhancement. Second, while the author explicitly states the importance of training the entire creative process via every corresponding phase of the OP-CPS program, hypotheses were only generated for two of the six stages (problem finding and problem solving). A more thorough approach would have been to assess the impact of OP-CPS training at each of the stages, which points to the overwhelming neglect of certain stages of the creative process, most notably the final stages that involve planning and implementation. Finally, Fontenot (1993) acknowledges that a major conceptual problem is the assumption among many scholars that the definitions of creativity and divergent thinking are synonymous and that many researchers have stated that little evidence exists to support the hypothesis that highly divergent thinking children become creative adults, raising the issue of whether tests of divergent thinking are good measures of actual or potential creative achievement. Despite her acknowledgement of this critically important methodological issue, rather than using a more sound and less controversial measurement of creativity (e.g., Amabile's Consensual Assessment Technique), Fontenot (1993) uses divergent thinking as the

only measure of creative performance, justifying her use with the following sentence "Significant correlations have been found, however, between divergent thinking and creativity" (p. 14).

What can be readily observed from these studies is that, although the authors acknowledge the importance and benefits of training the entire OP-CPS process, there is a particular emphasis on training and evaluating only certain stages (especially those that involve ideational skills training), and using divergent thinking as a measure of creative performance. From a measurement perspective, it should come as no surprise to any researcher that training ideational skills (i.e., the ability to generate multiple ideas) should show considerable benefit when creativity is measured via divergent thinking ability, given that the two are so highly related. Furthermore, despite a narrow focus and limited criterion space, the training programs still consisted of an entire workday (e.g., Fontenot, 1993) or even multiple days (e.g., Basadur et al. 1982). From a utility perspective, it's difficult to justify expending resources (e.g., time, money, energy) to develop training for skills that are not evaluated (e.g., planning implementation) as part of the training assessment.

In an effort to address this issue of training utility, Clapham (1997) used a pretest-posttest design and randomly assigned 108 undergraduate students to one of three conditions: 30-minute full creativity training (n = 39), 10-minute ideational skills training only (n = 32), and a control group (n=37) (the control condition time was not indicated). The premise behind this design was to test whether certain components of a modified OP-CPS training program could be identified as critical to the enhancement of creativity and, in this way, justify the

streamlining of creativity training programs by including only those elements with the most crucial impact on enhancing creative performance. Such streamlining could, both theoretically and practically speaking, decrease the time and cost to organizations without sacrificing effectiveness.

Clapham's (1997) 30-minute full creativity training program was based on the training developed by Clapham and Shuster (1992), and consisted of six steps: completing a general creativity exercise, participating in several minutes of relaxation and stretching exercises, defining creativity as "recombination of elements which already exist for a useful purpose" (p. 37) and discussing the importance of creativity, listening to idea-generating techniques and examples, and listening to a description of personal factors that affect successful performance. The participants in the 10-minute ideational skills training only condition completed only step four (listening to idea-generating techniques). The participants in the control condition (time undisclosed) received alternate training that made no mention to creativity or generation of ideas and consisted of watching a word processing training video. All participants, regardless of training condition, completed the TTCT Figural Form A prior to training and the TTCT Figural Form B after completing their respective training.

The results from the Clapham (1997) study indicate that full creativity training and the ideational skills training conditions both had significant, positive effects on overall creativity scores, that these two conditions did not differ significantly from each other in terms of their overall effectiveness (i.e., Creative Index) or post-training subscores (e.g., fluency, originality, elaboration), and that both conditions showed significantly higher post-training scores on the

Creativity Index of the TTCT-Figural than those in the control condition. Based on these results, the author concludes that "providing simple, brief instructions on idea-generating techniques can have the same effect on overall scores of a creativity test as undergoing a more extensive creativity program," (p. 40) highlighting the implications of these findings for practitioners in terms of reducing training costs by placing an emphasis on the inclusion of ideational skills training at the expense of other elements of creativity training programs (e.g., OP-CPS).

Despite such compelling results and practical implications, several methodological shortcomings of this study should be noted. First, like many other creativity researchers, Clapham (1997) used a measure of divergent thinking (the TTCT) as the sole criterion to evaluate the effectiveness of these programs, providing no acknowledgement of the long standing debate over this practice and justifying her decision with a single reference to Milgram (1990), indicating simply that "divergent thinking predicts creative problem solving," (p. 233). Second, it should be noted that the author's claim that the full training program was based on the OP-CPS program is somewhat dubious. The content of each of the six steps in the Clapham (1997) study varied considerably from the traditional steps outlined in the OP-CPS program (e.g., relaxation techniques are not part of the OP-CPS), there was no opportunity for practice or feedback, and, most importantly, the cyclical repetition of divergent and convergent thinking (i.e., the hallmarks of the OP-CPS program) at each stage was not evidenced. Third, the control condition was not a true control in the sense that the actual time was undisclosed and participants watched a video as opposed to interacting with an instructor. Finally, it is plausible that the low sample and cell sizes contributed to the lack of significant differences between the full training and partial training (i.e., ideational skills training only) conditions.

Regardless, from a theoretical standpoint, the alleged benefits of training creativity via full OP-CPS training as opposed to training a single component like ideational skills training is an intriguing one and, from a practical standpoint, a very worthwhile one. What is proposed in the current study is a comparison of the relative impact of three different training regimens – full OP-CPS, ideational skills training only, and no creativity training – on innovative performance with significant theoretical and methodological improvements to those in the extant literature. A discussion of these improvements and the corresponding hypotheses follows.

The Importance of Planning

Taken together, the research discussed presents provocative ideas and compelling findings with regard to training creativity. However, this same body of research also presents several opportunities for improvement, both theoretically and methodologically, that will be addressed in the current study. Of particular note is the unfortunate neglect of the importance of planning, the set of skills trained in the final stage of the OP-CPS program (see Table 2) which play a critical role in the transition from creativity to innovation (Obsurn & Mumford, 2006).

As previously discussed, creativity and innovation are related but distinct concepts, and researchers (e.g., West, 1990, 2002) have suggested that the generation of novel ideas (i.e., creative thinking) is more important during the early stages of the creative process because, as the idea or product is adapted to organizational circumstances and stabilized, there is less need for creativity. What becomes important at the latter stages of the creative process, in many circumstances, is the need for planning implementation. Indeed, while some innovations are unplanned and emerge by accident (e.g., the Post-It notes developed in 3M), most innovations

are planned and managed, requiring copious amounts of an organization's energy and attention to ensure their effective implementation (West, 2002).

The notion of planning for the implementation of novel ideas has a long history, as even the earliest process models acknowledged that creativity involves more than simply generating ideas (e.g., Wallas, 1926). In fact, most modern process models of creativity continue to incorporate some form of implementation planning (e.g., Amabile, 1983; Fink et al., 1992; Mumford, et al., 1991; Parnes & Noller, 1972; Sternberg, 1986). As referenced earlier, one of the most empirically supported recent process models is the eight-stage model put forth by Mumford and colleagues (e.g., Baughman & Mumford, 1995; Mumford et al., 1991, 1996, 1997). This model emphasizes a more refined perspective on the innovation process, as it includes the various sub-processes involved in innovation (Hunter, Cassidy, & Ligon, in press). As shown in Table 2, the primary activities involved in creativity and innovation according to this eight-stage model are: opportunity identification; information gathering; concept selection; conceptual combination; idea generation; idea evaluation; implementation planning; and monitoring. A brief description of each of these stages is provided in Table 2, as a detailed discussion of each stage is beyond the scope of the current effort.

As Table 2 indicates, the eight stages of Mumford et al.'s (1991) creative process model map directly on to the six stages of the OP-CPS model , as well as modern 'plain language' versions of the OP-CPS model such as the Miller et al. (2001, 2002) model presented. The convergence of these three frameworks provides a strong theoretical and conceptual foundation for the current proposal, and highlights the notion that planning for the

implementation of novel ideas (see Training Module 3 'Planning and Implementing' in Table 2) is as important to successful innovation as efforts at the other stages of the creative process. In keeping with this idea, Mumford, Peterson, and Childs (1999) demonstrated that occupations requiring creative processing activities (e.g., problem construction, conceptual combination, and idea generation) also require implementation planning.

Planning makes it possible to refine and shape ideas in such a way as to facilitate their successful development and, in this way, it has an important influence on innovation (Osbburn & Mumford, 2006). The process model proposed by Mumford and colleagues (1991) points to the nature of skills (e.g., scanning and adaptive revision) that might influence planning, and two related skills, *penetration* (e.g., identification of key causes, restrictions, resources, and contingencies) and *forecasting* (e.g., projection of positive, negative, short-term, and long-term outcomes), appear to exert particularly important influences on planning performance (Osburn & Mumford, 2006). Early evidence to support the importance of these skills can be found in several studies, most notably in the early factor analytic work of Guilford and colleagues (e.g., Berger, Guilford, & Christensen, 1957; Kettner, Guilford, & Christensen, 1954; Merrifield, Guilford, Christensen, & Frick, 1962), where both a forecasting factor a penetration factor emerged as important determinants of people's ability to successfully ask key questions needed to reach a decision and to see the implications of changes, respectively. This same set of studies found that measures of planning capacities (i.e., penetration and forecasting) typically display strong positive correlations with creative ability.

More recent studies have investigated penetration and forecasting as important skills for innovation planning. Marta et al. (2005) used management scenarios to develop measures of forecasting and penetration as they related to the identification of key causes and restrictions. This study found that scores of leaders on these measures were related to the quality and originality (i.e., the same measures used to assess creativity in the current study) of group problem solving. In another recent study, Osburn and Mumford (2006) provided a two-hour training program that emphasized the acquisition of penetration and forecasting skills to 174 people who were subsequently tasked with implementing a new educational curriculum. The results indicated that training forecasting and penetration strategies improved performance with respect to quality and originality on the creative problem-solving task, and that this was most pronounced for highly creative individuals (i.e., those with high divergent thinking ability) but not necessarily those who were highly motivated or intelligent.

Implementation planning skills, such as penetration and forecasting, clearly represent important aspects of successful innovation, despite a relative lack of empirical attention in the creativity literature. However, rather than training penetration and forecasting skills and investigating them as independent measures as other researchers have done (e.g., Osburn & Mumford, 2006), the current study proposes a novel use of these two concepts by including them as a composite dependent measure termed *implementation planning*, which is conceptualized as one dimension of the overall dependent measure, *innovative performance* (see Figure 1). The other dimension of innovative performance is *creativity*, which is comprised of quality and originality (as opposed to divergent thinking), in the same way that other researchers have done (e.g., Redmond, Mumford, & Teach, 1993).

Hypotheses – Training Content

Taken together, the research presented points to several important conclusions regarding training for creativity/innovation: 1) Creativity and innovation are often critical for organizations to succeed in the modern workplace (e.g., Florida, 2002; Mumford, Peterson, & Childs, 1999), 2) While inherently related, creativity and innovation are distinct concepts whereby creativity involves the process leading to the generation of new ideas and innovation involves the process of translating such ideas into useful new products (Amabile, 1997; Scott & Bruce, 1994), 3) Creativity and innovation can be enhanced through training (e.g., Ma, 2006; Scott et al., 2004), 4) There is substantial support for the effectiveness of the OP-CPS program, in particular, to train creativity and innovation (e.g., Puccio et al., 2006), 5) In conjunction with the booming popularity of web/computer-based training is a growing body of research supporting this medium as a highly effective, and cost-benefiting, alternative to traditional face-to-face training (Sitzmann et al., 2006), 6) The research on CPS training has followed a narrow approach in two notable ways, to include an emphasis on training and evaluating only certain stages (e.g., ideational skills training) at the expense of others (e.g., implementation planning), and using divergent thinking as the lone measure of creative performance (e.g., Clapham, 1997), and 7) Planning is a critical, but often ignored, aspect of CPS training that is essential for the transition from creativity (i.e., work that is novel and appropriate) to innovation (i.e., the implementation or application of such work) (e.g., Osburn & Mumford, 2006).

Given these conclusions, an OP-CPS based training program was developed for web/computer-based administration. As previously noted, the training program consists of

three different training conditions– full OP-CPS (CPS), ideational skills training only (IDS), and no creativity training (control) – to assess the relative impact of each on innovative performance. Figure 1 provides a conceptual model of the relationships to be tested in the current study. The following set of hypotheses involves the relationships between training content (the IV) and innovative performance (the DV).

Despite an emphasis on training and evaluating only specific components of CPS, the research presented also supports that idea that training, irrespective of the stages included, enhances creativity (Clapham, 1997; Ma, 2006). As discussed, nearly all creativity process models include some aspect of planning in the latter stages (e.g., Amabile, 1996; Mumford et al., 1991), which is also reflected in most CPS training programs, including the OP-CPS (see Table 2). However, this important step is typically ignored by researchers in evaluating creativity training. Accordingly, the current study aims to demonstrate the unique benefits of planning by 1) comparing a full training program that includes the planning stages (i.e., CPS condition) with a training regimen that includes ideational skills training only (i.e., IDS condition), and 2) conceptualizing the dependent variable, innovative performance, as a composite of two dimensions –planning and implementation (i.e., penetration and forecasting) and creativity (i.e., quality and originality). Given this conceptualization, it is hypothesized that participants who receive full training (CPS) will produce work that judged to be more innovative than participants who receive partial training (IDS).

H1: Full OP-CPS training will demonstrate a stronger positive relationship with innovative performance than will IDS only or control training.

Ideational skills' training has been shown to be effective in enhancing creativity when creativity is conceptualized as a measure of divergent thinking (e.g., Basadur et al., 1982). Given the conceptual overlap between divergent thinking and the originality component of the creativity dimension proposed in the current study, it is highly plausible that the relationship between ideational skills training and creativity will hold. Therefore, it is hypothesized that participants who receive ideational skills training only (i.e., IDS only training) will produce work that is judged to be more innovative than participants who receive no creativity training.

H2: IDS only training will demonstrate a stronger positive relationship with innovative performance than will the training control.

The dependent variable in the current study, innovative performance, is comprised of two dimensions, implementation planning and creativity, and the previous hypotheses involve relationships with this composite measure. However, if the two dimensions of innovative performance are investigated separately (i.e., as *either* implementation planning or creativity), it is proposed that another set of interesting relationships will emerge. More specifically, it is hypothesized that the benefits from full OP-CPS training will be most pronounced when the dependent measure is conceptualized as implementation planning only, and that the benefits of full OP-CPS training will be diminished when the dependent measure is conceptualized as creativity only, such that participants in the full OP-CPS training and ideational skills training only conditions will produce work that is judged to be relativity equal.

H3: Full OP-CPS training will demonstrate a stronger relationship with the implementation planning dimension of innovative performance than will the partial OP-CPS training or control training.

H4: OP-CPS training and partial OP-CPS training will demonstrate similar relationships with the creativity dimension of innovative performance.

The hypotheses above highlight the following propositions: 1) CPS training, whether full or partial, can effectively enhance innovative performance, 2) Complete CPS training is more effective for enhancing innovative performance than is partial CPS training (or control training), 3) Partial CPS training is more effective for enhancing innovative performance than is no CPS training, 4) Complete CPS training is more effective for enhancing planning implementation, as defined by penetration and forecasting, than is partial CPS training, and 5) Complete CPS training and partial CPS training are equally effective for enhancing the creativity, as defined by quality and originality.

The critical factor in this set of hypotheses, of course, is the conceptualization of innovative performance as containing aspects of implementation planning *as well as* creativity, a conceptualization which, for the most part, has been largely ignored. Overall, it is proposed that "creativity" is more appropriately conceptualized as a two-dimensional measure containing dimensions of implementation planning and creativity and that, when this notion of innovative performance is used, full CPS training is the most effective method to enhance "creativity."

Another area where the current effort aims to improve upon extant theory and methodology in the creativity training literature is through the investigation of two important

moderating variables – creative personal-identity and intrinsic motivation. The proposed relationships are shown in Figure 1 and a discussion of each moderator is presented in the following sections.

Creative Personal-Identity as a Moderator

Creative personal-identity (CPI) is a relatively recent addition to the creativity literature, but one that has been shown to have a substantial impact on creative performance. While it might be easy to confuse creative self-identity with more well-known constructs such as creative self-efficacy, the two constructs are conceptually separate in many important ways. Fundamentally, the difference between identity and self-efficacy is that, while self-efficacy is constructed through individual background and experience over time, identity (i.e., both social identity and role identity) is the psychological manifestation of a category which an individual considers crucial to his/her self-concept (Brewer, 1991). With regard to creativity, Jaussi et al. (2007) explain that creative self-efficacy is similar to the concept of perceived competence for a creative task. In contrast, creative personal identity reflects the level of importance the category "creative" is to an individual's self-concept. Individuals high on CPI consider themselves to be creative and would use the label "creative" to describe themselves to others. Individuals low on CPI do not necessarily consider themselves to be creative and would not be likely to use the label “creative” to describe themselves to others.

CPI is a new construct in the creativity literature, but it has been shown to play an important role in understanding creative performance. Jaussi et al. (2007) demonstrated that creative personal identity was useful in predicting employee creativity. Most notably, these authors found that CPI explained additional variance in creative performance at work above

and beyond creative self-efficacy. Jaussi et al. (2007) posited that creative personal identity enhanced the effects of high creative self-efficacy by increasing the likelihood that individuals sought situations that would allow them to display creativity. This idea is based on the premise that individuals seek situations which allow them to affirm their personal identity through successful experiences (Brewer, 1991; Steele, 1988). In this way, those high in CPI may be more likely to seek out situations that allow for the display of creativity which, in part, may explain why CPI is related to creative performance.

Prior to the recent Jaussi et al. (2007) work, earlier studies involving similar creative self-concept variables suggest that creative personal identity has a strong relationship with creative performance. Wright (1975) found that creative self-concept (defined similarly to CPI) was significantly related to objective creativity. His results also demonstrated that those with a high creative self-concept were more accurate in their assessment of their creative ability than were those with a low creative self-concept. Sansawal (1982) found that creative self-concept was related to, but distinct from, creativity and problem solving ability.

The research presented suggests that the importance of creativity to an individual's self-definition may be an important moderator of the relationship between training and innovative performance. It is suggested that, those who view creativity as critical to their sense of self-identity will likely react to creativity training differently than those who view creativity as being relatively unimportant to their sense of self-identity. More specifically, while it is plausible that trainees who possess a stronger sense of CPI may be more likely to engage in the training exercises and to place more intrinsic value on creativity training, it is equally plausible that these same trainees already possess a strong sense of perceived creative competence and

established strategies for innovative performance and, therefore, stand to gain less from training than do those trainees low on CPI. In this way, trainees low on CPI may benefit more from CPS training and demonstrate a greater gain in innovative performance than trainees high on CPI.

In fact, there is some evidence to suggest that such a relationship will emerge in the current study. Zhou (2003) demonstrated that individuals low on creative personality (as measured by Gough's creative personality adjective scale, 1980) had less prior experience with, lower self-confidence toward, and lower self-esteem for creative activities. Zhou (2003) found that employees low in creative personality benefited (in terms of creative performance) from the presence of creative coworkers and developmental feedback significantly more than did employees high in creative personality. Zhou explained her results in terms of social cognitive theory, which suggests that those low in creative personality are more likely to look to others to learn strategies for creative performance. While Zhou investigated creative personality rather than CPI, her work provides evidence to suggest that creative personal identity may influence one's approach to training in a manner similar to that of creative personality.

H5: Creative personal identity will moderate the relationship between training and innovative performance, such that the relationship will be higher for trainees low in creative personal identity, regardless of training condition (i.e., both CPS and IDS).

Intrinsic Motivation as a Moderator

Because computer/web-based training, as previously discussed, places increased responsibility and autonomy on the trainee, user motivation for learning becomes a crucial issue (Brown & Ford, 2002). In fact, researchers have long agreed that motivation is a crucial

consideration in maximizing creativity (e.g., Collins & Amabile, 1999). By definition, motivation is typically described as what a person does (direction), how hard they work (intensity), and how long they work (persistence) (Kanfer, 1990). Generally speaking, when an individual's motivation for a given action is low, he/she will exert minimal effort toward the task (Kanfer, 1990), and this notion of minimal effort takes on a special meaning in relation to performance on creative tasks. Given that creative performance tasks typically include varying degrees of ambiguity, they are often referred to as "open" tasks because there is no clear answer (Osche, 1990). When an individual's motivation for a creative task is low, he/she is more likely to exert low effort by generating conventional, traditional ideas or products that are more familiar to him/her. In this way, low motivation generally inhibits creativity (Collins & Amabile, 1999). In contrast, highly motivated individuals may be more willing to deal with the ambiguity of a creative task and expend the effort necessary to find unusual ideas which are not immediately salient (McGraw & McCullers, 1979).

Several creativity researchers offer explanations for the relationship between motivation and creativity. For example, Martindale's (1999) theory of biological creativity suggests that under low neurological arousal (e.g., the low energy experienced with a lack of motivation), it is more difficult for the brain to access low-frequency synapses. As a result, the mind is more likely to follow well-traveled synaptic pathways and access conventional ideas (Martindale, 1999). Csikzentmihalyi's popular flow theory suggests that when one experiences optimal motivation for a task, one can slip into a state of optimal performance in which higher-order functioning seems effortless and creative genius may result (Csikszentmihalyi & Csikszentmihalyi, 1988). Simonton's (1999) work focuses on the power of bipolar or cyclothymic

episodes, when artists and writers are motivated into creativity by the energy that accompanies a manic episode. Amabile's (1983, 1996) tripartite component theory of creativity posits that creative performance is the combination of domain-relevant knowledge, creative thinking skills, and motivation. Taken together, what becomes readily apparent is that an overwhelming majority of the empirically-supported theories of creativity include the notion that creative production is driven in large part by an individual's inherent enjoyment of and satisfaction derived from, engaging in the creative process (Amabile, 1990; Amabile, Hennessey, & Grossman, 1986). This particular type of motivation is referred to by scholars as *intrinsic motivation*, which is typically contrasted with its counterpart, extrinsic motivation.

Characterized by the motivation "...to engage in an activity primarily for its own sake, because the individual perceives the activity as interesting, involving, satisfying, or personally challenging," (p. 297) intrinsic motivation is marked by a focus on the enjoyment and challenge of the task itself (Collins & Amabile, 1999). In contrast, extrinsic motivation is defined by Collins and Amabile (1999) as "...the motivation to engage in an activity primarily in order to meet some goal external to the work itself, such as attaining an expected reward, winning a competition, or meeting some requirement" (p. 297), and is marked by a focus on external reward or recognition and external direction of one's work. The notion that intrinsic motivation plays an important role in fostering creativity is not a new one, and has received empirical support for several decades. Early contributors to the idea of intrinsic motivation included Carl Rogers (1954) and Abraham Maslow (1943, 1959, 1968), who argued that creativity was motivated by a need to maximize our own potential rather than out of a desire for achievement. Stemming from their belief in this internally motivated drive, these influential

psychologists believed that creativity could only take place in the absence of external regulation. Other influential creativity scholars at this time went further, suggesting that the act of creating was itself a reward for creative individuals (e.g. Barron, 1963; MacKinnon, 1962). Similarly, Mansfield and Busse (1981) identified a passionate commitment to one's work as critical for creative discovery. Torrance (1981, 1983, 1987) demonstrated that individuals who were doing what they loved were more creative in their pursuits. Gruber and Davis (1988) demonstrated that highly creative people possessed an intense commitment to their work that was reflected in "…a fascination with a set of problems that sustains their work over a period of years" (as cited in Collins & Amabile, p. 300).

More recently, creativity scholars have demonstrated that individuals engaged in episodes of high creative production often describe a sense of losing track of time and immersing oneself in the task (e.g., Collins & Amabile, 1999). Building from Amabile's (1991) componential model, Sternberg and Lubart's (1991, 1992, 1995, 1996) investment theory of creativity suggests that intrinic motivation is critical for creativity because, under such motivation, individuals are more likely to truly concentrate on the task and thus more likely to capture unusual solutions based on attentiveness. Some research has suggested that simply thinking about the intrinsic reasons for doing a task can significantly boost creativity (Greer & Levine, 1991; Hennessey & Zbikowski, 1993). Carney (1986) demonstrated that art students who scored high on intrinsic imagery on the Thematic Apperception Test (i.e. those whose responses highlighted the joy of creating art) were more likely to persist in their field and to eventually achieve success, suggesting that persistence in the face of adversity may be a benefit of intrinsic motivation.

The effects of intrinsic motivation on creativity have been demonstrated outside of the lab in organizational settings as well. Amabile, Hill, Hennessey, and Tighe (1994) found that individuals in organizations who scored highly on the Work Preference Inventory (an inventory which examines the major components of intrinsic motivation for one's work) produced work that was more likely to be rated as highly creative. Benzer and Bergman (2007) found that self-reported intrinsic motivation for an open-ended creative problem solving task at work predicted participant's creativity scores on the task.

The research presented suggests that intrinsic motivation, like creative personal identity, may be an important moderator of the relationship between training and innovative performance. It is proposed that one's motivation to engage in the training exercises because the individual perceives the training as interesting, involving, satisfying, or personally challenging for its own sake will have a considerable positive impact on innovative performance.

H6: Intrinsic motivation will moderate the relationship between training and innovative performance, such that the relationship will be higher for trainees high in intrinsic motivation, regardless of training condition (i.e., both CPS and IDS).

Furthermore, it is hypothesized that there will be relationship between the two proposed moderators and the independent variable (i.e., training). More specifically, taking hypothesis 5 into account, those who stand to benefit *the most* from training are those trainees for whom creativity is less important to their self-identity but who are intrinsically motivated to engage in the training. This relationship would be revealed as a three-way interactions among training, creative self identity, and intrinsic motivation in predicting innovative performance.

H7: A three-way interaction will emerge, such that the relationship between training and innovative performance will be the highest for trainees who are low on creative self identity but high on intrinsic motivation.

Summary of Hypotheses and Research Goals

The conceptual model showing the relationships to be tested is provided in Figure 1. Given the established importance of creativity and innovation to organizations, the current study has several important purposes. First, this study will assess the overall effectiveness of an online training program for enhancing innovative performance. Second, this study will address the need to determine if specific training elements are more critical for success by comparing the relative impact of the full training regimen with a training regimen that includes only the ideational skills training elements. Third, this study investigates the often-neglected importance of planning as part of the innovation process by 1) introducing a measure of innovative performance that includes creativity and implementation planning dimensions, and 2) testing a series of hypotheses comparing the relative impact of the full and partial training regimens on these two dimensions in addition to the overall measure of innovative performance. Finally, this study investigates the moderating influence of creative personal identity and intrinsic motivation on the training programs and subsequent innovative performance.

A summary of the seven hypotheses to be tested is provided below:

H1: Full OP-CPS training will demonstrate a stronger positive relationship with innovative performance than will IDS only or control training.

H2: IDS only training will demonstrate a stronger positive relationship with innovative performance than will the training control.

H3: Full OP-CPS training will demonstrate a stronger relationship with the implementation planning dimension of innovative performance than will the partial OP-CPS training or control training.

H4: OP-CPS training and partial OP-CPS training will demonstrate similar relationships with the creativity dimension of innovative performance.

H5: Creative personal identity will moderate the relationship between training and innovative performance, such that the relationship will be higher for trainees low in creative personal identity, regardless of training condition (i.e., both CPS and IDS).

H6: Intrinsic motivation will moderate the relationship between training and innovative performance, such that the relationship will be higher for trainees high in intrinsic motivation, regardless of training condition (i.e., both CPS and IDS).

H7: A three-way interaction will emerge, such that the relationship between training and innovative performance will be the highest for trainees who are low on creative self identity but high on intrinsic motivation.

Chapter 2

Method

Participants

The total, final sample included 386 participants. A power analysis indicated that total number of participants in the resulting sample far exceeded the recommended number of participants to detect a small effect size at 90% power with an alpha of .05 (Huck, 2004). All participants were recruited from a large, public northeastern university through the psychology department's subject pool. The sample consisted of 248 females (64%) and 138 males (36%) ranging from 18 to 31 years of age (M = 19.8, SD = 1.57) and representing a wide array of undergraduate academic majors.

Though not formally proposed, an additional experimental condition was added to the study based on preliminary analyses during the first several weeks of online data collection. In addition to granting participants complete control over location and time for study completion, an additional sample of participants completed the study in a controlled atmosphere. Using the subject pool website, participants signed up for a specific timeslot and completed the study in a computer lab on campus. The lab contained 12 computer terminals and a maximum of 12 participants were permitted to complete the study during a given timeslot. Each of the 12 computer terminals provided sufficient privacy and headphones were used to prevent distraction. Once seated, participants were provided with the same hyperlink that the "non-lab" participants were provided to begin the study. Other than the differences presented, the procedure and study parameters were identical for both "lab" and "non-lab" samples.

The additional experimental condition created a 3 X 2 repeated-measures, factorial study design where training type (full OP-CPS, ideational skills training only, and control) and training environment (non-lab and lab) functioned as between-subjects factors while the pre and post-training measures (creativity, planning, and innovative performance) functioned as repeated within-subjects factors. The sub-sample demographics were similar to the overall sample. The non-lab sample consisted of 187 participants, including 134 females (72%) and 53 males (28%) ranging from 18 to 31 years of age (*M* = 19.9, *SD* = 1.57). The lab sample consisted of 199 participants, including 114 females (57%) and 85 males (43%) ranging from 18 to 30 years of age (*M* = 19.1, *SD* = 1.57). Table 3 provides the corresponding cell sizes.

Table 3: Sample Size by Study Condition (Cell Sizes)

		Training Type			
		Full OP-CPS	Ideational Skills Training Only	MLP* (Control)	**Total**
Training Environment	At home	59	65	63	187
	In Lab	66	67	66	199
Total		125	132	129	**386**

*MLP = Managerial Leadership Program (Blake & Mouton, 1964, 1999)

Measures

A full list of items is included in Appendix A. All items, with the exception of divergent thinking, were answered using a 5-point scale (1 = poor to 5 = excellent for all dimensions of innovative performance, and 1 = strongly disagree to 5 = strongly agree for all other variables). Divergent thinking scores were calculated using the method described below and standardized for analysis and interpretability with the other study measures.

Innovative Performance

As noted, the innovative performance tasks used below are distinct in terms of content, but are related (and thus comparable) in terms of the fundamental requirement in that all study participants were asked to design something novel and useful that can be evaluated using the four innovative performance criteria. These two tasks were completed by participants in each study condition (i.e., regardless of training content). The narrative for each task is provided below.

Pre-training task. "Each year Penn State has thousands of students visit campus to decide if they should choose this school to receive their education. During this visit, students see our campus and all of the senior gifts that have been donated to it. Please think of new senior gifts that would enhance our campus and make it more attractive to incoming students. For example, other students have dedicated statues or donated money towards something important to their class. The gifts can be temporary, and range in price from $1,000 to $30,000. Describe your gift, what it would look like, where it would be placed and how it might operate. Finally, describe what you think the impact would be on visiting students and their parents."

Post-training task. "Twenty-five years from now, what will it be like to live on campus? Describe what the dorms would look like, what kind of amenities they would offer, and how this would help students. Consider a typical students' daily life as well specific times of the school year. You can also think about areas the students share such as dining facilities, the gym, parking lots, and study areas."

To evaluate innovative performance, as reflected in the quality, originality, penetration, and forecasting of the responses provided by participants, a variation of Hennessey and Amabile's (1988) Consensual Rating Technique was applied. Initially, two judges read through written responses provided by participants, taking into account key attributes of the four proposed dimensions of innovative performance (Besemer & O'Quin, 1999; Marta et al., 2005; Mumford et al., 2002; Osburn & Mumford, 2006). Subsequently, these judges were asked to define how these attributes were manifest in responses exhibiting high, medium, and low levels of quality, originality, penetration, and forecasting and select example products marking these three scale points. These example products were then described in a brief summary form to provide product-based anchors for the four rating scales.

To appraise the quality, originality, penetration, and forecasting, four judges – all upper-level undergraduate students in psychology, were asked to read through the responses provided by participants and rate, on a 5-point scale, the four dimensions using the anchors presented in Appendix B. In applying these rating scales, the judges were asked to read the innovative performance task responses and then assess the levels of quality, originality, penetration, and forecasting evident using the high, medium, and low benchmarks provided by the rating scales (Redmond, Mumford, & Teach, 1993). Judges were provided with the pre and post-training responses only and were blind to all study conditions and identifying information.

Prior to this rating task, judges were provided with substantial training in applying these rating scales. This training included background information regarding the ratings to be made and the nature of the innovative performance tasks. Subsequently, judges were asked to rate

and discuss 15 sample products on each of the four dimensions to 1) clarify definitional issues and rating procedures and 2) to address rater calibration. The interrater agreement among trained judges was evaluated for each dimension and found to be in the acceptable range to proceed with rating. Judges met weekly during the rating process to address related issues and questions, as well as to assess calibration. All judges completed pre and post-training ratings for each participant on each of the four facets of innovative performance.

As shown in Figure 1, innovative performance is conceptualized in the current study as containing two dimensions: 1) creativity, which consists of quality and originality facets, and 2) planning, which consists of penetration and forecasting facets. Both pre-training and post-training measures of innovative performance, and the dimensions/facets, were collected. The parameters used for aggregation of these dimensions are provided below for both pre and post training.

Pre-training creativity dimension of innovative performance. To aggregate the pre-training creativity dimension of innovative performance, the correlation between pre-training quality and pre-training originality was calculated ($r = .40$, $p < .01$). This moderate, statistically significant correlation, along with the conceptual and empirical basis provided previously, justified aggregation of these dimensions to form the pre-training creativity dimension of innovative performance. The reliability of the judge-rated quality and originality dimensions was acceptable ($\alpha = .90$ and $\alpha = .83$, respectively).

Pre-training planning dimension of innovative performance. To aggregate the pre-training planning dimension of innovative performance, the correlation between pre-training

penetration and pre-training forecasting was calculated (r = .64, p < .01). This moderate to strong, statistically significant correlation, along with the conceptual and empirical basis provided previously, justified aggregation of these dimensions to form the pre-training planning dimension of innovative performance. The reliability of the judge-rated penetration and forecasting dimensions was acceptable (α = .78 and α = .80, respectively).

To form the overall, pre-training measure of innovative performance, the correlation between pre-training creativity and pre-training planning was calculated (r = .65, p < .01). This moderate to strong, statistically significant correlation, along with the conceptual and empirical basis provided previously, justified aggregation of these dimensions to form the pre-training measure of innovative performance.

Post-training creativity dimension of innovative performance. To aggregate the post-training creativity dimension of innovative performance, the correlation between post-training quality and post-training originality was calculated (r = .72, p < .01). This moderately to strong, statistically significant correlation, along with the conceptual and empirical basis provided previously, justified aggregation of these dimensions to form the post-training creativity dimension of innovative performance. The reliability of the judge-rated quality and originality dimensions was acceptable (α = .90 and α = .79, respectively).

Post-training planning dimension of innovative performance. To aggregate the post-training planning dimension of innovative performance, the correlation between post-training penetration and post-training forecasting was calculated (r = .77, p < .01). This moderate to strong, statistically significant correlation, along with the conceptual and empirical basis

provided previously, justified aggregation of these dimensions to form the post-training planning dimension of innovative performance. The reliability of the judge-rated penetration and forecasting dimensions was acceptable (α = .80 and α = .89, respectively).

To form the overall, post-training measure of innovative performance, the correlation between post-training creativity and post-training planning was calculated (r = .87, p < .01). This strong, statistically significant correlation, along with the conceptual and empirical basis provided previously, justified aggregation of these dimensions to form the post-training measure of innovative performance.

Moderator Variables

Creative Personal Identity. Creative personal identity was measured with Jaussi et al.'s (2007) four-item scale. Participants indicated the extent to which they agreed or disagreed with a series of statements on a scale of 1 to 5 (1=strongly disagree to 5=strongly agree). Sample items include "In general, my creativity is an important part of my self-image," "My creativity is an important part of who I am," and "Overall, my creativity has little to do with how I see myself (reverse scored)." (α = .92)

Intrinsic Motivation. Intrinsic motivation was measured using the intrinsic motivation subscale from Amabile et al.'s (1994) *Work Preference Inventory*. Participants indicated the extent to which they agreed or disagreed with a series of four statements on a scale of 1 to 5 (1=strongly disagree to 5=strongly agree). Sample items include "I enjoy tackling problems that are completely new to me," "Curiosity is the driving force behind much of what I do," and "I enjoy simple, relatively straightforward tasks (reverse scored)." (α = .82)

Covariates

The following key variables were included as potential control variables.

Divergent Thinking Ability. Measures of divergent thinking, in general, have been demonstrated to be reliable and valid across a wide range of studies (e.g., Kim, 2008). Divergent thinking will be measured for the current study using the alternative uses test developed by Guilford and colleagues (e.g., Berger, Guilford, & Christensen, 1957). This measure of divergent thinking has garnered strong empirical support and evidence for the construct validity of this test is well-documented (e.g., Merrifield, Guilford, Christensen, & Frick, 1962). Participants were given five minutes to generate as many alternative uses for an item (i.e., a cardboard box) as possible. The responses on this divergent thinking task were scored by the study author for fluency, flexibility and originality using the established scoring procedure as outlined in the test administration manual. ($\alpha = .75$)

Intelligence and academic achievement. Intelligence and creativity have been linked in a number of theoretical and empirical efforts (e.g., Sternberg & O'Hara, 1999) and, accordingly, the effects of IQ as well as general scholastic achievement were controlled for in the current study. Three self-report indicators were used: GPA, SAT verbal, and SAT quantitative. Self-report indicators of GPA and SAT scores typically correlate from .70 to .90 with actual scores (Furcot & Cook, 1994; Goldman, Flake, & Matheson, 1990; Kuncel, Crede, & Thomas, 2005) making them reasonably reliable proxies for intelligence and scholastic achievement, particularly when used as control variables. Moreover, there is some precedence for their use

in previous studies of creative performance (e.g., Kaufman & Baer, 2003). (These were entered as separate covariates, reliabilities were therefore not calculated)

Participant gender. Given the disproportionate number of females represented in the study's overall sample (as well as sub-samples), the gender of participants was evaluated as a potential covariate. Specifically, a case summary analysis revealed that female participants represented, on average, 64% of participants per condition. As such, there was a substantial amount of skew in the number of female participants compared to male participants in each condition. Accordingly, participant gender was included as a potential covariate in the present study and retained, as necessary, in order to partial out any variance attributable to participants' gender in the dependent variables of interest.

Additional Measures

While no hypotheses or predictions were formally proposed concerning the following measures, each represents an important addition to the current study for potential inclusion in *post-hoc* analyses. Inclusion of the personality measures is based on the work of Feist (1998, 1999) and other scholars demonstrating the nature of the 'creative personality' and the potential effect of these individual differences, both individually and collectively, on creative performance.

Openness to Experience. Openness to experience was measured using a modified, three-item version of the openness to experience subscale of Costa and McCrae's (1992) NEO-PI-R. Participants indicated the extent to which they agreed or disagreed with a series of statements

on a scale of 1 to 5 (1=strongly disagree to 5=strongly agree). Sample items include “I enjoy hearing new ideas,” and “I avoid philosophical discussions (reverse scored)”. (α = .45)

Anxiety. Anxiety was measured using a modified, four-item version of the anxiety subscale of Cattell, Eber, and Tatsuoka’s (1970) Sixteen Personality Factor Questionnaire (16PF). Participants indicated the extent to which they agreed or disagreed with a series of statements on a scale of 1 to 5 (1=strongly disagree to 5=strongly agree). Sample items include “I feel threatened easily,” and “I don’t let others discourage me (reverse scored).” (α = .73)

Introversion. Introversion was measured using a modified, four-item version of the introversion subscale of Gough's (1996) California Psychological Inventory (CPI). Participants indicated the extent to which they agreed or disagreed with a series of statements on a scale of 1 to 5 (1=strongly disagree to 5=strongly agree). Sample items include “I don’t like to draw attention to myself,” and “I am the life of the party (reverse scored).” (α = .81)

Conscientiousness. Conscientiousness was measured using a modified, three-item version of the conscientiousness subscale of Costa and McCrae’s (1992) NEO-PI-R. Participants indicated the extent to which they agreed or disagreed with a series of statements on a scale of 1 to 5 (1=strongly disagree to 5=strongly agree). Sample items include “I am always prepared,” and “I do just enough work to get by (reverse scored).” (α = .61)

Agreeableness. Agreeableness was measured using a modified, four-item version of the agreeableness subscale of Jackson, Paunonen, and Tremblay’s (2000) Six-Factor Personality Questionnaire (6FPQ). Participants indicated the extent to which they agreed or disagreed with a series of statements on a scale of 1 to 5 (1=strongly disagree to 5=strongly agree). Sample

items include “I tolerate a lot from others,” and “I am annoyed by others’ mistakes (reverse scored).” (α = .54)

Independence. Independence was measured using a modified, four-item version of the independence subscale of Jackson, Paunonen, and Tremblay’s (2000) 6FPQ. Participants indicated the extent to which they agreed or disagreed with a series of statements on a scale of 1 to 5 (1=strongly disagree to 5=strongly agree). Sample items include “I don’t care what others think,” and “I need the approval of others (reverse scored).” (α = .71)

Achievement Striving. Achievement striving was measured using a modified, three-item version of the achievement striving subscale of Jackson, Paunonen, and Tremblay’s (2000) 6FPQ. Participants indicated the extent to which they agreed or disagreed with a series of statements on a scale of 1 to 5 (1=strongly disagree to 5=strongly agree). Sample items include “I do more than what’s expected of me,” and “I need a push to get started (reverse scored).” (α = .78)

Dominance. Dominance was measured using a modified, four-item version of the dominance subscale of Gough's (1996) CPI. Participants indicated the extent to which they agreed or disagreed with a series of statements on a scale of 1 to 5 (1=strongly disagree to 5=strongly agree). Sample items include “I want to control the conversation,” and “I hate to seem pushy (reverse scored).” (α = .65)

Perceived Utility of Training. Following Kirkpatrick and Kirkpatrick’s (2006) well-documented protocol for evaluating training, the current study satisfies their first level of training evaluation by assessing trainee reactions to, and perceived utility of, the training that

they receive. Several attitudinal outcomes (e.g., satisfaction, perceived utility, and suggestions for improvement) were collected. Participants indicated the extent to which they agreed or disagreed with a series of related statements on a scale from 1 to 5 (1=strongly disagree to 5=strongly agree). Sample items include "I enjoyed this training," "I found this training to be useful," "I believe that improvements could be made to this training," and "I think that this training will have an impact on the manner in which I approach and solve problems in the future." Additionally, space was provided for open-ended response commentary.

Creative Self-Efficacy. Given its conceptual relationship with creative personal identity (as previously discussed in detail), creative self-efficacy is included in the current study and was measured using Beghetto's (2006) three-item scale. Participants indicated the extent to which they agreed or disagreed with a series of statements on a scale of 1 to 5 (1=strongly disagree to 5=strongly agree). Sample items include "I am good at coming up with new ideas," and "I have a good imagination." (α = .82)

Word Count. The total number of words used in the pre and post-training responses was included as an objective variable and calculated using Microsoft Word. Word count is conceptualized in the current study as a proxy measure of related constructs to include effort, fatigue, and engagement in the task.

Procedure

The current study employed a pretest-posttest design to assess the relative impact of three different computer-based training regimens on innovative performance: full OP-CPS training (CPS), ideational skills training only (IDS), and no creativity training (control). Table 4

outlines the procedure that was used for all participants, the corresponding average time for completion of each task (rounded to the nearest whole number, as determined during pilot testing and corroborated with final sample), the software employed, and the overall completion time by training condition.

Table 4: Procedure Outline

Step	Task	Description	*Completion Time Full & Control	*Completion Time Ideational Only	Software
1	Pre-training battery	Demographics, moderator variables, covariates	12 min.	12 min.	Qualtrics
2	Pre-training task	Design a senior class gift	10 min.	10 min.	
3	Introduction to OP-CPS	Overview of stages and major concepts	3 min.	1 min.	
4	Pre-training quiz	Brief T/F quiz	2 min.	2 min.	
5	Training				
		Full OP-CPS training (CPS)	27 min.		
		Ideational skills training only (IDS)		9 min.	Articulate
		Control training (Control)	27 min.		
6	Post-training quiz	Brief T/F quiz	2 min.	2 min.	
7	Post-training task	Design the dorm room of the future	10 min.	10 min.	
8	Post-training battery	Reactions and perceived utility of training	4 min.	4 min.	Qualtrics
			Total Time		
		Full OP-CPS training	70 min.		
		Ideational skills training only		50 min.	
		Control training	70 min.		

*Average completion time determined via pilot testing and corroborated with final sample. Values rounded to nearest whole number.

As Table 4 shows, the pre and post-training data collection was done using Qualtrics online survey software. To ensure a seamless, streamlined training experience for participants, the entire study was accessible directly from the psychology department subject pool via a single hyperlink/URL. By clicking on this link, participants were immediately sent to the pre-training exercises in Qualtrics. Participants first completed the pre-training battery which included online questionnaires to obtain demographic information, the moderator variables, as well as the covariates, to include the divergent thinking exercise. The pre-training task that followed required participants to design a senior class gift for their university and, like the corresponding post-training task (see below), was designed to permit participants to engage in innovative performance. The senior gift task, and the corresponding narrative, is described in detail in the *Measures* section above.

Upon completion of the pre-training exercises, a customized feature coded into the Qualtrics program automatically sent participants to one of the three training conditions in Articulate Online via random assignment. The online training programs were all designed and created using Articulate, a highly specialized e-learning and training development software package. One of several key features of this software is the ability to include high-quality narration to accompany a given training protocol. Based on pilot testing, narrated dialogue was included in select phases of all three training programs based on evidence from pilot testing that doing so increased trainee attention, interaction, satisfaction, and enjoyment of the training. The training programs themselves were housed on Articulate Online servers, and a unique URL was assigned to each training regimen for access via the Internet.

Table 5 presents the content of the three online training programs in greater detail, to include the maximum amount of time allowed for completing each stage and the overall training regimens.

Table 5: Training Content and Maximum Time Allotment by Stage for Each Condition

	Training Condition			
	CPS	IDS		MLP (Control)
***OP-CPS Competencies**			****MLP Styles**	
Identify Goal or Challenge	5 min.		Country Club	5 min.
Gather Data	5 min.		Team	5 min.
Clarify the Problem	5 min.		Middle-of-Road	5 min.
Generate Ideas	5 min.	5 min.	Impoverished	5 min.
Select & Strengthen Solutions	5 min.	5 min.	Produce or Perish	5 min.
Plan for Action	5 min.		Style Review	5 min.
Total Maximum Training Time	30 min.	10 min.		30 min.

CPS =Full OP-CPS training, IDS = Ideational skills training only, MLP = Managerial Leadership
*Miller et al. (2001, 2002) Competencies
**Blake and Mouton (1964, 1985)

After a brief introduction to the stages and core concepts of their respective training program, participants were given a short quiz consisting of four true/false questions related to the introductory information presented. Quiz feedback and scores were provided, however all participants were permitted to proceed regardless of quiz score. After completing the pre-training quiz, participants in the experimental conditions were shown the narrative from the pre-training task (i.e., the senior gift task) again and informed that this same exercise would provide the framework for training in the OP-CPS process in that all subsequent responses would be based on this same task, but using the OP-CPS method. In this way, the same task that was used as a pre-training measure of innovative performance was now being used as the

guideline for systematic training in the OP-CPS process. Given participant's immediate familiarity with this exercise, it was assumed that approaching the same task, but in a manner consistent with the OP-CPS method as opposed to their default approach, would provide a stronger mental map for learning and later applying the OP-CPS system. Participants were then guided through either full OP-CPS process training (i.e., all six stages) or OP-CPS ideational skills training only (i.e., stages four and five only).

Miller et al.'s (2001, 2002) competency-based version of the OP-CPS was used as the theoretical and conceptual basis for the two experimental conditions, and participants were given a maximum of five minutes to complete the divergent and convergent thinking exercises for each stage trained (see Table 2 for a review of the OP-Stages). As noted, participants were permitted to move ahead to the next stage before the maximum time was reached, in an effort to provide some user control and flexibility. It should also be noted that, consistent with the OP-CPS process, participants were able to view previous stages at any time and could review their responses to the divergent to the convergent steps for each stage at will. While the proposed training will follow the OP-CPS steps in a traditional, linear fashion, it is recognized that innovation itself is an iterative, dynamic process and that activities at each stage can impact activities at the others (Hunter, Cassidy, & Ligon, in press).

Participants in the control condition did not receive training in the OP-CPS process (see Table 5). Instead, training in Blake and Mouton's (1964, 1985; McKee & Carlson, 1999) Managerial Leadership Program (MLP) was undertaken. The MLP is a behavioral leadership model that was introduced by Blake and Mouton in the 1960's. This model originally identified

five different leadership styles based on the *concern for people* and the *concern for production*. Each of the five leadership styles (country club, team, middle-of-the-road, impoverished, and produce or perish) was represented on a two-dimensional "leadership grid," with the *concern for production* and *the concern for people* on the "X" and "Y" axes, respectively. The "grid theory," as it is often referred to, has continued to evolve and develop in recent years (e.g., McKee & Carlson, 1999). This theory represents a particularly useful and appropriate framework for control content due to the "face validity" (i.e., after having completed the senior gift task) and the ability to effectively "map" the leadership styles onto the CPS stages (see Table 5).

Participants in the control condition were provided with a brief narrative on how the various MLP leadership styles often manifest in "real life," and were informed that the framework for training in the MLP program would be based on their subsequent responses to personal accounts of each style. For each style, participants were asked to 1) provide examples of that particular style from their own experiences, and 2) discuss their reactions to this style and its relative effectiveness. In this way, each style had a two-part response, which mirrored the divergent and convergent steps of the OP-CPS process. With the exception of the actual training content, this condition was as identical as possible to the full experimental training program in all aspects under the author's control to include (but not limited to) the use of a two-part scheme for each stage/style, the total number of stages/styles trained, time, user-control, aesthetics, and visual stimuli and transitions. Screen shots of the computer-based training programs are included in Appendix C.

After completing one of the three training regimens participants completed the post-training quiz which was identical to the first quiz, with the exception of one question for which the correct answer was reversed from the pre-training quiz. After post-training quiz participants were provided with a training "shape" and "color" which was used to verify their respective study condition and, by clicking on a hyperlink common to all training conditions, were automatically sent back to Qualtrics to complete the post-training exercises. Once in Qualtrics, participants were asked to provide their training "shape" and "color" to identify (and verify) their training condition. Participants then completed the post-training task which required participants to design the dorm room of the future. Both the pre and post-training tasks were designed to permit participants to engage in innovative performance. These tasks, and the corresponding narratives, are described in detail in the *Measures* section above. Both tasks, while distinct in terms of content, are related (and thus comparable) in terms of the fundamental requirement in that all study participants are asked to design something novel and useful that can be evaluated using the four innovative performance criteria (i.e., quality, originality, penetration, forecasting) and evidence for their validity and comparability has been demonstrated (e.g., Hunter, personal communication, 2011). Participants finished the study by completing the post-training battery, which consisted of reactions to the training among other study-related questions (see Appendix A).

Regarding study completion time (See Tables 4 and 5), several things should be noted. The time for some tasks was held constant, such that participants were not given the flexibility to move forward until the allotted time had expired. While there are drawbacks to this approach, it was decided that, for certain tasks, time should be controlled across participants to

increase the likelihood of capturing more complete data. Conversely, it was decided that permitting participants control to proceed at will would likely result in less complete data. The tasks for which time was controlled included: the divergent thinking exercise (five minutes), the pre and post-training exercises (both ten minutes), and the overview of the CPS stages (three minutes for full and control conditions and 1 minute for the ideational skills training only condition). Time was not controlled for in any of the other tasks, and participants were allowed to progress as each task or section was completed. The time difference, 70 minutes for both the full and control conditions and 50 minutes for the ideational skills training only condition, was driven by the differential number of stages trained for in each condition (see below for detailed descriptions). The maximum amount of time provided to complete the training exercises was thirty minutes for the full CPS and control conditions and ten minutes for the IDS condition (see Table 5). However, participants used varying degrees of the maximum allotted time to complete the training exercises and therefore the actual, average completion time for each training condition is less than the maximum permitted time (see Table 4).

It should be reiterated (see *Participants* section) that the procedures and study parameters, as outlined above, were identical for both lab and non-lab samples.

Analyses

Two sets of analyses are presented: the first set addresses the proposed hypotheses (to include differences in outcomes at the facet and dimension levels of innovative performance as well as by training environment), while the second set includes *post-hoc* analyses related to personality constructs as well as trainee reactions and perceived utility of training. Given that

the fundamental aim of the current study was to test the relative effectiveness of online OP-CPS training for enhancing innovative performance, the effects of training type were first tested by conducting a univariate analysis of covariance (ANCOVA) test. Follow-up pairwise comparisons were used, as necessary, to identify specific mean differences. While there were moderate to strong statistically significant correlations among all facet and dimension level measures for both pre and post training (.22 - .89), each was examined separately in addition to being tested in aggregate form. Support for the related, but distinct nature of these dimensions has been demonstrated in the literature (e.g., Bessemer & O'Quin, 1999; Osburn & Mumford, 2006). To address the additional influence of training environment at the facet and dimension levels, in addition to overall innovative performance, a repeated-measures multivariate analysis of covariance (MANCOVA) was conducted. This procedure, known as a *doubly-multivariate profile analysis* (Tabachnick & Fidell, 2007), allows for the control of error variance in the repeated-measures dependent variables attributable to any or all of the predetermined covariates. Univariate analysis of covariance tests (ANCOVAs) and follow-up pairwise comparison tests were also examined for each dependent variable to identify where specific mean differences existed.

Moderated, hierarchical multiple regression, following the Aiken and West (1991) procedures, was used to test for the hypothesized moderation and interaction effects. This approach for testing moderation was chosen to capitalize on the variance from the continuous moderators rather than dichotomizing (or trichotomizing) them as is done when using the multivariate analysis approach to testing moderation. Given the controversy surrounding difference scores, pre-training variables were included as covariates in all regression analyses

testing for the corresponding post-training effect to control for their relative effect(s) (Gully, 1994). Training type was dummy-coded, using the control condition as the reference group. Training environment was not dummy-coded, given that it was already dichotomous. Following the Aiken and West (1991) procedure, all continuous moderators were mean centered prior to moderation analysis to help eliminate issues with multicollinearity. Dummy coded IVs not centered but continuous moderators were centered prior to creating interaction terms. Dependent variables were not centered.

It should be noted that none of the statistical assumptions of these tests (e.g., homogeneity, sphericity, multicollinearity) were violated. All covariates were examined using the correlation matrices, as well as backwards stepwise deletion, and covariates were retained for each set of analyses if significant beyond $p \leq .10$ and/or were conceptually appropriate to include, in order to maximize degrees of freedom. Retained covariates can be found in Tables 6 - 17.

Chapter 3

Results

Descriptive Statistics and Correlations

Descriptive statistics and correlations are summarized in Tables 6 – 9. Table 6 provides the mean, standard deviations, and intercorrelations between the covariates, demographic variables, and the pre and post-training measures. Table 7 summarizes the descriptive statistics and correlations among the study variables and dimension level outcomes. Table 8 summarizes the descriptive statistics and correlations among the study variables and facet level outcomes, to include objective measures of word count. Table 9 summarizes the same information as Table 8, but for the lab sample only (so training environment is excluded from the table).

Table 6: Means, Standard Deviations, and Intercorrelations Between Demographic Variables, Divergent thinking, and Pre/Post Measures

	Mean	*SD*	1	2	3	4	5	6	7	8	9	10	11	12
1. Age	19.78	1.57	1											
2. GPA	3.22	0.49	-.06	1										
3. Math Sat	618.62	93.43	-.05	.20**	1									
4. Verbal SAT	603.88	90.03	.01	.18**	.45**	1								
5. Gender	NA	NA	-.04	.01	-.20**	.02	1							
6. Divergent Thinking	2.50	1.00	.00	-.01	.04	.02	-.03	1						
7. Pre Training Creativity	3.10	.80	.02	-.05	-.04	.00	-.06	.27**	1					
8. Pre Training Planning	2.72	.75	-.06	.01	-.06	.04	.05	.23**	.65**	1				
9. Pre Training Innovative Performance	2.91	.70	-.02	-.03	-.06	.02	.00	.28**	.92**	.90**	1			
10. Post Training Creativity	2.84	.80	-.12*	.11*	-.01	.09	-.02	.19**	.47**	.51**	.54**	1		
11.Post Training Planning	2.87	.88	-.13*	.10	-.05	.02	-.01	.20**	.48**	.53**	.55**	.87**	1	
12. Post Training Innovative Performance	2.85	.81	-.13*	.11*	-.03	.06	-.02	.20**	.49**	.54**	.57**	.96**	.97**	1

*p < .05, **p < .01

Table 7: Means, Standard Deviations, and Intercorrelations Among Study Variables and Dimension Level Outcomes[1]

	Mean	*SD*	1	2	3	4	5	6	7	8	9	10	11	12
1.Full CPS	.32	.47	1											
2.Ideational Skills Only	.34	.48	-.50**	1										
3. Control	.33	.47	-.49**	-.51**	1									
4. Training Environment	.52	.50	.02	-.01	-.01	1								
5. Creative Personal Identity	3.73	.90	.05	-.02	-.03	.09	1							
6.Intrinsic Motivation	3.50	.79	.04	-.02	-.02	-.02	.30**	1						
7.Pre Training Creativity	3.10	.80	-.03	-.02	.05	.25**	.13**	.08	1					
8.Pre Training Planning	2.72	.75	.04	-.02	-.02	.26**	.07	.00	.65**	1				
9.Pre Training Innovative Performance	2.91	.70	.00	-.02	.02	.28**	.11*	.04	.92**	.90**	1			
10. Post Training Creativity	2.84	.80	-.06	.05	.01	.33**	.09	.08	.48**	.51**	.54**	1		
11. Post Training Planning	2.87	.88	-.07	.09	-.02	.34**	.07	.05	.48**	.53**	.55**	.87**	1	
12. Post Training Innovative Performance	2.85	.81	-.07	.07	.00	.35**	.08	.07	.49**	.54**	.57**	.96**	.97**	1

*p < .05, **p < .01

[1]Note: All categorical variables (variables 1 – 4) dummy coded (Training Environment: 0 = outside of lab, 1 = in lab)

Table 8: Means, Standard Deviations, and Intercorrelations Among Study Variables, Facet Level Variables and Objective Variables[1]

	Mean	*SD*	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Full CPS	.32	.47	1														
2. Ideational Skills Only	.34	.48	-.50**	1													
3. Training Environment	.52	.50	.02	-.01	1												
4. Creative Personal Identity	3.73	.90	.05	-.02	.09	1											
5. Intrinsic Motivation	3.50	.76	.04	-.02	-.02	.30**	1										
6. Pre Training Quality	3.50	.91	.02	-.04	.30**	.06	.00	1									
7. Pre Training Originality	2.72	1.01	-.06	.00	.13*	.15**	.13*	.39**	1								
8. Pre Training Penetration	2.52	.81	.04	-.00	.23**	.06	.03	.63**	.20**	1							
9. Pre Training Forecasting	2.92	.84	.04	-.03	.23**	.07	-.03	.78**	.40**	.64**	1						
10. Pre Training Word Count[2]	168.83	80.26	.02	-.00	.30**	.13*	.04	.76**	.35**	.67**	.72**	1					
11. Post Training Quality	3.19	.89	-.05	.05	.33**	.06	.05	.58**	.25**	.38**	.55**	.54**	1				
12. Post Training Originality	2.48	.83	-.06	.04	.28**	.12*	.10*	.45**	.22**	.33**	.43**	.43**	.72**	1			
13. Post Training Penetration	2.58	.82	-.10*	.09	.27**	.05	.04	.50**	.22**	.38**	.52**	.52**	.79**	.60**	1		
14. Post Training Forecasting	3.15	1.05	-.04	.07	.36**	.07	.05	.56**	.25**	.38**	.53**	.55**	.89**	.73**	.76**	1	
15. Post Training Word Count[2]	177.32	88.90	-.10*	.12*	.38**	.11*	.08	.56**	.28**	.41**	.53**	.66**	.87**	.70**	.78**	.89**	1

*p < .05, **p < .01

[1]Note: All categorical variables (variables 1 – 4) dummy coded (Training Environment: 0 = outside of lab, 1 = in lab)

[2]Unstandardized values presented. Standardized values were used in analyses for interpretation.

Table 9: Means, Standard Deviations, and Intercorrelations Among Study Variables, Facet Level Variables, and Objective Variables for Lab Sample Only[1]

	Mean	*SD*	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. Full CPS	.33	.47	1													
2. Ideational Skills Only	.34	.47	-.50**	1												
3. Creative Personal Identity	3.81	.88	.05	-.04	1											
4. Intrinsic Motivation	3.48	.78	.10	-.07	.30**	1										
5. Pre Training Quality	3.74	.81	.04	.02	.02	-.03	1									
6. Pre Training Originality	2.84	.93	-.07	.03	.17*	.15*	.27**	1								
7. Pre Training Penetration	2.70	.84	.12	.04	-.01	.03	.57**	.09	1							
8. Pre Training Forecasting	3.11	.80	.11	-.03	.03	-.08	.76**	.33**	.61**	1						
9. Pre Training Word Count[2]	192.20	80.19	.08	.01	.10	.04	.74**	.19**	.65**	.66**	1					
10. Post Training Quality	3.50	.75	-.07	.07	.06	-.05	.44**	.08	.29**	.44**	.40**	1				
11. Post Training Originality	2.70	.78	-.12	.07	.17*	.08	.26**	.19**	.21**	.31**	.26**	.56**	1			
12. Post Training Penetration	2.80	.75	-.09	.11	.07	-.05	.42**	.10	.33**	.43**	.40**	.69**	.43**	1		
13. Post Training Forecasting	3.51	.89	-.05	.09	.11	.00	.44**	.13	.30**	.41**	.43**	.82**	.62**	.64**	1	
14. Post Training Word Count[2]	210.48	80.90	-.11	.17*	.14*	.05	.47**	.15*	.37**	.43**	.60**	.79**	.57**	.67**	.81**	1

*p < .05, **p < .01

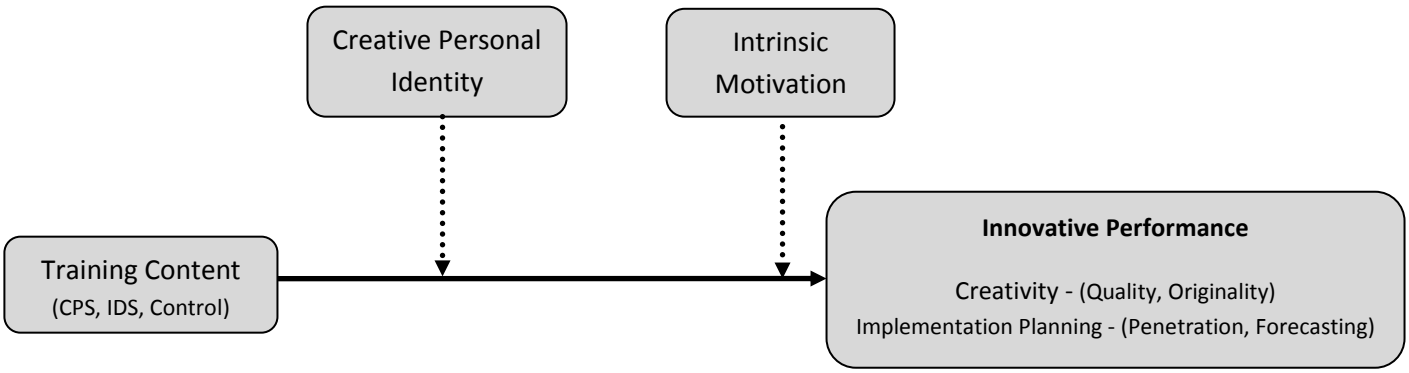
[1]Note: All categorical variables (variables 1 – 4) dummy coded (Training Environment: 0 = outside of lab, 1 = in lab)

[2]Unstandardized values presented. Standardized values were used in analyses for interpretation.

Tests of Hypotheses

The following results address the proposed hypotheses and the relationships tested are demonstrated in the conceptual model presented in Figure 1.

Figure 1. Conceptual model showing relationships to be tested.



It should be noted that, while no formal predictions regarding training environment were proposed, the relative impact of training environment is included in the discussion of hypotheses below. Hypotheses 1 – 2 address the relative effects of both experimental conditions on overall innovative performance and word count, hypotheses 3 and 4 address the relative effects of the experimental conditions on both the facet and dimension levels of innovative performance as well as word count, and hypotheses 5 – 7 address the moderating effects of creative personal identity and intrinsic motivation.

Hypothesis 1 – CPS Training and Innovative Performance

Hypothesis 1 predicted that Full OP-CPS training (full CPS) would demonstrate a stronger positive relationship with innovative performance than would IDS only or control training. Results of a two-way, repeated measures ANCOVA revealed a marginally significant main effect

for OP-CPS training on innovative performance, $F(2, 380) = 2.28$, $p < .10$, partial η2 = .01, controlling for age, GPA, and divergent thinking (see Table 10).

Table 10: Repeated Measures Analysis of Covariance for Training Type

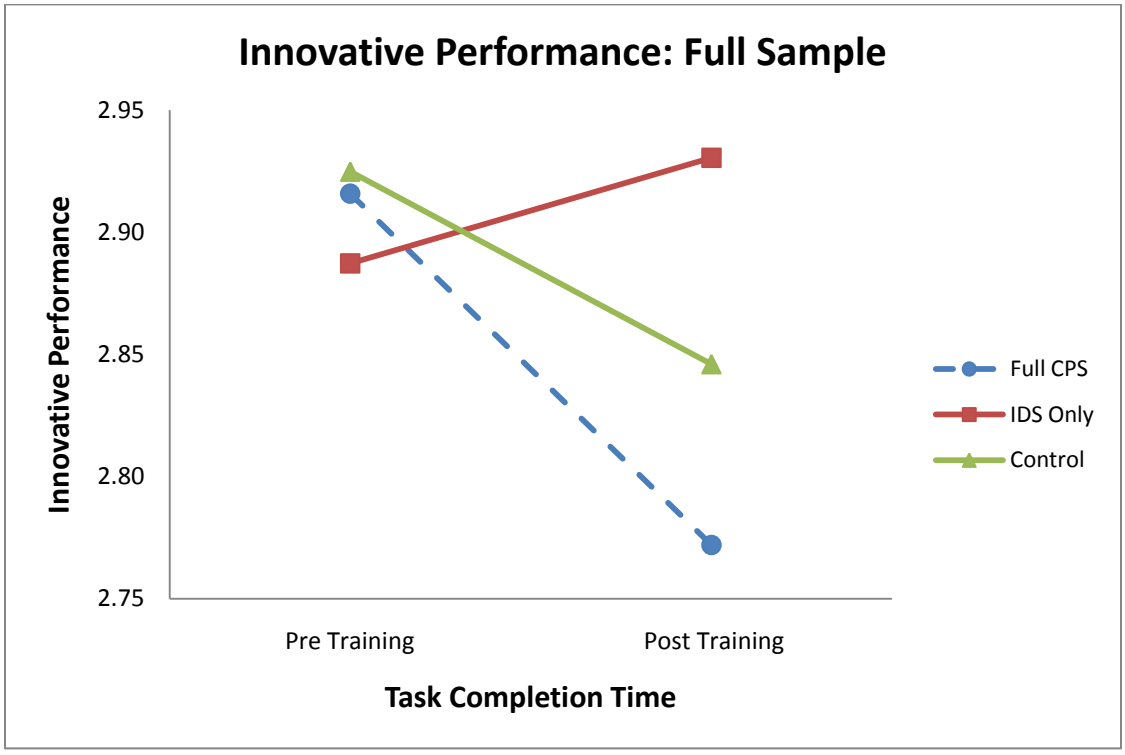
	F	*df*	*p*	*η2*
Intercept	35.99	1	.00	.09
Between Subject Effects				
Age	2.94	1	.09	.01
GPA	.98	1	.32	.00
Divergent Thinking	29.37	1	.00	.07
Training Type	.32	2	.73	.00
Within Subject Effects				
Task	.40	1	.53	.00
Age * Task	4.77	1	.03	.01
GPA * Task	7.83	1	.01	.02
Divergent Thinking * Task	.66	1	.42	.00
Training Type * Task	2.28	2	.10	.01

Note: F = F-ratio, *df* = degrees of freedom, *p* = significance level, η^2 = partial eta squared (effect size), outcome variable = innovative performance

Follow-up pairwise comparisons did not reveal any statistically significant differences between training conditions. However, as Figure 2 demonstrates, there was a distinct negative trend for the full CPS training condition, whereby innovative performance decreased from pre CPS ($M = 2.92$, $SD = .70$) to post CPS ($M = 2.77$, $SD = .19$) training. Conversely, a clear *positive* trend for the ideational skills training only (IDS) condition emerged whereby innovative

performance increased from pre IDS (*M* = 2.89, *SD* = .78) to post IDS (*M* = 2.93 , *SD* = .83) training. Based on this evidence, Hypothesis 1 was not supported.

Figure 2. Estimated marginal means of innovative performance by training type for full sample.



The same analysis, however, revealed a highly significant main effect for training environment on innovative performance, $F(1, 377) = 6.88$, $p < .001$, partial $\eta 2 = .02$ (see Table 11).

Table 11: Repeated Measures Analysis of Covariance for Training Environment

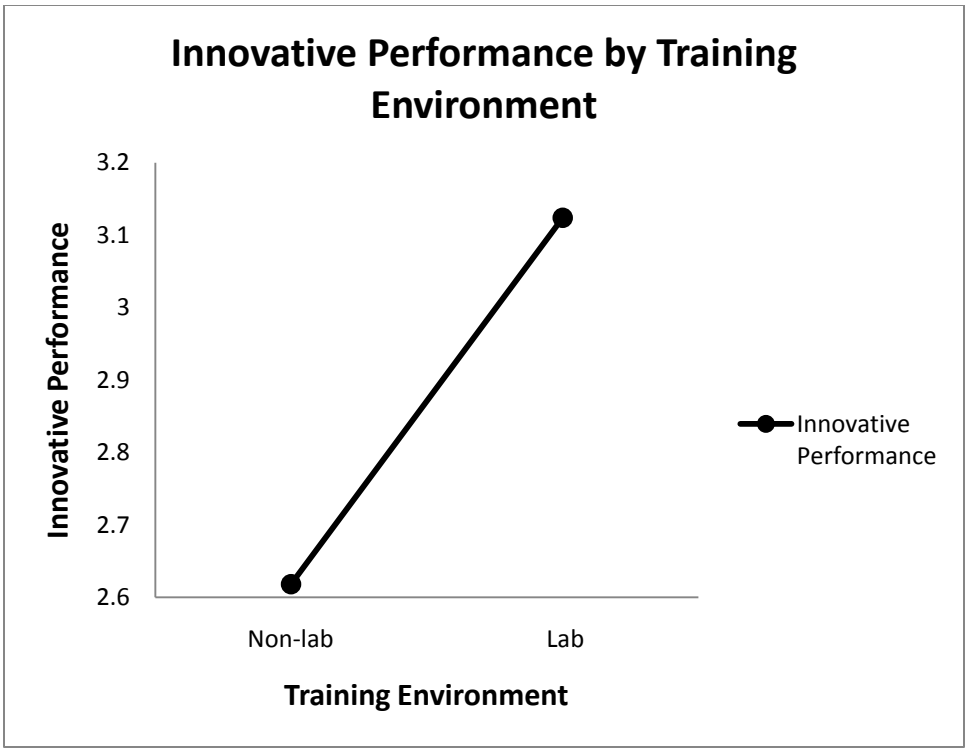
	F	*df*	*p*	*η2*
Intercept	16.61	1	.00	.04
Between Subject Effects				
Age	.01	1	.93	.00

GPA	6.58	1	.01	.02
Divergent Thinking	33.93	1	.00	.08
Training Environment	67.71	1	.00	.14
Within Subject Effects				
Task	.02	1	.88	.00
Age * Task	2.32	1	.13	.01
GPA * Task	10.91	1	.00	.03
Divergent Thinking * Task	.64	1	.43	.00
Training Environment * Task	6.88	1	.00	.02

Note: F = F-ratio, *df* = degrees of freedom, *p* = significance level, η^2 = partial eta squared (effect size), outcome variable = innovative performance

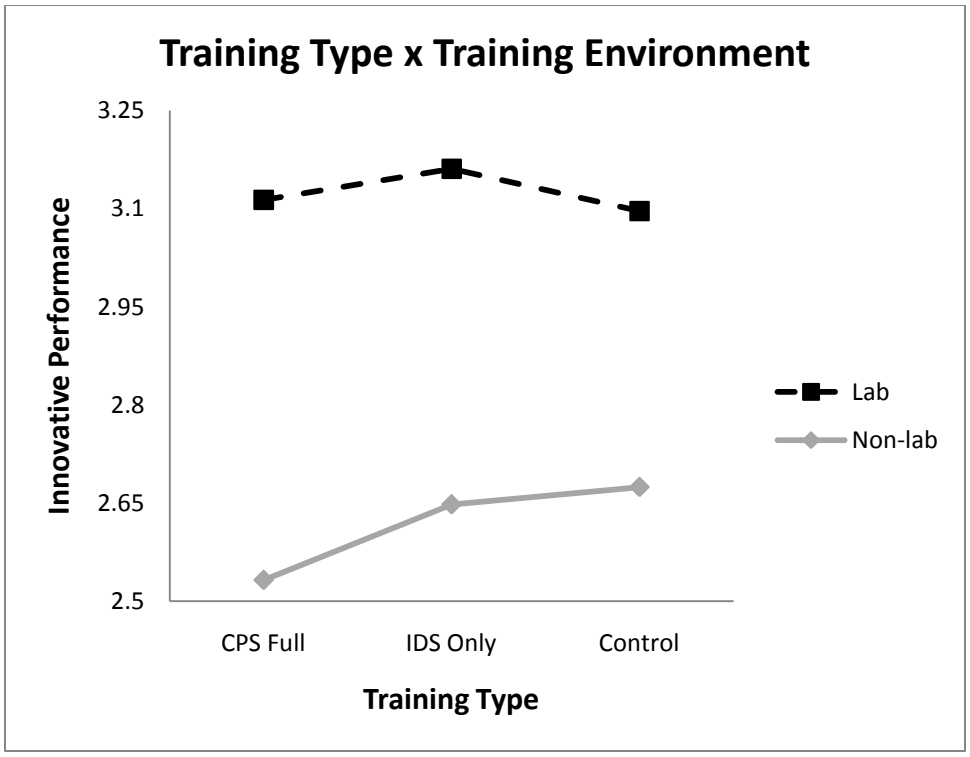
More specifically, innovative performance was significantly higher for the lab (*M* = 3.12, *SE* = .04) sample than the non-lab (*M* = 2.62, *SE* = .05) sample (see Figure 3).

Figure 3. Estimated marginal means of innovative performance by training environment for full sample.



The ANCOVA results for the interaction between training type and training environment failed to reach the $p < .10$ threshold, $F(2, 377) = 1.67$, $p = .19$, partial $\eta 2 = .01$, controlling for age, GPA, and divergent thinking. However, this result is demonstrated in Figure 4 to highlight the general trend of differences in aggregate innovative performance by training environment as opposed to by training type.

Figure 4. Estimated marginal means of innovative performance for training type x training environment interaction for full sample.



Hypothesis 2 – IDS Training and Innovative Performance

Hypothesis 2 predicted that IDS only training would demonstrate a stronger positive relationship with innovative performance than would the training control. As noted above, ANCOVA analysis revealed a marginally significant main effect for OP-CPS training, overall, on innovative performance, $F(2, 380) = 2.28$, $p < .10$, partial $\eta 2 = .01$, controlling for age, GPA, and divergent thinking (see Table 10). However, while follow-up pairwise comparisons did not reveal any statistically significant differences between training conditions, Figure 2 illustrates the distinct positive trend for the ideational skills training only (IDS) condition that emerged, whereby innovative performance increased from pre IDS ($M = 2.89$, $SD = .78$) to post IDS ($M = 2.93$, $SD = .83$) training, whereas innovative performance *decreased* for the control condition from pre control ($M = 2.92$, $SD = .63$) to post control training ($M = 2.84$, $SD = .82$).

This trend is also apparent when the previous finding that innovative performance differed by training environment is revisited (see Figures 3 and 4). As Figures 5 and 6 demonstrate, despite marginal significance of the overall interactive effect between training type and training environment, a general positive trend for the IDS only condition across training environments is evident, as compared to the full CPS and control conditions.

Figure 5. Estimated marginal means of innovative performance by training type for non-lab sample.

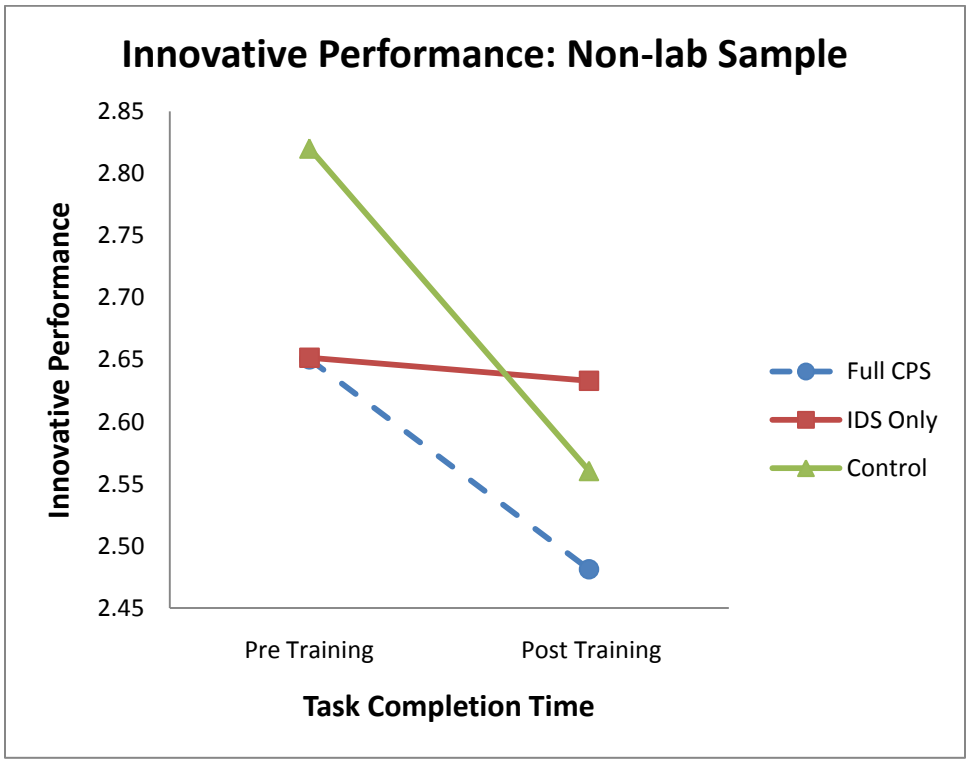
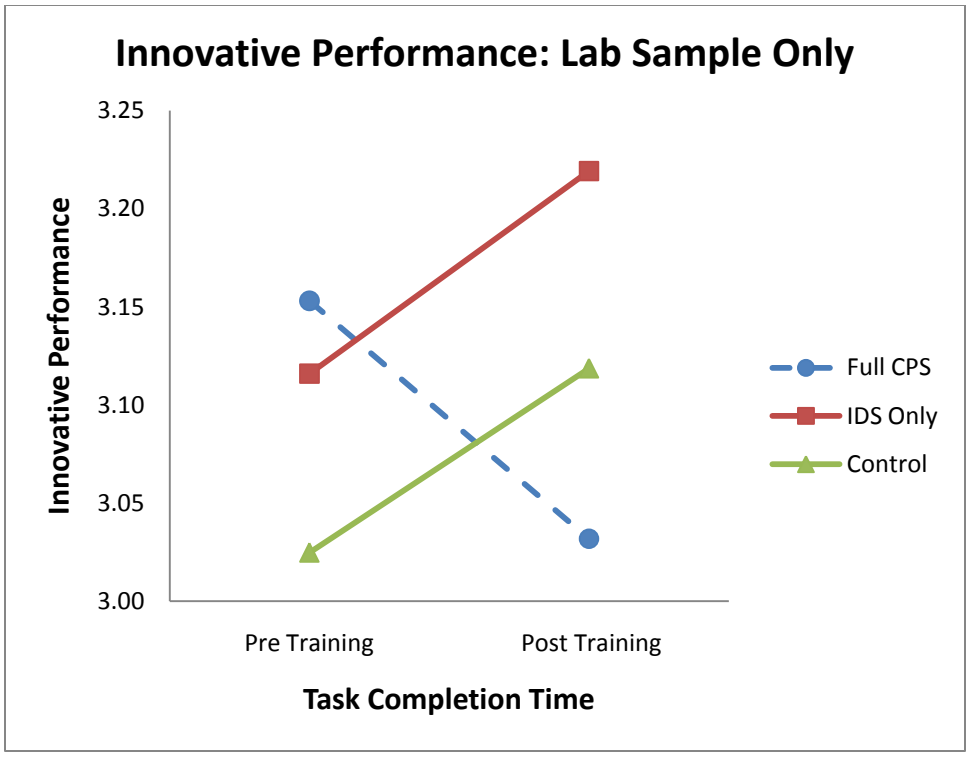


Figure 6. Estimated marginal means of innovative performance by training type for lab sample.



More specifically, in the non-lab sample, innovative performance in the IDS only condition remained relatively constant before (*M* = 2.66, *SE* = .08) and after (*M* = 2.64, *SE* =.09) training, while the OP-CPS and control conditions performance decreased (see Figure 5). In the lab sample, innovative performance in the IDS only condition increased from before (*M* = 3.12, *SE* = .08) to after (M = 3.21, SE =.09) training, as did innovative performance in the control condition (from *M* = 3.03, *SE* = .08 to *M* = 3.16, *SE* =.09) (see Figure 6). However, the overall innovative performance for the IDS only condition was higher. Based on the evidence provided, hypothesis 2 was supported, given the clear positive trend for the effectiveness of the IDS only condition on overall innovative performance, particularly in the lab sample.

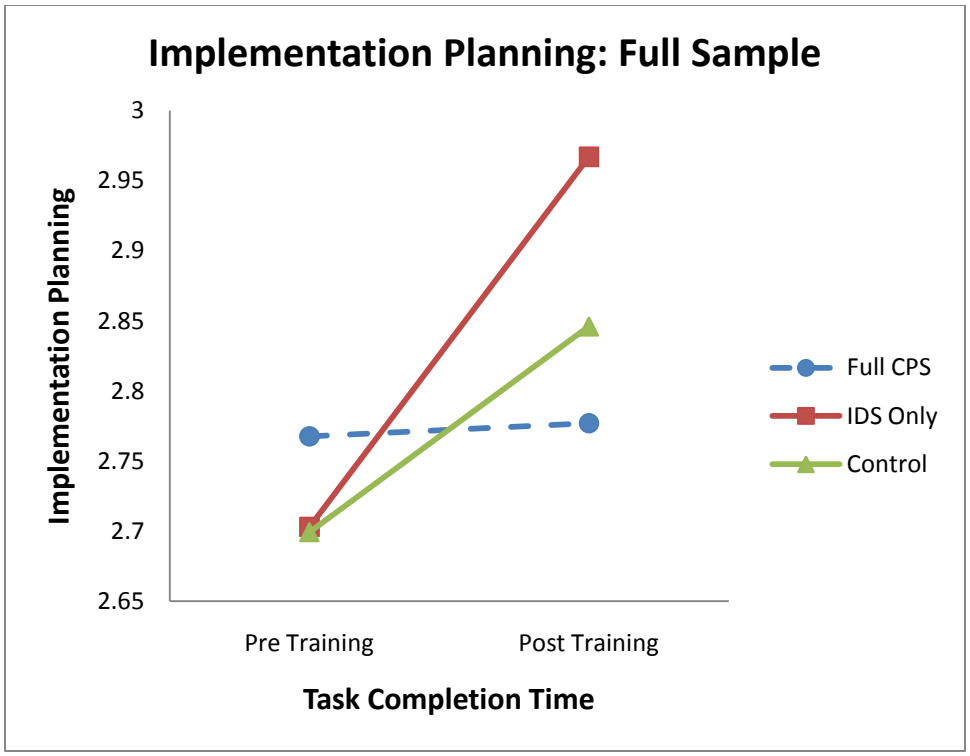
Additionally, a hierarchical multiple regression analysis was conducted to examine the effects of training type on the objective variable, post training word count. This analysis controlled for age, GPA, divergent thinking, and pre-training word count. Rather than

controlling for training environment, separate analyses were run for the lab and non-lab samples. The analyses revealed a significant positive relationship between the IDS only condition and post training word count for the lab sample (β = .26, t = 2.01, p < .05). Neither of the other two experimental conditions was found to have an effect on post training word count, regardless of training environment. Based on evidence presented, hypothesis 2 was supported.

Hypothesis 3 – Implementation Planning

Hypothesis 3 predicted that full OP-CPS training would demonstrate a stronger relationship with the implementation planning dimension of innovative performance than will the IDS only training or control training. Results from the ANCOVA for the full sample revealed a significant main effect for training type on the planning dimension of innovative performance, $F(2, 381) = 3.31$, $p < .05$, partial $\eta 2 = .02$, controlling for age, divergent thinking, and training type. Follow-up pairwise comparisons, however, did not reveal any statistically significant differences between training conditions for planning implementation. However, as Figure 7 demonstrates, there was a distinct positive trend for the ideational skills training only (IDS) condition, whereby innovative performance increased from pre IDS (M = 2.70, SE = .06) to post IDS (M = 2.97, SE = .08) training.

Figure 7. Estimated marginal means of implementation planning by training type for full sample.



Results from the same analysis using the in-lab sample only (and not controlling for training environment) revealed a significant main effect for training type on the planning dimension of innovative performance, $F(2, 380) = 3.89$, $p < .05$, partial $\eta 2 = .04$, controlling for age, GPA, and divergent thinking. When plotted, the relationships among the different training types were nearly identical for the lab sample including a clear, positive trend for the ideational skills training only condition.

To test for the effects of training type and training environment at the facet level of implementation planning (i.e., penetration and forecasting), a repeated measures MANCOVA was conducted. Results of this analysis revealed a highly significant multivariate main effect for training environment, Wilks' $\lambda = .95$, $F(4, 374) = 5.37$, $p<.001$, but no significant main effect for training type or interaction effects between training type and training environment. Regarding

penetration, there was a clear positive trend for the ideational skills training only (IDS) condition, whereby penetration increased from pre IDS training to post IDS training for both the lab (M_{diff} = .15, *SE* = .09) and non-lab (M_{diff} = .17, *SE* = .09) samples. Penetration decreased from pre CPS training to post training in the full CPS condition for both the lab and non-lab samples, and conflicting results for the control condition emerged such that penetration increased in the lab sample, but showed a modest decline in the non-lab sample. Regarding forecasting, a similar positive trend for the ideational skills training only (IDS) condition emerged, whereby forecasting increased from pre IDS training to post IDS training for both the lab (M_{diff} = .55, *SE* = .10) and non-lab (M_{diff} = .17, *SE* = .10) samples. Forecasting for both the CPS and control conditions increased from pre training to post training in the lab sample and slightly decreased for the non-lab samples. Figures 8 and 9 present the estimated marginal means for penetration and forecasting by training condition for the non-lab samples, respectively. Hypothesis 3, as stated, was not supported but a clear positive trend for the effectiveness of the IDS only condition on the penetration and forecasting facets of planning implementation should be noted.

Figure 8. Estimated marginal means of penetration by training type for non-lab sample.

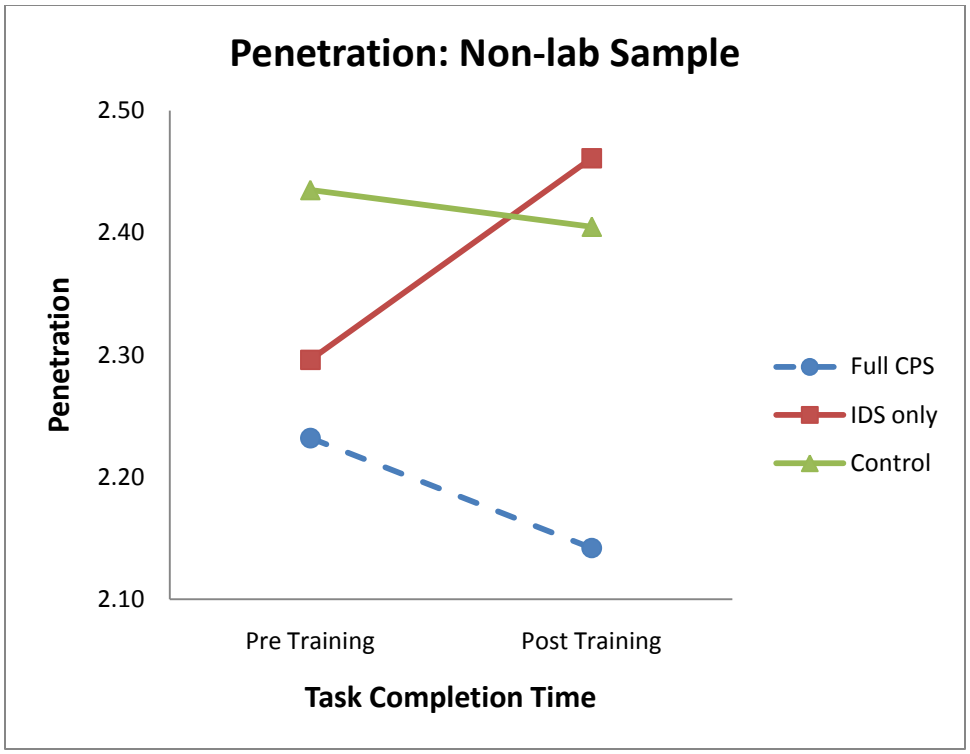
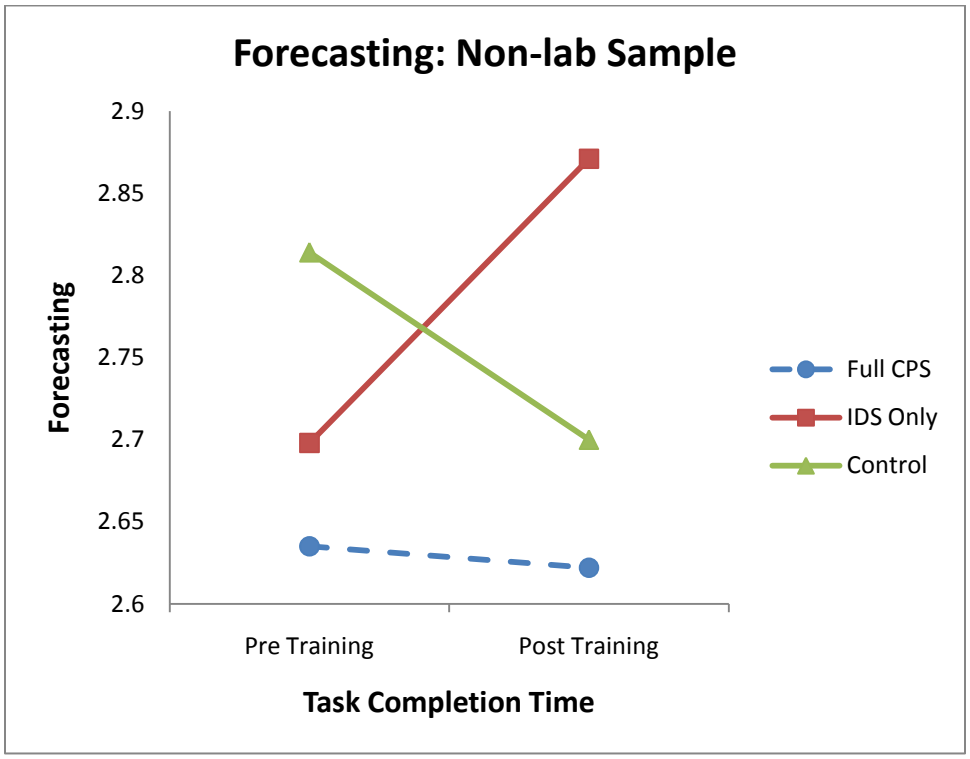


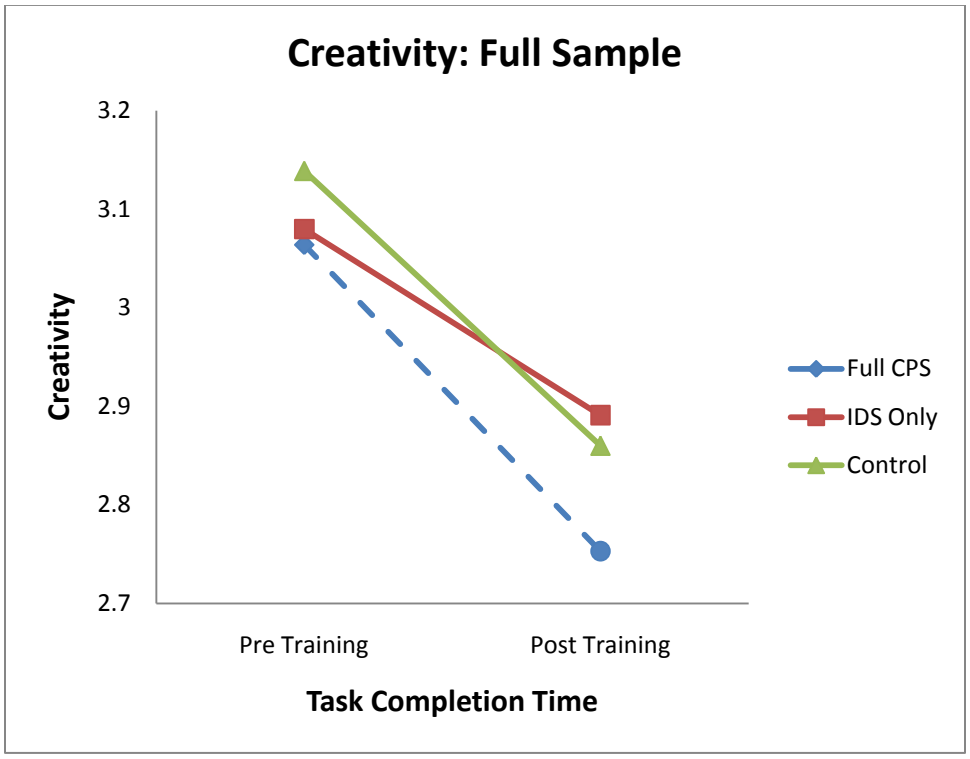
Figure 9. Estimated marginal means of forecasting by training type for non-lab sample.



Hypothesis 4 - Creativity

Hypothesis 4 predicted that OP-CPS training and partial OP-CPS training would demonstrate similar relationships with the creativity dimension of innovative performance. Results from the ANCOVA for the full sample did not reveal a significant main effect for training type on the creativity dimension of innovative performance, $F(2, 381) = .76$, $p = .47$, partial $\eta 2 = .00$, controlling for age, divergent thinking, and training environment. As Figure 10 demonstrates, there was a negative trend for all training types, whereby creativity decreased from pre training to post training, regardless of training content.

Figure 10. Estimated marginal means of creativity by training type for full sample.



Results from the same analysis using the in-lab sample only (and not controlling for training environment) also failed to reveal a significant main effect for training environment on

the creativity dimension of innovative performance, $F(2, 380) = .63$, $p = .54$, partial $\eta 2 = .00$, controlling for age, GPA, and divergent thinking. When plotted, the relationships among the different training types were nearly identical for both the lab and non-lab samples lab sample as both evidenced a clear negative trend from pre to post training.

To test for the effects of training type and training environment at the facet level of creativity (i.e., quality and originality), a repeated measures MANCOVA was conducted. Results of this analysis failed to reveal significant effects for training type or training environment. For both quality and originality, there was a general negative trend across training types and training environments from pre to post training, and there was no statistically significant difference between the full CPS and IDS only training conditions for creativity. Based on this evidence, Hypothesis 4 was supported given that no differences were found between the full CPS and IDS only training conditions.

Hypothesis 5 - Creative Personal Identity

Hypothesis 5 predicted that creative personal identity would moderate the relationship between training and innovative performance, such that the relationship would be higher for trainees low in creative personal identity (CPI), regardless of training condition (i.e., both CPS and IDS). Age, GPA, divergent thinking, and pre-training innovative performance were entered as the covariates in step 1, the training conditions and creative personal identity were entered in step 2, and the cross-product terms were entered in step 3. The results are summarized in Table 12.

Table 12: Interaction Between Training Content and Creative Personal Identity on Innovative Performance (Covariates Included)[1]

Variable	*b*	*SE B*	β	*t*	R^2	ΔR^2	*ΔF(dfs)*	*Sig. ΔF*
Step 1								
Age	-.06	.02	-.11	-2.57*				
GPA	.19	.07	.11	2.76**				
Divergent Thinking	.04	.04	.05	1.17				
Pre-training innovative performance	.64	.05	.55	12.80***	.35	.35	50.66 (4, 381)	.000
Step 2								
CPS	-.19	.08	-.06	-1.14				
IDS	.08	.08	.05	1.03				
CPI	.03	.04	.03	0.77	.36	.01	1.73 (3, 378)	.16
Step 3								
IDS X CPI	.08	.09	.06	0.90				
CPS X CPI	**.02**	**.10**	**.01**	**0.25**	**.36**	**.00**	**.43 (2, 376)**	**.65**

[1]N = 386. Values in bold are relevant to tests of hypotheses.

*p < .05. **p< .01. ***p < .001

CPS = Full CPS, IDS = Ideational skills training only, CPI = Creative Personal Identity

The interaction terms for both the full CPS and IDS only training conditions with creative personal identity did not produce a significant change in *R* in the prediction of post-training innovative performance, as *R* did not increase, and the change in the incremental F test was non-significant ($p = .65$). It should be noted that the incremental F test used with R^2 change (*Sig. ΔF*) is considered by most scholars to be the correct test to assess the significance of a set of dummy variables and that caution should be used in interpreting individual t-tests of *b* coefficients with dummy variables, if used at all (see Aiken and West, 1991 and Dawson & Richter, 2006 for a more complete discussion). Accordingly, Hypothesis 5, as proposed, was not supported. However, additional analysis revealed two important relationships which provide insight into the moderating effect of CPI.

When training environment and facet levels of innovative performance were examined as outcome measures, two notable findings related to Hypothesis 5 emerged. First, a significant interaction between the IDS only condition and CPI on post-training originality was found ($\beta = .15$, $t = 2.24$, $p < .05$), controlling for age, GPA, divergent thinking, and pre-training creativity. As Table 13 demonstrates, this interaction effect produced a significant change in *R* in the prediction of post-training originality, and the change in the incremental F test was significant (*Sig. ΔF* $p = .04$).

Table 13: Interaction Between Training Content and Creative Personal Identity on Post-Training Originality (Covariates Included)[1]

Variable	*b*	*SE B*	β	*t*	R^2	ΔR^2	*ΔF(dfs)*	*Sig. ΔF*
Step 1								
Age	-.03	.03	-.05	-1.13				
GPA	.15	.08	.09	1.87				
Divergent Thinking	.07	.04	.08	1.61				
Pre-training creativity	.39	.05	.38	7.77***	.17	.17	19.64 (4, 381)	.000
Step 2								
CPS	-.09	.10	-.05	-.90				
IDS	.03	.09	.02	.35				
CPI	.07	.04	.07	1.55	.18	.01	1.29 (3, 378)	.28
Step 3								
CPS X CPI	.00	.11	.00	.010				
IDS X CPI	**.23**	**.10**	**.15**	2.23*	**.19**	**.01**	**3.32 (2, 376)**	**.04**

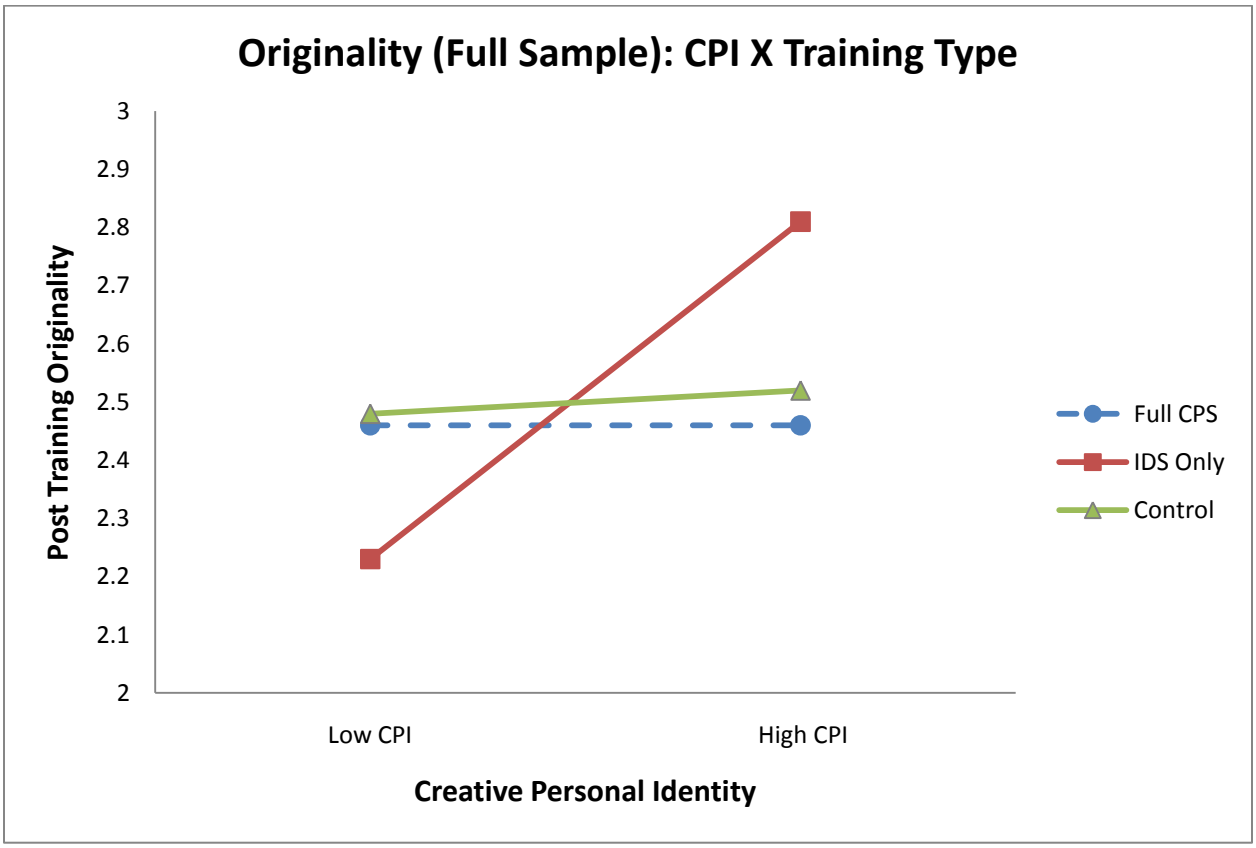
[1]N = 386. Values in bold are relevant to tests of hypotheses.

*p < .05. **p< .01. ***p < .001

CPS = Full CPS, IDS = Ideational skills training only, CPI = Creative Personal Identity

To facilitate the interpretation of the interaction, as Aiken and West (1991) recommend, simple slopes for the relationships between the training types and post-training originality at one standard deviation above and below the mean of CPI are plotted in Figure 11.

Figure 11. Simple slopes: CPI x Training Type Interaction for Post-Training Originality



Second, a significant interaction between the IDS only condition and CPI on post-training word count for the lab sample was found using conventional regression parameters (β = -.16, *t* = - 1.95 *p* = .05), controlling for age, GPA, divergent thinking, and pre-training word count. However, as Table 14 demonstrates, this interaction effect failed to produce a significant change in *R* in the prediction of post-training word count, and the change in the incremental F

test was non-significant (*Sig. ΔF p* = .14). Therefore, interpretation of this effect should be considered carefully with regard to the criteria for this type of analysis as noted above.

Table 14: Interaction Between Training Content and Creative Personal Identity on Post-Training Word Count: Lab Sample(Covariates Included)[1]

Variable	*b*	*SE B*	β	*t*	R^2	ΔR^2	*ΔF(dfs)*	*Sig. ΔF*
Step 1								
Age	-.01	.03	-.02	-0.42				
GPA	.25	.11	.13	2.34*				
Divergent Thinking	.07	.06	.07	1.22				
Pre-training word count	.53	.05	.59	9.90***	.38	.38	30.22 (4, 194)	.000
Step 2								
CPS	-.22	.12	-.11	-1.76				
IDS	.20	.12	.11	1.65				
CPI	.10	.06	.10	1.74	.43	.04	4.63 (3, 191)	.00
Step 3								
CDS X CPI	-.20	.14	-.11	-1.40				
IDS X CPI	**-.28**	**.14**	**-.16**	**-1.95***	**.44**	**.01**	**1.99 (2, 189)**	**.14**

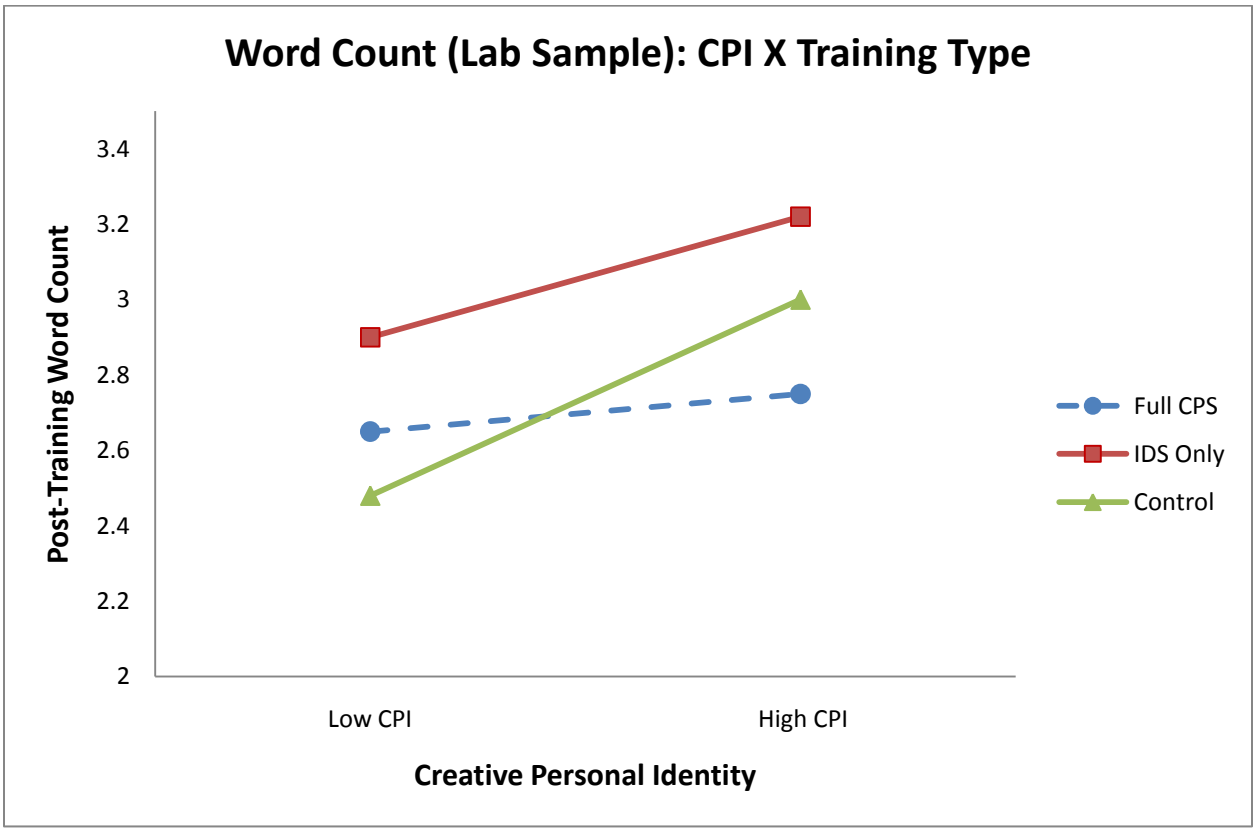
[1]N = 199. Values in bold are relevant to tests of hypotheses.

*p < .05. **p< .01. ***p < .001

CPS = Full CPS, IDS = Ideational skills training only, CPI = Creative Personal Identity

To facilitate the interpretation of the interaction, as Aiken and West (1991) recommend, simple slopes for the relationships between the training types and post-training word count at one standard deviation above and below the mean of CPI are plotted in Figure 12.

Figure 12. Simple slopes: CPI x Training Type Interaction for Post-Training Word Count



Hypothesis 6 – Intrinsic Motivation

Hypothesis 6 predicted that intrinsic motivation would moderate the relationship between training and innovative performance, such that the relationship would be higher for trainees high in intrinsic motivation, regardless of training condition (i.e., both CPS and IDS). Age, GPA, divergent thinking, and pre-training innovative performance were entered as the

covariates in step 1, the training conditions and intrinsic motivation were entered in step 2, and the cross-product terms were entered in step 3. The interaction terms for both the full CPS and IDS only training conditions with intrinsic motivation did not produce a significant change in *R* in the prediction of post-training innovative performance, as *R* did not increase, and the change in the incremental F test was non-significant ($p = .82$). Additional analyses investigating the impact of training environment and facet levels of innovative performance as outcomes were conducted, however no further significant moderator effects were found for intrinsic motivation. Therefore, Hypothesis 6 was not supported.

Hypothesis 7 – Creative Personal Identity and Intrinsic Motivation

Hypothesis 7 predicted that a three-way interaction would emerge, such that the relationship between training and innovative performance would be the strongest for trainees who were low on creative personal identity but high on intrinsic motivation. Age, GPA, divergent thinking, and pre-training innovative performance were entered as the covariates in step 1, the training conditions, creative personal identity, and intrinsic motivation were entered in step 2, and the two-way cross-product terms were entered in step 3, and the three-way cross product terms were entered in step 4. The three-way interaction terms including the full CPS and IDS only training conditions with each moderator did not produce a significant change in *R* in the prediction of post-training innovative performance, as *R* did not increase, and the change in the incremental F test was non-significant ($p = .51$). Hypothesis 7 was not supported.

However, when training environment and facet levels of innovative performance were examined as outcome measures, one notable finding related to Hypothesis 7 emerged. A

significant interaction between the full CPS condition, creative personal identity, and intrinsic motivation on post-training originality was found using conventional regression parameters (β = .15, t = 1.25 $p < .05$), controlling for age, GPA, divergent thinking, and pre-training creativity. This interaction effect produced a change in R (ΔR^2 =.02) in the prediction of post-training originality, and the change in the incremental F test was a marginally significant (*Sig. ΔF* p = .10).

To facilitate the interpretation of this three-way interaction, as Aiken and West (1991) recommend, simple slopes for the relationships between the training types, intrinsic motivation, and post-training originality at one standard deviation above and below the mean of CPI are plotted in Figures 13 and 14.

Figure 13. Simple slopes for Low Intrinsic Motivation x CPI x Training Type for Post-Training Originality

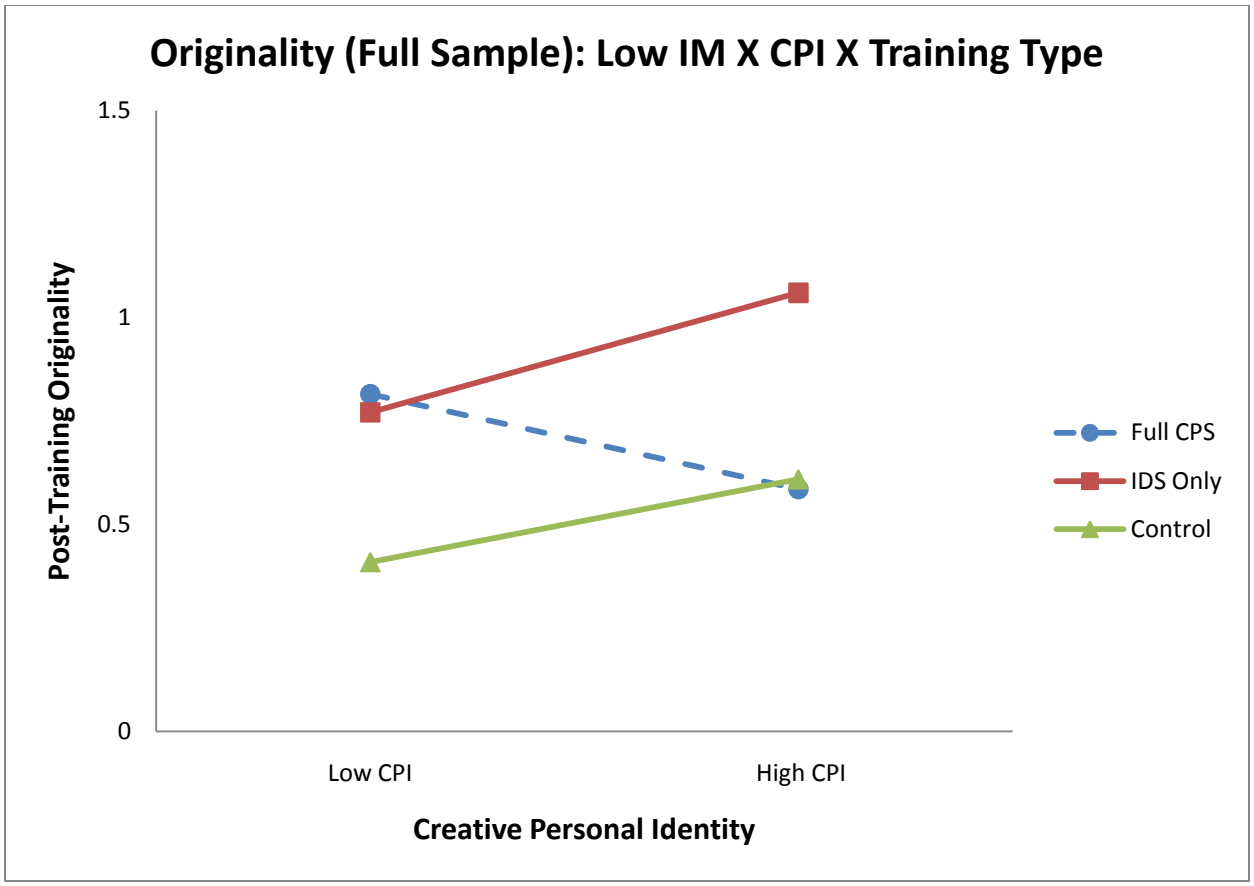
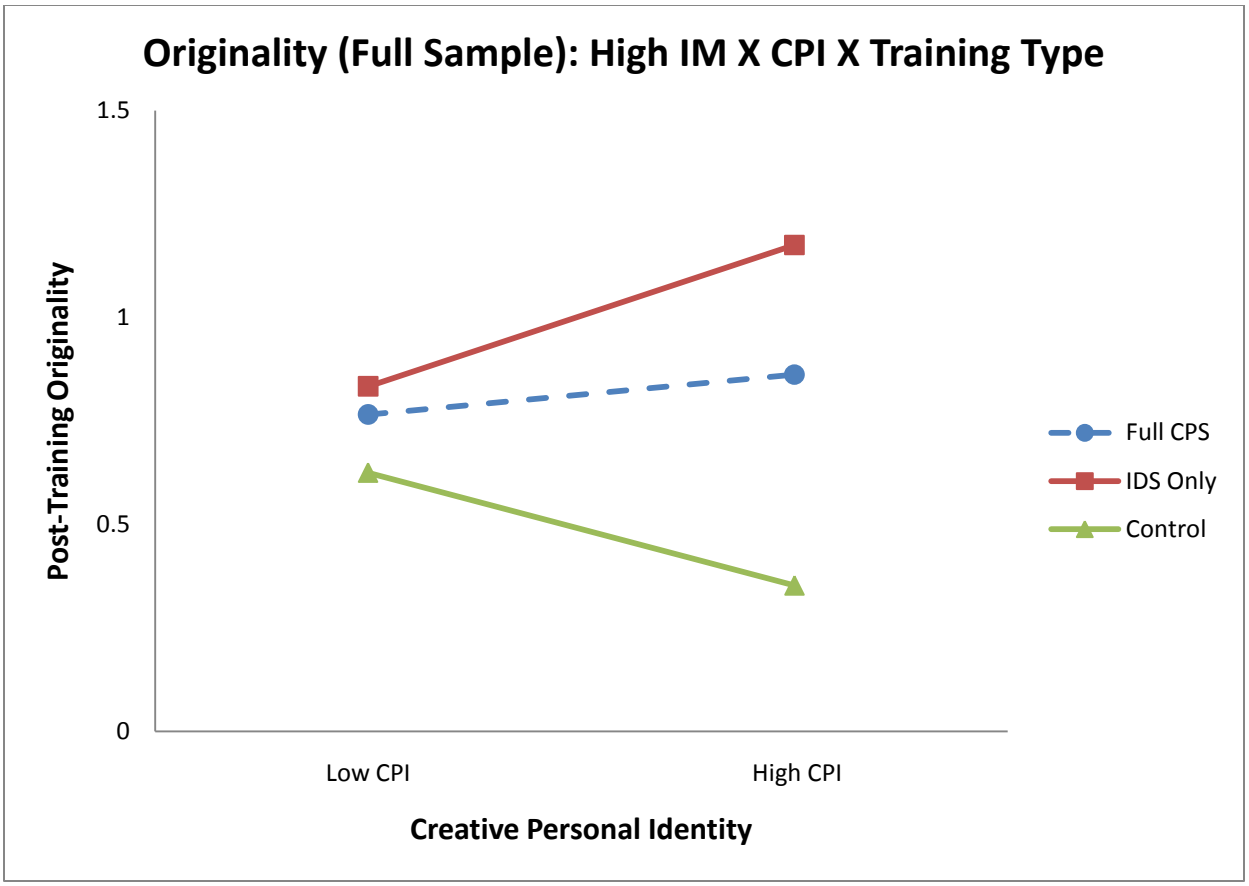


Figure 14. Simple slopes for High Intrinsic Motivation x CPI x Training Type for Post-Training Originality



Additional Analyses

In a series of *post-hoc* analyses, the impact of trainee reactions to, and perceived utility of, the training programs was explored. Table 15 presents the descriptives and correlations for this set of analyses.

Table 15: Means, Standard Deviations, and Intercorrelations Between Training Environment, Outcomes, and Trainee Reaction/Perceive Utility[1,3]

	Mean	*SD*	1	2	3	4	5	6	7	8	9	10	11	12
1. Training Environment	.52	.50	1											
2. Pre Training Word Count[2]	168.83	80.19	.30**	1										
3. Post Training Word Count[2]	177.32	80.90	.38**	.66**	1									
4. Pre Training Innovative	2.91	.70	.28**	.78**	.55**	1								
5. Post Training Innovative	2.85	.81	.35**	.57**	.90**	.57**	1							
6. Enjoyed the training	2.97	.95	.10*	.10	.18**	.07	.18**	1						
7. Given enough time	4.16	.82	.08	.12*	.13*	.10	.13*	-.07	1					
8. Training useful	3.32	.95	.02	.04	.14**	.04	.15**	.71**	.01	1				
9. Training interesting & engaging	2.96	1.04	.09	.08	.13*	.08	.12*	.74**	-.01	.71**	1			
10. Improvements could be made	3.42	.84	.06	-.05	-.05	-.01	-.04	-.15**	-.08	-.19**	-.17**	1		
11. Impact future problem solving	3.06	.99	.02	.05	.05	.06	.05	.61**	-.03	.63**	.67**	-.12*	1	
12. Envision applying in future	3.29	.10	.05	.05	.11*	.07	.12*	.66**	.00	.71**	.69**	-.16**	.79**	1

*p < .05, **p < .01

[1]Note: All categorical variables (variables 1 – 4) dummy coded (Training Environment: 0 = outside of lab, 1 = in lab)

[2]Unstandardized values presented. Standardized values were used in analyses for interpretation.

[3]The values for full CPS and IDS only were calculated but not included here, as none of the correlations were significant with perceived utility and trainee reactions measures.

Regarding the increase in word count across conditions and training environments, the findings presented, most notably for Hypothesis 2, provide some indication of the relative impact of training conditions (i.e., the IDS only condition) on this objective outcome. However, as Table 15 indicates, several other variables may play a role in driving the increase in word count from pre to post-training. A significant, positive relationship was found between a trainee's perception of having enough time to complete the training and both pre and post-training word count (r = .12 and .13, p < .05, respectively). Additionally, post-training word count was found to have significant relationships with other trainee reaction measures including the extent to which trainees 1) enjoyed the training (r = 18, p < .01), 2) found the training useful (r = .14, p < .01), 3) found the training interesting and engaging (r = .13, p < .05), and 4) could envision themselves applying what they learned in the future (r = .11, p < .05). Training types (i.e., full CPS and IDS only) are not included in Table 15 because the correlations with the trainee reaction and perceived utility measures were all found to be non-significant, ranging in magnitude from -.05 to .09, *ns*.

Despite these findings, a few interesting findings should be noted with regard to trainee's subjective experiences across, and between, training conditions. Overall, across conditions, the majority of participants agreed that they were given enough time to complete the training that they received (49.7%), that they found the training that they received useful (44.6%), that improvements could be made to the training (41.7%), that the training would have an impact on the manner in which they approach and solve problems in the future (34.3%), that they could envision applying what they learned from the training in the future (42.3%), and reported neutral responses regarding their enjoyment of their training (38.9%) and

as to whether they found the training interesting and engaging (33.2%). Also of note is the overwhelming majority of participants, regardless of training type, agreed or strongly agreed that they were given enough time to complete their respective training (84.7% of total sample).

Regarding *between* training conditions responses, the following notable findings emerged: 37.1% IDS only trainees agreed that the training they received would have an impact on the manner in which they approach and solve problems in the future compared to only 28.8% of the full CPS trainees, 10.4% of the full CPS trainees strongly agreed that improvements could be made to the training compared to only 6.1% of the IDS only sample, 10.6% of the full CPS trainees strongly disagreed that the training was interesting and engaging compared to just 6.9% of the IDS only sample, 8.3% of the IDS only trainees strongly agreed that the training was useful compared to just 4.0% of the CPS trainees, and while only 3.0% of the IDS only sample strongly disagreed that they enjoyed the training 8.8% of the full CPS trainees indicated this to be the case.

Given the strong support presented for the impact of training environment on post-training innovative performance, both at the dimension and facets levels, the next set of analyses addressed the impact of three trainee reaction and perceive utility measures on post-training innovative performance, controlling for training environment among other key covariates. Results from the hierarchical multiple regression analysis for the impact of trainee enjoyment of training (see Table 16) revealed a significant positive relationship between trainee enjoyment of the training and subsequent innovative performance ($\beta = .14$, $t = 3.55$, $p < .001$),

whereby training enjoyment significantly predicted an additional three percent of the variance in innovative performance beyond the covariates and training environment.

Table 16: Hierarchical Regression Analysis Predicting Innovative Performance From Training Enjoyment (Covariates Included)[1]

Variable	*b*	*SE B*	β	*t*	R^2	ΔR^2	*Sig. ΔF*
Step 1							
Age	-.06	.02	-.11	-2.57*			
GPA	.19	.07	.12	2.76**			
Divergent Thinking	.04	.04	.05	1.17			
Pre-training innovative performance	.64	.05	.56	12.80***	.35	.35	.00
Step 2							
Training Environment	.37	.07	.23	5.20***	.38	.03	.00
Step 3							
Enjoyed training	**.12**	**.03**	**.14**	3.55***	**.40**	**.03**	**.00**

[1]N = 386. Values in bold are relevant to post-hoc tests.

*p < .05. **p< .01. ***p < .001

CPS = Full CPS, IDS = Ideational skills training only, CPI = Creative Personal Identity

Results from the hierarchical multiple regression analysis for the impact of trainee engagement of training (see Table 17) revealed a significant positive relationship such that trainee engagement significantly predicted incremental variance in innovative performance beyond the covariates and training environment (β = .08, t = 1.91, $p \leq .05$). The impact of trainee's leaving the study access to the internet, at any point, was also assessed. Results from the hierarchical multiple regression analysis revealed a marginally significant negative relationship such that post-training innovative performance decreased for trainees who left the online study, at any point, to access other internet sites (β = -.16, t = -1.82, p = .07*g. ΔF* = .05).

Table 17: Hierarchical Regression Analysis Predicting Innovative Performance From Training Engagement (Covariates Included)[1]

Variable	*b*	*SE B*	β	*t*	R^2	ΔR^2	*Sig. ΔF*
Step 1							
Age	-.06	.02	-.11	-2.71**			
GPA	.17	.07	.12	2.46*			
Divergent Thinking	.04	.03	.05	1.23			
Pre-training innovative performance	.64	.05	.55	12.63***	.34	.34	.00
Step 2							
Training Environment	.36	.07	.22	5.20***	.37	.03	.00
Step 3							
Found training interesting and engaging	**.06**	**.03**	**.08**	1.91***	**.38**	**.01**	**.05**

[1]N = 386. Values in bold are relevant to post-hoc tests.

*$p \leq .05$. **$p < .01$. ***$p < .001$

CPS = Full CPS, IDS = Ideational skills training only, CPI = Creative Personal Identity

Finally, Table 18 presents means, standard deviations, and correlations related to personality constructs included in the study. It should be noted that only measures with reliabilities greater than .70 ($\alpha > .70$) were included in the analysis. Findings of note include 1) a significant, positive relationship between achievement striving and all four outcome measures at the $p < .01$ level, 2) non-significant relationships between anxiety and all four outcome measures, 3) a significant negative relationship between introversion and three of the four outcome measures, and 4) non-significant relationships between agreeableness and all four outcome measures.

Table 18: Means, Standard Deviations, and Intercorrelations Between Personality Measures and Outcomes

	Mean	*SD*	*1*	2	3	4	5	6	7	8
1. Pre Training Word Count[1]	168.83	80.19	1							
2. Post Training Word Count[1]	177.32	80.90	.66**	1						
3. Pre Training Innovative Performance	2.91	.70	.78**	.55**	1					
4. Post Training Innovative Performance	2.85	.81	.57**	.90**	.57**	1				
5. Achievement Striving	3.78	.77	.20**	.14**	.19**	.15**	1			
6. Anxiety	3.01	.80	.030	.03	.05	.05	-.01	1		
7. Introversion	2.74	.79	-0.15	-.14**	-.15**	-.11*	-.17**	.21**	1	
8. Agreeableness	3.37	.68	.09	.06	.07	.06	.12*	-.27**	-.07	1

*p < .05, **p < .01

[1]Unstandardized values presented. Standardized values were used in analyses for interpretation.

Chapter 4

Discussion

The primary aim of the study was to design, develop, implement, and test the relative effectiveness of three computer-based training programs for enhancing innovative performance. The training programs were developed from the ground up specifically for the current study and guided by the Osborn-Parnes Creative Problem Solving paradigm (e.g., Noller & Parnes, 1972). In addition to the different training types, an experimental condition for training environment was added during the course of data collection such that a subset of the sample took the online training in a controlled lab setting. Three distinct, but related, groups of hypotheses were examined with the two experimental conditions in mind: 1) The relative effectiveness of the three training programs for enhancing innovative performance, for both the full and partial (i.e., the lab and non-lab) samples (Hypotheses 1 -2), 2) the relative effectiveness of the three training programs for enhancing the dimension and facet levels of innovative performance, for both the full and partial (i.e., the lab and non-lab) samples (Hypotheses 3 - 4), and 3) the moderating influence of creative personal identity and intrinsic motivation on dimension level, facet level, and overall innovative performance, for both the full and partial (i.e., the lab and non-lab) samples (Hypotheses 5 - 7). The objective outcome measure of word count was also examined for each set of hypotheses. Support for the hypotheses was mixed, but an overall trend demonstrating the relative effectiveness of the IDS only training program emerged. The results of the study are addressed in more detail for each set of hypotheses, as outlined above, in the section that follows. This section is followed by

discussions of the theoretical and practical contributions, limitations, and finally implications of the study for future research.

Study Findings

Overall innovative performance

Taken together, results from testing the first set of hypotheses provided evidence to support the two most consistent study findings: 1) a distinct positive trend for the IDS only condition indicating that online IDS only training may be more effective for enhancing innovative performance, as compared to full CPS or control (MLP) online training, and 2) a strong environment effect indicating that the provision of online creative problem solving training in a more formal, controlled setting results in higher overall innovative performance than does the identical training in a non-lab setting. Despite hypotheses predicting that the full CPS training condition would evidence the strongest impact on subsequent innovative performance, results consistently showed a negative relationship between this training program and innovative outcomes. However, consistent with previous studies (e.g., Clapham, 1997), results provided solid evidence to support the notion that receiving creative problem solving training in the form of idea-generating techniques alone may be more effective for enhancing innovative performance than a more extensive program. Caution should be exercised, however, in prematurely jumping to this conclusion as it is plausible that the effects as evidenced were due to study design and/or sample-specific artifacts. More specifically, much of the research demonstrating the effectiveness of the OP-CPS program includes studies where the duration of the training program lasted several days or weeks, and in some cases, several

months (e.g., Basadur et al., 1992; Firestien & Luken, 1993; Kabanoff and Bottger, 1991). The current study required training that lasted for a maximum of 30 minutes and it is possible that effective, full OP-CPS training requires a longer training and incubation period. The full CPS condition was, on average, three-times longer than the IDS only training, but it also required learning four additional OP-CPS concepts in a maximum of only 20 additional minutes. Therefore, it is plausible that the relative ineffectiveness of the full CPS program might be explained by a combination of information overload and fatigue. Conversely, the relative effectiveness of the IDS only condition might be due to the appropriate provision of training time in relation to the amount of information to learn, which resulted in less fatigue. In support of this idea, regression analysis results revealed a significant positive relationship between the IDS only condition and post training word count for the lab sample ($\beta = .26$, $t = 2.01$, $p < .05$) and that neither of the other two experimental conditions was found to have an effect on post training word count, regardless of training environment. Word count was included in the current study as an objective proxy for effort and fatigue (or conversely, vigor) and these results provide some support for the notion that participants in the IDS only condition may have experienced less fatigue, more vigor and, consequently, exerted more effort into task responses.

With regard to the results demonstrating a strong training environment effect, a thorough literature review failed to find any studies in which lab and non-lab samples undergoing online creativity training were compared. The majority of the studies in the literature compare online training, whether for creativity or other outcomes, to non-web-based training. However, it is more than plausible that the participants who underwent training in a

more formal testing environment, which required them to sign-up for and appear at a specific time and place, were more conscientious and exerted more effort. Given that participants in the non-lab sample were provided free will in terms of the study location and completion time, and were not "supervised," per say, one can only surmised as to how much effort and concentration was put into learning and practicing the core concepts. In fact, results indicated that while 48% of the non-lab sample left the study to access the internet at any given time, only 4% of the lab sample did so. Of note, however, is that while there was a strong overall training environment effect, the general pattern by training type was nearly identical (see Figure 4).

Dimension and facet levels of innovative performance

Results from dimension and facet level set of hypotheses revealed patterns similar to those in the first set of hypotheses, whereby a distinct, positive trend for the relative effectiveness of the IDS only training condition and significant differences between the lab and non-lab samples emerged. Results by dimension, and corresponding facets, are discussed below.

Implementation Planning. A significant main effect for training type on the implementation planning dimension of innovative performance was found using the full sample. Plots of the estimated marginal means demonstrated that, while the full CPS training produced little effect on the implementation planning dimension of innovative performance, the IDS only condition produced a clear positive effect on planning, along with the control (though the effect was not as strong) (see Figure 7). Similar effects were demonstrated using

the lab sample only. At the facet level, a familiar positive trend for IDS only training was found across training environment for both the penetration and forecasting facets of planning, while mixed findings emerged for the full CPS and control training conditions. Of particular note, however, are two facet-level findings. The first is that the forecasting facet of planning increased for all training types, including the control, in the lab sample. This finding demonstrates that trainees in the lab, regardless of the training that they received, were more successful at identifying outcomes and restrictions in their plan for the future campus after training than prior to training for their plan for designing a senior class gift. What this may suggest, given that the effect was demonstrated for the control condition as well, is that a pre/post-training task effect may have been present such that forecasting was more likely given the requirements of the post-training task. However, this same effect did not emerge in the non-lab sample, so this explanation must be evaluated in context. The second notable finding that emerged is the relationships found for the IDS only condition at the facet levels for the non-lab sample (see Figures 8 and 9). Here, we see that the IDS only training had a distinct, positive effect on both penetration and forecasting, while the other conditions had clear negative effects. What is so significant about this finding is that: 1) despite the fact that the non-lab sample consistently performed below the lab sample, penetration and forecasting *increased* for non-lab sample participants in the IDS only condition, and 2) this finding emerged in spite of the fact that no formal training in implementation planning was provided for participants in the IDS only training condition. What this may suggest is that the some residual fatigue or concentration factor from the longer full CPS training may have been more evident in the non-lab sample where no formal "supervision" was present and, conversely, that the

diminished fatigue and more concerted effort provided by participants in the shorter IDS only condition was more evident in the non-lab sample, as compared to the full CPS training. In this way, it may be that the increase in penetration and forecasting for the IDS only trainees was due to less fatigue, rather than training effects, and that these differences in performance are be magnified in the non-lab sample for reasons previously discussed. It should also be noted that participants were granted free will during the training, such that they were not "forced" to complete each stage of training so it may be that participants, particularly those in the non-lab sample, simply did not complete the implementation planning portion of the training.

Creativity. Results of the analyses failed to reveal significant effects for training type or training environment on the creativity dimension of innovative performance. Furthermore, analyses indicated that there were no significant effects at the facet levels (i.e., quality and originality). While the findings supported the hypothesis that no significant differences between full CPS and IDS only training would emerge for creativity, or the corresponding facets, the general trends were unfortunatley in the opposite direction than predicted. More specifically, for both quality and originality, there was a general negative trend across training types and training environments from pre to post training. While these findings suggest that none of the training conditions were effective at enhancing creativity, it should be noted that other studies that have found significant gains in creativity and originality have often lasted as long as several months. For example Kabanoff and Bottger (1991) found that participants who engaged in two 80 minute OP-CPS sessions per week over a period of 10 weeks experienced the most significant gains in originality. This suggests that training for creativity, but not necessarily

implementation planning, is more effective if it is longer in duration and conducted over a longer course of time with repeated administrations.

Moderating influence of creative personal identity and intrinsic motivation

Results by moderator and their three-way interactions with training type are discussed below.

Creative personal identity (CPI). CPI was found to be positively correlated with several of the pre and post-training study variables, to include: pre-training originality (r = .15, p < .01), pre-training creativity (r = .13, p < .01), pre-training innovative performance (r = .11, p < .01), pre-training word count (r = .13, p < .05), as well as post-training originality (r = .12, p < .05;), and post-training word count (r = .11, p < .05). These relationships generally suggest that higher levels of creative personal identity are related to increases in a variety of innovative performance indicators.

With regard to the moderating effect of CPI on overall innovative performance, a significant interactive effect did not emerge for either OP-CPS training condition. However, analyses at the facet and dimension level and when stratified by training environment revealed two notable findings: 1) a significant interaction between the IDS only condition and CPI on post-training originality for the full sample was found (β = .15, t = 2.24, p < .05) (see Table 13) and 2) a significant, negative interaction between the IDS only condition and CPI on post-training word count for the lab sample (β = -.16, t = - 1.95 p = .05) (see Table 14).

The first finding demonstrates that, when CPI is taken into account, an effect for the IDS only training condition emerges such that those who received IDS only training exhibited differential levels of originality based on the importance of creativity to their self-concept, even when controlling for several significant predictors (including divergent thinking). As the plot of the simple slopes in Figure 11 demonstrates, the IDS training condition had a clear, positive effect on post-training originality, as compared to the other training conditions. More specifically, post-training originality performance is highest when participants were higher on CPI and in the IDS condition. Moreover, originality was lowest when participants were lower on CPI and in the IDS condition. While in the direction opposite to that predicted, it appears that creative personal identity impacted the effectiveness of IDS only training. Consequently, it may be that, when participants are lower on CPI they respond less favorably to training while those higher on CPI respond particularly well to the IDS only training as opposed to the full CPS training.

The second finding reveals an interaction between the IDS only condition and CPI for the lab sample such that those who received IDS only training exhibited differential levels of post-training word count based on the importance of creativity to their self-concept, even when controlling for several significant predictors. These results suggest that CPI has an effect on both subjective and objective outcomes for trainees receiving ideational skills training only. As noted above, the second finding failed to produce a significant change in *R* in the prediction of post-training word count, and the change in the incremental F test was non-significant (*Sig. ΔF* $p = .14$). Therefore, interpretation of this effect should be considered carefully with regard to the criteria for this type of analysis as in the *Results* section. Regardless, as the plot of simple

slopes in Figure 12 demonstrates, post-training wordcount is highest for participants who were higher on CPI and in the IDS only training condition. This result supplements the finding above with an objective outcome variable, indicating that when participants are higher on CPI they tend to respond more favorably to IDS only training in terms of the overall length of their post-training responses (conceptualized for this study as an indicator of effort and engagement).

Intrinsic motivation (IM). IM was found to be correlated with fewer pre and post-training study variables than was CPI. More specifically, IM was positively correlated with both pre ($r = .13$, $p < .05$), and post-training originality ($r = .10$, $p < .05$) only.

With regard to the moderating effect of IM on overall innovative performance, a significant interactive effect did not emerge for either OP-CPS training condition. The interaction terms for both the full CPS and IDS only training conditions with intrinsic motivation did not produce a significant change in *R* in the prediction of post-training innovative performance, as *R* did not increase, and the change in the incremental F test was non-significant ($p = .82$). Additional analyses investigating the impact of training environment and facet levels of innovative performance as outcomes were conducted, however no further significant moderator effects were found for intrinsic motivation. Given the low, non-significant zero-order correlations among IM and the pre and post-training variables, as presented, this finding was not surprising (see Table 7). However, given the substantial amount of evidence supporting the notion that motivation, and particularly intrinsic motivation, is a crucial consideration for maximizing creativity, this finding was quite surprising (e.g., Benzer and Bergman, 2007; Collins & Amabile, 1999). It should be noted, however, that *extrinsic*

motivation, the counterpart to intrinsic motivation was not measured in this study. Defined by Amabile (1999) as "...the motivation to engage in an activity primarily in order to meet some goal external to the work itself, such as attaining an expected reward, winning a competition, or meeting some requirement" (p. 297), it may be that, in this particular study, extrinsic motivation was a more powerful driving force behind performance differences, given that the ultimate goal of the study for many participants was, likely, class credit. Some evidence for this may be found in the inclusion of GPA as a covariate. GPA is likely to encompass aspects of both intrinsic and extrinsic motivation and evidenced consistent, strong, and positive relationships with outcomes, indicating by proxy that extrinsic motivation may, in fact, have played a role in study outcomes in addition to intrinsic motivation.

Three-way interactions. Results indicated that the three-way interaction terms including the full CPS and IDS only training conditions with each moderator did not produce a significant change in *R* in the prediction of post-training innovative performance, as *R* did not increase, and the change in the incremental F test was non-significant ($p = .51$). However, when training environment and facet levels of innovative performance were examined as outcome measures, one notable finding emerged. A significant interaction between the full CPS condition, creative personal identity, and intrinsic motivation on post-training originality was found ($\beta = .15$, $t = 1.25$ $p < .05$), indicating that those who received full CPS training exhibited differential levels of originality based on the importance of creativity to their self-concept and their level of intrinsic motivation, even when controlling for several significant predictors (including divergent thinking). While this interaction was significant, it only predicted an additional two-percent of the variance in the prediction of post-training originality, and the change in the incremental F

test was a marginally significant (*Sig. ΔF p* = .10). While encouraging, explanations for these results should be considered carefully given the information provided regarding statistical significance.

Regardless, the simple slope plots for this three-way interaction provide some illustration of the interactive relationships. As Figures 13 and 14 demonstrate, post-training originality was highest among participants who were higher on CPI, higher on intrinsic motivation, and received IDS only training. In contrast, performance was lowest among participants who were higher on CPI, higher on intrinsic motivation and did not receive creativity training (i.e., control training). What this might suggest is that, if one is inherently motivated and creativity is an important part of one's self concept, then ideational skills training may be particularly helpful for enhancing originality.

Post-hoc analyses. The *post-hoc* analyses included an investigation of the impact of trainee reactions to, and perceived utility of, the training that they received as well as several personality constructs. As Table 15 demonstrates, significant, positive relationships of note include those between post-training word count and trainee's perceptions of having enough time to complete the training ($r = .13$, $p < .05$), and the extent to which trainees enjoyed the training ($r = 18$, $p < .01$), 2), found the training useful ($r = .14$, $p < .01$), found the training interesting and engaging ($r = .13$, $p < .05$), and could envision themselves applying what they learned in the future ($r = .11$, $p < .05$). The relationships of these positively valenced subjective reactions with word count lend support for the idea that, the less fatigued (or conversely, the more engaged) that participants were in the training, the more likely they were to provide

effortful responses to the post-training task. The next logical question, however, is whether or not these differences in subjective reactions were variable by training type, so as to support the notion that the effectiveness of IDS only training might be attributable, at least in part, to these reactions via the experience of less fatigue as compared to full CPS or control trainees.

Interestingly, the correlations among training type (i.e., full CPS and IDS only) and training environment (i.e., lab and non-lab) with trainee reaction and perceived utility measures were all found to be non-significant, ranging in magnitude from -.05 to .09, *ns,* indicating a lack of a main effect for the subjective experiences of participants across training type and environment. However, several commonalties in subjective reactions across, and differences between, training types do provide some interesting information. The overwhelming majority of participants, regardless of training type, agreed or strongly agreed that they were given enough time to complete their respective training (84.7% of total sample), suggesting that trainees were not rushed to provide responses. Overall, across conditions, the majority of participants agreed that they found the training that they received useful (44.6%), that the training would have an impact on the manner in which they approach and solve problems in the future (34.3%), and that they could envision applying what they learned from the training in the future (42.3%), all indications that trainees generally had favorable reactions to the training that they received. However, 41.7% of participants also agreed that improvements could be made to the training that they received. While this figure is still less than one-half of the total sample, it is an indication that reactions to some aspects of the training programs were not entirely favorable. The findings below provide some interesting insight into how these

subjective responses differed by training type, revealing a clear pattern that supports the idea that IDS only trainees had more favorable reactions to training than did full CPS trainees.

Regarding *between* training conditions responses, the following notable findings emerged: 37.1% IDS only trainees agreed that the training they received would have an impact on the manner in which they approach and solve problems in the future compared to only 28.8% of the full CPS trainees, 10.4% of the full CPS trainees strongly agreed that improvements could be made to the training compared to only 6.1% of the IDS only sample, 10.6% of the full CPS trainees strongly disagreed that the training was interesting and engaging compared to just 6.9% of the IDS only sample, 8.3% of the IDS only trainees strongly agreed that the training was useful compared to just 4.0% of the CPS trainees, and while only 3.0% of the IDS only sample strongly disagreed that they enjoyed the training 8.8% of the full CPS trainees indicated this to be the case. Taken together these findings suggest that trainees in the IDS only condition generally had more favorable reactions to the training than did full CPS participants which may, in turn, partially explain the relative effectiveness of the IDS only condition in terms of fatigue. More specifically, it might be that participants in the IDS only condition experienced less fatigue and, consequently, had more positive reactions to the training which together may have driven their consistent increases in innovative performance. Conversely, it might be that participants in the full CPS condition experienced more fatigue and, consequently, had more negative reactions to the training which together may have driven their consistent decreases in innovative performance.

With regard to additional outcomes, trainee's subjective experiences were found to predict overall innovative performance. More specifically, results emerging from a series of regression analyses indicated that trainees who enjoyed the training (Table 16) and found the training interesting and engaging (Table 17) exhibited higher innovative performance (β = .14, *t* = 3.55, *p* < .001 and β = .08, *t* = 1.91, *p* ≤ .05, respectively). Regression analyses also indicated that trainees who left the online study, at any point, to access other internet sites demonstrated a decrease in post-training innovative performance (β = -.16, *t* = -1.82, *p* = .07, *sig.ΔF* = .05). This finding provides support for the idea that consistently lower performance of the non-lab sample might be explained, at least in part, by their 12-fold increase in study departure to access the internet (recall that 48% of the non-lab sample left the study to access the internet at any given time compared to only 4% of the lab sample). Of final note, is the finding that achievement striving exhibited a significant, positive relationship with all four outcome measures at the p < .01 level, providing support for the notion that some motivational construct, other than intrinsic motivation, was likely at work.

Theoretical Contributions

While findings from the current study demonstrated mixed support for the formally proposed hypotheses, several notable theoretical contributions were provided. Little work has been published in the area of web-based creativity training and, to the author's knowledge, this study represents the first true experimental test of the OP-CPS paradigm using completely online training programs. In this way, the current study represents a unique contribution to the both training and creativity/innovation literatures alike as well as an effective merging of the

two. Accordingly, every study aim was carefully designed and evaluated to further the conceptual understanding of training for innovative performance. First, the development and evaluation of several web-based training programs to enhance innovative performance adds to the body of literature involving computer-based training (CBT) as well as the limited, but growing, extant literature involving computer-based creativity/innovation training (Puccio, Firestien, Coyle, & Masucci, 2006). Every primary study in these areas not only adds unique information on its own, but contributes to the collective body of literature from which important conclusions can be drawn and generalized across these research areas in the form of meta-analyses.

Another contribution is the examination of the specific training elements that may be more critical for success. Traditionally, the focus of research on creativity training has primarily been on the overall effectiveness of various programs at the expense of identifying which components of a given training program are more critical for success than others (Clapham, 1997). By comparing the relative impact of the full training regimen (i.e., full CPS) with a partial training regimen that includes only the ideational skills training elements (i.e., IDS only), the current study addresses this gap in the literature.

The research on creativity training has also followed a narrow approach in other notable ways, to include the use of divergent thinking as the sole indicator of creative performance (e.g., Fontenot, 1993), and the overwhelming neglect of the role of implementation planning in the creative/innovative process (e.g., Osburn & Mumford, 2006). The current study addresses both of these limitations. Whereas divergent thinking is commonly used as an *indicator* of

creative performance it was included in the current effort as a covariate such that the effect of divergent thinking was *controlled for* when assessing the impact of training on innovative performance. In turn, innovative performance was measured using a composite measure of four dimensions: quality, originality, penetration, and forecasting. This novel approach to measuring innovative performance is both conceptually and theoretically grounded (e.g., Besemer & O'Quin, 1999; Marta, Lerits, & Mumford, 2005; Mumford et al., 2002; Osburn & Mumford, 2006) and represents an important addition to the extant literature, particularly due to the inclusion of facets that involve planning.

The final theoretical contribution of the current study is the inclusion of two moderators, creative personal identity and intrinsic motivation, that have been linked to the creative process and training separately (e.g., Amabile, 1983, 1996; Jaussi, Randel, & Dionne, 2007), but have not been addressed collectively as part of the same conceptual model. More specifically, in addition to investigating the influence of each of these constructs on the relationship between training and innovative performance, the three-way interactive effects between the proposed moderators and the levels of the independent variables (i.e., training type and environment) was also addressed. In this way, a more complete picture of the relationships among these variables was established and a merging of these two related, but somewhat disparate, literatures forged.

Practical Contributions

This study also provided important contributions to practice in addition to theoretical contributions. Decades of research has provided substantial support for the effectiveness of the

OP-CPS program, in particular, to train creativity and innovation in organizations (e.g., Noller & Parnes, 1972; Puccio et al., 2006). Indeed the OP-CPS model has endured to balance application with research and is among the creative process models that has received clear attention from researchers and practitioners alike. However, according to many researchers, much work still remains to be done to increase the practical benefits of this training program, as many more people appear to be applying CPS programs (like the OP-CPS) in organizations than those who are investigating or documenting the relative benefits of such training programs in terms of the types of desired outcomes or types of people undergoing training (Puccio et al., 2006). The current effort answers this call, in part, by examining the outcome (i.e., innovative performance) in a unique fashion that may be of particular practical benefit to organizations in that creativity *and* implementation planning are considered, both critical aspects to successful innovation (Osburn & Mumford, 2006). Additionally, the inclusion of a variety of demographic and individual difference measures as covariates and moderating variables, presents a more rigorous and realistic picture of those employees who might stand to benefit the most from such organizational training.

The practical contribution with perhaps the most considerable impact, however, involves a greater understanding of the specific aspects of online training that appear to enhance innovative performance which might, in turn, can be used to inform practitioners about the relative increases in effectiveness and efficiency in the delivery of these programs. What is apparent from the current study is that participants who received online training involving ideational skills training only evidenced clear increases in innovative performance, across several different outcome measures, despite that fact actual training time was, on

average, 1/3 that of the full OP-CPS training. The implications for practitioners, in terms of efficiency and cost, are clear and as Clapham (1997) suggested over a decade ago "the trend is to do more with less," (p. 33) and that is certainly the case in today's organizational environment, perhaps even more so. According to a recent report surveying over 200 U.S. companies, employers rate creativity and innovation among the top five skills that will increase in importance over the next five years (Lichtenberg, Woock, & Wright, 2008). The same authors indicate, however, that training rarely matches the most pressing needs of the workplace and that stimulating innovation/creativity and enabling entrepreneurship surfaced among the top 10 challenges of U.S. CEO's. Another recent report concluded that, given similar findings, employers must evaluate how well in-line their employee training programs are with the strategic value placed on innovation and creativity (Casner-Lotto, Rosenblum, & Wright, 2009).

The source of the rift between the demand for creativity/innovation training and the actual availability of such programs is likely to involve the necessity, as Clapham (1997) suggested, to accomplish more with less and that one way to cut expenses yet retain creativity training is to develop streamlined creativity training programs that can be easily delivered, but do not compromise effectiveness. Given the results of the current study, particularly regarding the relative effectiveness of the online ideational skills training program, the current study provides a unique contribution that specifically addresses this notion.

Limitations

Several of the study's limitations have been discussed, however a more complete discussion of these should be considered. First, the student sample may have presented

particular problems given that students were 1) required to complete the study for class credit (though students did have the choice of which studies to complete for course credit), and b) the limited demographic diversity in the student population of the psychology subject pool may limit the generalizability of the results to some extent. The third potential limitation related to using a student sample was addressed during the course of data collection. More specifically, it became apparent that unsupervised students who completed the training in an informal setting might differ from those who completed training in a more formal, supervised atmosphere (Scott et al., 2004). Consequently, the additional experimental condition of "training environment" was included in the study.

Second, the seemingly age-old question as to generalizability of experimental lab studies to real-world, applied settings must be acknowledged. Studies of creativity training in both field and lab settings have traditionally been included in meta-analytic research and lab studies involving creativity training are quite common (e.g., Scott et al., 2004). Furthermore, there is evidence that effects observed in field settings and experimental settings are highly correlated (Anderson, Lindsay, & Bushman, 1999; Cohen-Chararsh & Spector, 2001). Thus, although generalizing to applied settings is cautioned, it does not appear unreasonable as a starting point for future field investigations.

Third, the decisions involving measure inclusion may have impacted outcomes in some ways; however this limitation really became apparent only in hindsight. Based on findings, a measure of extrinsic motivation may have also been included in the study to permit a better understanding of the motivational factors that may have driven the outcomes. Related to this,

is that all of the moderator and personality variables were self-reported by participants and it is possible (though unlikely) that common method bias affected the results regarding these variables. One way of addressing this issue in future research would be to obtain behavioral measures of motivation, such as time *willingly* spent on the creativity task (Deci & Ryan, 1985). Additionally, several of the personality variables were not included in the analysis due to poor reliability/internal consistency (i.e., $\alpha < .70$, e.g., openness to experience and conscientiousness). The decision to include more measures with fewer items as opposed to fewer measures with more items was likely the cause of the unreliability of these measures. However, there was a delicate balance to be maintained between gathering the most information possible with careful consideration of participant time. Future studies may incorporate fewer measures with at least four items to avoid low reliability.

Fourth, as discussed previously, it is possible that stronger effects may have emerged if the current study employed a longer duration of training and/or a longitudinal approach to training as some other researchers have done in the past (see Puccio et al., 2006). While it is possible that the duration of the training may not have been long enough in the current study, the goal was to test the relative effectiveness of different OP-CPS training programs using a completely streamlined online protocol and, in doing so, it was decided that training lasting longer than that provided and/or at multiple points in time was less important than testing for immediate effects in a reduced period of time. Given the likelihood of fatigue, particularly in the full CPS condition as suggested, it is also likely that a longer training time might have resulted in increased attrition and even weaker training effects.

Fifth, while the study satisfied Kirkpatrick and Kirkpatrick's (2006) first level of training evaluation by including assessments of trainee reactions and perceived utility, an assessment of learning (Kirkpatrick and Kirkpatrick's second level) was not included. Inclusion of participant's resulting increases in knowledge or capability would have provided an even greater understanding of the pattern of results.

Finally, a limitation with regard to comparing pre and post assessments should be noted. It could be argued that comparing different pre and post-training measures of innovative performance, as opposed to more traditional pre/post-test experimental approaches that utilize the same measures of repeated performance, is a limiting factor of the current study. Indeed, the pre and post-training tasks utilized in this study are commonly used solely as outcome measures, or as covariates, and some caution should be exercised when using them to examine trends over time. However, these measures can be particularly useful when to put to use as controls for baseline ability prior to training, as was the case in the current study. In this way, an effort was also made to refrain from explicitly using difference scores in performance as the outcome variable(s) given the controversy surrounding this practice. Alternatively, the order of the two innovative performance tasks could have been counterbalanced.

Future Research

The results and limitations of this study highlight particular areas in need of further research. First, it is important to test whether these results can be replicated in an applied work sample. As with conventional training and development efforts in organizations, motivation and engagement impact the effectiveness of online training, but the impact is likely to be more

salient in a student sample where the ultimate goal for many is class credit, as opposed to genuine enhancement of innovative performance and it is plausible that this scenario made it more difficult to find support for the study hypotheses. Trainees in organizational settings typically elect to participant in online training and development opportunities as part of their professional development, increasing the likelihood that a given participant might possess some fundamental level of motivation to take the training more seriously than would a given student participant. Furthermore, the Creative Problem Solving paradigm itself is potentially of greater overall appeal to leaders in organizations interested in fostering of a climate of creativity and innovation than for college students.

Second, future research might attempt to conduct a similar study using a longitudinal approach. In fact, an interesting follow-up effort might include repeated administrations of the same online training programs developed for the current study over a finite period of time to not only test the same sets of hypotheses, but for the presence of training transfer and trainee learning. Given the evidence to support such approaches, but the dearth of studies utilizing solely web-based training, such efforts might prove to be particularly informative. Future studies might also address how a seamless, computer-based, completely online training program might be most effectively designed and implemented when using a longer duration of actual training.

A final area for useful future research might be to further examine the profile of trainees for whom online CPS training might be particular effective. Such efforts might attempt to replicate the moderator findings from the current study and continue to extend our

understanding of how such constructs operate. Of particular importance is the continued exploration of CPI. Given that this is a relatively new variable in the literature, future investigations might examine whether CPI itself can be enhanced through training. Additional moderators not examined in the current study for moderating effects should also be explored, including (but not limited to) personality variables (e.g., conscientiousness, openness to experience) and perceived utility of training measures.

Conclusion

The ability to enhance innovation is crucial for organizational success in today's rapidly changing and technologically-driven workplace. In order for employees and employee teams to contribute to organizational innovation in the modern world of work, online training has emerged as a significant trend for organizational training and development. However, little research has been published on how to best design and implement such training to enhance innovation among employees. With the well-documented Osborn-Parnes Creative Problem Solving program as the conceptual framework, three online training programs were developed, implemented, and evaluated for their relative effectiveness for enhancing innovative performance. Innovative performance was conceptualized as having two dimensions, creativity and implementation planning, each consisting of two facets (quality and originality and penetration and forecasting, respectively) and hypotheses were tested with these variables as outcomes measures, both in aggregate form and separately. An additional experimental condition for training environment involving lab and non-lab samples was also investigated as

was the relative moderating influence of two variables: creative personal identity and intrinsic motivation.

Although hypotheses were only partially supported, several interesting findings emerged. Of particular note were two consistent findings: 1) a distinct positive trend for the IDS only condition indicating that online IDS only training may be more effective for enhancing innovative performance, as compared to full CPS or control training, and 2) a strong environment effect indicating that the provision of online creative problem solving training in a more formal, controlled setting results in higher overall innovative performance than does the identical training in a non-lab setting. In addition, evidence for the interactive effect of creative personal identity emerged. Taken together, the current study represents an important step towards achieving a more complete understanding of how to best design and implement online training for innovation and, as such, is a meaningful contribution to the literature with a value for both scholar and practitioner alike.

Appendix A

Study Measures
(Note: R = reverse coded item)

Creative Personal Identity

1. In general, my creativity is an important part of my self-image.

2. My creativity is an important part of who I am.

3. Overall, my creativity has little to do with how I see myself. (R)

4. My ability to be creative is an important reflection of who I am.

Creative Self-Efficacy

1. I am good at coming up with new ideas

2. I have lots of good ideas.

3. I have a good imagination.

Intrinsic Motivation

1. I enjoy tackling problems that are completely new to me.

2. I enjoy trying to solve complex problems.

3. The more difficult the problem, the more I enjoy trying to solve it.

4. Curiosity is the driving force behind much of what I do.

5. I enjoy simple, relatively straightforward tasks. (R)

Openness to Experience

1. I enjoy hearing new ideas.

2. I avoid philosophical discussions. (R)

3. I have a vivid imagination.

Achievement Striving

1. I do more than what's expected of me.

2. I plunge into tasks with all my heart.

3. I need a push to get started. (R)

Dominance

1. I want to control the conversation.

2. I lay down the law to others.

3. I challenge others' points of view.

4. I hate to seem pushy. (R)

Anxiety

1. I am afraid that I will do the wrong thing.

2. I feel threatened easily.

3. I feel crushed by setbacks.

4. I don't let others discourage me. (R)

Introversion

1. I don't like to draw attention to myself.

2. I don't talk a lot.

3. I keep in the background.

4. I am the life of the party. (R)

Independence

1. I don't care what others think.

2. I feel it's okay that some people don't like me.

3. I need the approval of others. (R)

Conscientiousness

1. I am always prepared.

2. I carry out my plans.

3. I do just enough work to get by. (R)

Agreeableness

1. I tolerate a lot from others.

2. I accept people as they are.

3. I am annoyed by others' mistakes. (R)

4. I hold a grudge. (R)

Appendix B

Definitions, Scales, and Benchmarks for Innovative Performance Facets (exemplars not shown)

BENCHMARKS: QUALITY – SENIOR GIFT

Quality = response is logical, complete, and coherent.

Logical: Is the solution logical? Are the characteristics relevant?

Completeness: Is the solution complete? Are all of the ideas fully and wholly developed? Does the solution address all of the major issues of the problem?

Coherence: Does the solution make sense? Is it coherent?

Scale and Benchmarks

5) Excellent rating: The solution is exceptionally logical. The solution includes all necessary elements for developing a senior gift, and is soundly complete. The solution is clear and exceptionally coherent.

4) Average to excellent rating

3) Average rating: The solution has logical elements to it. Though missing some key elements, most ideas are complete. The solution may contain one or two confusing elements, but makes general sense, overall.

2) Poor to average rating

1) Poor rating: The solution is illogical and incomplete. It does not make sense and fails to provide an answer to the problem in a sound, rational, manner.

BENCHMARKS: ORIGINALITY – SENIOR GIFT

Originality = response is unexpected, elaborate, and descriptive.

Unexpected: Did the participant approach the problem in a novel, imaginative unpredictable, or innovative manner?

Elaborative/Descriptive: Did the participant provide a rich answer—one that helps the reader visualize the solution?

Scale and Benchmarks

5) Excellent rating: The solution is clearly unique. It has core elements that appear wholly original—particularly to the participant. It is clear what the classroom would look like as well as operate. The solution is exceptionally rich and descriptive.

4) Average to excellent rating

3) Average rating: The solution has a few original and unique elements. The solution, however, still contains many predictable concepts. The solution is somewhat descriptive.

2) Poor to average rating:

1) Poor rating: The solution is very predictable and fails to provide any new or unique ideas. The solution completely lacks richness and descriptiveness. It is almost impossible to visualize the proposed course.

BENCHMARKS: PENETRATION - SENIOR GIFT

Penetration = response identifies causes operating in a situation or interdependencies among causes.

Identifies the causes operating in a situation: Are the factors that impact or influence other elements of the situation included? Are the causes having multiple outcomes identified? Have the causes that can be acted upon or altered been determined?

Identifies the interdependencies among causes: Have the causes that must occur together if the desired outcomes are to be attained been determined?

Evaluates the relative importance of causes: Has the importance of outcomes influenced by altering a cause been evaluated?

Scale and Benchmarks

1) Poor rating: The solution does not identify the causes operating in a situation or interdependencies among causes and fails to evaluate the relative importance of causes.

2) Poor to average rating

3) Average rating: The solution identifies some causes operating in a situation **or** interdependencies among causes but fails to evaluate the relative importance of causes.

4) Average to excellent rating

5) Excellent rating: The solution identifies several key causes operating in a situation **or** interdependencies among these causes.

BENCHMARKS: FORECASTING – SENIOR GIFT

Forecasting = response identifies outcomes and restrictions in a situation.

Projects positive and negative outcomes: Does the solution assess how plan implementation will change a situation and the number and nature of positive consequences that result? Does the solution assess how plan implementation will change a situation and the number and nature of negative consequences that result?

Projects short-term and long-term outcomes: Does the solution assess the outcomes that will both immediately result after plan implementation? Does the solution asses the outcomes likely to emerge over an extended period of time if planned actions are sustained?

Projects likely contingencies and restrictions: Does the solution assess the conditions required for or likely to shape the successful implementation of the plan?

Projects likely errors in plan execution: Does the solution assess the conditions under which the plan will encounter obstacles or things that might go wrong?

Anticipates the conditions calling forecasting of backup plans: Does the solution assess the conditions that might arise that will require an alternative approach to plan implementation?

Scale and Benchmarks

1) Poor rating: The solution does not include a projection of either positive/negative or short/long-term outcomes. It does not assess plan contingencies, likely errors, or address backup plans.

2) Poor to average rating

3) Average rating: The solution projects some positive/negative or short/long-term outcomes. Though missing some other key elements, the solution attempts to address at least one of the remaining forecasting elements.

4) Average to excellent rating

5) Excellent rating: The solution addresses many of the forecasting elements necessary for developing a senior gift.

BENCHMARKS: QUALITY – FUTURE CAMPUS

Quality = response is logical, complete, and coherent.

Logical: Is the solution logical? Are the characteristics relevant?

Completeness: Is the solution complete? Are all of the ideas fully and wholly developed? Does the solution address all of the major issues of the problem?

Coherence: Does the solution make sense? Is it coherent?

Scale and Benchmarks

5) Excellent rating: The solution is exceptionally logical. The solution includes all necessary elements for developing a new classroom, and is soundly complete. The solution is clear and exceptionally coherent.

4) Average to excellent rating

3) Average rating: The solution has logical elements to it. Though missing some key elements, most ideas are complete. The solution may contain one or two confusing elements, but makes general sense, overall.

2) Poor to average rating

1) Poor rating: The solution is illogical and incomplete. It does not make sense and fails to provide an answer to the problem in a sound, rational, manner.

BENCHMARKS: ORIGINALITY – FUTURE CAMPUS

Originality = response is unexpected, elaborate, and descriptive.

Unexpected: Did the participant approach the problem in a novel, imaginative unpredictable, or innovative manner?

Elaborative/Descriptive: Did the participant provide a rich answer—one that helps the reader visualize the solution?

Scale and Benchmarks

5) Excellent rating: The solution is clearly unique. It has core elements that appear wholly original—particularly to the participant. It is clear what the classroom would look like as well as operate. The solution is exceptionally rich and descriptive.

4) Average to excellent rating

3) Average rating: The solution has a few original and unique elements. The solution, however, still contains many predictable concepts. The solution is somewhat descriptive.

2) Poor to average rating:

1) Poor rating: The solution is very predictable and fails to provide any new or unique ideas. The solution completely lacks richness and descriptiveness. It is almost impossible to visualize the proposed course.

BENCHMARKS: PENETRATION – FUTURE CAMPUS

Penetration = response identifies causes operating in a situation or interdependencies among causes.

Identifies the causes operating in a situation: Are the factors that impact or influence other elements of the situation included? Are the causes having multiple outcomes identified? Have the causes that can be acted upon or altered been determined?

Identifies the interdependencies among causes: Have the causes that must occur together if the desired outcomes are to be attained been determined?

Evaluates the relative importance of causes: Has the importance of outcomes influenced by altering a cause been evaluated?

Scale and Benchmarks

1) Poor rating: The solution does not identify the causes operating in a situation or interdependencies among causes and fails to evaluate the relative importance of causes.

2) Poor to average rating

3) Average rating: The solution identifies some causes operating in a situation **or** interdependencies among causes but fails to evaluate the relative importance of causes.

4) **Average to excellent rating**

5) Excellent rating: The solution identifies several key causes operating in a situation **or** interdependencies among these causes.

BENCHMARKS: FORECASTING – FUTURE CAMPUS

Forecasting = response identifies outcomes and restrictions in a situation.

Projects positive and negative outcomes: Does the solution assess how plan implementation will change a situation and the number and nature of positive consequences that result? Does the solution assess how plan implementation will change a situation and the number and nature of negative consequences that result?

Projects short-term and long-term outcomes: Does the solution assess the outcomes that will both immediately result after plan implementation? Does the solution asses the outcomes likely to emerge over an extended period of time if planned actions are sustained?

Projects likely contingencies and restrictions: Does the solution assess the conditions required for or likely to shape the successful implementation of the plan?

Projects likely errors in plan execution: Does the solution assess the conditions under which the plan will encounter obstacles or things that might go wrong?

Anticipates the conditions calling forecasting of backup plans: Does the solution assess the conditions that might arise that will require an alternative approach to plan implementation?

Scale and Benchmarks

1) Poor rating: The solution does not include a projection of either positive/negative or short/long-term outcomes. It does not assess plan contingencies, likely errors, or address backup plans.

2) Poor to average rating

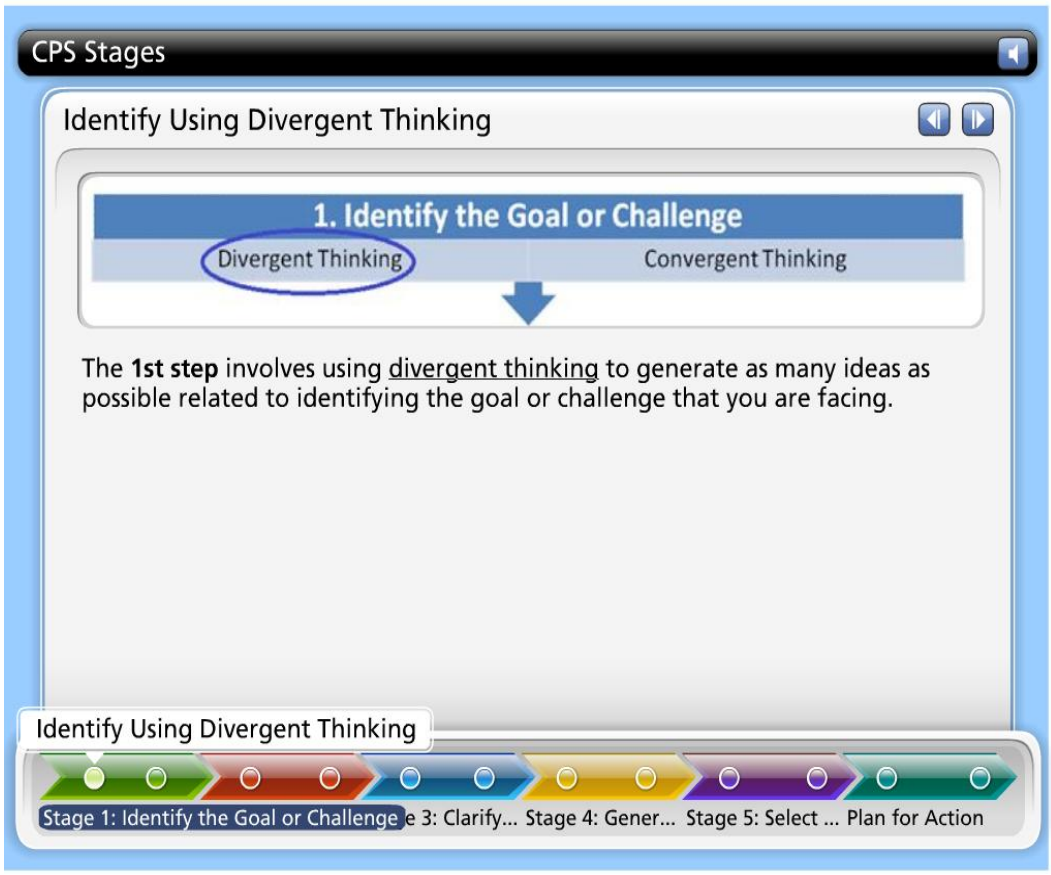
3) Average rating: The solution projects some positive/negative or short/long-term outcomes. Though missing some other key elements, the solution attempts to address at least one of the remaining forecasting elements.

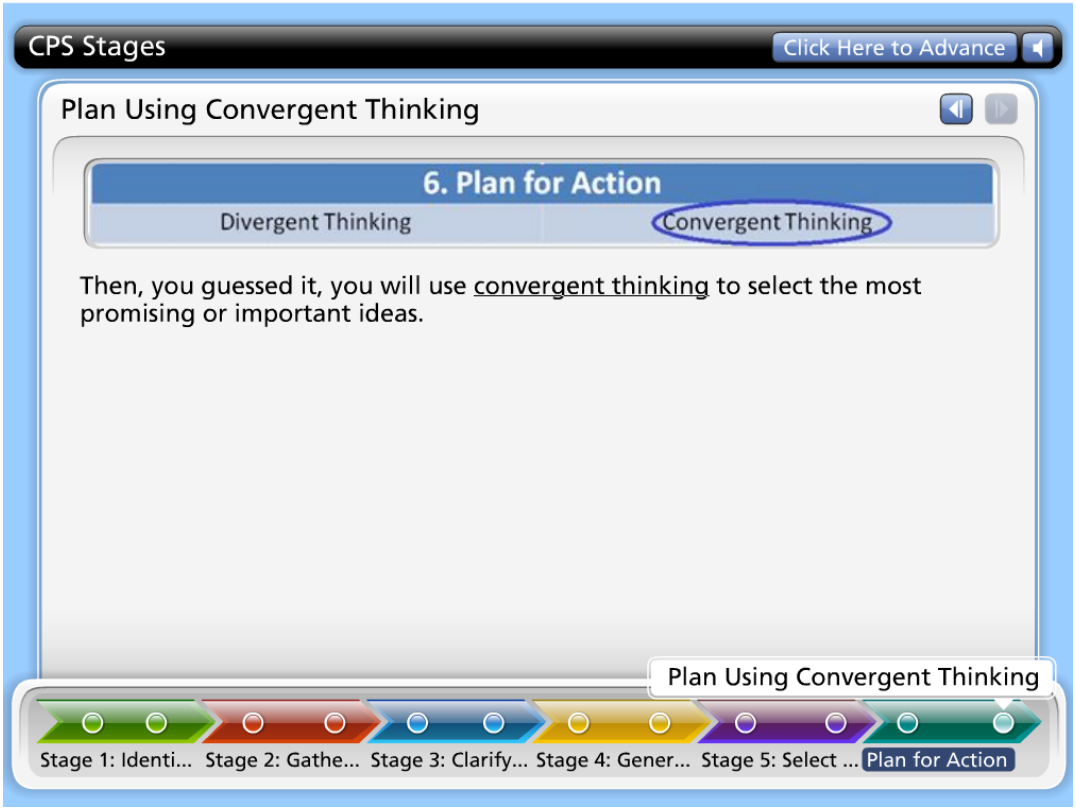
4) **Average to excellent rating**

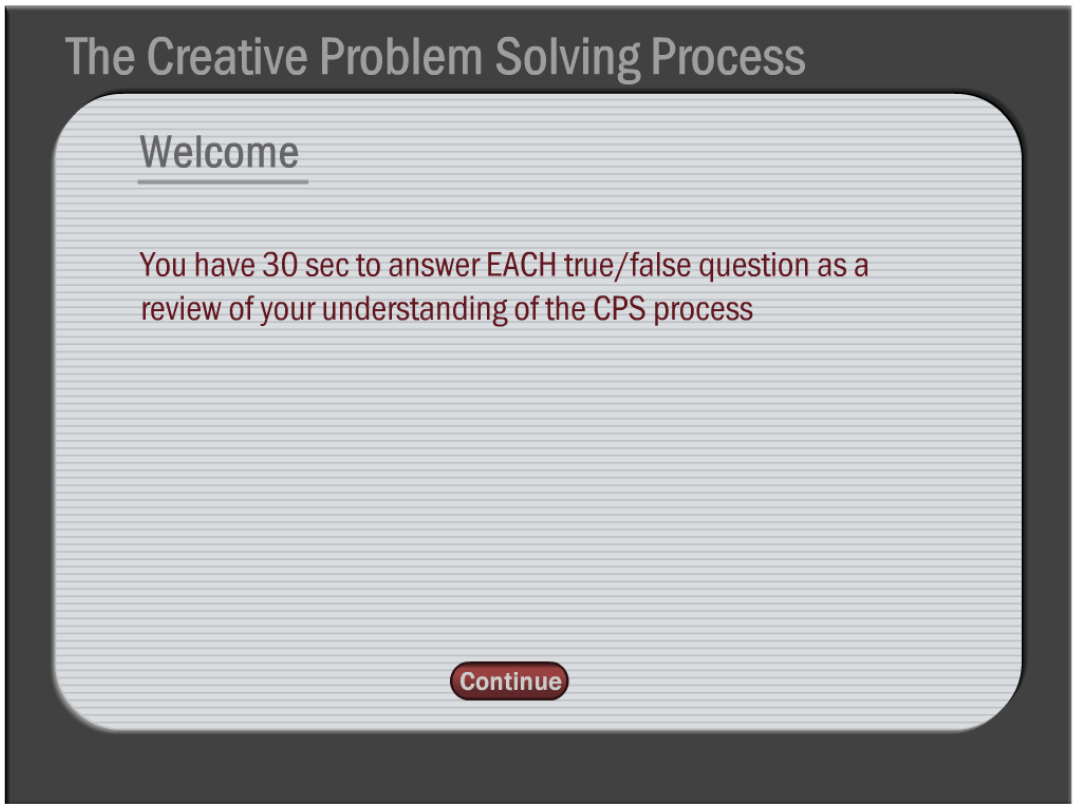
5) Excellent rating: The solution addresses many of the forecasting elements necessary for developing the campus of the future.

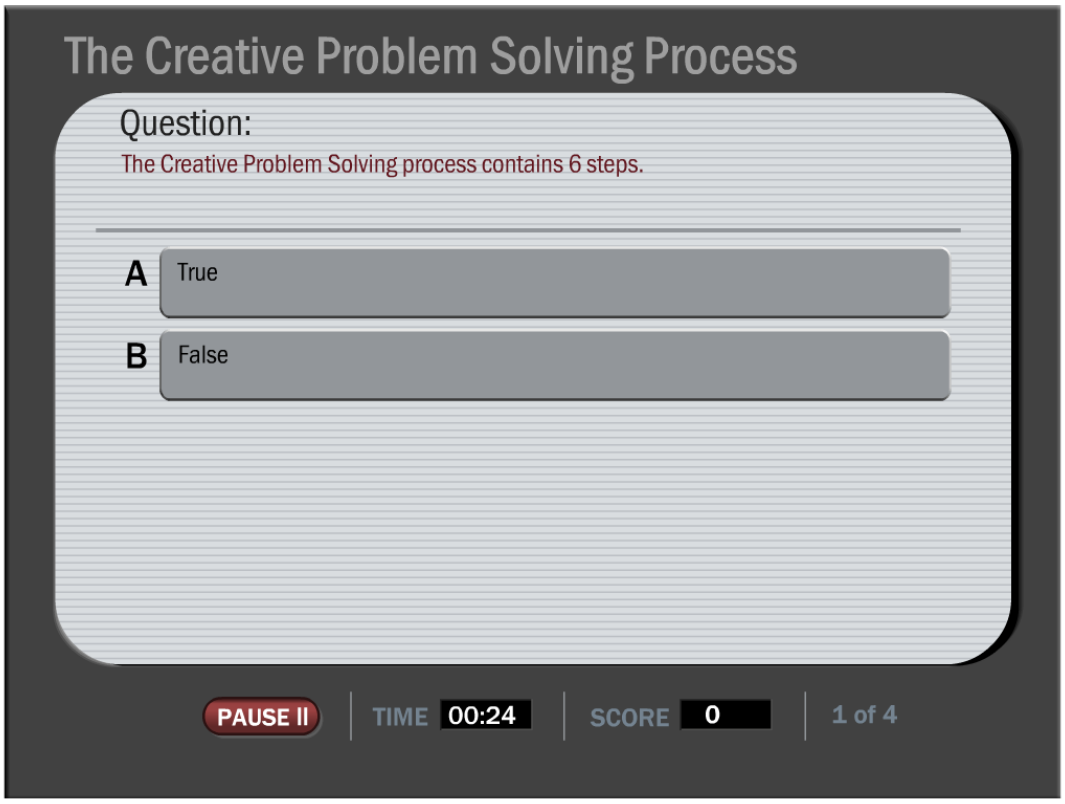
Appendix C

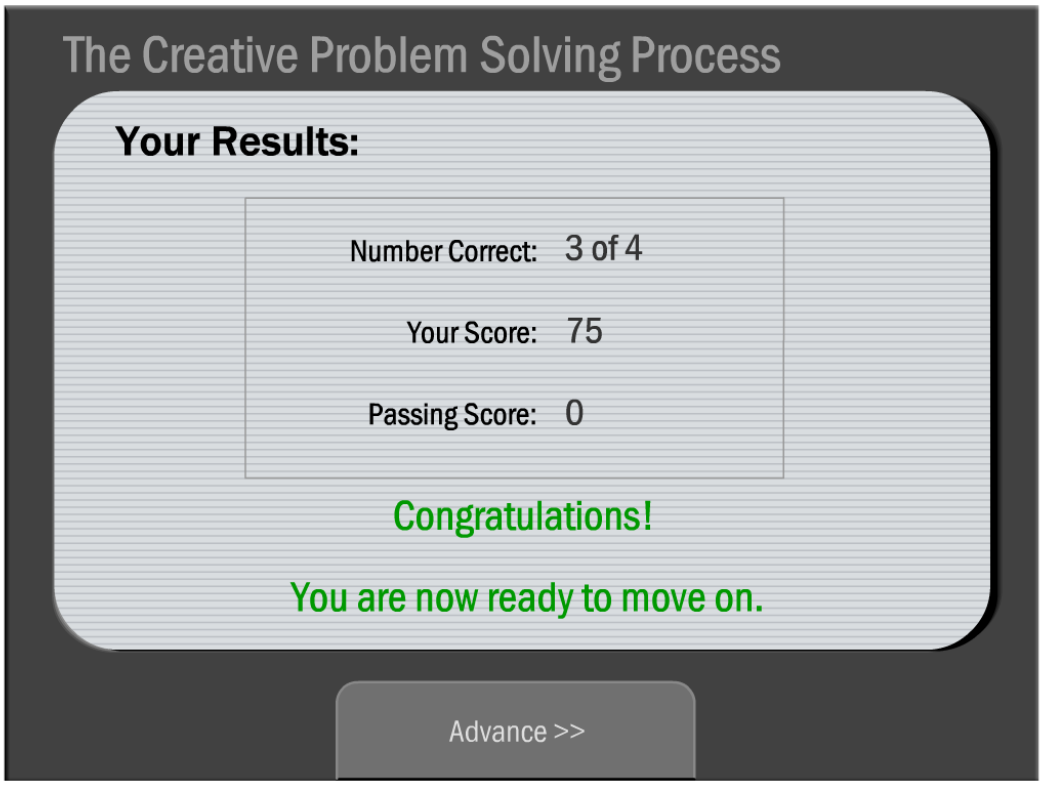
Online Training Screenshots

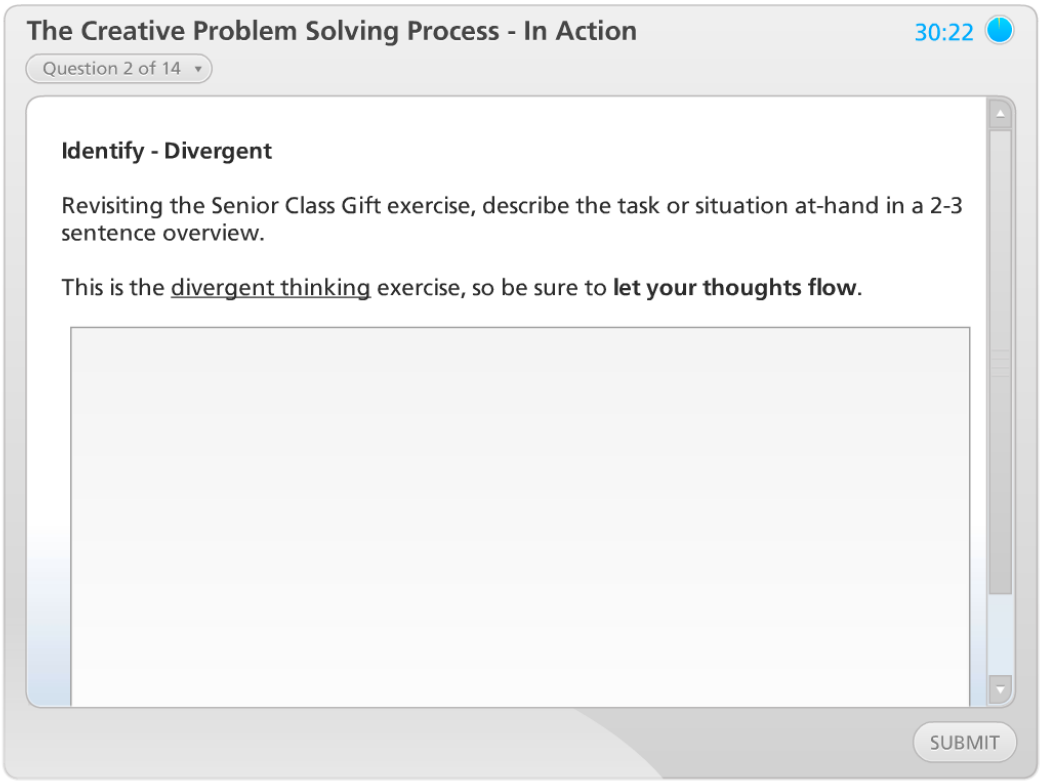



CPS Stages
Click Here to Advance
Plan Using Convergent Thinking
6. Plan for Action
Divergent Thinking
Convergent Thinking
Then, you guessed it, you will use convergent thinking to select the most promising or important ideas.
Plan Using Convergent Thinking
Stage 1: Identi...
Stage 2: Gathe...
Stage 3: Clarify...
Stage 4: Gener...
Stage 5: Select ...
Plan for Action


The Creative Problem Solving Process
Welcome
You have 30 sec to answer EACH true/false question as a review of your understanding of the CPS process
Continue


The Creative Problem Solving Process
Question:
The Creative Problem Solving process contains 6 steps.
A
True
B
False
PAUSE II
TIME
00:24
SCORE
0
1 of 4


The Creative Problem Solving Process
Your Results:
Number Correct: 3 of 4
Your Score: 75
Passing Score: 0
Congratulations!
You are now ready to move on.
Advance >>


The Creative Problem Solving Process - In Action
30:22
Question 2 of 14
Identify - Divergent
Revisiting the Senior Class Gift exercise, describe the task or situation at-hand in a 2-3 sentence overview.
This is the divergent thinking exercise, so be sure to let your thoughts flow.
SUBMIT

Your Training Color and Shape is…

ORANGE SQUARE

Please Click the Link Below to Continue

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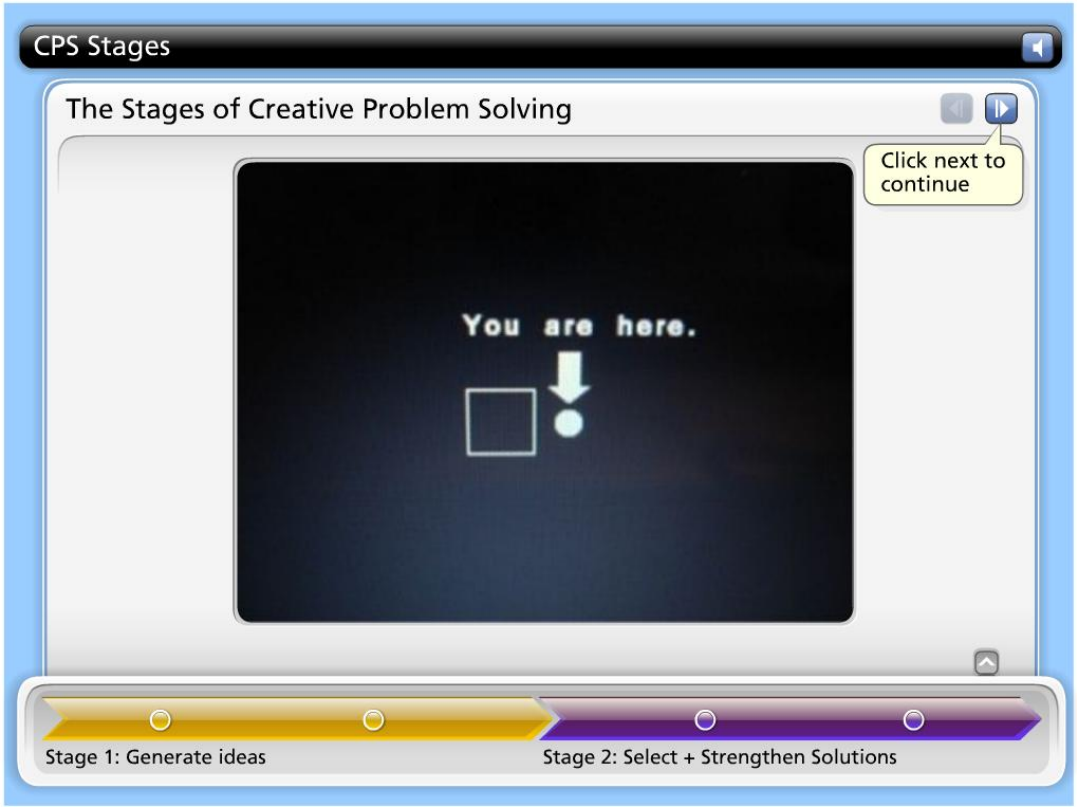
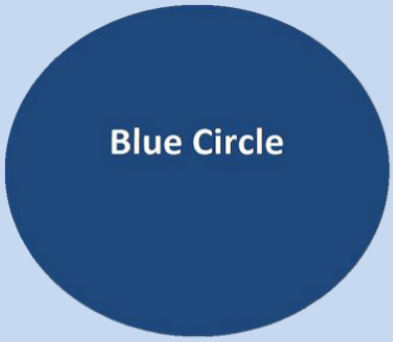

CPS Stages
The Stages of Creative Problem Solving
Click next to continue
You are here.
Stage 1: Generate ideas
Stage 2: Select + Strengthen Solutions

Your Training Color and Shape is…

BLUE CIRCLE



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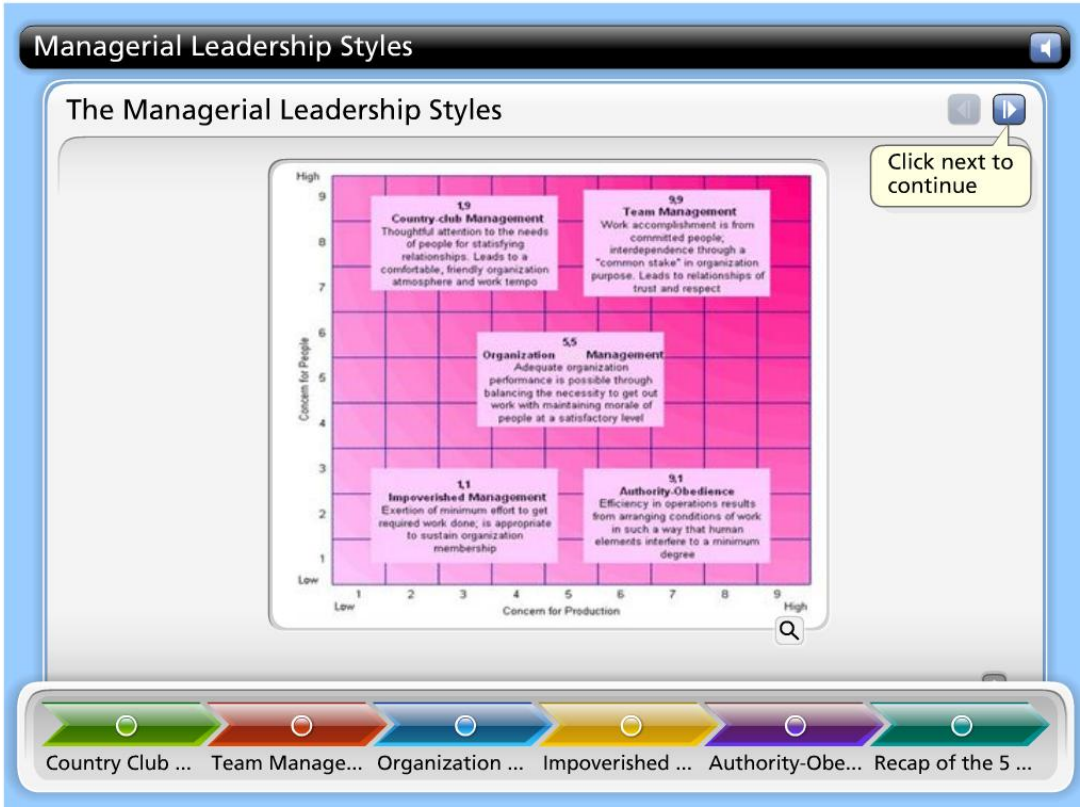
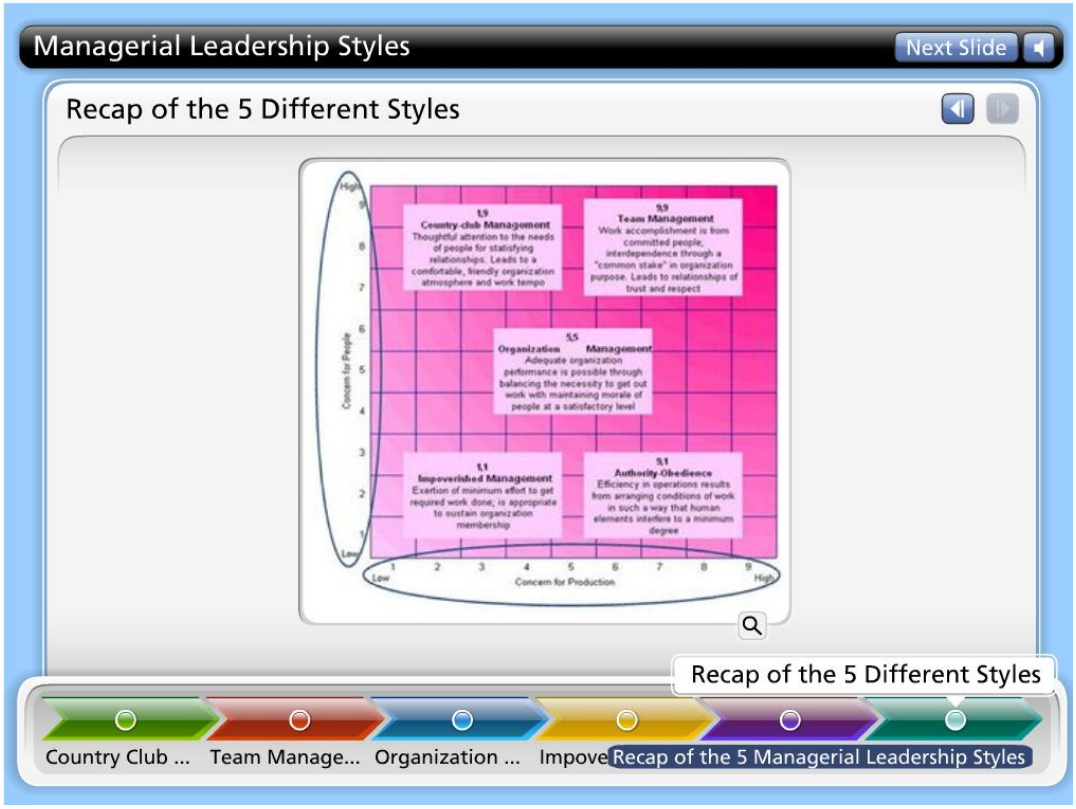
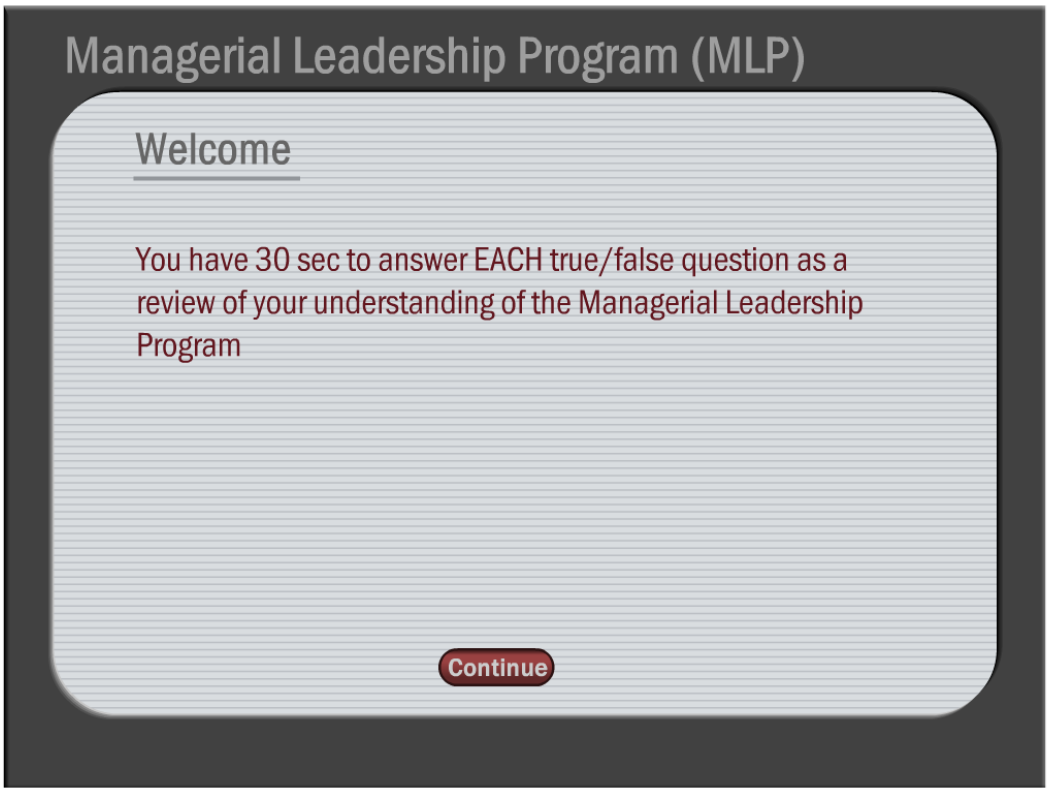
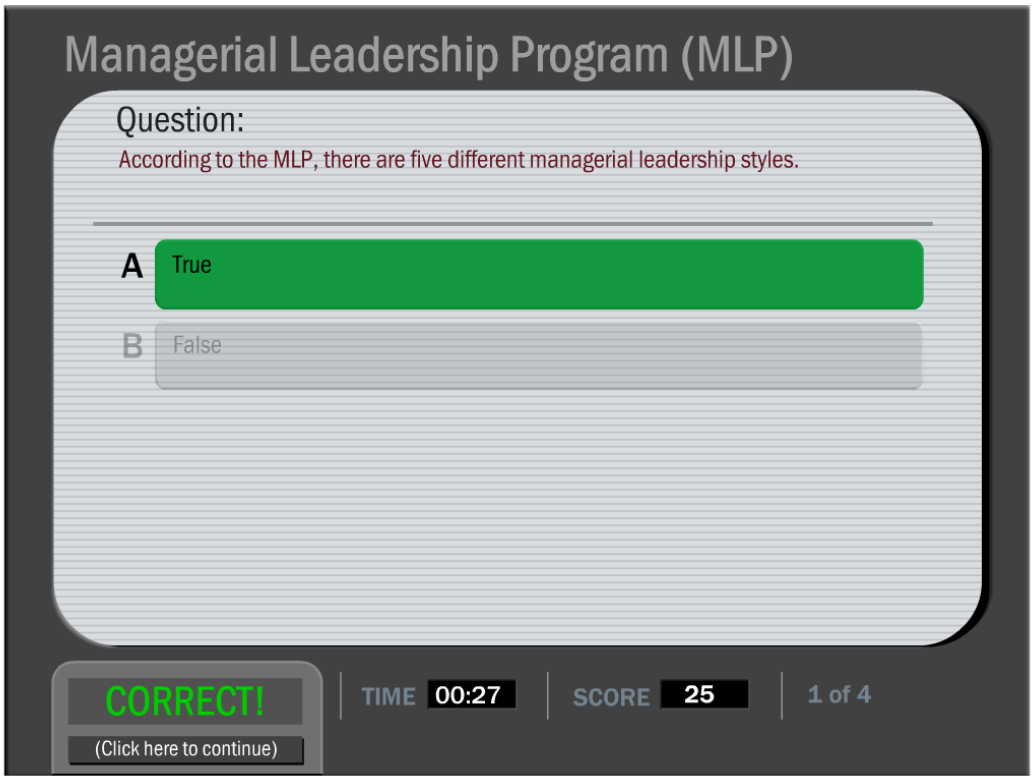
Intro to Managerial Leadership Training
Welcome!
Hello and welcome to Managerial Leadership training. This program will guide you through a series of modules that will introduce you to the Managerial Leadership Program, or MLP for short. Before we begin the training modules, let's start with a brief introduction to what exactly MLP entails and where it came from.
Origins of The Managerial Leadership Program
Managerial Leadership Takes Off
The Heart of Managerial Leadership

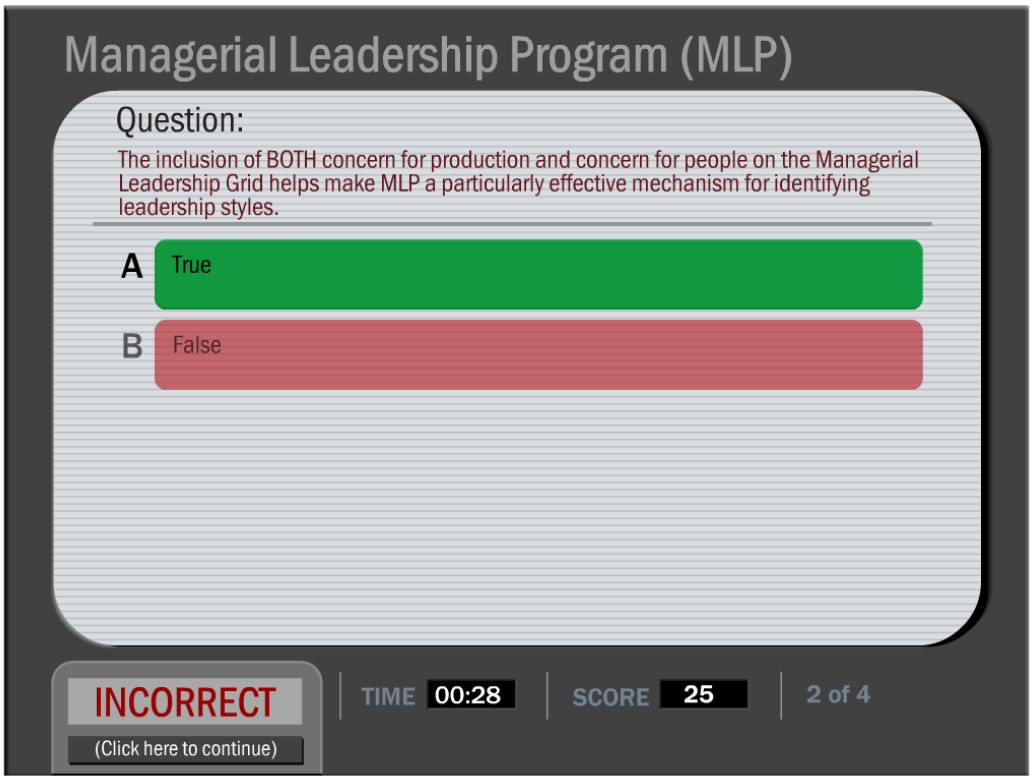

Managerial Leadership Styles
The Managerial Leadership Styles
Click next to continue
High
Low
Concern for People
Concern for Production
1,9
Country-club Management
Thoughtful attention to the needs of people for satisfying relationships. Leads to a comfortable, friendly organization atmosphere and work tempo
9,9
Team Management
Work accomplishment is from committed people; interdependence through a "common stake" in organization purpose. Leads to relationships of trust and respect
5,5
Organization Management
Adequate organization performance is possible through balancing the necessity to get out work with maintaining morale of people at a satisfactory level
1,1
Impoverished Management
Exertion of minimum effort to get required work done; is appropriate to sustain organization membership
9,1
Authority-Obedience
Efficiency in operations results from arranging conditions of work in such a way that human elements interfere to a minimum degree
Country Club ...
Team Manage...
Organization ...
Impoverished ...
Authority-Obe...
Recap of the 5 ...

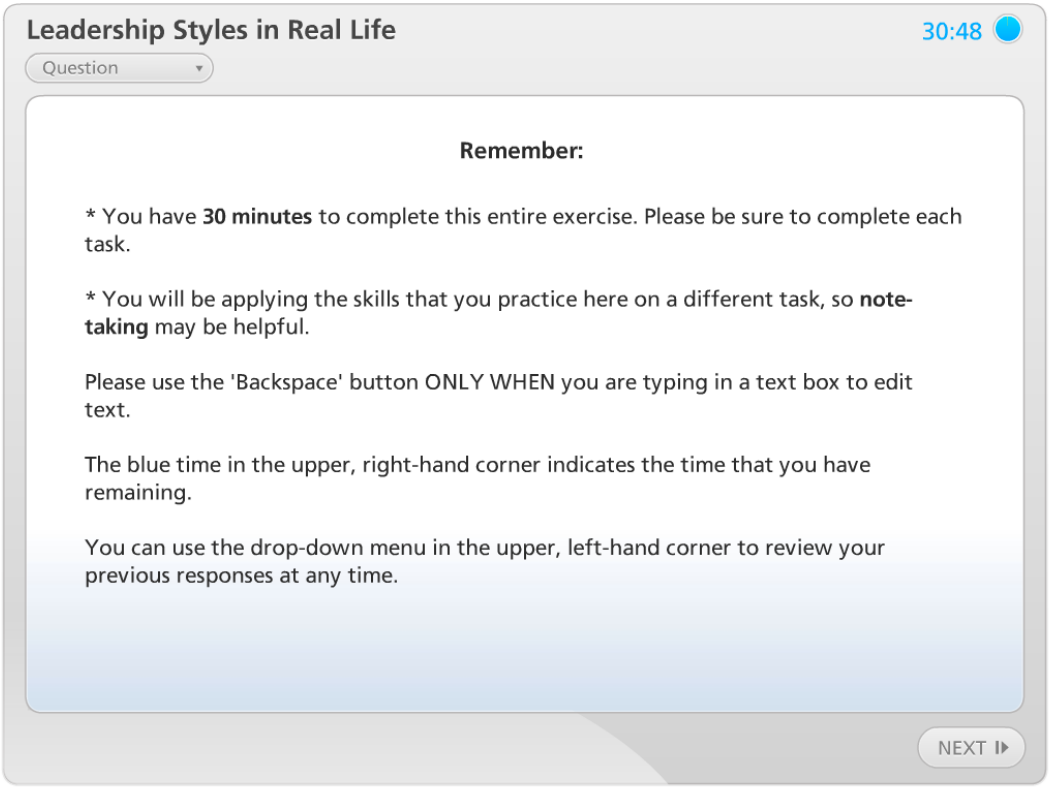

Managerial Leadership Styles
Next Slide
Recap of the 5 Different Styles
1,9
Country club Management
Thoughtful attention to the needs of people for statisfying relationships. Leads to a comfortable, friendly organization atmosphere and work tempo
9,9
Team Management
Work accomplishment is from committed people; interdependence through a "common stake" in organization purpose. Leads to relationships of trust and respect
5,5
Organization Management
Adequate organization performance is possible through balancing the necessity to get out work with maintaining morale of people at a satisfactory level
1,1
Impoverished Management
Exertion of minimum effort to get required work done, is appropriate to sustain organization membership
9,1
Authority-Obedience
Efficiency in operations results from arranging conditions of work in such a way that human elements interfere to a minimum degree
Concern for People
Concern for Production
Low
High
Recap of the 5 Different Styles
Country Club ...
Team Manage...
Organization ...
Impove
Recap of the 5 Managerial Leadership Styles


Managerial Leadership Program (MLP)
Welcome
You have 30 sec to answer EACH true/false question as a review of your understanding of the Managerial Leadership Program
Continue


Managerial Leadership Program (MLP)
Welcome to CHOICES.
Your objective is to answer each question correctly before time runs out.
Simply click the correct answer with your mouse.
Click the pause button to stop the clock during play.
PAUSE II
Your time remaining will count down in seconds.
TIME 00:02
Your score will be calculated along the way.
SCORE 100
Your progress will update as you advance.
1 of 4
Click the GO button to get started!
GO!

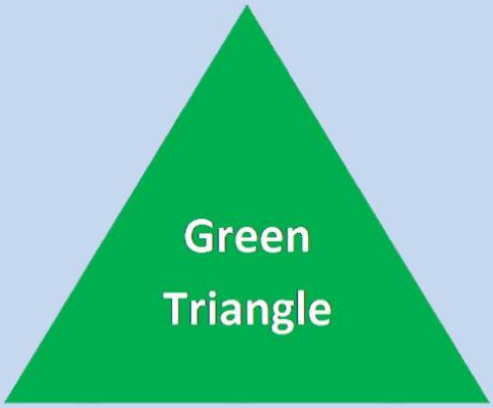

Managerial Leadership Program (MLP)
Question:
According to the MLP, there are five different managerial leadership styles.
A
True
B
False
CORRECT!
(Click here to continue)
TIME
00:27
SCORE
25
1 of 4


Managerial Leadership Program (MLP)
Question:
The inclusion of BOTH concern for production and concern for people on the Managerial Leadership Grid helps make MLP a particularly effective mechanism for identifying leadership styles.
A
True
B
False
INCORRECT
(Click here to continue)
TIME
00:28
SCORE
25
2 of 4


Leadership Styles in Real Life
30:48
Question
Remember:
* You have 30 minutes to complete this entire exercise. Please be sure to complete each task.
* You will be applying the skills that you practice here on a different task, so note-taking may be helpful.
Please use the 'Backspace' button ONLY WHEN you are typing in a text box to edit text.
The blue time in the upper, right-hand corner indicates the time that you have remaining.
You can use the drop-down menu in the upper, left-hand corner to review your previous responses at any time.
NEXT

Your Training Color and Shape is…

GREEN TRIANGLE



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References

Aguinis, H., & Kraiger, K. (2009). Benefits of training and development for individuals, teams, and society. *Annual Review of Psychology, 60*.

Aiken, L. & West, S. (1991). Multiple Regression: Testing and Interpreting Interactions. London: Sage Publications.

Amabile, T. M. (1983). The social psychology of creativity: A componential conceptualization. *Journal of Personality and Social Psychology, 45(2)*, 357-376.

Amabile, T. M. (1988). A model of creativity and innovation in organizations. In B. M. Staw, & L. L. Cummings (Eds.), *Research in Organizational Behavior*, vol. 10 (pp. 123–167). Greenwich, CT: JAI Press.

Amabile, T. M. (1990). Within you, without you: The social psychology of creativity, and beyond. In M. A. Runco& R. S. Albert (Eds.), *Theories of creativity* (pp. 61-91). Newbury Park, CA: Sage Publications.

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

Amabile, T. M. (1997). Entrepreneurial creativity through motivational synergy. *Journal of Creative Behavior, 31,* 18–26.

Amabile, T. M., Hill, K. G., Hennessey, B. A., & Tighe, E. M. (1994). The work preference inventory: Assessing intrinsic and extrinsic motivational orientations. *Journal of Personality and Social Psychology, 66(1)*, 950-967.

Amabile, T. M., Hennessey, B. A., & Grossman, B. S. (1986). Social Influences on Creativity: The Effects of Contracted-For Reward. *Journal of Personality and Social Psychology, 50(1),* 14-23.

Amabile, T. M., & Gryskiewicz, N. D. (1989). The creative environment scales: Work environment inventory. *Creativity Research Journal, 2*(4), 231-253.

American Society for Training and Development (2009). 2010 State of the industry report. Retrieved from: http://www.astd.org/NR/rdonlyres/EEEEBED3-0EFB-44DE-85C5-1745614DED75/0/2009SOIRreleaseFINAL.pdf

Anderson, C., Lindsay, J. J., & Bushman, B. J. (1999). Research in the psychology laboratory: truth or triviality? *Current Directions in Psychological Science, 8,* 3-9.

Barron, F. (1970). Creativity. In P. E. Vernon (Ed.), *Creativity* (pp. 273-288). Penguin books.

Basadur,M. S., Graen, G. B., & Scandura, T. A. (1986). Training effects on attitudes toward divergent thinking among manufacturing engineers. *Journal of Applied Psychology, 71,* 612–617.

Basdur, M. ,& Finkbeiner, C. T. (1985). Measuring preference for ideation in creative problem solving training. *Journal of Applied Behavioral Science, 21,* 37-49.

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

Basadur, M., & Hausdorf, P. A. (1996). Measuring divergent thinking attitudes related to creative problem solving and innovation management. *Creativity Research Journal, 9,* 21-32.

Basadur, M., Pringle, P., Speranzini, G. & Bacot, M. (2000). Collaborative problem solving through creativity in problem definition: Expanding the pie. *Creativity and Innovation Management, 9,* 54-76.

Basadur, M., Taggar, S., & Pringle, P. (1999). Improving the measurement of divergent thinking attitudes in organizations. *The Journal of Creative Behavior, 33,* 75-111.

Basadur, M. S., Wakabayashi, M., & Graen, G. B. (1990). Individual problem-solving styles and attitudes toward divergent thinking before and after training. *Creativity Research Journal, 3*, 22-32.

Basadur, M. S., Wakabayashi, M., & Takai, J. (1992). Training effects on the divergent thinking attitudes of Japanese managers. *International School of Intercultural Relations, 16,* 329–345.

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

Begehtto, R. A. (2006). Creative self-efficacy: Correlates in middle and secondary students. *Creativity Research Journal, 18(4),* 447-457.

Benedek, M, Fink, A., & Neubauer, A. C. (2006). Enhancement of ideational fluency by means of computer-based training. *Creativity Research Journal, 18(3),* 317-328.

Benzer, J., & Bergman, M. (2007, April). *You must be creative! Performance feedback, intrinsic motivation and creativity.* Paper presented at the meeting of the Society for Industrial-Organizational Psychology Conference, New York, New York.

Berger, R. M., Guilford, J. P., & Christensen, P. R. (1957). A factor analytic study of planning abilities. *Psychological Monographs, 71*, 1-29.

Besemer, S. P., & O'Quin, K. (1999). Confirming the three-factor creative product analysis matrix model in an American sample. *Creativity Research Journal, 12(4),* 287-296.

Birdi, K. (2007). A lighthouse in the desert? evaluating the effects of creativity training on employee innovation. *Journal of Creative Behavior, 41*(4), 249-270.

Blake, R. & Mouton, J. (1964). The managerial grid: The key to leadership excellence. Houston: Gulf Publishing Co.

Blake, R. & Mouton, J. (1985). The managerial grid III: The key to leadership excellence. Houston: Gulf Publishing Co.

Brewer, M. B. (1991). The social self: On being the same and different at the same time. *Personality and Social Psychology Bulletin, 17,* 475-482.

Brown, G. B., & Ford, J. K. (2002). Using computer technology in training: Building an infrastructure for active learning. In K. Kraiger (Ed.) *Creating, implementing, and managing effective training and development: State-of-the-art lessons for practice* (pp. 192-233). San Francisco, CA: Jossey-Bass.

Burstiner, I. (1973). Creativity training: Management tool for high school department chairmen. *Journal of Experimental Education, 41,* 17–19.

Carey, L. J., & Flower, L. (1989). Foundations for creativity in the writing process. In Glover, J. A., Ronning, R. R., and Reynolds, C. R. (Eds.) *Handbook of creativity* (pp. 383-303). London: Wiley.

Carney, S. (1986). *Intrinsic motivation in successful artists from early childhood to middle age.* Unpublished doctoral dissertation. University of Chicago.

Casner-Lotto, J., Rosenblum, E., & Wright, M. (2009). *The Ill-Prepared U.S. Workforce: Exploring the Challenges of Employer-provided Workforce Readiness Training*. The Conference Board, Research Report.

Cattell, R. B., Eber, H. W., & Tatsuoka, M. M. (1970). *The handbook for the sixteen personality factor (16PF) questionnaire.* Champaign, IL: Institute for Personality and Ability Testing.

Clapham, M. M. (1997). Ideational skills training: A key element in creativity training programs. *Creativity Research Journal, 10,* 33-44.

Clapham, M. M., & Schuster, D. H. (1992). Can engineering students be trained to think more creatively? *Journal of Creative Behavior, 26*, 156-162.

Clements, D. H. (1991). Enhancement of creativity in computer environments. *American Educational Research Journal, 28,* 173-187.

Clements, D. H. & Gullo, D. F. (1984). Effects of computer programming on young children's cognition. *Journal of Educational Psychology, 76,* 1051-1058.

Cohen-Charash, Y. & Spector, P. E., (2001). The role of justice in organizations. *Organizational Behavior and Human Decision Processes, 86,* 278-321.

Collins, M. A., & Amabile, T. M. (1999). Motivation and creativity. In R. J. Sternberg (Ed)., *Handbook of creativity* (pp. 297-309). New York: Cambridge University Press.

Conlin, M. (2006, June 19). Champions of innovation. *Business Week,* 19-26.

Costa, P. T., Jr., & McCrae, R. R. (1992). *Revised NEO Personality Inventory (NEO-PI-R) and NEO Five-Factor Inventory (NEO-FFI) professional manual*. Odessa, FL: Psychological Assessment Resources.

Cramond, B., Matthews-Morgan, J., Bandalos, D., & Zuo, L. (2005). A report on the 40-year follow-up of the torrance tests of creative thinking: Alive and well in the new millennium. *Gifted Child Quarterly, 49*(4), 283-291.

Cropley, A. J. (1990). Creativity and mental health. *Creativity Research Journal, 3,* 167–178.

Cropley, A. J. (1997). Fostering creativity in the classroom: General principals. In M. A. Runco (Ed.), *Handbook of creativity Research: Volume one* (pp. 83–114). Norwood, NJ: Ablex.

Cropley, D. H., & Cropley, A. J. (2000). Fostering creativity in engineering undergraduates. *High Ability Studies, 11*(2), 207-219.

Csikszentmihalyi, M., & Csikszentmihalyi, I. S., (Eds.). (1988). *Optimal experience: Psychological studies of flow in consciousness.* Cambridge University Press.

Daniels, R. R., Heath, R. G., & Enns, K. S. (1985). Fostering creative behavior among university women. *Roeper Review, 7,* 164–166.

Davila, T., Epstein, M. J., & Shelton, R. D. (2007). *The creative enterprise : Managing innovative organizations and people*. Westport, Conn.: Praeger.

Davis, R. B. (1984). *Learning mathematics: The cognitive science approach to mathematics education.* Norwood, NJ: Ablex.

DeRosa, D. M., Smith, C. L., & Hantula, D. A. (2007). The medium matters: Mining the long-promised merit of group interaction in creative idea generation tasks in a meta-analysis of the electronic group brainstorming literature. *Computers in human behavior, 23,* 1549-1581.

Dominowski, R. L. (1995). Productive problem solving. In S. M. Smith, T. B. Ward, & R. A Finke (Eds.), *The creative cognition approach* (pp. 73-95). Cambridge, MA: MIT Press.

Estrada, C. A., Isen, A. M., & Young, M. J. (1994). Positive affect improves creative problem solving and influences reported source of practice satisfaction in physicians. *Motivation and Emotion, 18,* 285–299.

Feist, G. J. (1998). A meta-analysis of personality in scientific and artistic creativity. *Personality and Social Psychology Review, 2,* 290-309.

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

Feldhusen, J.F., Treffinger, D.J. & Bahlke, S.J. (1970). Developing Creative Thinking: The Purdue creativity problem. *The Journal of Creative Behavior, 4*, 85-90.

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

Firestien, R. L. (1990). Effects of creative problem solving on communication behaviors in small groups. *Small Group Research, 21,* 507-21.

Firestien, R. L.. & McCowan, R. J. (1988). Creative problem solving and communication behaviors in small groups. *Creativity Research Journal, 1,* 106-114.

Florida, R. (2002). *The rise of the creative class*. New York: Basic Books.

Fontenot, N.A. (1993) Effects of training in creativity and creative problem finding upon business people. *Journal of Social Psychology, 133*, 11–22.

Fritz, R. L. (1993). Problem solving attitude among secondary marketing education students. *Marketing Educators Journal, 19,* 45–59.

Frucot, V. G., & Cook, G. L. (1994). Further research on the accuracy of student self-reported grade point averages, SAT scores, and course grades. *Perceptual and Motor Skills, 79*, 743-746.

Frymire, B . (2006, October 7). The search for talent; Business and Society. *The Economist*, 8498, 11.

Galunic, D. C., & Eisenhardt, K. M. (2001). Architectural innovation and modular corporate forms. *The Academy of Management Journal, 44(6)*, 1229-1249.

Gatignon, H., Tushman, M. L., Smith, W., & Anderson, P. (2002). A structural approach to assessing innovation: Construct development of innovation locus, type and characteristics. *Management Science, 48,* 1103–1122.

Gibson, C. B., & Gibbs, J. L. (2006). Unpacking the concept of virtuality: The effects of geographic dispersion, electronic dependence, dynamic structure, and national diversity on team innovation. *Administrative Science Quarterly, 51,* 451-495.

Gilson, L. L. (2008). Why be creative: A review of the practical outcomes associated with creativity at the individual, group, and organizational levels. In J. Zhou & C. E. Shalley (Eds.), *Handbook of organizational creativity* (pp. 303-322). New York, NY: Lawrence Glass, G. V. (1978) Integrating findings: the meta-analysis of research. In Shulman, *L. S.* (Ed.), *Review of research in education* (pp. 351-379). Itasca, IL: Peacock.

Goldman, B. A., Flake, W. L., & Matheson, M. B. (1990). Accuracy of college students' perceptions of their SAT scores, high school and college grade point averages relative to their ability. *Perceptual and Motor Skills, 70*, 514.

Gough, H. G. (1980). *The adjective check list manual.* Palo Alto, CA: Consulting Psychology Press.

Gough, H. G. (1996). *CPI Manual: Third Edition*. Palo Alto, CA: Consulting Psychologists Press.

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

Greer, M., & Levine, E. (1991). Enhancing creative performance in college students. *Journal of Creative Behavior, 25,* 250-255.

Gruber, H. E., & Davis, S. N. (1988). Inching our way up Mount Olympus: The evolving-systems approach to creative thinking. In R. J. Sternberg (Ed.), *The nature of creativity* (pp. 143-169). Cambridge, New York: Cambridge University Press.

Guilford, J. P. (1950). Creativity. *American Psychologist, 5*(9), 444-454.

Guilford, J. P., & Tenopyr, M. L. (1968). Implications of the Structure-of-Intellect model for high school and college students. In W. B. Michael (Ed.), *Teaching for creative endeavor: Bold new venture* (pp. 25-45). Bloomington: Indiana Univ. Press.

Harkins, J. D., & Macrosson, W. K. (1990). Creativity training: An assessment of a novel approach. *Journal of Business and Psychology, 5*(1), 143-148.

Hennessey, B. A., & Zbikowski, S. (1993). Immunizing children against the negative effects of reward: A further examination of intrinsic motivation training techniques. *Creativity Research Journal, 6,* 297-308.

Holland, S. (1989). *Artificial intelligence, education, and music: The use of artificial intelligence to encourage and facilitate music composition by novices*. Institute of Educational Technology, ERIC Document Reproduction Service No. ED 329 452, Bucks, England: Walton Bletchley.

Huck, S. W. (2004). *Reading statistics and research* (4th ed.). Boston: Pearson.

Hunsaker, S. L. (2005). Outcomes of creativity training programs. *Gifted Child Quarterly, 49*(4), 292-299.

Hunter, S.T., Cassidy, S.E., Ligon, G.S. (in press). Planning for Innovation: A Process Oriented Perspective. In Mumford, M.D. (Ed.), *Handbook of Organizational Creativity*. Elsevier Press.

Jaben, T. H. (1983). The effects of creativity training on learning disabled students' creative expression. *Journal of Learning Disabilities, 16,* 264–265.

Jackson, D. N., Paunonen, S. V., & Tremblay, P. F. (2000). *Six Factor Personality Questionnaire Manual*. Port Huron, MI: Sigma Assessment Systems.

Jaussi, K. S., Randel, A. E., Dionne, S. D. (2007). I am, I think I can, and I do: The role of personal identity, self-efficacy, and the cross-application of experiences in creativity at work. *Creativity Research Journal, 19(2),* 247-258.

Kabanoff, B., & Bottger, P. (1991). Effectiveness of creativity training and its relation to selected personality factors. *Journal of Organizational Behavior, 12*(3), 235-248.

Kanfer, R. (1990). Motivation theory and industrial and organizational psychology. In M. D. Dunnette & L. M. Hough (Eds.), *Handbook of Industrial and Organizational Psychology* (2nd Ed., Vol. 1, pp. 76-170). Palo Alto: Consulting Psychologists Press.

Kaufman, J. C. & Baer, J. (2003). Do we really want to avoid Denny's?: The perils of defying the crowd. *High Ability Studies, 14*, 149-150.

Kay, S. I. (1998). Curriculum and the creative process: Contributions in memory of a Harry Passow Roeper Review: *A Journal on Gifted Education, 21,* 5–13.

Keller-Mathers, S. (1990). Impact of Creative Problem Solving Training on Participants' Personal and Professional Lives: A Replication and Extension. *Unpublished Masters Thesis,* State University of New York, College at Buffalo.

Kettner, N. W., Guilford, J. P., & Christensen, P. R. (1954). A factor analysis study across the domains of reasoning, creativity, and evaluation. *Psychological Monographs, 59*, 1-31.

Khan B. (1997). *Web-based instruction*. Englewood Cliffs, New Jersey: Educational Technology Publications.

Kim, K. H. (2008). Meta-analyses of the relationship of creative achievement to both IQ and divergent thinking test scores. *Journal of Creative Behavior, 42*, 107-130.

Kirkpatrick, D.L, & Kirkpatrick, J. D. (2006). *Evaluating training programs: The four levels*. San Fransisco: Berrett-Koehler.

Kovac, T. (1998). Effects of creativity training in young soccer talents. *Studia Psychologica, 40,* 211–218.

Kraiger, K., & Jerden, E. (2007). A new look at learner control: Meta-analytic results and directions for future research. In S. M. Fiore & E. Salas (Eds.), *Where is the learning in distance learning?* Towards a science of distributed learning and training (pp. 65-90). Washington, DC: APA Books.

Kuncel, N. R., Crede, M. & Thomas, L. L. (2005). The validity of self-reported grade point averages, class ranks, and test scores: A meta-analysis and review of the literature. *Review of Educational Research, 75*, 63-82.

Lichtenberg, J., Wook, C., & Wright, M. (2008). *Ready to Innovate: Are Educators and Executives Aligned on the Creative Readiness of the U.S. Workforce?* The Conference Board, Research Report.

Lim, C., Park, K., & Hong, M. (2010). An Instructional Model with an Online Support System for Creative Problem Solving. International Journal for Educational Media and Technology, 4 (1), 4-12.

Lubart, T. (2005). How can computers be partners in the creative process: Classification and commentary on the special issue. *International Journal of Human-Computer Studies, 63,* 365-369.

Ma, H. (2006). A synthetic analysis of the effectiveness of single components and packages in creativity training programs. *Creativity Research Journal, 18*(4), 435-446.

Mansfield, R. S., & Busse, T. V. (1981). *The psychology of creativity and discovery: Scientists and their work.* Chicago: Nelson Hall.

Martindale, C. (1999). Biological bases of creativity. In R. J. Sternberg (Ed.), *Handbook of creativity* (pp. 137-152). Cambridge, United Kingdom: Cambridge University Press.

Marta, S., Leritz, L. E., & Mumford, M. D. (2005). Leadership skills and the group performance: Situational demands, behavioral requirements, and planning. *Leadership Quarterly, 16(1),* 97-120.

Maslow, A. H. (1943). A theory of human motivation. *Psychological Review, 50,* 370-396.

Maslow, A. H. (1959). Creativity in self-actualizing people. In H. A. Anderson (Ed.)., *Creativity and its cultivation* (pp. 83-95). New York: Harper.

Maslow, A. H. (1968). *Toward a psychology of being* (2nd ed.). Princeton, NJ: Van Nostrand Reinhold.

McCormack, A. J. (1971). Effects of selected teaching methods on creative thinking, self-evaluation, and achievement of studies enrolled in an elementary science education methods course. *Science Teaching, 55,* 301–307.

McGraw, K. O. & McCullers, J. C. (1979). Evidence of a detrimental effect of extrinsic incentives on breaking a mental set. *Journal of Experimental Social Psychology,15,* 285-294.

McKee, R. & Carlson, B. (1999). The power to change. Austin: Grid International Inc.

Meador, K. S. (1994). The effects of synectics training on gifted and non-gifted kindergarten students. *Journal for the Education of the Gifted, 18,* 55–73.

Merrifield, P. R., Guilford, J. P., Christensen, P. R., & Frick, J. W. (1962). The role of intellectual factors in problems solving. *Psychological Monographs, 76*, 1-21.

Milgram, R. M. (1990). Creativity: An idea whose time has come and gone? In M. A. Runco& R. S. Albert (Eds.), Theories of creativity (pp. 215-233). Newbury Park, CA: Sage Publications.

Miller, B., Vehar, J., & Firestien, R. (2001). *Facilitation: A door to creative leadership* (3rd ed.). Williamsville, NY: Innovation Resources, Inc.

Miller, B., Vehar J. & Firestien R. (2002). *Creativity unbound*. Williamsville, New York: Innovation System Group.

Morse, L. W., & Morse, D. T. (1995). The influence of problem-solving strategies and previous training on performance of convergent and divergent thinking. *Journal of Instructional Psychology, 22*(4), 341-348.

Mumford, M. D. (2002). Social innovation: Ten cases from Benjamin Franklin. *Creativity Research Journal, 14,* 253–266.

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

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

Mumford, M. D., & Gustafson, S. B. (1998). Creativity syndrome: Integration, application, and innovation. *Psychological Bulletin, 103*, 27-43.

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

Mumford, M. D., Peterson, N. G., & Childs, R. A. (1999). Basic and cross-functional skills: Taxonomies, measures, and findings in assessing job skill requirements. In N. G. Peterson, M. D. Mumford, W. C. Borman, P. R. Jeanneret, & E. A. Fleishman (Eds.), *An occupational information system for the 21st century: The development of O*NET* (pp. 49–76). Washington, DC: American Psychological Association.

Mumford, M. D., Schultz, R. A., & Osburn, H. K. (2002). Planning in organizations: Performance as a multi-level phenomenon. In F. J. Yammarino & F. Dansereau (Eds.), *Many faces of multi-level issues* (pp. 3-65). Oxford, England: Elsevier.

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

Newman F. &, Scurry J. (2001). Online technology pushes pedagogy to the forefront. *The Chronicle of Higher Education*, *47*, B7–B10.

Nickerson, R. S. (1999). Enhancing creativity. In R. J. Sternberg (Ed.), *Handbook of creativity* (pp. 392-430). New York, NY: Cambridge University Press.

Noller, R. B., & Parnes, S. J. (1972). Applied creativity: The creative studies project: The curriculum. *Journal of Creative Behavior, 6,* 275-294.

Noller, R. B., Parnes, S. J., & Biondi, A. M. (1976). *Creative authorbook.* New York: Schuster.

Osbom, A.F (1953). *Applied imagination.* New York: Charles Scribner's Sons.

Osborn, A.F. (1963) *Applied imagination: Principles and procedures of creative problem solving*. New York, NY: Charles Scribner.

Osburn, H. K., & Mumford, M. D. (2006). Creativity and planning: Training interventions to develop creative problem-solving skills. *Creativity Research Journal, 18 (2),* 173-190.

Osche, R. (1990). *Before the gates of excellence: The determination of creative genius.* Cambridge University Press.

Paradise, A. (2007). *State of the industry: ASTD 's annual review of trends in workplace learning and performance.* Alexandria, VA: ASTD.Parnes, S. J. (1966). *Manual for institutes and programs*. Buffalo, NY: Creative Education Foundation.

Parnes, S. J. (1967). *Creative behavior guidebook*. New York: Scribners.

Parnes, S.J. (1987) The creative studies project. In S.G. Isaksen (ed.), *Frontiers of creativity research* (pp. 156–88). Buffalo, NY: Bearly Limited.

Parnes, S. J., & Noller, R. B. (1972). Applied creativity: The creative studies project: Partial results of the two year program. *Journal of Creative Behavior, 6,* 164-186.

Parnes, S.J. and Noller, R.B. (1973) Applied creativity: The creative studies project: Part IV – Personality findings and conclusions. *The Journal of Creative Behavior* , 7, 15–36.

Polewsky, S., & Will, H., (1996). Creativity workshops: Tools for innovation in organization? *European Journal of Work and Organizational Psychology, 5(1),* 43-51.

Puccio, G. J., Firestien, R. L., Coyle, C, & Masucci, C. (2006). A review of the effectiveness of CPS training: A focus on workplace issues. *Creativity and innovation management, 15(1),* 19-33.

Redmond, M. R., Mumford, M. D., & Teach, R. J. (1983). Putting creativity to work: Leader influences on subordinate creativity. *Organizational Behavior and Human Decision Processes, 55,* 120-151.

Reiter-Palmon, R., Mumford, M. D., & Threlfall, K. U. (1998). Solving everyday problems creatively: The role of problem construction and personality type. *Creativity Research Journal, 11,* 187–198.

Renzulli, J. S., & Callahan, C. M. (1975). Developing creativity training activities. *Gifted Child Quarterly, 19*(1), 38-45.

Rickards, T., & Freedman, B. (1979). A re-appraisal of creativity techniques in industrial training. *Journal of European Industrial Training, 3*, 3–8.

Rogers, C. (1954). Towards a theory of creativity. *ETC: A Review of General Semantics,11,* 249-260.

Rose, L. H., & Lin, H. (1984). A meta-analysis of long-term creativity training programs. *Journal of Creative Behavior, 18*(1), 11-22.

Rosenberg MJ. (2001). *e-Learning: Strategies for delivering knowledge in the digital age*. New York: McGraw Hill.

Rump, E. E. (1982). Relationships between creativity, arts-orientation, and esthetic preference variables. *Journal of Psychology, 110,* 11–20.

Runco, M. A. (1997). *The creativity research handbook*. Cresskill, N.J.: Hampton Press.

Runco, M. A., & Basadur, M. (1993). Assessing ideational and evaluative skills and creative styles and attitudes. *Creativity and Innovation Management, 2,* 166-173.

Sansawal, D. (1982). Verbal creativity, self concept, and problem solving behavior: A factor analytic study. *Psycho-lingua, 12(2),* 129-138.

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

Scott, G., Leritz, L. E., & Mumford, M. D. (2004a). The effectiveness of creativity training: A quantitative review. *Creativity Research Journal, 16*(4), 361-388.

Scott, G., Leritz, L. E., & Mumford, M. D. (2004b). Types of creativity training: Approaches and their effectiveness. *Journal of Creative Behavior, 38*(3), 149-179.

Shalley, C. E., & Zhou, J. 2008. Organizational creativity research: A historical overview. In J. Zhou and C. Shalley (Eds.) *Handbook of Organizational Creativity*, 3-31. New York: Lawrence Erlbaum and Associates.

Shalley, C. E. Gilson, L., & Blum, T. C. 2000. Matching creativity requirements and the work environment: Effects on satisfaction and intentions to leave. *Academy of Management Journal, 43*, 215-223.

Simonton, B. K. (1999). Creativity from a historiometric perspective. In R. J. Sternberg (Ed.), *Handbook of creativity* (pp. 116–136). Cambridge, England: Cambridge University Press.

Simonton, D. K. (2007). Review of creativity: Theories and themes: Research, development, and practice. *Psychology of Aesthetics, Creativity, and the Arts, 1,* 251-252.

Sitzmann, T., Kraiger, K., Stewart, D., & Wisher, R. (2006). The comparative effectiveness of web-based and classroom instruction: A meta-analysis. *Personnel Psychology, 59,* 623-664.

Solomon, C. M. (1990). Creativity training. *Personnel Journal, 69,* 64–71.

Steele, C. M. (1988). The psychology of self-affirmation: Sustaining the integrity of the self. In L. Berkowitz, (Ed.), *Advances in experimental social psychology* (Vol. 21, pp. 261- 302). San Diego, CA: Academic Press.

Sternberg, R. J. (1986). Toward a unified theory of human reasoning. *Intelligence, 10, 281-314.*

Sternberg, R. J. (1988). *The nature of creativity: Contemporary psychological perspectives*. New York: Cambridge University Press.

Sternberg, R. J. (1999). *Handbook of creativity*. Cambridge, U.K. New York: Cambridge University Press.

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

Sternberg, R. J., & Lubart, T. I. (1995). An investment perspective on creative insight. In R. J. Sternberg & J. E. Davidson (Eds.), *The nature of insight* (pp. 535-558). Cambridge, MA: The MIT Press.

Sternberg, R. J., & Lubart, T. I. (1996). Investing in creativity. *American Psychologist, 51*(7), 677-688.

Sternberg, R. J. & Lubart, T. I. (1999). The concept of creativity: Prospects and paradigms. In R. J. Sternberg (Ed.), *Handbook of creativity* (pp. 3-15). New York, NY: Cambridge University Press.

Stokels, D., Clithertoe, C., & Zmundzinas, M. (2002). Qualities of the work environment that promote perceived support for creativity. *Creativity Research Journal, 14*, 137-147.

Sugrue, B., & Rivera, R. J. (2005). *State of the industry: ASTD's annual review of trends in workplace learning and performance*. Alexandria, VA: ASTD.

Tabachnick, B. G., & Fidell, L. S. (2007*). Using Multivariate Statistics* 5th Edition. Boston: Pearson.

Taggar, S. (2002) Individual creativity and group ability to utilize individual creative resources: A multilevel model. *Academy of Management Journal, 45*, 315-330.

Torrance, E. P. (1981). Predicting the creativity of elementary school children (1958-1980) - And the teacher who made a difference. *Gifted Child Quarterly, 25,* 55-62.

Torrance, E. P. (1983). The importance of falling in love with "something." *Creative Child and Adult Quarterly, 8,* 72-73.

Torrance, E. P. (1987). Future career image as a predictor of creative achievement in the 22-year longitudinal study. *Psychological Reports, 60,* 574.

Tushman, M. L., & O'Reilly, C. A. (1996). Ambidextrous organizations: Managing evolutionary and revolutionary change. *California Management Review, 38*, 8-30.

Tushman, M. L., & O'Reilly, C. A. (1997). *Winning through innovation*. Cambridge, MA: Harvard Business School Press.

Tesluk, P. E., Farr, J. L., & Klein, S. R. (1997). Influences of organizational culture and climate on individual creativity. *Journal of Creative Behavior, 31*, 27−41.

Torrance, E. P. (1972). Can we teach children to think creatively? *Journal of Creative Behavior, 6,* 114–143.

Torrance, E. P., & Presbury, J. (1984). The criteria of success used in 242 recent experimental studies of creativity. *Creative Child & Adult Quarterly, 9*(4), 238-243.

West, M. A. (1990). The social psychology of innovation in groups. In M. A. West & J. L. Farr (Eds.), *Innovation and creativity at work: Psychological and organizational strategies* (pp. 309-333). Chichester, England: Wiley.

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

Wallas, G. (1926). *The art of thought*. New York: Harcourt Brace.

Wang, C. W., & Horng, R. Y. (2002). The effects of creative problem solving training on creativity, cognitive type and R&D performance. *R&D Management, 32,* 35-45.

Wright, R. (1975). The interrelationship of creativity, self-esteem, and creative selfconcept. *Psycho-lingua, 12(2),* 11-15.

Zellmer-Bruhn, M., & Gibson, C. B. (2006). Team strategic context: Implications for process and performance. *Academy of Management Journal, 49*, 501–518.

Zhou, J. (2003). When the presence of creative coworkers is related to creativity: Role of supervisor close monitoring, developmental feedback, and creative personality. *Journal of Applied Psychology, 88,* 413-422.

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SELECTED PUBLICATIONS & CONFERENCE PRESENTATIONS

Hunter, S.T., **Cassidy, S.E.**, Ligon, G.S. (in press). Planning for Innovation: A Process Oriented Perspective. In Mumford, M.D. (Ed.), Handbook of Organizational Creativity. Thousand Oaks: Sage.

Fairchild, J., **Cassidy, S.E.**, Cushenberry, L., & Hunter, S.T., (2011). Integrating technology with the creative design process. In Mesquita, A. (Ed.), Technology for Creativity and Innovation: Tools, Techniques and Applications. IGI Global Press.

Cassidy, S.E., Rizzuto, T., Clark, O., Lodato. M., Brooks-Shessler, L., & Bedwell, W. I-O, I-O, It's Off to Work…or School…We Go? (2011, April). In **Cassidy, S.E**. (Chair/moderator), debate conducted at the Society for Industrial and Organizational Psychology Annual Conference, Chicago, IL.

Cassidy, S.E. (2010). The value of applied experience: Bridging the scientist-practitioner gap in graduate school and beyond. The Industrial Organizational Psychologist, 48(2), 120-130.

Cassidy, S.E., Hunter, S.T., & Cushenbery, L. (2010, August). Preliminary evidence in support of the multi-level factor structure of Hunter et al.'s (2005) general taxonomy of creative climate. Poster session presented at the American Psychological Association Annual Conference, San Diego, CA.