DISSERTATION

DESIGNING COMPUTER-BASED TRAINING FOR CREATIVITY: AN EXAMINATION OF LEARNER CONTROL, FEEDBACK, AND CREATIVE PERSONAL IDENTITY

Submitted by

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WE HEREBY RECOMMEND THAT THE DISSERTATION PREPARED UNDER OUR SUPERVISION BY APRIL SMITH ENTITLED DESIGNING COMPUTER-BASED TRAINING FOR CREATIVITY: AN EXAMINATION OF LEARNER CONTROL, FEEDBACK, AND CREATIVE PERSONAL IDENTITY BE ACCEPTED AS FULFILLING IN PART REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY.

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ABSTRACT OF DISSERTATION

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Increasing employee creativity is important for organizational innovation and survival in increasingly adaptive markets. Computer-based training is a popular trend in most organizations, yet little research has examined how to design computer-based creativity training. The present study applied cognitive evaluation theory to guide the design of a computer-based creativity training program. It was hypothesized that by offering participants learner control and feedback, their intrinsic motivation and creativity on brainstorming exercises would increase.

Two hundred and forty-one college students participated in a two-hour online training program about the creative problem solving process. A 3 X 2 ANOVA design was used with feedback and learner control as factors. Participants either had no learner control over the training program, or received learner control over pacing and type of example viewed. In addition, participants either received no feedback, regular performance feedback, or performance feedback paired with strategy advise. Although hypotheses about learner control and feedback were not supported due to training administration factors, the study did support the importance of perceived self-determination and perceived competence in predicting intrinsic motivation for creative training exercises. In addition, creative personal identity emerged as an important variable to include in future investigations, as it related to perceived competence, intrinsic motivation, and creative performance. Suggestions for adjustment to administration factors, future areas of research, and contributions of the study are also discussed.

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DEDICATION

I dedicate this work to my amazing graduate school support group: Rachel Johnson, Mark Mazurkiewicz, and Connie Pfeiffer. Without you, I never would have made it here.

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Introduction

Creativity in the workplace is the foundation of organizational innovation. Employers increasingly acknowledge that facilitating employee creativity relates not only to employee well-being (Kurtzburg, 2005), it can also contribute to a company's financial viability (King, 1990). Many organizations have moved to include some form of creativity training in their training and development efforts (Solomon, 1990). Though effects differ based on theoretical model and desired outcomes, in general creativity training does appear to produce an effect of practical significance on creativity (Scott, Leritz, & Mumford, 2004).

However, most forms of creativity training examined in the literature represent traditional, face-to-face classroom formats. There is a dramatic trend in most organizations toward implementing online versions of training (Aguinis & Kraiger, 2009), which provide convenience for both the employee and the employer (Brown & Ford, 2002). Computer-based instruction (CBI) has received little attention in the creativity training literature, with the majority of studies in this area focusing on teaching children in a school setting. As I will describe later, there are several aspects unique to the creativity literature which indicate that a computer-based training format may facilitate the motivational mechanisms that optimize creativity.

In the present study, I evaluated the effects of two design issues in CBI, learner control and feedback, on the unique motivational processes that comprise creative performance. I will use cognitive evaluation theory (Deci & Ryan, 1985) to propose that learner control should enhance creative performance through trainees' perceived self-determination (how autonomous they feel during the task), and that feedback will contribute to creativity through perceived competence (trainees' beliefs that they are capable of performing the creative task well). Later I will propose that creative personal identity, the extent to which the trainee perceives creativity to be an important part of his/her self-concept, is a potential moderator of the effectiveness of online creativity training design. Trainees who are low on creative personal identity may be the ones who benefit most from creativity training. By examining creative personal identity as a moderator, I will take an aptitude-treatment interaction approach toward designing computer-based creativity training. Figure 1 presents the heuristic model which I will build throughout the introduction. This figure depicts the relationships proposed by the theory presented in the current study. Figure 2 provides additional information by presenting the manner in which all hypotheses were tested.

What is Creativity?

Theories of creativity can generally be placed into one of four categories: person, process, press, or product (Rhodes, 1961). Person-oriented theories focus on describing the personality traits and other individual differences unique to creative individuals (MacKinnon, 1965). Process-oriented theories often take a cognitive approach by examining the role of factors like knowledge, memory, and attention deployment in creativity (Runco, 2004). Theories that fit under the "press" category examine the forces which press on the individual to produce creativity, such as social dynamics, culture and climate (Amabile, Goldfarb & Brackfield, 1990). These factors are referred to as "contextual" influences on creativity by many researchers. Finally, product-oriented theories of creativity focus on describing the nature of the creative product itself (O'Quinn & Besemer, 1989). Such investigations often conceptualize creativity as how unique the product is (i.e. how many others came up with the same idea). As I will describe later, the framework I have chosen for the present study, Creative Problem Solving, involves elements of each of these four theoretical approaches. In the present study, creativity is conceptualized by examining the divergent thinking skills present in participants' creative products. Divergent thinking skills represent how easily an individual can produce many ideas (fluency), particularly ideas that represent many different lines of thinking (flexibility) (Hocevar, 1979). Measuring divergent thinking skills is a common way of assessing creativity (Puccio, Firestien, Coyle, & Masucci, 2006) and has been related to creative personality and creative achievement (Runco, 2004). In the present study, creativity was conceptualized as the fluency and flexibility present in participants' brainstorming responses as a measurement of their divergent thinking ability. Thus a helpful definition of creativity to keep in mind during the paper is:

> ...the ability to link seemingly disparate ideas into a novel synthesis. The potential to achieve such a novel synthesis is increased by having a reservoir of distinctly different ideas about something plus a number of subtle ways to express each of the ideas. (Snyder, Mitchell, Bossomaier, & Pallier, 2004, pp. 416)

Why is Creativity Important?

One of the best ways to quantify the value of creative performance is through its link to the organizational-level variable of innovation. Individual employee creativity is the foundation for organizational innovation (Amabile, 1988; Mumford & Hunter, 2005). There is reason to believe that organizational innovation is a key determinant of organizational performance. Eisenhardt and Tabrizi (1995) found that the rate of new product flow to the market was an important determinant of high technology firm performance. Geroski, Machin and Van Reenen (1993) found that innovation rate related to profit both directly and indirectly. Organizations that successfully innovate also formulate stronger business plans (Dean & Sharfman, 1996), adjust more quickly to radical environmental change, and better understand the possibilities of new technologies (Cohen & Levinthal, 1990).

Employee creativity is one important component of organizational innovation. Employee creativity may be one necessary element for organizations to survive in the competitive and rapidly changing market (Loeb, 1995). Most manufactured products are now redesigned every five to 10 years (or, in the high-tech industry, every six to 12 months). The result is that employees must become adept at abandoning old strategies and learning new ones (Hunter & Schmidt, 1996). Adaptive performance, which includes the facet of solving problems creatively, is increasingly viewed as a necessary dimension of good general job performance (Pulakos, Arad, Donovan, & Plamondon, 2000). In addition to benefits to the organization, employee creativity provides individual benefits as well. Creativity has been linked to mental health and emotional well-being (Kurtzburg, 1995; Runco, 2004; Simonton, 1999), suggesting that creative employees may be better equipped to deal with stress effectively in the workplace.

Research has looked at a variety of indicators of creative performance. Among other operationalizations, creativity has been measured as number of ideas submitted to a suggestion box, number of patents accomplished in a research and development setting, and number of original ideas voiced during discussion (Puccio et al., 2006). Although it can be difficult to assess the net value of such "creative" contributions, most organizational decision makers would agree that the more suggestion box contributions, patent submissions, and brainstorming points voiced by an employee, the greater likelihood that one of these contributions will lead to a new, successful organizational process or product. These creative contributions contribute to the organization's ability to innovate and succeed in the market. In general, the literature offers several reasons why employee creative performance is valuable to any organization.

Not all employees are equally likely to be creative. Recent meta-analyses indicate that personality traits like Extraversion (in general, reflecting how outgoing a person is) and Openness to Experience (reflecting an adventurous nature and open-mindedness) can predict whether an employee will be creative at work (Eder & Sawyer, 2007). Employees in complex jobs with high autonomy are also more likely to be creative, as are those who work in team settings that allow for low-conflict open exchange of ideas (Hunter, Bedell, & Mumford, 2007). Finally, employees are more likely to be creative when there are reward structures in place that explicitly reward creative performance (Hunter et al.).

Although we now know some of the individual and organizational-level predictors of creativity in the workplace, in practice this knowledge does not guarantee organizational creativity. Our goal is often to increase the creativity of *incumbent* employees in their *existing* positions (that is, we cannot always hire for creative personality nor do we always have control over the organizational-level policies that can facilitate creativity). In these situations, training existing employees on how to increase creativity is a useful tool. In fact, Solomon (1990) reported that over half of organizations use some form of creativity training with their employees. Often these training efforts involve a day-long "off-campus" workshop delivered by an independent facilitator, focusing on increasing humor or spontaneity and thus creativity (Conlin, 2006; Polewsky & Will, 1996). Another example of popular organizational creativity training involves taking an intact team through successive workshop exercises with the goal of creatively solving a specific organizational problem (Puccio et al., 2006). These training efforts are often not evaluated or externally published (Scott, Leritz, & Mumford, 2004). Innovation is a crucial organizational competitive advantage for the next century (Conlin, 2006). Employee creativity is the building block of organizational innovation. Given this, it is important to increase the quality of research on employee creativity training. In the next section I will briefly overview the published literature to date on creativity training.

Creativity training

There are a variety of conceptualizations of creativity, each with its own corresponding training approach. Some approaches emphasize motivational and dispositional characteristics like personality (e.g. Domino, Short, Evans, & Romano, 2002; McCrae, 1987), affective mechanisms like mood and idea association (e.g. Martindale, 1999), cognitive processes during idea generation (e.g. Baughman & Mumford, 1995), or skill at exploiting environmental opportunities (e.g. Simonton, 1999). The Purdue Creative Thinking program is one of the best known systematic investigations of creativity training. This program focused on teaching and practicing divergent thinking skills (i.e. the ability to generate multiple alternative solutions as opposed to one correct solution) across 28 audio taped lessons focusing on fluency (number of responses), flexibility (category shifts in responses), originality (uniqueness of responses), and elaboration (refinement of responses). Alencar, Feldhusen, and Widlak (1976) and Speedie, Treffinger, and Feldhusen (1971) found some support for the program's ability to increase divergent thinking.

Other authors have based their training programs on models which emphasize the cognition involved in creative solution. For example, McCormack (1971, 1974), and Baughman, Mumford, and Clapham (1997) found that training participants on the use of a checklist which covers the cycles of creative cognition (e.g. problem finding, information gathering, concept selection, and conceptual combination) was useful for creative problem solving performance. Mumford, Baughman, and Sager (2003) found that the creative problem solving skills of penetration (assessing the multiple causes of a situation) and forecasting (projecting the outcomes of one's plan) were related to creative ability and could be taught in a training context.

Arguably the best known process-based training approach is the Creative Problem Solving program most famously refined by Parnes and colleagues (Noller & Parnes, 1972; Noller, Parnes, & Biondi, 1976; Parnes & Noller, 1972). The origins of CPS 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. A number of researchers have refined and individualized the process over the years, but the main characteristics remain the same. CPS involves multiple steps which Van Gundy (1990) labels Opportunity-finding, Fact-finding, Problem-finding, Idea-finding, Solution-finding, and Acceptance finding. In each step, the user(s) are guided through divergent thinking exercises (exercises aimed at generating a wide variety of ideas) and convergent thinking exercises (exercises which help the user focus in on the most promising ideas). This focus on proper problem definition, the incorporation of both creative and analytical thinking, and planning for implementation of the final solution are some of the reasons why CPS has been an attractive model for both academic and organizational settings (Puccio et al., 2006).

The effectiveness of CPS in enhancing creativity has been supported by a number of sources. A recent review by Puccio et al. (2006) describes how CPS has been used effectively in multiple settings to change attitudes, behavior and group process. For example, the work of Basadur and colleagues (e.g. Basadur & Finkbeiner, 1985; Basadur & Hausdorf, 1996) has shown that CPS is effective in changing employees' preference for premature convergence (narrowing in on one solution early on) and acceptance of active divergence (entertaining multiple possibilities). 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.

Several researchers have also demonstrated that CPS is effective for changing behavior. Examples 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.

Finally, CPS has also been related to an increase in effective group processing. Firestien (1990) and Firestien and McCowan (1988) and 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. In addition, they produced a significantly greater number of ideas as well as significantly higher quality ideas than non-trained groups. Basadur, Pringle, Speranzini, and Bacot (2002) described how application of the CPS process to a union-management negotiation led to greater levels of trust, cooperation, and more creative solutions. Puccio et al.'s (2006) review provides strong evidence that CPS training produces benefits for creativity-related attitudes, behavior, and group processes over no training at all. CPS has been shown to be effective in a variety of populations, including adults in a workplace setting (Puccio et al.). Puccio et al. noted that CPS appears to be useful for transfer of training, with sustained effects measured up to one and one half year after training.

In their recent meta-analysis of creativity training programs, Scott et al. (2004) found a positive effect for creativity training on creativity. Further, their investigation of the internal validity of creativity training found no evidence that these effects are reliant on demand characteristics in the training setting. When examining the effect sizes for different types of training outcome criteria, they found that training which focused on teaching divergent thinking and creative problem solving skills showed the strongest effects. Divergent thinking skills comprised participants' increased abilities to generate more responses, draw responses from more categories, and produce more unique and elaborated responses after creativity training. Creativity training studies which increased problem solving skills focused on helping participants through the process with steps such as problem identification, information gathering, choosing an option, and building acceptance for the solution. Scott et al.'s meta-analysis also found that creativity training is more effective when it encourages participants to apply material to "real-world" problems and involves a variety of exercises for practice.

Based on Scott et al.'s (2004) results, for the present study I chose to adopt the Creative Problem Solving (CPS) framework as the focus of training content. CPS teaches both categories of skills identified by Scott et al.'s meta-analysis to produce the greatest training effects. CPS teaches fluency, flexibility, originality, and elaboration in combination with a systematic approach toward problem-identification and acceptance-planning for the creative solution. Through each stage, the trainee is guided through divergent and convergent thinking brainstorming exercises. I provide further description of CPS in the present study in the Method section.

Computer-based creativity training

I have established that many organizations now offer some form of creativity training to their employees, and that creativity training can be effective in increasing participants' attitudes toward creativity as well as their creative behavior. Computer-based training is a popular trend in most organizations (Paradise, 2007), yet to date there have been few attempts to develop computer-based forms of creativity training (Benedek, Fink & Neubauer, 2006). One potential reason for the lack of computer-based creativity training is the viewpoint that computers are too analytical and rigid to produce anything other than noncreative thinking (Clements, 1991). 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). These workshops may serve as an enjoyable team-building experience (Polewsky & Will) as much as they are useful for actual long-term changes in creativity. Creativity training designers may perceive that these experiences would be difficult to translate into a computer-based format.

Yet the computer offers a potentially powerful tool for users to develop creativity (Clements, 1991). Lubart (2005) provided a four-part framework for the potential contributions of computers to creativity. These roles are cleverly summarized as computer as nanny, computer as pen-pal, computer as coach and computer as colleague. Computer as nanny takes place when computers are used to alert the user when deadlines are approaching or save cognitive load on the user by taking over menial tasks such as auto-saving files. The computer can act as pen-pal through electronic emailing and conferencing systems that allow long-distance collaboration between individuals. The computer can act as coach by providing tutorials to learn a new process, or by providing a database of potential sources of inspiration. Computer as colleague programs involve the computer actively contributing to the creative dialogue with the user, learning and modifying ideas or providing random stimuli to facilitate further user generation. All of these potential roles for the computer in the creative process speak to the fact that there is not one unitary definition of the creative process. Creative production will be different for different users based on their individual needs. Novices and experts differ in their creative process and in the kind of computer tools most useful to them (Bonnardel & Marmeche, 2005). This means that flexible computer tools which allow for user individuality and preference will better facilitate creativity.

Although there has been very little empirical research, there is some early evidence that computer-based training is an effective way of teaching divergent thinking skills. Benedek et al. (2006) found that a computer-based training which involved practicing divergent thinking exercises increased ideational fluency (number of ideas generated) in participants. Though only three studies were included and they represented training for school children, Scott et al.'s (2004) meta-analysis of creativity training methods found a Cohen's Δ of .77 for computer-based creativity training. Scott et al. called for more research on computer-based creativity training, given that this area has obvious potential for teaching creativity skills. A fair amount of research indicates that computer programs can aid children in the development of creativity thinking abilities, such as figural creativity (e.g. Clements & Gullo, 1984), verbal creativity (Clements, 1991), mathematical creativity (Davis, 1984), creative writing (Carey & Flower, 1989), and musical composition (Holland, 1989) because children are allowed to "play" around with concepts rather than worrying about getting it right the first time in order to conserve paper (Clements, 1995).

Recently research has started to adjust to the marriage of technology and creativity in more work-related settings, through investigations of electronic brainstorming. Electronic brainstorming research rose out of the need to avoid the evaluation apprehension that can limit participation in typical group discussions. DeRosa, Smith, and Hantula (2007) conducted a meta-analysis of the electronic brainstorming literature and found that electronic group brainstorming produced a higher quantity and quality of ideas and resulted in higher group member satisfaction than did traditional face-to-face brainstorming groups. They also compared electronic brainstorming to nominal groups (those which were simply an aggregation of individual responses). Interestingly, they found an interaction for group size. Electronic brainstorming groups outperformed nominal groups only when the group size was large; small nominal groups outperformed electronic groups. 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) posited that electronic brainstorming is more effective than face-to-face brainstorming because social psychological group interferences are reduced. For example, production blocking (the fact that while one member is giving a suggestion another member cannot be using that same time to give a suggestion) is reduced in an electronic format. Conceptual combination is also facilitated by electronic brainstorming, since members have all previous responses easily visible on their screens and can thus more easily build off of previous suggestions. Of course, DeRosa et al. also offered that the anonymity enabled by electronic brainstorming reduces evaluation apprehension while generating ideas. These findings certainly support that a training focusing on teaching creative skills may be more appropriate in a computer-based setting than in a traditional group training environment, where social psychological impediments to participation may exist.

Because computer-based training places increased responsibility/autonomy on the learner, user motivation for learning becomes a crucial issue (Brown & Ford, 2002). Next I will review literature which describes the important role of motivation in creative performance.

Motivation and Creativity

Motivation is a crucial consideration in maximizing creativity (Collins & Amabile, 1999). Motivation is frequently described as what a person does (direction), how hard they work (intensity), and how long they work (persistence) (Kanfer, 1990). In general, when an individual's motivation for a given action is low, he/she will exert minimal effort toward the task (Kanfer). Tasks that allow for creative performance have some degree of ambiguity, and are referred to as "open" tasks because there is no clear answer (Osche, 1990). When an individual is low on motivation for a creative task, he/she is more likely to exert low effort by generating conventional, traditional ideas that are familiar to him/her. Thus low motivation generally inhibits creativity (Collins & Amabile). In contrast, highly motivated individuals may be more willing to deal with the ambiguity of a creative task and expend the effort to find unusual ideas which are not immediately salient (McGraw, 1978).

Several creativity theorists offer explanations for the relationship between motivation and creativity. Martindale's theory of biological creativity posited that under low neurological arousal (such as 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 theory of flow suggested that when an individual experiences optimal motivation for a task, he/she can slip into a state of optimal performance in which higher-order functioning seems effortless and creative genius can result (Csikszentmihalyi & Csikszentmihalyi, 1988). Simonton's work focused on the power of bipolar or cyclothymic episodes, when artists and writers are motivated into creativity by the energy that accompanies a manic episode (Simonton, 1999). Theresa Amabile's three-component theory of creativity posited that while domain-relevant knowledge and creative thinking skills are necessary for creativity to take place, the third crucial component is the motivation of the individual (Amabile, 1983).

Regardless of the individual theory chosen, a majority of the theories of creativity discuss the role of motivation in creative production. Psychodynamic theories made some early attempts to describe the motives that drive creative production, such as a fundamental need to master one's environment (White, 1959) or an unconscious need to resolve psychological conflicts (e.g. Klein, 1976; Oshse, 1990). However, the majority of theoretical and empirical work in the field has been driven by the belief that creativity is motivated by the individual's enjoyment and satisfaction derived from engaging in the creative activity (Collins & Amabile, 1999). The concept of motivation driven by enjoyment of the activity has evolved to be labeled intrinsic motivation.

Intrinsic vs. Extrinsic Motivation

Intrinsic motivation is the primary paradigm of motivation that has been researched in the field of creativity. Intrinsic motivation is 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; it is marked by a focus on the challenge and the enjoyment of the work itself" (Collins &

Amabile, 1999, p. 297). Intrinsic motivation has come to be contrasted with extrinsic motivation. Collins and Amabile define extrinsic motivation 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; it is marked by a focus on external reward, external recognition, and external direction of one's work. (p. 297)

Many case studies early in the creativity research literature describe how highly creative individuals exhibit a passionate love of their work (e.g. Barron, 1963; MacKinnon, 1962). Episodes of high creative production by such individuals are often described by losing track of time and immersing oneself in the task (Collins & Amabile, 1999). Mansfield and Busse (1981) identified a passionate commitment to one's work as important for scientific discovery. Torrance (1981, 1983, 1987) found that those who were doing what they loved were more creative in their pursuits. Gruber (1986; Gruber & Davis, 1988) found 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).

Early contributors to the idea of intrinsic motivation included Carl Rogers (1954) and Roger 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. Because of their belief in this internally motivated drive, both psychologists believed that creativity could only take place in the absence of external regulation. Later influential authors such as Torrance (1962) furthered this view of motivation by asserting that the act of creating was itself a reward for creative individuals, one which was more important to them than any external reward. Crutchfield (1962) distinguished internally-driven motivation for creating from ego-involved or extrinsic motivation for creating, where "the achievement of a creative solution is a means to an ulterior end, rather than the end in itself" (p.121). Crutchfield saw these motivational tendencies as more stable personality traits, arguing that people who tend to go along with group opinions contrary to their own are in general more motivated by extrinsic/ego-involved reasons for creating. Several of his studies found that people who were more inclined to yield to the pressure for conformity exhibited lower levels of creativity than did nonconformists (Collins & Amabile, 1999).

The study of creative motivation was abandoned for twenty years while researchers attempted to identify the personality characteristics of creative individuals (Runco, 2004). In 1982, Amabile renewed this line of research by building off of the foundation of Rogers (1954) and Crutchfield (1962). She proposed the intrinsic motivation hypothesis: "The intrinsically motivated state is conducive to creativity, whereas the extrinsically motivated state is detrimental" (1982; p.91). This hypothesis became one of the three cornerstones of her componential model of creativity (Amabile, 1982, 1983), and has captured the attention of many creativity researchers since that time (Collins & Amabile, 1999).

The terms intrinsic and extrinsic motivation became regular features in theory and research on creativity. Woodman and Schoenfeldt's (1989, 1990) interactionist model of creative behavior acknowledged intrinsic motivation as an important individual component that facilitates creativity. Csikszentmihalyi (1990) suggested that intrinsic motivation contributes to creative production because individuals who are intrinsically motivated are better able to identify opportunities or problems that best lend themselves to creative solutions. If an individual is conducting a task out of enjoyment for the task itself, he or she is more likely to approach it with a sense of wonder and exploration which in turn can facilitate creative discovery. Csikszentmihalyi argued, along with Gardner (1993), that high levels of intrinsic motivation and relatively low levels of extrinsic motivation may aid creative individuals to be more independent and less susceptible to pressures of conformity. Sternberg and Lubart (1991, 1992, 1995, 1996) built off of Amabile's componential model to propose an investment theory of creativity. They identified task-focused motivation as being crucial for creativity because under such motivation individuals are more likely to truly concentrate on the task, thus making them more likely to capture unusual solutions based on attentiveness. They outlined how intrinsic motivators are often the cause of task-focused motivation, and how some extrinsic motivators that actually increase the individual's focus on the task may also facilitate this motivation.

The research literature has supported the facilitative effects of intrinsic motivation on creativity. Some research has suggested that simply thinking about the intrinsic reasons for doing a task can significantly boost creativity on the task (Greer & Levine, 1991; Hennessey & Zbikowski, 1993). Carney (1986) found 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, indicating that persistence in the face of adversity may be a positive effect of intrinsic motivation.

Several studies in organizational settings have found that participants' intrinsic motivation predicted independent evaluation of the creativity of their work. Amabile, Hill, Hennessey, and Tighe (1994) found that individuals 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. One form of measuring intrinsic motivation in experimental settings is to measure time-on-task during a free choice period. Such experiments commonly ask participants to complete a puzzle activity of some sort. Participants are allowed to entertain themselves as they wish during mid-experiment "down time". They can either continue playing with the puzzle activity, read magazines in the room, or entertain themselves as they see fit. One indication of intrinsic motivation is whether the participant chooses to work on the puzzle activity during his/her free choice period, because it is a behavioral indicator that the individual is experiencing task involvement even when there is no external control requiring that the task be performed. Zhou (1998) found that time-on-task during a free choice period significantly predicted creativity scores for an in-box memo task. Benzer and Bergman (2007) found that participants' reported intrinsic motivation for an open-ended creative problem solving task predicted their creativity scores on the task.

The literature contrasts intrinsic motivation with extrinsic motivation. Researchers in this area contend that when we are focused on obtaining a reward or completing a task because it is being required of us (extrinsic motivation), our brains are more likely to gravitate to tried-and-true solutions that have produced results for us in the past (Isaksen, Treffinger, & Dorval, 2000). This is an adaptive response which serves us well in everyday life; it is not practical to seek out novel solutions to every problem we encounter, particularly when someone is waiting for our product or we have an incentive for using an established approach (Bristol & Viskontas, 2006). Thus extrinsic motivation (the motivation to complete a task because one wants to receive a reward or please someone else) is not necessarily a negative type of motivation. Extrinsic motivation simply tends to lead to more conventional ideas and performance because when an individual is focused on the outcome over the process he/she leans toward using approaches that have been successful in the past. This is antithetical to creativity because creative production requires the breaking of mental sets (James, Clark, & Cropanzano, 1999). Intrinsic motivation is characterized by an enjoyment of the process itself, rather than a focus on the final product (such as creating something worthy of praise or reward).

The research literature provides support for the negative relationship between extrinsic motivation and creativity. A recent meta-analysis conducted by Deci, Koestner, and Ryan (1999) found that all external rewards examined decreased creative performance. For example, when subjects were offered either a completion-contingent or performance-contingent monetary reward for painting a picture, judges rated the subjects' pictures as less creative than the pictures of subjects in a no reward condition (Hennessey, 1982; Koestner, Ryan, Bernier, & Holt, 1984). Anticipation of evaluation appears to be another way of triggering extrinsic motivation. Amabile (1979) told college-aged participants that the collages they were to create would be evaluated at the end of the session. She found that the expectation of evaluation led to significantly less creative collages than in a control condition. Competition, surveillance, and deadlines have also been negatively linked to intrinsic motivation and creativity (Amabile, 1983; Amabile & Gryskiewicz, 1987; Amabile & Gryskiewicz, 1989).

An important clarification in the literature is that rewards that are explicitly aimed at rewarding creative thinking *can* bring about intrinsic motivation (Amabile, 1997; Eisenberger & Rhoades, 2001; Eisenberger & Shanock, 2003). In general, these authors explain that extrinsic motivators such as performance evaluation lead to decreased creativity because in the absence of specific direction to be creative, individuals assume that those offering the rewards want to see traditional, previously successful examples of performance. If an individual is focused on gaining an external outcome he or she will want to rely on strategies that have been rewarded in the past. This involves a narrowing of performance to conventionally rewarded behaviors. However, extrinsic motivators need not necessarily inhibit creativity. When it is made clear that an extrinsic motivator will specifically be given for *creative* performance, such rewards can lead to intrinsic motivation (Eisenberger & Shanock).

Cognitive Evaluation Theory

Now that I have established the importance of intrinsic motivation for creativity, I will introduce the reader to cognitive evaluation theory (CET). Deci and Ryan's (1985) CET is an empirically testable theory of intrinsic motivation which can help guide the design of a training targeted at teaching creativity skills. CET has provided a rich theoretical background for research on the determinants of intrinsic and extrinsic motivation. The theory states that an individual's motivation for a task is determined by his/her perceived self-determination and perceived competence toward the task. Perceived self-determination is the degree to which the individual perceives that he/she has a choice in performing the task. It is sometimes referred to as autonomy or perceived control by different researchers (Runco, 2004). Perceived competence is the degree to which the individual believes he/she is capable of performing the task well. When an individual is experiencing high perceived competence, he/she feels confident in their ability to perform the task. Other theorists include similar constructs in their motivational theories such as self-efficacy from Social Cognitive Theory (Bandura, 1977) and perceived behavioral control from the Theory of Planned Behavior (Ajzen, 1991). CET posits that when a given task situation facilitates both high perceived self-determination and high perceived competence, the individual will be intrinsically motivated to engage in the task. The central thesis of the theory is that when individuals feel like they are both capable of performing well *and* in control of their actions, they are likely to be highly intrinsically motivated toward performing a given task.

Perceived self-determination. The first main determinant of intrinsic motivation in CET is perceived self-determination. Self-determination is the individual's perception that he/she is free from control (Deci & Ryan, 1985). In general, the theory states that people must feel free from pressures and controls in order to be intrinsically motivated in their behavior. Research has supported that when individuals perceive that control over their own actions has been taken from them, their intrinsic motivation for the task suffers as a result (Amabile & Gryskiewicz, 1987). Such pressures can result from controlling rewards (Deci & Ryan), imposed deadlines (e.g. Amabile, DeJong, & Lepper, 1976), surveillance (e.g. Plant & Ryan, 1985) anticipated evaluation (e.g. Amabile, 1979), or negative feedback (Deci & Ryan). I will proceed to describe this research in further detail.

Deci and colleagues conducted a series of studies examining the effects of external controls on participants' intrinsic motivation. Their research first examined monetary rewards as a means of exerting external control. Deci (1971) found that participants who were paid $1 for each spatial relations puzzle solved were significantly less intrinsically motivated toward the task than were participants who were not paid. In this experiment and many others from the early laboratory investigations, intrinsic motivation was measured as time playing with the puzzles during a free-choice period. A second study reported by Deci extended the investigation into the field setting of a college newspaper office. Those reporters who were paid for each headline they wrote experienced significant drops in self-reported intrinsic motivation from before to after the experiment, and were significantly less intrinsically motivated than a control group which received no monetary rewards for headline writing. Other researchers soon replicated the detrimental effects of money on intrinsic motivation with different tasks such as playing chess (Pritchard, Campbell, & Campbell, 1977) and creating art work (Anderson, Manoogian, & Reznick, 1976). Effects were also replicated with different conceptualizations of intrinsic motivation, such as enjoyment ratings of the task (Calder & Staw, 1975; Yoshimura, 1979 as cited in Deci & Ryan, 1985) or perceived job satisfaction (Pinder, 1976). Eden (1975) found a negative correlation between financial rewards and intrinsic motives in male factory workers. In general, these studies indicated that offering rewards for task performance had a negative effect on intrinsic motivation for the task.

Research expanded to look at the effects of other types of rewards on intrinsic motivation. For example, Lepper, Greene, and Nisbett (1973) found that preschoolers who were given a good player award posted on the bulletin board for completing art projects were significantly less likely to play with art materials in a follow-up free choice period. These results were replicated in Anderson, Manoogian, and Reznick (1976), Greene and Lepper (1974), and Loveland and Olley (1979). Studies exploring the motivators of tokens, toys, food, and prizes produced similar effects in participants ranging from preschool to high school (Greene, Sternberg, & Lepper, 1976; Harackiewicz, 1979; Lepper & Greene, 1975; McLoyd, 1979; Ross, 1975).

Other experiments explored the idea that more explicitly controlling outside constraints also lead to decrements in task intrinsic motivation. Deci and Cascio (1972) found that participants completing a puzzle activity in an attempt to avoid punishment (a "noxious" buzzer) were less intrinsically motivated toward the task. Lepper and Greene (1975) and Plant and Ryan (1985) found that open video camera surveillance significantly hurt intrinsic motivation for a puzzle solving activity. Pittman, Davey, Alafet, Wetherill, and Kramer (1980) found a similar effect when surveillance was conducted directly by another person in the room. Amabile, DeJong, and Lepper (1976) found that imposing a deadline on puzzle completion significantly decreased intrinsic motivation as measured through free-choice and questionnaire methods. Smith (1974) and Amabile (1979) found that anticipation of evaluation also hurt the intrinsic motivation of participants engaging in artistic tasks. Mossholder (1980) found that goal imposition on an assembly task produced better performance than in the no-goal condition, but led to decrements in satisfaction and intrinsic motivation.

Eventually Deci (1975) and Deci and Ryan (1980) developed Cognitive Evaluation Theory to address the motivational mechanisms at work in such experiments.

Building off of the work of deCharms (1968) in the area of behavior change, and Heider (1958) on the influence of interpersonal interactions, Cognitive Evaluation Theory evolved to link perceived self-determination to the issue of perceived locus of causality. When a person is intrinsically motivated, he/she engages in the task "…for internal rewards such as interest and mastery" (Deci & Ryan, 1985, p.49). He/she perceives the source causing his/her behavior as coming from within. Extrinsic motivation is then connected with external perceived locus of causality, where the reason for engaging in the task is to obtain an outside reward or "comply with an external constraint" (p.49). Thus when rewards were presented in the above described experiments, participants became focused on performing the task because of the external motivators rather than for the intrinsic enjoyment of the task. In the experiments where constraints such as surveillance, deadlines, and anticipated evaluation were employed, CET posited that these variables are often perceived as outside controls on behavior.

Cognitive evaluation theory framed low self-determination as the state of motivation when individuals believe they are engaging in a behavior primarily to acquiesce to outside influences rather than their own internal influences. Perceived self-determination is low in such instances because extrinsic motivators are perceived to be exerting control over behavior. The overall mechanism is similar to that of Cognitive Dissonance Theory (Festinger, 1957), which states that individuals are most psychologically comfortable when aligning their attitudes with their behavior. Thus if an external control is present and a person is still engaging in the behavior, the individual may be more likely to believe that he/she is performing the task because of the extrinsic motivator and not in fact because he/she truly enjoys the task itself.

Deci and Ryan (1985) also incorporated research which provides guidance on the contingencies necessary for external motivators to lead to an external locus of causality: salience and expectancy. In order to investigate claims that the effect of external motivators was merely to distract participants from their focus on the task, Ross (1975) conducted a study where rewards were combined with distracter tasks. Participants in conditions of reward paired with a distracter task (e.g. "think about snow") showed no decrements in intrinsic motivation. Those participants who were instructed to "think about the reward" as they completed the task were significantly less motivated than the "snow" group and the control group. This indicates that external motivators do not work through distraction, but that they must be salient to the individual in order to have an effect. The mere presence of a reward does not immediately wither intrinsic motivation; only when it is salient and apparent to the individual will it affect intrinsic motivation. This effect was further supported by research indicating that reward expectancy influences whether intrinsic motivation is hurt. If the individual is not expecting to receive the reward, then intrinsic motivation may not suffer unless unexpected rewards become expected (Greene & Lepper, 1974; Lepper et al., 1973).

Finally, some research has taken the approach of increasing intrinsic motivation by attempting to increase participants' perceived self-determination on experimental tasks. Zuckerman, Porac, Lathin, Smith, and Deci (1978) allowed some college student participants to choose which three puzzles they would work on during a session, and proportion their 30 minutes of time in any way they saw fit. Participants in the experimental condition were significantly more intrinsically motivated (as measured by free-choice and questionnaire method) than were control participants in a yoked condition. Swann and Pittman (1977) found similar effects when children were given the illusion of choice on which of three activities to play first. Simon and McCarthy (1982; as cited in Deci & Ryan, 2005) increased intrinsic motivation in children by offering actual choice of play activity. These experiments provided some evidence that perceived self-determination could not only be used to hurt intrinsic motivation, but it could also be enhanced in order to increase intrinsic motivation. In summary, much of the experimental work that went into the formation of CET indicates that perceived self-determination is an important determinant of intrinsic motivation.

Perceived competence. Cognitive evaluation theory proposed perceived competence as the other main determinant of intrinsic motivation. Perceived competence reflects one's self-confidence in the ability to perform a task well. Deci (1975) suggested that competence is acquired by tackling situations that are optimally challenging for the individual. Individuals who feel competent at a task are most likely to be intrinsically motivated toward it. According to Deci and Ryan (1985), there are two conditions necessary for perceived competence to affect motivation. First, the task must be sufficiently challenging but not overly difficult. Even if an individual feels competent toward a task, they will not experience intrinsic motivation if the task is too simple. Second, perceived self-determination for their behavior within the task setting must be present. If individuals feel controlled in their actions, regardless of competence level, they will not experience ideal motivation (Deci & Ryan).

Feedback is the main mechanism through which individuals make perceived competence judgments (Deci, 1975). In the "real world" we receive this feedback from interaction with our environment, by encountering experiences of success and failure.

Many studies built into cognitive evaluation theory have looked at the effects of feedback in an experimental setting. The overall theme of these studies is that when feedback is positive and delivered in a non-controlling manner, participants' perceived competence for the task increases. For example, Blanck, Reis, and Jackson (1984) and Deci (1971) found that when participants received positive verbal feedback for working on puzzles, they were more intrinsically motivated than were control subjects. Russell, Studstill, and Grant (1979) replicated these results; in addition, they found that participants who received positive feedback inherently within the task were even more intrinsically motivated than were those who received verbal feedback. Dollinger and Thelen (1978) found that verbal rewards (positive feedback) led to significantly higher intrinsic motivation than a tangible-reward condition. These studies indicated that positive feedback increases perceived competence which in turn increases intrinsic motivation. Other research has found that negative feedback which decreases competence, such as "your time was below average," can hurt intrinsic motivation (Deci, Cascio, & Kursell, 1973). Vallerand and Reid (1984) found that positive feedback increased intrinsic motivation while negative feedback decreased it. Their path analysis indicated that perceived competence mediated between feedback and intrinsic motivation.

Cognitive evaluation theory and creativity. When individuals feel competent (perceived competence) and autonomous (perceived self-determination) in their actions, they are more likely to be cognitively flexible by being able to think outside of conventional categories and associate new ideas (Deci & Ryan, 1985). Consistent with this reasoning, McGraw (& Fiala, 1982; & McCullers, 1979) found that participants who were offered extrinsic motivators for participation were significantly worse at breaking mental sets during problem solving than were participants who were offered no external rewards. This indicates that an understanding of individuals' perceived competence and self-determination for a task may help us predict whether they will perform creatively on the task. Independent of the cognitive evaluation theory framework, a recent meta-analysis in the creativity literature essentially supports the role of perceived self-determination and perceived competence in creative performance. Autonomy refers to the individual's perception that he/she is free to accomplish a task in the manner of his/her choosing, and has been found to have a moderate relationship with creative performance (Eder & Sawyer, 2007). Eder and Sawyer also found that self-efficacy for creativity was a strong predictor of creative performance at work. Self-efficacy for creativity represents an individual's confidence that he/she can perform creatively at his/her job. The concepts of autonomy and creative self-efficacy are similar to self-determination and perceived competence in cognitive evaluation theory. Finally, I have previously discussed the important role that intrinsic motivation plays in predicting creative performance. CET provides perceived self-determination and perceived competence as specific and measurable mechanisms which can help predict intrinsic motivation for a task. These two motivational mechanisms should thus be important measurements included in a training program aimed at increasing creative performance. This lead to my first hypothesis (please see Figure 1 for a full heuristic model, and Figure 2 for a depiction of hypothesis testing):

H1: Perceived self-determination (H1A) and perceived competence (H1B) will relate positively to creative performance in training.

In the present study, I attempted to improve perceived self-determination and perceived competence for the creativity training task through specific training features. When participants feel in control of their behavior on the task and feel confident that they can perform competently on the task, they are more likely to be cognitively flexible and confidently explore the task. This should translate into more creative responses on the task. Thus I expected that participants with enhanced perceived self-determination and perceived competence would perform with more creativity on the training task.

As established above, Deci and Ryan (1985) explained that intrinsic motivation is the result of perceived self-determination and perceived competence. Rewards and deadlines serve to limit the perceived range of behavioral alternatives open to subjects. When participants feel controlled, they do not feel self-determined in their actions. This makes it difficult to feel intrinsically motivated to execute the task, instead feeling like one is performing the task for others (extrinsic motivation). Intrinsic motivation has been established as an important component of creativity. In the present study, I included intrinsic motivation as the mechanism through which perceived competence and perceived self-determination affect creative performance. As depicted in Figure 1 and Figure 2, my second hypothesis was:

> H2: Intrinsic motivation will mediate the relationship between perceived self-determination and perceived competence on creative performance in training.

Perceived self-determination and perceived competence of the participant should improve creative performance on the task through the effects of increased intrinsic motivation for the task.

Cognitive evaluation theory states that without self-determination, it is not possible for an individual to feel competence even if he/she experiences success in the task. Without self-determination, successes are attributed to the controlling aspects of the situation rather than to a person's individual abilities (Deci & Ryan, 1985). Thus CET states that perceived competence only positively contributes to intrinsic motivation when the individual perceives self-determination in his/her actions. Benzer and Bergman (2007) found support for the importance of self-determination and its moderating effect on perceived competence. They found that self-determination moderated the relationship between perceived competence and intrinsic motivation; such that when self-determination was low perceived competence had no effect on intrinsic motivation. I attempted to replicate this effect in the present study. As depicted in Figure 1 and Figure 2, perceived self-determination should mediate the relationship between perceived competence and intrinsic motivation.

H3: Perceived self-determination will moderate the relationship between perceived competence and intrinsic motivation.

I have discussed the current state of creativity training in the literature, as well as a theory of motivation which can prove useful in facilitating creativity. If creativity is maximized by increasing individuals' perceived autonomy (self-determination) and confidence toward the task (perceived competence), the next question becomes how can we design creativity training programs that capitalize on this knowledge? In order to be most effective, creativity training programs must promote intrinsic motivation by allowing participants to a) feel in control of their actions (perceived self-determination) and b) feel confident that they can perform the task well (perceived competence). Yet most traditional classroom-based training programs involve training at a level that is most appropriate for the group rather than for the individual (Brown & Ford, 2002). This can lessen perceived self-determination for the participants because they are not free to explore learning in their own way and at their own pace. This may not be crucial in some learning situations. However, this format presents a potentially serious issue when the goal of learning is to increase creativity. In addition, it can be difficult for participants to develop perceived competence in a classroom-based training setting because this format makes it difficult to deliver immediate, personalized feedback regarding participants' creative performance. It can be difficult for training facilitators to stop the group in order to give each person immediate feedback on their creative performance.

The above issues indicate that one way to improve creativity training programs would be to translate them into computer-based formats. As I will describe shortly, computer-based instruction can offer the exploration and self-pacing necessary to maximize perceived self-determination. In addition, CBI can also provide the automated feedback necessary to help participants develop perceived competence for the creativity task. Next I will introduce theory and research on computer-based training.

Computer-based training

Technology-based instruction refers to instruction delivered through technology such as computer work stations, computer software web-accessed training, personal digital assistants (PDAs) and MP3 players (Aguinis & Kraiger, 2009). In this paper I will refer more specifically to computer-based instruction (CBI), which can refer to instruction accessed on a computer be it through the web or a software program. Although it is still unclear whether (CBI) saves money over the long run (Brown & Ford, 2002), it offers many other conveniences that explain its growing popularity. Learners can choose when to take training, be it on the job or during personal time if the goal is professional development. In addition, if the training is accessible through the web or a software CD, there is no need for the trainee to coordinate transportation to a traditional classroom setting. From an organizational standpoint, training can be more easily standardized in a CBI format because variations across sessions and trainers are eliminated.

Although many principles of traditional classroom learning also apply to computer-based learning, CBI also requires some separate considerations (DeRouin, Fritzsche, & Salas, 2004). For example, traditional classrooms emphasize the need to structure learning so that new lessons build on prior learning, and mastery is developed through progressive exercises. Thus frequent, specific feedback is a best practice recommendation (Kluger & DeNisi, 1996). Designers of computer-based learning must also consider sequencing and feedback. However, since computer-based learning focuses on the individual (as opposed to normative learning in the classroom) more attention must be paid to teaching in an individualized manner. Not every learner will want to receive the same kind of feedback, for example (DeRouin et al.). Finally, another difference from traditional classroom learning principles is that in CBI responsibility for learning shifts from the instructor to the learner (Sitzmann, Kraiger, Stewart & Wisher, 2006). The majority of computer-based training research has focused on school settings and has given less attention to the learning processes taking place (Brown & Ford, 2002). Translating a poorly designed training to a computer-based format is not enough to increase trainee learning. Deliberate attention must be paid to how the computer medium can facilitate and even enhance true learning. The learner control literature attempts to address the needs of individualized learners (DeRouin et al.).

Learner control

Learner control is "...a mode of instruction in which one or more key instructional decisions are delegated to the learner" (Wydra, 1980, pp. 3). The learner control literature started before technology-based instruction was a common practice, originally referring to options offered to learners in classroom settings (Steinberg, 1989). Learner control can cover many aspects of instructional design, such as control over pacing, sequence, content, method of presentation, difficulty, and incentives (DeRouin et al., 2004). Learner control allows the user to tailor a training program's style or content to his/her specific needs and preferences. There is evidence that learner control can improve reactions to training and improve learning (e.g. Freitag & Sullivan, 1995). However, other research has found that learner control can also have adverse affects on these outcomes (e.g. Carlson, 1991; Lai, 2001).

Brown and Ford (2002) noted that designers of CBI must approach learner control cautiously, citing Tennyson's (1980) study which found that learners often stop practicing before they are proficient. Part of the problem in their view is that learners do not know what they do not know. This is particularly true for learners with the least amount of knowledge. Brown and Ford explained that there are two opinions on how to ensure that learner control features are used wisely. First, the computer can retain control over the critical functions of instruction. Second, the computer can provide guidance to the learner on how to best use learner control features. Ideally, the two approaches can be integrated.

Program control of instruction can be very helpful in teaching basic knowledge and skills, but there is the possibility that it may hurt training motivation. Trainees may experience frustration that the computer is taking decisions out of their hands. Brown and Ford posited that trainees with previous knowledge or experience may become particularly frustrated with high program control. Research does suggest that those with prior knowledge learn less in programmed control compared to learner controlled computer-based training (Gay, 1986).

A review and meta-analysis conducted by Niemic, Sikorski, and Walberg (1996) found a weak, negative relationship between learner control and learning outcomes. The learner control technology and literature advanced quickly after Niemic et al.'s meta-analysis, leading Sitzmann et al. (2006) and Kraiger and Jerden (2007) to re-examine its effects. Kraiger and Jerden's meta-analysis found that, while some learner control is better than no learner control, the effect size appears to be small. Further, they found that learner control appears to have a greater effect on skill-based learning over declarative knowledge tasks. Kraiger and Jerden also found that learner control is more effective in work-related settings than in educational ones, and that it has a greater effect when trainees have no previous experience with the task. Of interest was the finding that control over pace and navigation produced greater results than control over content. They did not find evidence that learner control improved trainee affective reactions to the program.

Sitzmann et al.'s (2006) meta-analysis of web-based versus traditional training environments found that in web-based instruction (WBI) amount of learner control positively related to declarative knowledge learning. Regarding practice, they found that when both web-based and traditional classroom instruction involved practice, web-based instruction was more effective for acquiring declarative knowledge. However, when neither form of instruction involved practice, classroom instruction was more effective for declarative knowledge gains. Feedback was found to be helpful in both forms of instruction. Finally, when both forms of instruction involved practice, WBI proved to be most effective. Type of trainee (e.g. student versus adult) did not affect these outcomes. Overall, when comparing web-based and classroom instruction with identical features, they found no significant differences between learning and affective reactions for the two mediums, indicating that the training techniques (e.g. lecture, exercises, etc.) matter more than whether the instruction is given in-person or over a computer. Sitzmann et al's meta-analysis indicated that WBI was as effective for learning and affective responses as was classroom instruction and that learner control improved the effectiveness of such training.

Though the learner control literature has advanced to overcome the criticisms of early reviewers, there is still a great deal that we do not know about the process through which it works. Most researchers do agree that learner control features need to be tailored to specific learning contexts (Niemic et al., 1996). Features should not be offered to learners because they can be, but because they are the appropriate medium for best teaching the content (Brown & Ford, 2002). The learner control literature has examined both declarative and procedural knowledge learning. One of the areas of cognition that has not been covered is creative thinking. In the present study, I will argue that there are several reasons why learner control will yield favorable results when applied to creativity training.

Creativity and learner control. Though there has been little research on the relationship between learner control and creativity, I believe that learner control features should be particularly beneficial for training creativity skills. First, learner control has been linked to increased trainee intrinsic motivation (Kraiger & Jerden, 2007). For example, Becker and Dwyer (1994) found that learners using a computer-aided learner-controlled program reported higher intrinsic motivation than those working on a paper-based task. I have already established that intrinsic motivation is an important determinant of creativity (Amabile, 1979). Thus learner control is likely an essential design consideration in a creativity-focused CBI setting.

Individualization of learning environments to the particular content or needs of a learner is generally accepted as useful for learning (Rossett & Chan, 2008). Creative individuals are often high on individual orientation (Feist, 1998) and develop their own meta-cognitive strategies (Jaussi, Randel, & Dionne, 2007). The highly individualized capabilities of learner-controlled CBI should be particularly important for creativity training because creative production is a highly individualized process. This leads to the expectation that learner controlled computer-based creativity training should be a more appropriate format for acquiring creative thinking skills than traditional computer-based creativity training.

The above stated reasons provide evidence that a learner-controlled computer-based training would be appropriate for teaching creative thinking skills. However, cognitive evaluation theory provides the framework to help us examine *why* learner control features may produce an increase in creative performance during such training. Learner control should be positively related to self-determination, because it will increase trainees' perception that they have autonomy over their actions on the task. In the present study, learner control will be conceptualized as control over pacing and control over type of example viewed. Sitzmann et al.'s (2006) meta-analysis indicated that both are among the most effective conceptualizations of learner control in terms of increased learning and learner reactions. When participants are given the ability to go at their own pace, view previous slides when necessary, and select the type of example that will be most useful for them personally, they should feel more autonomous during the training. Thus, as depicted in Figure 1 and Figure 2, my next hypothesis is:

> H4: Learner control will relate positively to perceived self-determination during training.

By having control over the pacing of their instruction and the types of examples they view, participants should feel more in control of their actions and self-determined in their behavior on the task. As I proposed earlier in the paper, self-determination should be positively related to creative performance through its effect on intrinsic motivation. When individuals feel they have control over their own actions, they are more likely to experience intrinsic enjoyment of the task. Thus intrinsic motivation means that the individual is more likely to explore new ideas and increases the likelihood that the individual's performance will be creative. This leads to the following hypothesis depicted in Figure 1 and Figure 2:

> H5: Learner control will relate positively to intrinsic motivation (H5A) and creative performance in training (H5B).

Figure 3 presents the portion of the heuristic model relating specifically to learner control hypotheses, with a description of the theoretical links implied by the hypotheses tested.

Learner control should improve participants' creative performance on the training task through the mechanism of increased self-determination. Next I will describe how another feature of computer based instruction, feedback, should improve creative performance through the mechanism of increased perceived competence.

Feedback in computer-based training

Opportunity for feedback is an important element of effective training (Kraiger, 2003). The computer-based training literature also emphasizes the importance of feedback in order to increase learning (e.g. Brown & Ford, 2002). Azevedo and Bernard (1995) asserted that feedback is one of the most important components of computer-based instruction. Ideal computer-based feedback stimulates reflection on the part of the learner, so that he/she understands how to avoid mistakes in the future. Azevedo and Bernard's meta-analysis of feedback in computer-based instruction found that computer instruction featuring feedback raised achievement scores on average 80% more than did computer-based instruction without feedback. Sitzmann et al.'s (2006) meta-analysis found that feedback was beneficial to learning in both web-based and classroom instruction, but web-based instruction incorporating feedback was slightly more effective ($d = .16$) for declarative knowledge acquisition than classroom instruction with feedback.

Sales (1988) reviewed the possibilities for providing feedback in computer-based instruction. Sales noted that the first option, no feedback, is often included as a control condition and consistently yields the lowest performance from participants. Knowledge of correct response (KCR) is the next type of feedback, where the user is informed only when he/she has made the correct choice. Research has found this to be one of the least effective forms of feedback. Knowledge of incorrect responses (KIR) has been shown to be more effective by helping learners develop correct strategies. The most common form of feedback in CBI is knowledge of correct responses and incorrect responses with correct responses given (KR w/CR). Research does support the advantage of this type of feedback on developing learning strategies and performance (Sales, 1988). Another type of feedback is knowledge of correct response and incorrect response with correct response given paired with an explanation of why the answer was incorrect and how to make the right choice next time (KR w/CR + E). Finally, knowledge of consequence (KC) feedback lets the learner know the results of their actions without judgment, and is particularly useful in simulations involving decision making.

Sales (1988) emphasized that the type of feedback must be determined by the desired learning outcome of the computer-based instruction. One type of outcome is cognitive strategies, where it is the designer's goal that learners will be able to develop their own strategies which allow them to manipulate future information. Sales stated that knowledge of consequence is the most useful feedback type for this outcome, though at times it may be appropriate to pair it with other types. Although there can be many types of creativity outcomes, the majority of models in the literature emphasize the importance of creative thinking skills (e.g. Amabile, 1982; Sternberg, 1999). The present study used training on the Creative Problem Solving (CPS) process in specific. CPS guides users through exercises that help them generate multiple creative options for a problem and then select the most promising solutions. CPS training focuses on developing cognitive strategies which learners can use for future creative problem solving efforts. Thus knowledge of consequence (KC) should be the most appropriate form of feedback for the present creativity training context. Given that there are no "right" answers or consequences during a brainstorming session, an example of knowledge of consequence feedback in this setting would be: "You generated 23 ideas during that brainstorming exercise."

Feedback and creativity. There has been a large amount of research exploring the relationship among feedback, motivation, and creativity. According to Deci and Ryan (1985), feedback can either be perceived as controlling or promoting autonomy. Controlling feedback limits the options open to a person by emphasizing what the recipient "must" or "should" do. Controlling feedback appears to undermine personal choice and thus decrease self-determination. Controlled behavior is often less flexible and more characterized by tension more than autonomous behavior. In contrast, feedback delivered in an informational style promotes autonomy by mentioning what the recipient "might" or "could" try differently (e.g. Benzer & Bergman, 2007).

According to cognitive evaluation theory, feedback affects intrinsic motivation through the recipient's perceived competence. When trainees receive feedback stating how well they did, it helps form their perception of how competent they are on the task. Many studies applying cognitive evaluation theory have used performance feedback in their manipulations (e.g. Benzer & Bergman, 2007; Elliot & Harkiewicz, 1996; Zhou, 1998). Performance feedback tells the participant how well he/she did in comparison to the "average" performer. Positive performance feedback indicates that the participant performed better than the average person who performs the task. One example of a strong experimental manipulation comes from Zhou, who informed participants that they performed better than 80% of previous participants. Negative performance feedback tells participants that they performed worse than the average participant. For her negative feedback condition, Zhou told participants that they were in the bottom 20% of performers on the task. These manipulations affected participants' perceived competence for the experimental task, after controlling for pre-feedback perceived competence. Thus feedback appears to affect perceived competence for a task by providing information regarding whether the individual is performing competently. As I will explain shortly for the present study participants were given positive, informational feedback. This leads to the following hypothesis for the present study :

H6: Feedback will relate positively to perceived competence.

Positive feedback should have a positive effect on intrinsic motivation and creativity, as well. As previously discussed, cognitive evaluation theory predicts that increased perceived competence for the task increases the likelihood that the individual will experience intrinsic motivation while performing the task, because confident participants are more likely to feel secure to enjoy and explore the boundaries of task performance. When one feels confident that one is competent, one is less focused on performing to prove oneself, and can instead take the time to "play around" with ideas and approaches toward the task. As previously cited research indicates, this increased intrinsic motivation in turn increases the likelihood that the participant's responses will be creative. Thus previously discussed theory indicates that feedback will increase intrinsic motivation and creativity.

Research also provides support that feedback can increase intrinsic motivation and creativity. Deci (1971) as well as Weiner and Mander (1978) provided early evidence that positive performance feedback increased intrinsic motivation. Amabile and Gryskiewicz (1987) found that creativity in a research and development laboratory was facilitated by supportive feedback. Zhou (1998) found that positive, informational feedback had the highest relation to creativity of any feedback combination. Zhou (2003) found that developmental feedback positively related to employee creativity if creative coworkers were present. Thus research indicates that performance feedback has been related to perceived competence, intrinsic motivation, and creativity (please refer to Figures 1 and 2 for a visual depiction):

H7: Feedback will relate positively to intrinsic motivation (H7A) and creative performance in training (H7B).

Figure 4 presents the portion of the heuristic model relating specifically to feedback hypotheses, with a description of the theoretical links implied by the hypotheses tested. Computer-based training may be the most appropriate format to take advantage of the benefits of feedback on intrinsic motivation. Russell, Studstill, and Grant (1979) found that positive feedback that was self-administered inherently in the task led to higher intrinsic motivation than positive feedback administered by the experimenter. Automatic feedback delivered by the computer may thus be more useful for intrinsic motivation than that delivered by a traditional trainer. In fact, research does show that feedback is most beneficial to learning when it is presented immediately (Azevedo & Bernard, 1995; Lysakowski & Walberg, 1982). In addition, Deci, Betley, Kahle, Abrams, and Porac (1981) found that direct, face-to-face competition decreased intrinsic motivation for participants. A face-to-face brainstorming session could be considered such a situation, since participants are essentially competing for ‘air time’ during generating, and despite instructions otherwise group members often make evaluative statements regarding others’ contributions (Isaksen et al., 2000). Thus feedback may prove even more beneficial to creativity in a computer-based setting, where feedback can be delivered immediately after task completion and the face-to-face competition of traditional classroom CPS brainstorming is removed.

I believe it is important to examine both the role of feedback (mentioned by many authors as an essential part of computer-based training) *and* learner control features (which should affect motivation through self-determination) in designing successful computer-based creativity training. Feedback should increase intrinsic motivation and creativity through perceived competence. Learner control should increase intrinsic motivation and creativity through perceived self-determination. Together the two features should provide for a computer-based training context that is most conducive to the development of creative thinking skills.

Both the motivational and computer-based instruction literature agrees that feedback is an essential variable in improving performance. Ideally, both positive versus negative feedback and informational versus controlling should be explored experimentally. For the present study, I chose to deliver only positive, informational feedback to participants. This choice was based on literature indicating that negative feedback is never optimal for creative performance (Zhou, 1998). Positive feedback in a variety of delivery methods (e.g. with or without rewards) seems to universally enhance intrinsic motivation (Deci & Ryan, 1985).

The training employed in the present study is consistent with prior research showing that positive, informational feedback will be effective for improving creativity. However, there has been little research regarding the effect on creativity of pairing feedback with suggestions on how to improve performance. Power analysis revealed that the study would not have adequate sample size to create a separate cell for feedback sign or style. Thus this variable was held constant. In doing so, I was able to examine the effects of another variable important to learner control settings which may have important consequences for an aptitude-treatment interaction approach to creativity training: feedback when paired with strategy advice.

Advisement in Computer-based Training

Many authors have mentioned the importance of providing advice to trainees during computer-based instruction (e.g. Aguinis & Kraiger, 2009; Brown & Ford, 2002; DeRouin et al., 2004; Murphy & Davidson, 1991). Computer-based instruction should facilitate meta-cognitive mechanisms which in turn allow the learner to better judge his/her training needs (DeRouin et al.). Advisory control refers to advice generated by the computer program regarding progress or suggested courses of action (Kraiger & Jerden, 2007). Given that this is a form of learner control, the learner still has the option of choosing whether to follow the advice given. Examples of advisement include self-tests with feedback, which provide trainees with information on how many further examples they should view or how many practice items to take.

There are various ways to conceptualize advisory control in computer-based training. Murphy and Davidson (1991) developed an "adaptive guidance" condition where learners were given the option to continue practicing or to advance directly to the post-test after receiving performance feedback. Advisement can also be used to provide the learner with advice on how to best use their control over sequencing or content (Aguinis & Kraiger, 2009). Several studies have found a positive effect for this kind of advisement (e.g. Bell & Kozlowski, 2002; Milheim & Martin, 1991). Niemic et al. (1996)

also described another form of advisement in learner control: programs like the Minnesota Adaptive Instruction System (MAIS) were developed to provide advice on progress and suggested courses of action, but still leave the choice to the learner.

Advisement is best paired with performance feedback, because the user is provided with information regarding whether a strategy adjustment is needed. In general, we would expect advisement paired with feedback to produce gains in perceived competence (assuming that the feedback is positive, as it will be in the present study) through the effect of the feedback. As previously argued, this indicates that positive, informational feedback paired with advisement may facilitate intrinsic motivation and thus creativity. I will refer to this combination as "advisory feedback." An example for the present context might look like:

> You have generated 23 ideas: this in the top 20% of trainees who take this course. Keep up the good work. Here is a tip you can try on the next exercise if you like: Remember to ask yourself 'Am I keeping in mind fluency, flexibility, originality, and elaboration while I am brainstorming?'

Advisement in this context involves reminding the user of previously learned content (that is, fluency, flexibility, originality, and elaboration) and pointing out that it will be useful in following sections of the training. As discussed, research on advisement indicates that these kinds of strategy suggestions can improve training outcomes. Advisory feedback should still improve trainees' perceived competence for the training task by letting them know that they are competent. In addition, it provides trainees with advice on how to use previously-learned material to improve their performance even more. In general, advisory feedback should be positively related to participant creativity because of these effects and should be a useful inclusion in CBI creativity training programs. However, one advantage of CBI is the ability to individualize to the learner rather than to generalize to what is most appropriate for the group (Brown & Ford, 2002). As the learner control literature indicates (Kraiger & Jerden, 2007), individual differences can sometimes moderate the effectiveness of CBI features. Because CBI does allow for maximizing individualized learning, it is important to explore potential moderators which may affect the effectiveness of certain training features for different learners. One potential moderator that may help us differentiate between different types of effective advisory feedback in CBI creativity training is the construct of creative personal identity.

An aptitude-treatment interaction approach to advisement. Kraiger and Jerden's (2007) model proposed that learner characteristics can moderate the relationship between learner control and learning. Yet there is still little research regarding which kinds of learner control will be most appropriate for different learners (Brown & Ford, 2002). In the present study I chose to take an aptitude-treatment interaction approach in order to discover which forms of computer-based training will be most useful for different types of learners seeking to learn creative thinking skills. In the present study, I examined creative personal identity as a potential moderator.

Creative personal identity. Creative personal identity (CPI) is a relatively new construct that may be important to consider in creativity training. CPI originates from the literature on identity. Identity is defined as the psychological manifestation of a category (Brewer & Gardner, 1996). Identity can be broken into social (based on comparison between oneself and a group) or personal (self-focused, based on the importance one places on an aspect of self-definition) (Brickson, 2000; Randel & Jaussi, 2003). A personal identity is one which an individual considers crucial to his/her self-concept (Brewer, 1991). Jaussi et al. (2007) explained that personal identity is constructed through individual background and experience over time and is separate from social identity or role identity (identity based on the importance of a category within a specific role, such as at work). Creative personal identity is also separate from creative self-efficacy (Jaussi et al.), another creative self-concept variable that represents "employees' beliefs that they can be creative in their work roles" (Tierney & Farmer, 2002; p. 1137). 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 of "creative" is to an individual's self-concept (Jaussi et al.). Individuals high on CPI consider themselves to be creative and would use the label of "creative" to describe themselves to others. Individuals low on CPI would say that it is not important to them that they be creative or that others label them as creative.

Creative personal identity is a new construct in the creativity literature which may be useful in understanding creative performance. Jaussi et al. (2007) found that creative personal identity was useful in predicting employee creativity. They found that CPI explained additional variance in creative performance at work above and beyond creative self-efficacy. In addition, they argued 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 is because individuals seek situations which allow them to affirm their personal identity through successful experiences (Brewer, 1991; Steele, 1988). Thus those high in CPI may be more likely to seek out situations that allow for the display of creativity, and this may be one reason why CPI is related to creativity.

Though there has been little research in the area, some early studies in the area of creative self-concept variables also indicate that creative personal identity will be useful in predicting creative performance. Wright (1975) did find that creative self-concept (defined similarly to CPI) was significantly related to objective creativity. His results also supported that those with a high creative self-concept were relatively accurate in their assessment of their creative ability. Sansawal (1982) found evidence that participants' creative self-concept was related to but also distinct from their creativity and problem solving ability.

The importance of creativity to an individual's self-definition may be a potentially important moderator in the effectiveness of creativity training. Those who consider it crucial whether they are considered creative may react to creativity training features differently than do those who place little importance in creative self-definition. In particular, perceived competence on creative tasks may be particularly important to examine in regard to creative personal identity. Trainees high on CPI may be more likely to already have high perceived competence toward creative performance on a task, whereas those low on CPI may need more help in order to develop perceived competence.

In the present study, I investigated creative personal identity (CPI) as a potential moderator of the relationship between perceived competence and in particular advisory feedback. There is research indicating that advisory feedback should be useful for facilitating intrinsic motivation and creativity in trainees who are low on creative personal identity. Zhou (2003) argued that individuals low on creative personality (measured with Gough's creative personality adjective scale, 1980) had less prior experience with, lower self-confidence toward, and lower self-esteem for creative activities. Zhou found that employees low in creative personality benefited (in the form of creative performance) from the presence of creative coworkers and developmental feedback significantly more than did employees high in creative personality. Zhou explained these 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. Though Zhou looked at creative personality rather than creative personal identity, this study provides some evidence that an individual's creative personal identity may influence how willing he/she is to look for advice on how to improve creative performance and improve based on developmental feedback.

It may be that in a creativity training setting, learners low in CPI will appreciate the strategy reminders provided during advisory feedback because these individuals are less likely to have their own strategies for performance in the creative task in mind. Low CPI trainees are more likely to look to outside sources of information regarding how to be creative and to benefit from developmental feedback (Zhou). As a reminder, an example of positive, informational advisory feedback would be:

> You generated 23 ideas during the brainstorming exercise: this in the top 20% of trainees who take this course. Keep up the good work. Here is a tip you can try out on the next exercise if you like: Remember to ask yourself 'Am I keeping in mind fluency, flexibility, originality, and elaboration while I'm brainstorming?'

Such suggestions should help learners low in creative personal identity to develop additional strategies for performance on the creative task. Thus it is likely that advisory feedback will be *beneficial* to creative performance of trainees who are low in creative personal identity.

There is reason to believe that learners high in creative personal identity will not benefit from advisory feedback. Those with high CPI for a given skill are likely to have already created their own strategies for performance in the domain (Jaussi et al., 2007). Jaussi et al. found that those high in creative CPI were more likely to report using a specific creative thinking strategy (applying a personal hobby to one's understanding of a work problem) than those low in CPI. Because it is an integral part of their self-concept, those high in creative personal identity are more likely to have already developed strategies regarding their creative performance. A similar effect may happen with those high in creative personal identity; they may be less likely to benefit from advice given during creativity training because they have already established their own strategies for performance. This led me to propose the following interaction (please refer to Figure 1 and Figure 2 for a visual depiction):

> H8: Creative personal identity will moderate the relationship between advisory feedback and perceived competence, such that the relationship will be higher for those low in creative personal identity.

If it is true that CPI moderates the usefulness of advisory feedback in computer-based creativity training, we may be better able to design computer-based creativity training that is most effective for different kinds of users. Since creative personal identity is positively related to creativity, it may be most useful to design creativity training which targets those who are not already high on creative personal identity (Jaussi et al., 2007; Zhou, 2003). From a resource perspective, it may prove most useful to design CBI creativity training that is targeted toward those low on creative personal identity because these may be the users who will benefit most from such training.

In summary, in the present study I examined the effect of two features of computer-based training, learner control and automated feedback, on the motivational mechanisms that affect creativity. In addition, I examined whether creativity is important to the trainees' self-definition (creative personal identity) as a potential moderator to consider in training design. The overall goal of the study was to use the wealth of theory and research on creative motivation to design effective computer-based creativity training.

Summary of Hypotheses

Before I proceed to the Method section, I will provide a brief summary of the hypotheses proposed for the present study. Figure 1 provides a visual depiction of the heuristic foundation for hypotheses. However, I also acknowledge that the factors of learner control and feedback may affect intrinsic motivation and creative performance through means other than perceived self-determination and perceived competence. For this reason, hypothesis testing examined direct effects between learner control and feedback and intrinsic motivation and creative performance (rather than perceived self-determination and perceived competence as full mediators). Figure 2 summarizes the manner in which hypotheses were examined. The following hypotheses apply to validation of cognitive evaluation theory in the present setting:

H1: Perceived self-determination (H1A) and perceived competence (H1B) will relate positively to creative performance in training.

H2: Intrinsic motivation will mediate the relationship between perceived self-determination (H2A) and perceived competence (H2B) on creative performance in training.

H3: Perceived self-determination will moderate the relationship between perceived competence and intrinsic motivation.

The following hypotheses were informed by a more specific application of cognitive evaluation theory to the present investigation. Please reference the full heuristic model of Figure 1 and the hypothesis testing model of Figure 2. In addition, Figures 3 and 4 also present a more specific isolation of the heuristic linkages implied by the theory presented for learner control and feedback, respectively.

H4: Learner control will relate positively to perceived self-determination.

H5: Learner control will relate positively to intrinsic motivation (H5A) and creative performance in training (H5B).

H6: Feedback will relate positively to perceived competence.

H7: Feedback will relate positively to intrinsic motivation (H7A) and creative performance in training (H7B).

H8: Creative personal identity will moderate the relationship between advisory feedback and perceived competence, such that the relationship will be higher for those low in creative personal identity.

Method

Participants

In total, 275 participants participated in the study. Ten students participated from an Organizational Behavior course at Denver University. Twenty-five students from the Interior Design Capstone course at Colorado State University also participated. One-hundred and fifty participants from PSY100 and 81 participants from PSY250 chose to complete the study as partial fulfillment of their class research requirement. Eight PSY100 students and three PSY250 students were eliminated from the data set for failing to complete one or more of the six total questionnaires, or for spending less than 30 minutes total on the entire study. This left 266 total participants. Power analysis indicated that for a 3 X 2 factorial ANOVA design involving six cells, 240 subjects would be needed in order to detect a small effect size at 80% power and alpha set at .05 (Huck, 2004). Thus the total number of participants exceeded the recommended number of participants based on power analysis.

In order to evaluate whether aggregation into a single sample was appropriate, an ANOVA was run to evaluate if any individual sample was significantly different on hypothesis variables. The analysis indicated that the four samples were significantly different on perceived self-determination at Time 1 ($F(3, 230) = 7.21$, $p < .01$, $\eta^2 = .01$) and Time 2 ($F(3, 229) = 8.64$, $p < .01$, $\eta^2 = .02$). Follow-up t-tests on Time 1 perceived self-determination revealed that the Interior Design sample ($M = 15.84$, $SD = 3.08$) was significantly different from the PY100 sample (M = 21.05, SD = 5.75 for PY100, $t(172)$ = 4.12, $p < .001$, $\eta^2 = .08$), the PY250 sample (M = 20.99, SD = 5.71, $t(73) = 4.20$, $p < .001$, $\eta^2 = .15$), and the Organizational Behavior class sample (M = 23.10, SD = 6.31, $t(33)$ = 4.60, $p < .001$, $\eta^2 = .27$). Follow-up t-tests on Time 2 perceived self-determination also showed the Interior Design sample to be different from all other samples: M = 16.94, SD = 3.99 for Interior Design, M = 21.39, SD = 6.40, $t(171) = 3.36$, $p < .001$, $\eta^2 = .05$ for PY100, M = 21.46, SD = 5.82, $t(73) = 3.49$, $p < .005$, $\eta^2 = .11$ for PY250, M = 24.90, SD = 6.78, $t(33) = 4.33$, $p < .001$, $\eta^2 = .25$ for the Organizational Behavior class. There were no other significant differences among samples. The Interior Design Capstone participants received the training in a slightly different format; these students logged on together as a class during assigned class time (participants were informed the class prior that this was a voluntary opportunity to help fulfill their accreditation computer hours, and that if they did not wish to participate they could choose an alternate activity). Participants within the course were randomly assigned to cells; the course instructor informed me that as a result some students shared with each other that they had learner control over the training while others did not. Because of the significant statistical differences for this sample on perceived self-determination, the difference in study administration, and the potential that the learner control manipulation was revealed, the decision was made to remove this sample from subsequent analysis.

The final total number of participants for analysis in the study was thus 241. Participants were randomly assigned to cells at the time of sign-up. After the removal of the Interior Design sample, the cell numbers were: Cell 1 (no learner control, no feedback), n = 41; cell 2 (learner control, no feedback) n = 39; cell 3 (no learner control, feedback), n = 38; cell 4 (learner control, feedback) n = 42; cell 5 (no learner control, advisory feedback), n = 37; cell 6 (learner control, advisory feedback), n = 44. The sample was 73% female with a mean age of 20.17. 83 % were Caucasian, 9.5% Hispanic/Latino, 3.3% Asian, 2.5% African American, and 1.7% Native American. For education level, 2.1% of participants reported Some High School, 15.8% respondents reported High School or GED only, 73.4% Some College, 5.4% Associates Degree, and 3.3% BA or BS. When asked their familiarity with the creative problem solving process, 23.7% responded "Not at all," 18.3% responded "I've heard of brainstorming," 44.8% I've informally brainstormed before," 8.7% "I've participated in formal brainstorming sessions before," 2.9% "I've participated in formal 'focusing' sessions before, and 1.7% "I've participated in a creative problem solving workshop before." Twenty-six percent were psychology majors, 13.9% were undeclared, 4.1% health and exercise science, and the remaining participants were spread across 33 majors. Forty-three point six percent were currently employed, with an average of 16.49 hours per week.

Measures

Please see the Appendix A for a full list of items. Excepting the creative performance exercises, all items were answered on a six-point scale with anchor points ranging from 1= strongly disagree to 6= strongly agree.

Creative personal identity

Creative personal identity was measured with the four-item scale developed by Jaussi et al. (2007). An example item is "My creativity is an important part of who I am" (alpha = .88).

Perceived self-determination

Perceived self-determination was measured with a six-item scale developed by Deci and Ryan (2005). An example item is "I believe I had some choice about doing this activity" (alpha = .90 Time 1, alpha = .94 Time 2).

Perceived competence

Perceived competence was measured with a seven-item scale developed by Deci and Ryan (2005). An example item is "I am satisfied with my performance at this task" (alpha = .88 Time 1, alpha = .94 Time 2).

Intrinsic motivation

Intrinsic motivation was measured through the items used in Elliot and Harkiewicz (1996). Three items measured task involvement and were developed by Elliot and Harkiewicz. A sample item is "During the brainstorming exercise I just completed, I... was totally absorbed in the exercise" (alpha = .67 Time 1, alpha = .60 Time 2). In addition, five items from Deci and Ryan (2005) were used. Three items measured enjoyment for the task. An example item is "I enjoyed doing this activity very much" (alpha = .92 Time 1, alpha = .95 Time 2). Two items measured interest for the task. An example reverse-coded item is "I thought this exercise was boring" (alpha = .84 Time 1, alpha = .87 Time 2). The overall alpha for the intrinsic motivation scale was (.89) at Time 1, and (.90) at Time 2.

Confirmatory factor analyses. In order to ensure that the motivational variables (intrinsic motivation, perceived self-determination, and perceived competence) represented separate motivational factors rather than one global motivational factor, a confirmatory factor analysis was completed for Time 1 and Time 2. For Time 1, the three factor solution ($\chi^2(167) = 502.66, p < .000$, NFI = .91, CFI = .94, GFI = .83, RSMEA = .092) was a significant improvement over the one factor solution, ($\chi^2(170) = 2460.02, p < .000$, NFI = .70, CFI = .72, GFI = .49, RSMEA = .237; difference $\chi^2(3) = 1957.26, p < .000$). The three factor solution was also a significant improvement over the one factor solution at Time 2, ($\chi^2(167) = 391.86, p < .000$, NFI = .95, CFI = .97, GFI = .86, RSMEA = .075 for the three factor solution; $\chi^2(170) = 3041.97, p < .000$, NFI = .77, CFI = .78, GFI = .44, RSMEA = .265; difference $\chi^2(3) = 2650.11, p < .000$)).

Creative performance

Participants' responses to creative performance exercise one, creative performance exercise two, and creative performance exercise three were rated for level of creativity. Scoring of ideas generated during a brainstorming exercise can be controversial, as some traditional scoring methods are heavily influenced by number of responses generated or whether a response is unique as compared to responses provided by other participants (Hocevar, 1979). In the present study the scoring technique recently developed by Snyder et al. (2004) was employed. This technique produces a Creativity Quotient (CQ) which takes into account not just pure fluency (number of ideas) but also how many different categories of ideas (flexibility) are represented in the participant's responses. The CQ is based on information theory (Shannon & Weaver, 1949) which essentially applies to state that the information provided toward understanding an individual's creative ability by each new brainstorming response diminishes each time the response does not represent a new category. The formula provides a progressively smaller increase in creativity quotient with each new response that falls within a previously mentioned category, and then applies a logarithm base 2 which contributes to a normal distribution for the variable. The result is that if, for example, two participants each provided five responses to a brainstorming task regarding potential uses for a brick, the participant who listed five uses for a brick that all fall under the category of "building" would receive a lower creativity score than the participant who had two responses under the "building" category, two responses under the "weapon" category, and one response under the "heat conductance" category. This method has been shown to provide a better measurement of creativity than just fluency of ideas, and is not as cohort-dependent as rating responses for uniqueness (which requires scoring each response based on the percentage of participants who presented the same response) (Snyder et al.).

Two raters blind to condition, myself and a trained research assistant, scored the exercises. Scoring categories were developed according to principles of categorization outlined by Rosch (1988) as recommended by Snyder et al. (2004), example categories for the paper exercise taken from Snyder et al., a previous study I had conducted using the brick and paperclip exercises (Smith & Kraiger, 2007), and emergence of new categories based on rater agreement. Rater training consisted of scoring five responses for each exercise on the number of categories present, then discussion and calibration of scoring. After discussion, an additional five responses for each exercise were scored independently and answers were compared. Notes regarding scoring decisions were added to the coding sheet at each round of discussion. An additional five responses for each exercise were scored; after comparison of scores, it was determined that the raters were ready to each score the same subset of responses for calculation of inter-rater consistency. Raters independently scored the same subset of 60 participant responses, as this was 20% of the total 241 participants. CQ was calculated for each exercise for each rater. Consistency between the two raters on CQ was (r = .99) for creative performance exercise one, (r = .97) for creative performance exercise two, and (r = .99) for creative performance exercise three. After discussion and documentation of differences in scoring, this was deemed acceptable consistency for proceeding with independent rater coding for the remaining exercises. The original fifteen responses from training and the 60 responses from consistency comparison were randomly re-assigned to raters for re-rating.

Each rater completed five waves of rating with approximately 25 participants per wave over the course of three weeks. Waves were created randomly from data across cells and study administration timelines in order to prevent order effects on the ratings. Raters were instructed to rate five participants at a time, and for each five participants raters started on a different brainstorming exercise (e.g. sometimes raters would start by rating brainstorming exercise three, then move to brainstorming exercise one, then move to brainstorming exercise two, etc.) As an additional check on rater effects, correlations and t-tests were run for coding wave and rater. No significant correlations or mean differences were found with any study variables. Appendix B lists the coding categories used by the raters for each creative performance exercise.

Control variables. Based on previous research, several control variables were measured. Some research indicates that women may feel more controlled by praise than do men, even with the same informational-style feedback (Deci & Ryan, 1985). For this reason, gender was measured as a potential control variable in the present study. Kraiger and Jerden (2007) found that learner control was more effective for learning when the trainee had no prior task experience. For this reason, prior experience with the Creative Problem Solving process was also measured as a potential control variable. Age was also measured as this has also shown to correlate with intrinsic motivation and creativity (Sternberg & O'Hara, 1999). Finally, time taken during each creative performance exercise was also measured, given that the instructions for the learner control conditions may make participants in these conditions more likely to exit the exercise early. However, there were no significant correlations between the measured control variables and variables related to hypotheses (please see Table 1 for values). Because of this, these variables were not controlled for in analysis.

Manipulation check. At the conclusion of the training, participants were asked to rate the degree to which they used learner control and received feedback and strategy advice during the training. Three items asked participants about their use of learner control features during the training. Two items asked participants about whether they received feedback during the training. Finally, an open ended overall manipulation check item asked participants what was the purpose of the study. Qualitative review of responses indicated that no participants (out of the 238 who responded to the question) correctly guessed the use of learner control and feedback manipulations.

Perceived challenge. Based on Elliot and Harkiewicz (1996), participants were asked three items regarding whether the training exercises were at an adequate challenge level, as this is important to establish in investigations of Cognitive Evaluation Theory. Because of item wording, items could not hang together in a reliable scale (alpha = .62; no alpha calculated in Elliot & Harkiewicz; instead, mean scores were examined) so items were examined individually to ensure that participants perceived the brainstorming exercises to be adequately challenging but not overly challenging or easy (scale of 1 to 6): "For me, the exercises were too difficult" ($M = 2.83$, $SD = .84$), "For me, the exercises were too easy" ($M = 3.78$, $SD = .92$), and "I felt that the exercises were at an adequate challenge level" ($M = 4.33$, $SD = .94$).

Training utility. Finally, participants were asked three items regarding their affective reaction and perceived utility of the training. A sample item is "This training was useful for me" (alpha = .85).

Procedure

Please see Figure 5 for a depiction of the experimental timeline. Participants were randomly assigned to cells at the time of sign-up. The training was created with Adobe Captivate, a program for designing online training workshops. The training was accessed through the RAMCT online education system. The training guided participants through the Creative Problem Solving process including the use of brainstorming techniques and was based on Isaksen et al. (2000). For all participants, the training was split into two sessions (session one: sixty minutes, session two: ninety minutes). Figure 6 presents the structure and menu of the training that all participants viewed. Participants were instructed to complete session two within 48 hours of session one. Participants in learner control conditions were presented with an explanation of their ability to control the pacing (backward and forward) of the training program (DeRouin et al., 2004). Control over pacing is one of the most common forms of learner control. Pacing control is a facet of learner control which allows the user to determine how long to spend on a page or section before continuing. Kraiger and Jerden (2007) found that control over pacing and sequencing was more effective for learning than was control over content. In addition, participants in learner control positions were allowed to choose what type of example (school-related, home-related, or work-related) they would like to view. This choice was presented to them within each of the three training sections (please see Figure 7 for a visual depiction). In no-learner control conditions the computer automatically advanced to the next page after a preprogrammed amount of time, and participants were presented with the examples relating to improving the quality of their time at school (Figure 8 presents an example).

Participants were presented with an overview of the Creative Problem Solving process and the guidelines for generating and focusing during brainstorming exercises. CPS involves choosing a general problem area to take through the problem solving process. Pilot testing revealed that participants may enjoy CPS more if they are given some initial guidance on what kind of problems are most appropriate for the process. In the past, individuals who choose inappropriate problems (e.g. those which are close-ended or are unrealistic because the individual has little influence over implementing new ideas) expressed frustration later in the process. Because of this effect participants were presented with three options for problem solving: a) "Improving the quality of my time at school", b) "Improving the quality of my time at work", or c) "Improving the quality of my time at home." These options were designed to allow them the choice over three domains, and to be open to many interpretations as to whether the participant chose to interpret "quality" as meaning efficiency, satisfaction, etc. These two goal options were designed to be broad enough to allow participant self-determination but narrow enough to help participants choose fruitful goal areas from the start of the process.

Participants then started the first section, which included a brief explanation of the 'Defining the Challenge' stage of CPS and guided users through a generating and focusing exercise entitled "Wouldn't it Be Nice If?" and "The Three Tests of Ownership" (Isaksen et al., 2000). Generating exercises are probably most familiar as brainstorming, and in CPS they present specific questions and stimuli to participants to help them generate a variety of useful and original ideas. This kind of brainstorming is what is commonly referred to as "divergent thinking" in the creativity literature, where the focus is on generating multiple solutions to a problem. Generating exercises are immediately followed by focusing exercises during CPS. Focusing exercises involve convergent thinking, where the focus is on converging on the most appropriate solution for a given context. Each focusing exercise used questions and stimuli to guide the user through choosing the three most original and useful ideas generated. The participant then carried over these three chosen ideas into the next stage of Creative Problem Solving.

As depicted in Figure 5, Time 1 measurement of creative performance, intrinsic motivation, self-determination, and perceived competence for the task took place after the conclusion of stage one. At the end of stage one, participants were instructed to complete creative performance exercise one (Figure 9), where they were instructed to generate as many potential uses for a brick as possible within three minutes (Figure 10). Because five of the first ten participants attempted to directly complete brainstorming exercise one without viewing the stage one training slides, a password was added to each brainstorming exercise. The password was given at the conclusion of each stage. For participants in learner control conditions, the instructions for the brainstorming exercise read:

For three minutes, generate as many potential uses for a brick as you can. Make sure you delimit your ideas with a comma or by hitting 'ENTER'. Remember the guidelines for generating! Although it is good to challenge yourself for the entire three minutes, if you run out of ideas you do have the option of submitting the assessment at any time during the exercise.

This was designed to allow participants to feel in control of the exercise even though the RAMCT quiz system presented a time limit during the exercise. The instructions for participants in non-learner control conditions were: “For three minutes, generate as many potential uses for a brick as you can. Make sure you delimit your ideas with a comma or by hitting 'ENTER'. Remember the guidelines for generating!” Immediately after completion of brainstorming exercise one, participants filled out a questionnaire regarding their intrinsic motivation, self-determination, and perceived competence for the task. This concluded the first training session and participants were instructed to return to complete session two within 48 hours.

Session two of the training started by guiding participants through stage two of the Creative Problems Solving process: ‘Idea finding.’ This stage used specific questions and stimuli to guide the user in generating creative solutions to the three problem statements chosen in stage one by using an exercise titled “Visual Imagery” (Isaksen et al., 2000). Participants then completed the focusing exercise for stage two, which guided them through choosing one solution through ratings of uniqueness and realism (Isaksen et al., 2000).

After stage two was complete, participants engaged in creative performance exercise two. This exercise instructed them to generate as many potential uses for a paperclip as they could within three minutes. As with creative performance exercise one, participants in learner control conditions were again given the additional instructions "Although it is good to challenge yourself for the entire three minutes, if you run out of ideas you do have the option of submitting the assessment at any time during the exercise" in order to allow for perceived autonomy on the task. Immediately after the completion of creative performance exercise two, participants in feedback conditions were presented with feedback from the computer. In the RAMCT system, this involved feedback appearing in the center of the screen (Figure 11). As described earlier, feedback was designed to be informational and positive (meaning that it emphasizes that the person is competent in reference to others), and was either advisory or non-advisory. Non-advisory feedback was presented as follows: "The number of brainstorming ideas you generated during this exercise is in the TOP 20% of participants who take this training program. Good job!" Advisory feedback was identical with an additional tip included:

> The number of brainstorming ideas you generated during this exercise is in the TOP 20% of participants who take this training program. Good job! Here is a tip you can try during the last brainstorming exercise if you like: Remember to ask yourself 'Am I keeping in mind number of ideas (fluency), different categories of ideas (flexibility), and elaboration of my ideas while I'm brainstorming?'

This advice was a reminder of content covered in stage two of the training. Immediately following feedback (or immediately following the creative performance brainstorming exercise in non-feedback conditions), participants completed Time 2 measurements of intrinsic motivation, perceived self-determination, and perceived competence for the task.

This is consistent with previous research (e.g. Benzer & Bergman, 2007; Zhou, 1998) in which motivational measures were taken immediately after feedback was given.

Finally, participants completed generating and focusing exercises in stage three, 'Building Acceptance'. This stage guided participants through goal setting and action planning to ensure the success of their chosen solution (Isaksen et al., 2000). Immediately following completion of stage three, participants completed the Time 3 creative performance exercise. This exercise instructed them to generate as many potential uses for a piece of paper as they could during three minutes. Once again, participants in learner control conditions received the additional instruction designed to allow for perceived self-determination: "Although it is good to challenge yourself for the entire three minutes, if you run out of ideas you do have the option of submitting the assessment at any time during the exercise." No feedback was given for the Time 3 creative performance exercise. After completion of the Time 3 creative performance exercise, participants answered questions regarding what type of examples they chose to view throughout the training, what type of problem they took through the CPS process, and what their chosen outcome statements were for each of the three stages. In addition, participants answered manipulation check items aimed at evaluating the effectiveness of the learner control and feedback manipulations.

Results

Descriptive Statistics and Correlations

Descriptive statistics and correlations among variables are summarized within Table 1 and Table 2. Table 1 summarizes correlations among descriptive study variables and the outcome variables of creative performance Time 1, Time 2, and Time 3. Table 2 summarizes correlations among variables examined within study hypotheses.

Manipulation Checks

Manipulation checks were conducted to evaluate whether the intended learner control and feedback manipulations were effective. A one-way ANOVA indicated that participants in the learner control condition experienced significantly higher learner control (M = 13.44, SD = 2.75), than those in no learner control conditions (M = 11.32, SD = 3.21, $F(1, 235) = 29.62$, $p < .001$, $\eta^2 = .11$). However, a one-way ANOVA did not support the feedback manipulation check ($F(2, 235) = .69$, $p = .503$, $\eta^2 = .06$; M = 5.26, SD = 2.22 for No feedback group, M = 5.16, SD = 2.14 for feedback group, M = 5.55, SD = 2.07 for advisory feedback group).

Tests of Hypotheses

Hypothesis 1

Hypothesis 1 stated that perceived self-determination (H1A) and perceived competence (H1B) would relate positively to creative performance in training. This hypothesis was evaluated by examination of correlation coefficients as well as through multiple regression analysis within and between Time 1, Time 2, and Time 3 measurements. As Table 2 summarizes, perceived competence Time 1 significantly correlated with creative performance Time 1 ($r = .31, p < .01$) and with creative performance Time 2 ($r = .19, p < .01$), supporting Hypothesis 1b. Hypothesis 1a received no support, as perceived self-determination Time 1 did not significantly correlate with creativity at Time 1 or Time 2. Neither Time 2 perceived self-determination or perceived competence significantly correlated with creative performance at Time 3. In summary, obtained correlations provided partial support for Hypothesis 1b but failed to support Hypothesis 1a.

A multiple regression analysis was conducted also to examine the effects of Time 1 perceived self-determination and perceived competence on Time 1 creative performance. First, assumptions of normality, linearity, and multicollinearity were evaluated. Table 3 summarizes descriptive statistics for all examined variables. The skewness and kurtosis values, as well as scatter plot and histograms (not shown), supported the linearity, normality, and homoscedacity of the data. By examining standardized residuals over 3.0, two outlier cases were identified on the outcome variable of creativity time 1; after an examination of data accuracy it was determined that the subjects were from the intended population and the cases were retained for analysis. In addition, examination of Mahalanobis distances revealed no outlier cases over the critical Chi square value of 13.82 for two variables (i.e. perceived self-determination and perceived competence). Examination of the condition index and variance proportions statistics indicated that multicollinearity was not present in the relationship between Time

1 perceived self-determination, Time 1 perceived competence, and Time 1 creative performance .

Multiple regression analysis revealed a statistically significant but small effect on creative performance Time 1 ($R^2 = .05$, $F(2, 236) = 5.61$, $p < .01$) of the combined Time 1 perceived self-determination and Time 1 perceived competence model. Perceived self-determination Time 1 did not have a significant relationship with creative performance Time 1 ($\beta = -.04$, $p = .54$). However, Time 1 perceived competence did significantly relate to creative performance at Time 1 ($\beta = .20$, $p < .01$). Therefore, Hypothesis 1a was not supported, but Hypothesis 1b did receive support at Time 1.

Hypothesis 1 was next examined between Time 1 and Time 2 by regressing creative performance Time 2 on perceived self-determination and perceived competence at Time 1. Assumptions of linearity, normality, homoscedacity, and multicollinearity were evaluated as described above. No significant violations of assumptions were detected, and no outlier cases emerged. Descriptive statistics are summarized also in Table 3.

Next multiple regression analysis was used to evaluate Hypothesis 1 between Time 1 and Time 2. Because of the high correlation ($r = .47$) between creative performance Time 2 and creative performance Time 1, creative performance Time 1 was controlled for in the analysis. The model containing perceived self-determination Time 1 and perceived competence Time 1 did not account for significant additional variability in creative performance Time 2 after controlling for creative performance Time 1 ($\Delta R^2 = .01$, $\Delta F(3, 235) = 1.59$, $p = .21$). Perceived self-determination Time 1 did not significantly predict creative performance Time 2 ($\beta = -.01$, $p = .82$). In addition, perceived competence Time 1 did not significantly predict creative performance Time 2 ($\beta = .10, p = .08$). In summary, Hypothesis 1 was not supported when looking between Time 1 and Time 2 measurements.

Next Hypothesis 1 was examined by examining relationships within Time 2. Once again, assumptions of linearity, normality, homoscedacity, and multicollinearity were evaluated for regression of Time 2 creative performance on Time 2 perceived self-determination and perceived competence. Descriptive statistics are summarized in Table 3. The scatter plot, histograms, skewness and kurtosis values supported the linearity, normality, and homoscedacity of the data and indicated that no transformations should be made. Examination of Mahalanobis distances revealed no outlier cases over the critical Chi square value of 16.27 when three variables are involved. Examination of the condition index and variance proportions statistics indicated that multicollinearity was not present in the relationship between Time 2 perceived self-determination and Time 2 perceived competence with Time 2 creative performance.

Multiple regression analysis was used to regress Time 2 creative performance on Time 2 perceived self-determination and perceived competence, after controlling for Time 1 creative performance in Step 1. The model explained significant additional variance in Time 2 creative performance ($\Delta R^2 = .07$, $\Delta F(2, 233) = 11.01, p <.01$). Consistent with the examination of Hypothesis 1 within Time 1, perceived competence was significantly related to creative performance ($\beta = .27, p < .01$) but perceived self-determination was not ($\beta = -.05, p = .38$). Thus once again Hypothesis 1a did not receive support but Hypothesis 1b was supported.

Finally, Hypothesis 1 was examined between Time 2 and Time 3 by regressing creative performance Time 3 onto perceived self-determination and perceived competence at Time 2. Assumptions of linearity, normality, homoscedacity, and multicollinearity were evaluated as described above. No significant violations of assumptions were detected, and no outlier cases emerged. Descriptive statistics are summarized also in Table 3.

The full model in multiple regression analysis contained Time 2 perceived self-determination and Time 2 perceived competence in prediction of creative performance Time 3 after controlling for creativity Time 1 and Time 2. The model did not explain significant additional variance in Time 3 creative performance ($\Delta R^2 = .01$, $\Delta F(2, 232) = 1.19$, $p = .30$). Neither perceived self-determination Time 2 ($\beta = .07$, $p = .23$) nor perceived competence Time 2 ($\beta = -.07$ $p = .22$) were significantly related to creative performance. Hypothesis 1 did not receive support by examining relationships between Time 2 and Time 3. In summary, Hypothesis 1a was not supported. Hypothesis 1b received some support when relationships were examined *within* time measurements, but not *between* time measurements.

Hypothesis 2

Hypothesis 2 predicted that intrinsic motivation would mediate the relationship of perceived self-determination and perceived competence on creative performance. In keeping with James and Brett's (1984) recommendation to establish temporal sequence before mediation analysis, this hypothesis was evaluated by examining perceived self-determination and perceived competence at Time 1, intrinsic motivation at Time 2, and creative performance at Time 3.

Based on simulation studies conducted by MacKinnon, Lockwood, Hoffman, West, & Sheets (2002), the asymmetric distribution of products approach (MacKinnon & Lockwood, 2001) was chosen to evaluate the significance of an indirect effect through intrinsic motivation. This approach provides a good balance between statistical power and Type I error rate in comparison to other approaches to mediation analysis (MacKinnon et. al., 2002; Shrout & Bolger, 2002). Following the recommendations of MacKinnon, Lockwood, and Williams (2004), I first calculated the indirect effect by (1) regressing creativity on intrinsic motivation, (2) regressing perceived self-determination (H2a) or perceived competence (H3a) on creativity, (3) determining the coefficient for the indirect effect by taking the product of step 1 and 2. These values are summarized in Tables 4 and 5. Next the standard error for the indirect effect was estimated using the Sobel (1987) method, which is generally accepted as the least biased method of estimation (MacKinnon et al., 2004). The Sobel estimate of the standard error for the indirect effect was obtained based on a bootstrapping sample approach in order to account for any nonnormality or sample size issues (MacKinnon et al., 2004; Preacher & Hayes, 2004; Shrout & Bolger). Bootstrapping is a technique which takes a large number of samples (each sample the size of the study sample) from the data, with replacement, and computes desired coefficients for each sample. In the current study, I chose to conduct bootstrapping for 1000 samples. Thus the final estimate of the standard error for the indirect effect was its mean across 1000 samplings. Bootstrapping and Sobel estimation were conducted with SPSS macros provided by Preacher and Hayes.

A traditional approach to testing mediation involves testing the significance of the indirect effect by dividing the product coefficient by its standard error and comparing the value to a standard normal distribution as a z-score. The asymmetric distribution of products approach instead compares values to a distribution based on the product of two standardized variables. Simulation studies generally support this approach as more appropriate because it is often unreasonable to assume that the distribution of a product term will be normal, even if the individual elements of the product term are normally distributed (MacKinnon et al., 2004). Thus the significance of the indirect effect for H2a and H2b was evaluated by consulting tables provided by Meeker, Cornwell, and Aroian (1981) in order to create confidence intervals. As summarized in Table 4, Hypothesis 2a (for perceived self-determination) was supported, as the indirect effect was statistically significant ($B = .04$, $\sigma = .016$, $\beta = .098$, 95% confidence interval for $B = (.004, .074)$). As summarized in Table 5, Hypothesis 2b (for perceived competence) was not supported; the indirect effect was not statistically significant ($B = .038$, $\sigma = .017$, $\beta = .115$, 95% confidence interval for $B = (.001, .037)$). I chose to examine this hypothesis further by creating a wider confidence interval based on a 99% confidence coefficient. The 99% confidence interval (-.013, .089) included zero, supporting that the indirect effect for the relationship between perceived competence and creative performance through intrinsic motivation was not significant.

Hypothesis 3

Hypothesis 3 predicted that perceived self-determination would moderate the relationship of perceived competence on intrinsic motivation. This relationship was examined using hierarchical regression analysis on variables at Time 1. Prior to analysis, assumptions of linearity, normality, homoscedacity, and multicollinearity were evaluated. Descriptive statistics are summarized in Table 2. The scatter plot, histograms, skewness and kurtosis values supported the linearity, normality, and homoscedacity of the data and indicated that no transformations should be made. Examination of Mahalanobis distances revealed four cases over the critical Chi square value of 16.27 when three variables are involved. Examination of the data indicated that one participant had likely responded to intrinsic motivation items without regard for whether items were reverse coded. This case was eliminated from further analysis. Examination of the other potential outliers indicated that they came from the population of interest, and these cases were retained in analysis. Examination of the condition index and variance proportions statistics indicated that multicollinearity was not present, excepting for the expected multicollinearity between the interaction term and the two predictors. Although tolerance values were relatively low (perceived competence Time 1 = .08, self-determination Time 1 = .04, interaction term = .03) these values were not low enough to be automatically excluded from analysis given a criterion of.01 (Tabachnik & Fidell, 2001a).

As summarized in Table 6, Hypothesis 3 was not supported. The interaction term (perceived competence Time 1 times perceived self-determination Time 1) did not produce a significant change in R^2 in prediction of intrinsic motivation at Time 1.

Hypothesis 4 and 5

Hypothesis 4 and 5 predicted that learner control would be related positively to perceived self-determination (H4) and intrinsic motivation (H5A) and creative performance (H5B). Preliminary assumption testing was conducted to check for normality, linearity, outliers, and multicollinearity for each dependent variable across the two groups (no learner control or learner control). Table 7 and Table 8 summarize the descriptive statistics. All values appeared within acceptable range and no outliers emerged in either group. Tabachnik and Fidell (2001b) advised that the variance for each dependent variable should not exceed a 10:1 ratio across groups; examination of variance values indicate that no dependent variable showed a smallest to largest variance ratio from one group to another that was larger than 1.23:1 (for intrinsic motivation). In addition, the Box's Test of Equality of Covariance Matrices was not significant, supporting the assumption of homogeneity of variance-covariance matrices. In addition, Levene's test of homogeneity of variances was not significant, supporting that this assumption was met between groups for each dependent variable.

A one-factor MANOVA was conducted with perceived self-determination, intrinsic motivation, and creative performance all at Time 1 as dependent variables. Because no feedback manipulations had been administered at Time 1, feedback was not included as a second factor for this analysis. Analysis indicated a very small main effect for learner control on the combined dependent variables F (3, 236) = 2.79, p = .04; Λ = .97; η^2 = .03. However, examination of each dependent variable indicated no significant differences between learner control groups at Time 1 (please see Table 9 for values). As summarized in Table 9, strength of association as measured through eta-squared for each follow-up test was very small, ranging from .008 to .013. Hypotheses 4 and 5 were not supported at Time 1.

Hypothesis 4 and 5 were then evaluated by examining the effects of learner control on self-determination, intrinsic motivation, and creative performance at Time 2. Once again, preliminary assumption testing was conducted to check for normality, linearity, outliers, and multicollinearity for each dependent variable across the two groups (no learner control or learner control). Descriptive statistics are provided also in Tables 5 and 6. Descriptive statistics revealed three missing cases which were subsequently removed for this analysis: one case within the no learner control group without a score for self-determination Time 2, and two cases within the learner control group, one without an intrinsic motivation Time 2 score, and the other without a self-determination time 2 score. Examination of distributions, skewness, and kurtosis values indicated no violation of assumptions of normality and linearity for each dependent variable. Examination of Mahalanobis distances revealed one outlier case over the critical Chi square value of 16.27 for three variables ($\chi^2 = 16.63$) within the learner control group. Examination of the case indicated that while the participant did produce a low score on perceived self-determination at Time 2, there was no indication that the case did not represent the population of interest and it was thus retained for further analysis. Variance values of each dependent variable were relatively equal across the two groups, as the highest small to large variance ratio was 1.34:1. In addition, the Box's Test of Equality of Covariance Matrices was not significant, supporting the assumption of homogeneity of variance-covariance matrices. The Levene's test of homogeneity of variances was also not significant for each dependent variable, supporting the assumption of homogeneity of variance for the analysis.

A two-factor MANCOVA was conducted with learner control and feedback as independent factors, self-determination, intrinsic motivation, and creative performance at Time 2 as dependent variables, and self-determination, intrinsic motivation, and creative performance at Time 1 as covariates. No interaction between factors was hypothesized; feedback was included in order to evaluate whether interaction was present. Consistent with expectations, there was no significant effect for the learner control*feedback term for any dependent variable. There was no global main effect for learner control on the set of dependent variables: $F(3, 226) = 1.27, p = .29; \Lambda = .98; \eta^2 = .02$. Because of this, between-subjects effects for each dependent variable were not examined. Values are summarized in Table 10. As with analysis for hypothesis 4 and 5 at Time 1, strength of association as measured through eta-square was very low for each follow-up test, ranging from .000 to .013. Table 12 summarizes means and standard deviations for each combination of factors. Hypothesis 4 and Hypothesis 5 did not receive support at Time 2.

Finally, Hypothesis 5B (that learner control would relate positively to creative performance in training) was examined for creative performance Time 3. Descriptive statistics are summarized within Tables 5 and 6. Distribution, skewness, and kurtosis values indicated no violation of assumptions of normality and linearity of creative performance Time 3. Variance values of creative performance Time 3 were equal across the two groups, with a ratio of 1.08:1. No outliers emerged in either group from examination of Mahalanobis distance. The Levene's test of homogeneity of variances was not significant, supporting the assumption of homogeneity of variance for the analysis. Consistent with expectations, there was no significant effect for the learner control*feedback term for any dependent variable. There was no effect for learner control on creative performance Time 3: $F(1, 230) = .25, p = .62; \eta^2 = .01$. Hypothesis 5 was not supported at Time 3.

Hypothesis 6 and 7

Hypothesis 6 predicted that feedback would relate positively to perceived competence. Hypothesis 7 predicted that feedback would relate positively to intrinsic motivation (7A) and creative performance (7B). Because the feedback manipulation was administered after creative performance exercise two but before the motivational questionnaire at Time 2, these hypotheses were examined with self-determination and intrinsic motivation Time 2, and creative performance Time 3. Preliminary assumption testing was conducted to check for normality, linearity, outliers, and multicollinearity for each dependent variable across the three groups (no feedback, feedback, and advisory feedback). Tables 13 through 15 summarize the descriptive statistics. All values appeared within acceptable range and no outliers emerged in the three groups. Variance ratios were relatively equal for each dependent variable across the three groups, supporting the assumption of equal variances. In addition, the Box's Test of Equality of Covariance Matrices was not significant, supporting the assumption of homogeneity of variance-covariance matrices. Levene's test of homogeneity of variances was significant for perceived competence at Time 2, indicating that the error variance for this variable was not equal across groups: $F(5, 230) = 2.46, p = .03$. Because MANCOVA is fairly robust to violations of this assumption when samples sizes are relatively equal across cells (as in the present study) (Tabachnick & Fidell, 2001b) and because the sensitive Box's M test was not significant, I chose to continue analysis in order to explore whether an effect emerged.

A two-factor MANCOVA was conducted with feedback and learner control as independent factors, self-determination and intrinsic motivation at Time 2, and creative performance at Time 3 as dependent variables because the feedback manipulation was administered after creative performance exercise two but before self-determination and intrinsic motivation Time 2. Self-determination and intrinsic motivation Time 1, as well as creative performance at Time 2 were included as covariates. No interaction between factors was hypothesized; learner control was included in order to evaluate whether interaction was present. Consistent with expectations, there was no significant effect for the feedback*learner control term for any dependent variable. There was no global main effect for feedback on the set of dependent variables: $F(6, 225) = .56, p = .76; \Lambda = .99; \eta^2 = .01$. Because of this, between-subjects effects for each dependent variable as well as post-hoc comparisons were not examined. As summarized in Table 11, eta-square effect sizes were very low for each follow-up test, ranging from .000 to .006. Values are summarized in Table 11. Table 12 summarizes means and standard deviations for each combination of factors. Hypothesis 6 and Hypothesis 7 were not supported.

Hypothesis 8

Hypothesis 8 predicted that creative personal identity would moderate the relationship between advisory feedback and perceived competence, such that the relationship would be higher for those low in creative personal identity. Preliminary assumption testing was conducted for creative personal identity across the three groups (no feedback, feedback, and advisory feedback). Descriptive statistics are summarized within Table 15. The scatter plot, histograms, skewness and kurtosis values supported the linearity, normality, and homoscedacity of the data.

Hierarchical multiple regression analysis was conducted by first dummy coding the feedback factor with the no-feedback condition as the reference group. Creative personal identity was entered in step 1, advisory feedback in step 2, and the cross-product term was entered in step 3. As summarized in Table 16, Hypothesis 8 was not supported. The interaction term for creative personal identity and advisory feedback did not produce a significant change in R^2 in the prediction of perceived competence Time 2, as R^2 only increased from .009 to .010 ($\beta = -.07, p = .84$).

Additional Analyses

In order to further explore the lack of significant effects for the learner control and feedback manipulations, additional analysis was run in order to determine if groups differed on certain study variables. First, amount of time taken on each creative performance exercise between the learner control and no-learner control groups was explored; this was done in order to evaluate if participants in learner control conditions felt more autonomous to end the creative performance exercise before the three minute time limit, thus producing slightly lower scores than participants in no learner control conditions because they had slightly fewer responses. Examination of the mean amount of time taken on creative performance exercises showed no significant differences between learner control groups and very low effect sizes (please see Table 17 for means, standard deviations, and effect sizes). However, the learner control group did take significantly less time in minutes to complete the training than the no learner control group, though the effect was small $t(1, 236) = -3.66, p < .001, \eta^2 = .05$ ($M = 103.53, SD = 37.60$ for no learner control, $M = 85.50, SD = 38.29$ for learner control). Finally, independent samples t-tests were run in order to evaluate whether learner control or feedback groups differed significantly on their perceived utility of the training. No significant differences on perceived utility were found for the learner control groups: $t(1, 236) = -.467, p = .64, \eta^2 = .0009$ ($M = 17.19, SD = 3.88$ for no learner control, $M = 17.40, SD = 3.25$ for learner control). In addition, no significant differences on perceived utility of training were found for the feedback groups: $F(2, 237) = .166, p = .85, \eta^2 = .001$ ($M =$

17.44, $SD = 3.83$ for no feedback group, $M = 17.32$, $SD = 3.33$ for feedback group, and $M = 17.12$, $SD = 3.56$ for advisory feedback group).

Discussion

The purpose of this study was to design and test a computer-based creative problem solving training that maximized motivation and creative performance, as guided by Cognitive Evaluation Theory. In this study, I manipulated levels of learner control and feedback in order to increase intrinsic motivation and creative performance within brainstorming exercises. Most hypotheses were not supported; the exception was the relationship between participants' perceived competence and their creative performance, and the mediating effect of intrinsic motivation on the perceived self-determination to creative performance relationship. These results supported the importance of perceived competence and perceived self-determination in promoting creativity during online creativity training, but hypotheses regarding the importance of learner control and feedback did not receive support. In the following sections I will summarize and offer possible reasons for the study's results. I will next discuss the contributions and the limitations of the study. Finally, I will offer suggestions for future research on computer-based creativity training.

Cognitive Evaluation Theory and Creativity

Perceived competence

Results for the expected relationship of participants' perceived self-determination and perceived competence on creative performance only partially emerged. Perceived competence related positively to creative performance when the relationship was examined *within* Time 1 and Time 2, but not *between* Time 1 to Time 2 or Time 2 to Time 3. This is consistent with other studies, which have found that these motivational variables have the greatest relationship to creativity when examined specifically for motivation for the current task (rather than using current motivational states to predict future creative performance) (e.g. Benzer & Bergman, 2007; Deci & Ryan, 2005; Zhou, 1998). This indicates that further studies should examine whether creative performance during training relates to creativity after the training program; although Cognitive Evaluation Theory specifically applies to motivation for the task at hand, other motivational theories which address long-term motivational factors should be incorporated in order to evaluate transfer of creativity training issues. It should, however, be noted that CPS is generally supported as the best creativity training program for long-term transfer of training even up to one year later (Puccio et al., 2006).

Although no relationship *between* times emerged for these motivational variables, it is significant that a relationship was found *within* measurement time periods. Perceived competence represents how confident an individual is that he/she can perform well on a specific task. Participants' perceived competence for creative performance exercise one and exercise two related to their creative performance scores for these exercises. Given that creativity exercises are inherently ambiguous with low performance feedback inherent in the task (Zhou, 2003), it is even more crucial that participants feel competent of their ability to perform in a creativity exercise. This result indicates that creativity training programs should focus on promoting participants' perceived competence for creative performance through techniques such as providing easier, positive practice experiences early or including demonstrations of relevant role models succeeding on the task before the participant attempts the task (Bandura, 1977).

Perceived self-determination

Results did not emerge as expected for the effect of perceived self-determination on creative performance. In Cognitive Evaluation theory, perceived self-determination is considered the most important determinant of intrinsic motivation even over perceived competence. In the present study, there was no significant relationship between self-determination and creative performance either within or between measurement time periods. Examination of descriptive statistics for self-determination indicated that participants' scores on self-determination were relatively low and did not significantly change from Time 1 to Time 2 ($M = 20.76$, $SD = 5.74$ Time 1, $M = 21.23$, $SD = 6.35$ Time 2, score range: 6-36). This is not surprising given that all participants were students completing the study for course credit or extra credit. The study had been originally conceptualized for a working sample population. Although the PSY100 and PSY250 students were allowed to choose which studies they wanted to complete in order to receive their course requirement, it is likely that the fundamental requirement that they complete the current study because they needed course credit was sufficient to lower participants' self-determination regardless of the amount of learner control offered to participants.

Intrinsic Motivation and Creativity

Intrinsic motivation as mediator

Intrinsic motivation was proposed as the mechanism through which perceived self-determination and perceived competence affected creative performance. Intrinsic motivation did emerge as a partial mediator of the self-determination to creative performance relationship but did not appear as a mediator of the perceived competence to creative performance relationship. This provides additional information regarding the motivational mechanisms for these effects, given that regression analysis revealed a small relationship between perceived competence and creative performance but no relationship between perceived self-determination and creative performance. The limitations in the current study regarding participant levels of self-determination make it difficult to extrapolate further as to whether self-determination only affects creative performance through intrinsic motivation whereas perceived competence can have a direct effect on creative performance. In addition, it is important to note that the indirect effect was small for intrinsic motivation between self-determination and creative performance ($\beta = .098$). It may also be important to note that the indirect effect for the perceived competence relationship was only narrowly excluded on the upper bound of the 95% confidence interval, indicating that with a slightly higher degree of power this relationship may have been significant. Although future research needs to be conducted to explore the complexity of these relationships, overall these results provide some preliminary evidence that one way to improve participant intrinsic motivation for creativity exercises may be to specifically target perceptions of self-determination and perceived competence. This is an important first step in creativity training research, as no prior research has specifically examined how to increase participant intrinsic motivation in order to increase creativity in training.

Perceived self-determination as moderator

As a test of one aspect of Cognitive Evaluation Theory, the current study examined whether perceived competence could positively relate to intrinsic motivation in the absence of perceived self-determination (i.e. if self-determination moderated the relationship between perceived competence and intrinsic motivation). Previous research indicated that if individuals felt controlled in their actions, regardless of their perceived competence level they would not experience intrinsic motivation for the task (e.g. Benzer & Bergmann, 2007). A moderator relationship did not emerge in the present study. This is not surprising given limitations to self-determination measurement previously discussed. Perceived competence did explain a respectable twelve percent of the variance in intrinsic motivation. When entered in the second step perceived self-determination also explained an additional seven percent of the variance in intrinsic motivation. Though the moderator relationship did not emerge, these results do support that the variables of perceived competence and perceived self-determination are useful for understanding what determines the intrinsic motivation of a participant on a creativity exercise.

Learner Control, Motivation, and Creativity

A significant effect for learner control on perceived self-determination, intrinsic motivation, and creativity did not emerge. Although the global test was significant at Time 1, no individual tests were significant for any dependent variable. The global test was not significant at Time 2 or Time 3. Examination of the dependent variable means indicated that self-determination and intrinsic motivation were slightly higher in the learner control group, but that creative performance scores were slightly lower. This effect was explored in Table 17 by examining the amount of time taken on each brainstorming exercise between the learner control and no-learner control groups; this was done in order to evaluate if participants in learner control conditions felt more autonomous to end the creative performance exercise before the three minute time limit, thus producing slightly lower scores than participants in no learner control conditions because they had slightly fewer responses. Examination of the mean amount of time taken on brainstorming exercises showed no significant differences between learner control groups, but the learner control group did take significantly less time in minutes to complete the training than the no learner control group. It is possible that the students in the learner control groups used their control to more quickly finish the experiment, skipping over parts of the training that would have helped them improve their creativity scores. Tennyson (1980) did warn that learner control, particularly when offered to novice learners, may not always be effective because learners tend to stop practicing before they are proficient on the task.

Feedback, Motivation, and Creativity

Contrary to expectations, feedback did not produce a significant effect on perceived competence, intrinsic motivation, or creative performance. There was no global effect of feedback on the set of dependent variables. Examination of means for the feedback groups does not present a clear picture; perceived competence is slightly lower in the feedback groups compared to the no feedback group, but intrinsic motivation and creative performance are slightly higher. Given that the manipulation check did not support that the feedback manipulation was salient enough to affect participants, these results are not surprising. Because the study was delivered through the RAMCT online learning management system, the administration of feedback was very constrained. Once participants completed creative performance exercise two, they hit the 'Submit' button. At this time, feedback appeared in plain text on the screen (please see Figure 10 for a visual depiction). The font was small and non-descript on the screen. Unfortunately the RAMCT system did not allow for modification of the appearance or delivery of the feedback. It is likely that many participants did not notice the presence of the performance feedback that appeared on their screen. Additionally, it is possible that participants did not believe the feedback manipulation; the way that feedback was displayed in RAMCT had a static appearance (the original Adobe Captivate version included separate text boxes for information like "20%", to support the feel that the computer had just generated the feedback specific to the participant) did not necessarily support the assumption that the computer had generated feedback specific to the participant's brainstorming responses. In addition, feedback was presented only once in the present study (immediately after creative performance exercise two). This was an intentional design feature in order to obtain a measure of motivation and creativity prior to feedback presentation. However, research indicates that frequent, immediate feedback is the most effective (Azevedo & Bernard, 1995); thus it is likely that the feedback manipulation would have had a stronger effect if it was presented repeatedly after each creative performance exercise in the training rather than at just one point during the training.

Creative personal identity (CPI) was proposed as a potential moderator of the relationship between advisory feedback and perceived competence. This relationship was not significant. Once again, it is likely that the lack of a significant feedback manipulation affected the results of this hypothesis. However, correlations did support that CPI, a relatively new construct in the field of creativity, has value in investigations of creative performance. Creative personal identity was positively related to Time 1 intrinsic motivation ($r = .14, p < .05$), Time 1 perceived competence ($r = .21, p < .01$), Time 1 creative performance ($r = .16, p < .05$), Time 2 perceived competence ($r = .13$ $p < .05$), Time 2 creative performance ($r = .15, p < .05$), and Time 3 creative performance ($r = .22$, $p < .01$). These results are consistent with those of Jaussi et al. (2007) who found that creative personal identity predicted employees' creative behavior. These correlations are also consistent with the nomological network I would expect to see in the data. Creative personal identity represents the degree to which being creative is an important part of an individual's self-concept (Brewer, 1991). Thus I would expect to see that CPI relates to participants' perceived competence but not to their perceived self-determination on the creativity task, given that CPI is often based on an individual's past successful experiences with creative performance (Jaussi et al.). Also of note is that the relationship between CPI and creative performance was slightly stronger for Time 3 creative performance than it was for Time 1 or Time 2 creative performance. This indicates that CPI may be particularly important for participants at the end of training. The theory of CPI is fairly new and currently unable to support hypotheses about why this may be the case. It may be that individuals' perceived competence decreased over the course of the training unless CPI was high. It is also possible that for the current study participants were losing motivation for the creative performance task by the end of the training. Individuals high in CPI are more likely to be motivated to confirm their self-beliefs as someone who is creative (Jaussi et al.) so these individuals may have been more motivated to perform on creative performance exercise three than individuals who were low or average on CPI. Theory and research on CPI are still developing, but these questions should be addressed in future studies.

Implications of the Study

My Ideal Experiment

I believe the design of the present study has the potential to be useful for future research investigations. There are a number of factors that I would look forward to adjusting if I had the opportunity to do the study again. The first factor is the participant sample. The study was originally designed to be used as a part of the City of Brighton's Leadership Development Series. This group comprises supervisors, managers, and executives from a variety of companies. When it became apparent that this group would not be available in time for the study's timeline, a student sample was used. Students chose to take the study as a means of fulfilling a course requirement. This likely affected students' motivation for the training tasks. Further, since the study was accessible online twenty-four hours a day, it is unclear whether students fully attended to the details of the training. Students received 2.5 research credits for completion of all exercises and questionnaires; it seems likely that some students took advantage of their learner control in order to move through the study more quickly than others. Task involvement is an important component of intrinsic motivation, one which increases the likelihood for creative performance because one is highly attentive to the details of the task and thus more likely to note unusual connections within the task information (Sternberg, 1999). Reliabilities for task involvement were low (alpha = .67 Time 1, alpha = .60 Time 2), indicating that this facet of intrinsic motivation may have been affected by the student sample in a non-supervised setting (In order to evaluate this effect, I conducted all analyses with a measure of intrinsic motivation that removed task involvement, and no significant differences to hypothesis testing emerged).

Motivation and attentiveness are issues which affect online courses offered in organizational training and development catalogues as well, but I believe these issues in a student sample made it particularly difficult for the study hypotheses to receive support. In fact, Kraiger and Jerden (2007) did find that learner control was more useful in work settings than in academic settings. Trainees in organizational settings usually elect to take online training courses as part of their professional development, making it more likely that the participant at least possesses some basic level of motivation to take the training seriously. Further, the Creative Problem Solving process is a topic that more likely appeals to managers interested in managing creative decision making in their job duties than it does to college students who have had little exposure to principles of communication and leadership. In future experiments along these lines, I would look forward to using an organizational sample for the training.

I would also look forward to the opportunity to create an online training program with more fidelity to a true online organizational training and development course. In the current study, RAMCT was the only available interface for placing the training program online; we eventually learned that housing the Adobe Captivate file with an online learning management system site that would collect responses directly from Captivate would have been very cost prohibitive, and that simply placing the file on a CSU website would not allow us to collect any data from participants. Continuing education had been open to allowing one of their programmers design the study in a more adaptive web format including personalized feedback for participants, but then was unable to offer this service due to other project commitments.

RAMCT presented certain limitations that made it difficult to execute some aspects of the study as planned. Because of the limitations of the RAMCT design shell, participants viewed the interactive training slides and then had to exit out of the slides to complete brainstorming exercises and motivational questionnaires that were created with the RAMCT quiz function. Because of this, changes had to be made to the training which likely affected its effectiveness. For example, I had originally intended to collect and score participants' brainstorming responses from the three stages of CPS. These three stages guided them through creative exercises aimed at helping them improve the quality of their time at school, at home, or at work. These responses could have been coded for fluency and flexibility. These exercises were designed to be of personal importance to the participants, ensuring that participants attended enough to the task that variability in motivation and creativity could emerge. The RAMCT system could not collect participants' interactive responses from the three stages of CPS exercises (Adobe Captivate allows participants to type directly into text boxes on the screen, so that they are brainstorming how to improve the quality of their time directly on the computer screen. Unfortunately, the RAMCT system could not actually record this data. Participants were instructed to write down their outcomes from these exercises and type them into a worksheet at the end of the training, but this data was often incomplete as many students forgot to do so).

In order to collect some data on creative performance, I instead had participants complete a series of classic Torrance Unusual Uses exercises (Torrance, 1966) which they accessed through the Quiz menu. Participants were presented with everyday objects and instructed to brainstorm as many potential uses for the objects as possible. While this has been shown to be a useful tool for measuring creativity (Runco, 2004), it was likely not as personally relevant to participants as the personal problem solving exercises contained within the training. In addition, because five of the first ten participants attempted to complete the brainstorming exercises without actually viewing the training slides leading up to each exercise, I had to add a password function to enter each exercise to ensure participants viewed relevant training content. This likely affected participants' perception of self-determination. This issue could be easily resolved in a cohesive Adobe Captivate version of the training program. Further, the quiz function in RAMCT did not allow for much learner control, and a timer was always present on the screen letting participants know how much time they had left to complete the exercise. This is likely to have lowered perceived self-determination for the task, as presenting deadlines has been shown to negatively affect intrinsic motivation (Amabile, DeJong, & Lepper, 1976). As I discussed earlier, the feedback function in RAMCT was also less than ideal (please see Figure 11); feedback was not very salient on the screen and may not have been noticed by most participants. A future version of the experiment could place the originally designed Adobe Captivate training on a learning management system site that would collect data directly from Captivate interactive interfaces. This would improve the flow of the training, the salience of the feedback, and the learner control manipulation on the creativity found in the three stages exercises.

Contributions of the Study

Although there are several changes that I would look forward to making to the participant sample and the training administration, the study does still provide some useful contributions. Very little work has been conducted in the area of online creativity training; to my knowledge, the current paper represents the first synthesis of the creativity and the computer-based instruction literatures and is certainly the first application of learner control to creative performance. It also represents one of the few attempts to put the research on perceived competence, perceived self-determination, and intrinsic motivation to use in an applied creativity intervention rather than in an experimental task with little external validity. The results provided preliminary evidence that targeting perceived self-determination and perceived competence may be one way of increasing intrinsic motivation for creative exercises during training. In addition, the study supported the importance of creative personal identity for prediction of motivation and creativity in training. This is a relatively new variable which can be included in future creativity training investigations.

In addition, for the current study I created a complete online training workshop that allows participants to interactively experience the Creative Problem Solving process in just two hours. To my knowledge, this is the first product of its kind and can serve as a model for how to cover this material when time limits are tight (CPS is often taught over the course of 2-7 day-long training workshops). This training program can be requested from me for use in other settings. The design of the study can also serve as a model for future research, as it employs an experimental ANOVA design paired with measurement of variables at three time periods.

The results of the study also supported the usefulness of online creativity training programs. Participants' creativity scores improved across the course of the training (M = 6.81 for Time 1, M = 7.70 for Time 2, M = 8.88 for Time 3) at the same time that time taken on brainstorming exercises declined over the course of the training. This indicates that participants' creativity increased over the course of the training at the same time that they may have became more efficient on completing creativity exercises. The learner control group was also able to produce the same level of creativity in exercise responses as the no learner control groups, but in an average of eighteen minutes less time spent overall on the training. Overall, utility reactions to the training were also favorable (M = 17.29, score range 6-24), indicating that participants liked the training and that they would use something from the training in the future. Participants also reported that the exercises were at an adequate challenge level (M = 4.33 of out 6). Although the specific hypotheses regarding training design could not be answered by the present study, overall it did provide evidence that creativity training can be placed in an online format. Finally, the study also supported that the new construct of creative personal identity is a useful predictor of creative performance in an online training program.

Limitations

Several of the study's limitations have already been discussed. The study used a student sample which may not generalize to the adult working population originally intended as the target of the research. The student sample may have presented particular problems for the study's hypotheses given that students were a) required to complete the study for class credit (though students did have the choice of which studies to complete for course credit), and b) students were unsupervised given the online nature of the training. Future studies that are forced to use a student sample may improve upon these weaknesses by holding supervised computer lab sessions or collecting creativity data based on problem solving exercises of more personal importance to participants (Scott et al., 2004).

An additional limitation is that the administration of the training program may not have external validity as representative of a true online training program format. As previously discussed, the RAMCT interface presented limitations to the original training design by forcing participants to exit the training program to take time-bound "quizzes" (creative performance exercises and motivational questionnaires) which likely interrupted the flow of the training and affected perceptions of self-determination. These limitations can be overcome by programming the entire training as well as questionnaires within Adobe Captivate or a similar computer-based training design program. The feedback function in RAMCT may also have limited the effectiveness of this manipulation; future studies should ensure that presentation of performance feedback is salient for participants.

Another important limitation to note is that perceived self-determination, perceived competence, and intrinsic motivation were self-reported by participants. Though factor analysis did support that these were distinctly measured constructs, it is possible that common method bias affected the results regarding these variables. One way of addressing this issue in future research would be to obtain a behavioral measure of intrinsic motivation, such as time willingly spent on the creativity task (Deci & Ryan, 1985).

Future Directions

The study issues mentioned above need to be addressed in future investigations; there are still strong theoretical reasons to believe that learner control and feedback should facilitate intrinsic motivation and creativity, and further studies are needed to explore these factors. Additional studies should also employ multiple conceptualizations of learner control (e.g. sequencing, content) and forms of feedback (e.g. positive vs. negative, informational vs. controlling) given that no research has applied these concepts to online creativity training. Intrinsic motivation leads to persistence in the face of challenges on the task (Deci & Ryan, 2005), and is likely to be particularly important for online creativity training programs because there is no outside trainer encouraging the participant. Future studies need to examine ways that participants can be encouraged to persist even when faced with frustration on ambiguous creativity tasks; this knowledge is crucial for future computer-based creativity research. There are several reasons to believe that computer-based instruction is a potentially powerful frontier in creativity that is worth exploring: it can allow for more individuality (Lubart, 2005), the ability to "play" around with ideas more easily (Clements, 1995) and can remove the trainee from the inhibiting effects of in-person group interaction (DeRosa et al., 2007). Future research must continue to explore the possibilities of computer-based creativity training.

The present study provided preliminary support for the importance of perceived self-determination and perceived competence in prediction of intrinsic motivation during creativity training. Future studies should attempt to replicate this finding and explore alternate ways of increasing self-determination and competence during an online training. Possible moderators to be investigated would include familiarity with computers

(Shlechter, 2001) or reason for taking the training (e.g. for personal development, or as part of a requirement for a leadership development curriculum).

Finally, future research should continue to examine the role of creative personal identity in creativity training performance. The present study found evidence that CPI is related to intrinsic motivation and creativity. It may prove more efficient for organizations to design online creativity training programs that are tailored to employees who are low in CPI, given that those high in CPI are less likely to need training. This is a relatively new variable in the literature, and future investigations should also examine whether CPI can be enhanced through training.

Conclusion

Creativity training is crucial in order for employees to contribute to company innovation in the rapidly changing world of work. Online training is the trend for organizational training and development courses, yet there has been very little research on how to design online creativity training programs. This study used perceived self-determination, perceived competence, and intrinsic motivation to guide the design of a computer-based creativity training program. Learner control and performance feedback were manipulated in order to maximize participant motivation and creativity. Although hypotheses about learner control and feedback were not supported due to training administration factors, the study did support the importance of perceived self-determination and perceived competence in predicting intrinsic motivation for creative training exercises. In addition, creative personal identity emerged as an important variable to include in future investigations. Training employees on how to develop creativity can have benefits for both the organization and the well-being of employees; it is important for the effectiveness of all organizations that future research continues to explore ways to make online creativity training accessible, informative, motivating, and effective.

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Table 1

Correlations Between Demographic Variables and Creative Performance

		Mean	St. Dev	1	2	3	4	5	6	7	8	9	10	11	12
1	Minutes to complete training	92.94	37.52	(NA)											
2	# training sessions	4.17	2.56	.24**	(NA)										
3	# of training days	1.90	1.11	.12*	.25**	(NA)									
4	Age	20.61	5.47	-.01	-.18**	-.04	(NA)								
5	Gender	NA	NA	-.08	-.09	-.02	-.02	(NA)							
6	Education	2.98	.71	-.06	-.22**	-.11	.42**	.13*	(NA)						
7	Familiarity with CPS	1.59	1.19	-.09	-.12*	.02	-.08	.06	-.01	(NA)					
8	Creative Personal Identity	18.58	3.64	-.04	-.07	.08	.07	.08	.06	.13*	(.88)				
9	Creative Performance Time 1	6.89	2.40	.06	-.01	.07	.13*	-.05	.12	.14*	.16*	(NA)			
10	Creative Performance Time 2	7.70	2.92	.05	.02	-.05	.20**	.04	.05	-.02	.15*	.47**	(NA)		
11	Creative Performance Time 3	8.87	3.42	-.10	-.01	.01	.12	-.05	.09	.16*	.22**	.46**	.54**	(NA)	
12	Utility of training	17.29	3.56	.09	.09	-.02	.11	.03	-.05	-.06	.12	.01	.10	.07	(.85)

Note. * $p < .05$, ** $p < .01$.

Table 2

Correlations Between Study Variables Examined in Hypotheses

		Mean	St. Dev	1	2	3	4	5	6	7	8	9	10
1	Creative Performance Time 1	6.89	2.40	(NA)									
2	Creative Performance Time 2	7.70	2.92	.47**	(NA)								
3	Creative Performance Time 3	8.87	3.42	.46**	.54**	(NA)							
4	Creative Personal Identity	18.58	3.64	.16*	.15*	.22**	(.88)						
5	Intrinsic Motivation Time 1	31.21	7.06	.26**	.22**	.13*	.14*	(.89)					
6	Self-determination Time 1	20.76	5.74	-.04	-.03	-.01	-.08	.34**	(.90)				
7	Perceived Competence Time 1	23.06	4.63	.21**	.19**	.07	.21**	.33**	.04	(.88)			
8	Intrinsic Motivation Time 2	31.25	7.01	.15*	.29**	.20**	.11	.61**	.31**	.20**	(.90)		
9	Self-determination Time 2	21.23	6.35	-.05	-.01	.03	-.03	.22**	.80**	.05	.39**	(.94)	
10	Perceived Competence Time 2	24.21	4.92	.12	.31**	.12	.13*	.19**	.05	.52**	.57**	.20**	(.94)

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

Table 3

Descriptive Statistics for Study Variables Examined in Regression Hypotheses

	Mean	St. Dev	Skew	SE	Kurtosis	SE
Creativity Time 1	6.81	2.34	0.37	0.16	0.65	0.31
Creativity Time 2	7.70	2.91	0.46	0.16	0.41	0.31
Creativity Time 3	8.88	3.41	0.52	0.16	0.59	0.31
Self-determination Time 1	20.76	5.74	0.04	0.16	-0.30	0.31
Perceived Competence Time 1	23.06	4.63	-0.32	0.16	-0.41	0.31
Intrinsic Motivation Time 1	31.50	7.14	-0.25	0.16	-0.14	0.31
Self-determination Time 2	21.23	6.35	0.03	0.16	-0.50	0.31
Perceived Competence Time 2	24.21	4.92	-0.11	0.16	-0.30	0.31
Intrinsic Motivation Time 2	31.54	7.02	-0.14	0.16	-0.17	0.31

Table 4

Test of the Indirect Effect of Intrinsic Motivation on the Relationship of Perceived Self-Determination to Creative Performance

	Variable	*B*	*SE B*	β	R^2	Lower bound 95% confidence limit	Upper bound 95% confidence limit
Step 1	Time 2 Intrinsic Motivation regressed on Time 1 Self-Determination	.390**	.078	.312	.097	.238	.543
Step 2	Time 3 Creative Performance regressed on Time 2 Intrinsic Motivation	.100**	.031	.206	.042	.039	.161
Step 3	Indirect effect (Product of Step 1 and Step 2)	.039*	.016[a]	.098	-	.004[b]	.074[b]

Note. * = $p < .05$, ** = $p < .01$. [a] = Standard error of the indirect effect was generated using the Sobel (1987) method with bootstrapping based on 1000 samples. [b] = Confidence limits based on values obtained from Meeker (1981) as described in MacKinnon, Lockwood, and Williams (2004).

Table 5

Test of the Indirect Effect of Intrinsic Motivation on the Relationship of Perceived Competence to Creative Performance

	Variable	*B*	*SE B*	β	R^2	Lower bound 95% confidence limit	Upper bound 95% confidence limit
Step 1	Time 2 Intrinsic Motivation regressed on Time 1 Perceived Competence	.383**	.094	.256	.065	.197	.569
Step 2	Time 3 Creative Performance regressed on Time 2 Intrinsic Motivation	.100**	.031	.206	.042	.039	.161
Step 3	Indirect effect (Product of Step 1 and Step 2)	.038	.017[a]	.115	-	.001[b]	.037[b]

Note. ** = $p < .01$. [a] = Standard error of the indirect effect was generated using the Sobel (1987) method with bootstrapping based on 1000 samples. [b] = Confidence limits based on values obtained from Meeker (1981) as described in MacKinnon, Lockwood, and Williams (2004).

Table 6

Interaction Between Perceived Self-Determination and Perceived Competence on Intrinsic Motivation

Variable	*B*	*SE B*	β	Δ R^2	R^2
1. Perceived Competence	.257	.349	.165	.123**	.123
2. Self-determination	.042	.396	.033	.074**	.197
3. Perceived Competence X Self-determination	.013	.016	.305	.002	.199

Note. All variables used were collected at Time 1. ***p* <.01.

Table 7

Descriptive Statistics for Study Variables Examined in Hypothesis 4 and Hypothesis 5 for No Learner Control Groups

	Mean	St. Dev	Skew	SE	Kurtosis	SE
Self-determination Time 1	20.74	5.74	-.04	.23	-.28	.45
Intrinsic Motivation Time 1	30.62	7.59	-.19	.22	.09	.44
Creative Performance Time 1	7.10	2.51	.64	.22	.33	.44
Self-determination Time 2	21.25	6.48	.14	.23	-.63	.45
Intrinsic Motivation Time 2	30.72	7.56	-.08	.22	.01	.44
Creative Performance Time 2	8.08	3.09	.43	.22	-.07	.44
Creative Performance Time 3	9.23	3.34	.48	.23	.77	.45

Table 8

Descriptive Statistics for Study Variables Examined in Hypothesis 4 and Hypothesis 5 for Learner Control Groups

	Mean	St. Dev	Skew	SE	Kurtosis	SE
Self-determination Time 1	21.76	5.68	-.04	.22	-.12	.43
Intrinsic motivation Time 1	32.74	6.82	-.41	.22	-.24	.43
Creativity Performance Time 1	6.64	2.34	.08	.22	.47	.43
Self-determination Time 2	22.07	6.31	-.07	.22	-.30	.43
Intrinsic Motivation Time 2	32.21	6.52	-.19	.22	-.53	.43
Creative Performance Time 2	7.35	2.69	.40	.22	1.01	.43
Creative Performance Time 3	8.54	3.48	.60	.22	.58	.44

Table 9

Multivariate Analysis of Variance for Hypotheses 4 and 5 at Time 1

Effect:	Multivariate $F(df)$	p	η^2	Λ
Learner Control	2.77 (3, 232)	.042*	.035	.967

Tests of Between-Subjects Effects

Dependent Variables:	Univariate $F(df)$	p	η^2
Self-determination	3.18 (1)	.076	.013
Intrinsic Motivation	1.84 (1)	.177	.008
Creative Performance	2.59 (1)	.109	.011

Note. * = $p < .05$.

Table 10

Multivariate Analysis of Variance for Hypotheses 4 and 5 at Time 2

Effect:	Multivariate $F(df)$	p	η^2	Λ
Learner Control	1.27 (3, 226)	.286	.017	.983

Tests of Between-Subjects Effects

Dependent Variables:	Univariate $F(df)$	p	η^2
Self-determination	.014 (1)	.906	.000
Intrinsic Motivation	.210 (1)	.647	.001
Creative Performance	2.90 (1)	.090	.013

Table 11

Multivariate Analysis of Variance for Hypotheses 6 and 7

Effect:	Multivariate $F(df)$	p	η^2	Λ
Feedback	.560 (3, 450)	.760	.007	.985

Tests of Between-Subjects Effects

Dependent Variables:	Univariate $F(df)$	p	η^2
Perceived Competence Time 2	.021 (1)	.502	.006
Intrinsic Motivation Time 2	.029 (1)	.972	.000
Creative Performance Time 3	.053 (1)	.949	.000

Table 12

Descriptive Statistics for Perceived Self-Determination, Intrinsic Motivation, and Creative Performance Time 2 per Experimental Condition

	Experimental condition	Self-determination		Intrinsic Motivation		Creative Performance	
		M	*SD*	*M*	*SD*	*M*	*SD*
1.	No Learner Control/ No Feedback	21.19	7.19	31.05	7.78	7.65	3.23
2.	Learner Control/ No Feedback	22.46	6.37	30.7	7.16	7.13	3.19
3.	No Learner Control/ Feedback	21.11	5.9	31.06	7.12	7.92	2.79
4.	Learner Control/ Feedback	21.37	6.31	32.46	6.23	7.73	2.53
5.	No Learner Control/ Advisory Feedback	21.61	6.34	30.46	7.67	8.74	3.22
6.	Learner Control/ Advisory Feedback	22.14	6.29	33.18	6.21	7.21	2.43

Table 13

Descriptive Statistics for Study Variables Examined in Hypotheses 6-8 for No Feedback Groups

	Mean	St. Dev	Skew	SE	Kurtosis	SE
Perceived Competence Time 2	24.17	5.20	-.01	.27	-.57	.53
Intrinsic Motivation Time 2	30.88	7.41	-.07	.27	.09	.53
Creative Performance Time 3	8.66	3.55	.86	.27	.93	.53
Creative Personal Identity	18.31	3.84	-.48	.27	-.05	.53

Table 14

Descriptive Statistics for Study Variables Examined in Hypotheses 6-8 for Feedback Group

	Mean	St. Dev	Skew	SE	Kurtosis	SE
Perceived Competence Time 2	24.01	4.99	-.11	.28	.16	.55
Intrinsic Motivation Time 2	31.82	6.65	-.12	.28	-.32	.55
Creativity Performance Time 3	9.02	3.05	.46	.28	.68	.55
Creative Personal Identity	18.55	3.27	-.31	.28	-.25	.55

Table 15

Descriptive Statistics for Study Variables Examined in Hypotheses 6-8 for Advisory Feedback Group

	Mean	St. Dev	Skew	SE	Kurtosis	SE
Perceived Competence Time 2	23.82	4.91	-.20	.27	-.35	.53
Intrinsic Motivation Time 2	31.94	7.00	-.21	.27	-.29	.53
Creativity Performance Time 3	8.93	3.64	.28	.27	.35	.53
Creative Personal Identity	18.34	3.79	-.58	.27	.64	.53

Table 16

Interaction Between Advisory Feedback and Creative Personal Identity on Perceived Competence Time 2

Variable	*B*	*SE B*	β	Δ R^2	R^2
1. Creative Personal Identity	.144	.114	.105	.009	.009
2. Advisory Feedback	.424	3.49	.040	.010	.010
3. Advisory Feedback X Creative Personal Identity	-.038	.186	-.068	.000	.010

Table 17

Descriptive Statistics and T-Tests for Amount of Time (in Seconds) Taken on Creative Performance Exercises

		Creative Performance Exercise 1		Creative Performance Exercise 2		Creative Performance Exercise 3	
		M	*SD*	*M*	*SD*	*M*	*SD*
1.	No Learner Control	190.20	36.12	172.48	51.59	168.04	45.63
2.	Learner Control	194.83	62.47	175.32	48.27	167.34	42.76

Note. $t(1,228) = .68$, $p = .50$, $\eta^2 = .002$ for exercise one, $t(1,228) = .43$, $p = .67$ $\eta^2 = .0008$ for exercise two, and $t(1, 233) = .12$, $p = .90$ $\eta^2 = .0001$ for exercise three.

Figure 1. Heuristic model.

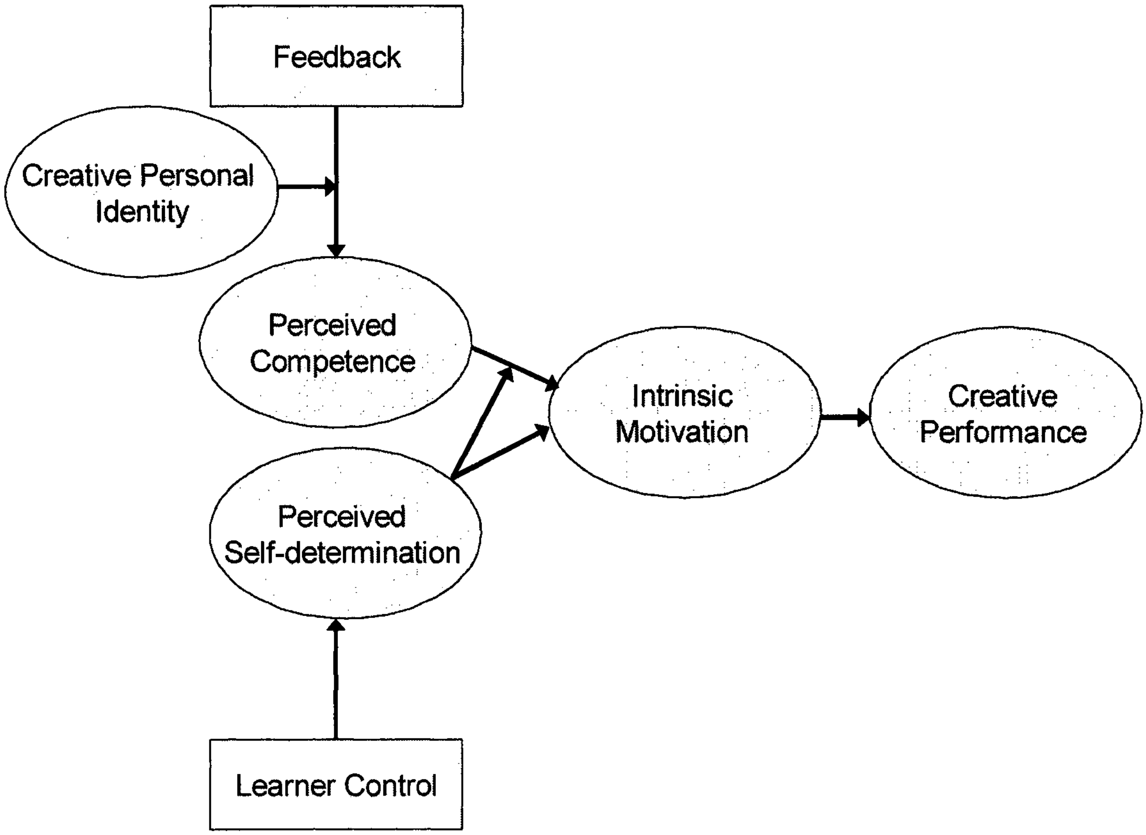


Figure 2. Model describing how hypotheses were tested.

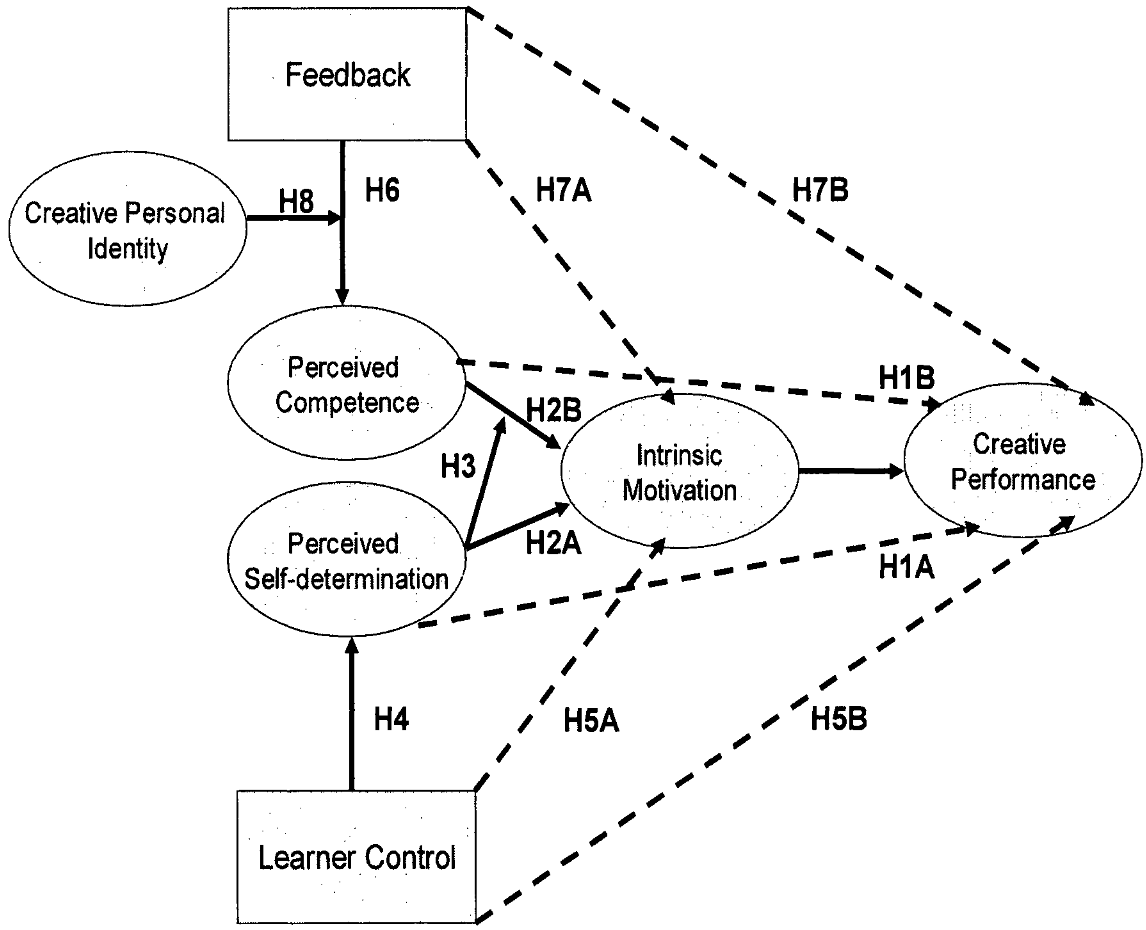


Figure 3. Model specific to learner control heuristics and hypotheses.

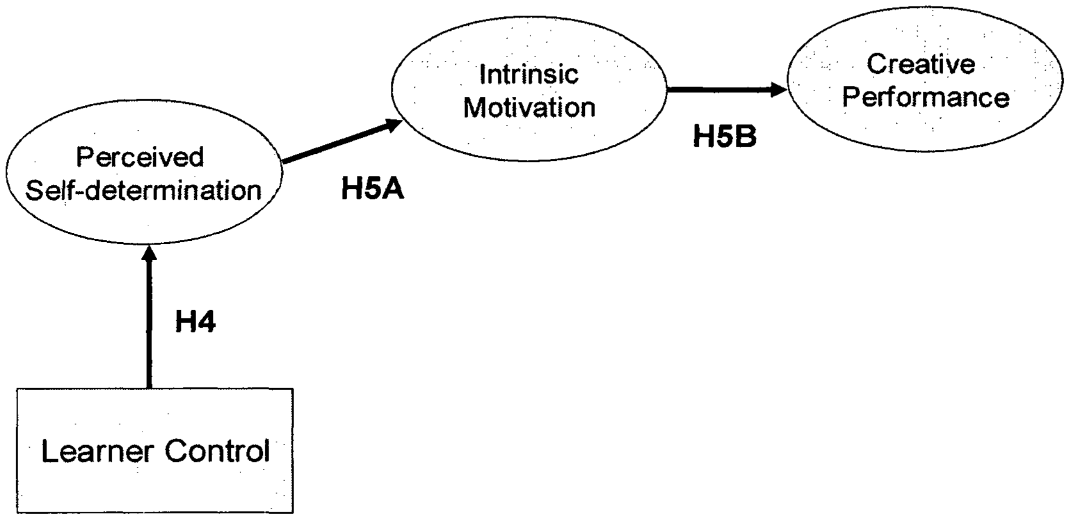


Figure 4. Model specific to feedback heuristics and hypotheses.

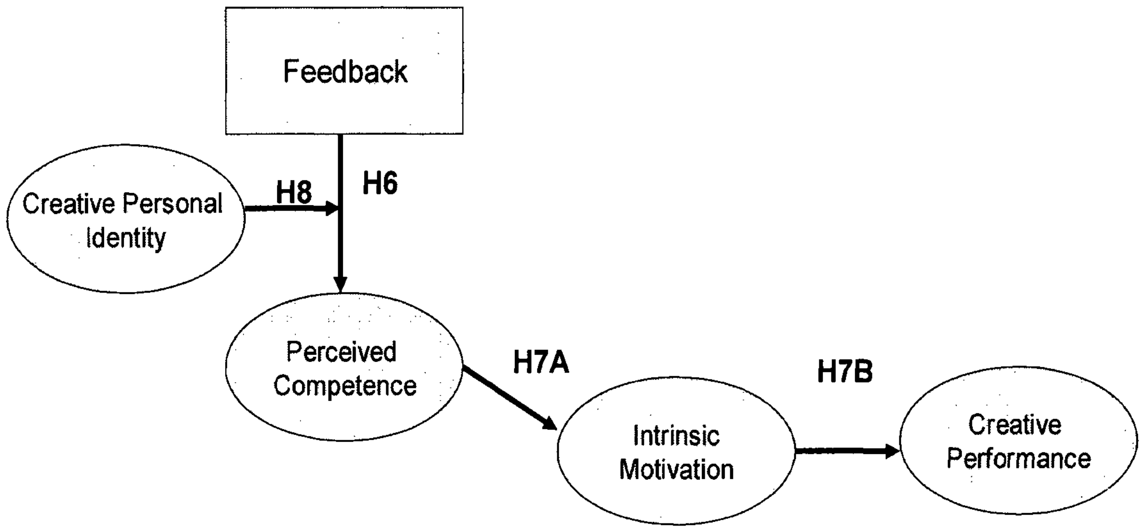


Figure 5. Experimental Timeline.

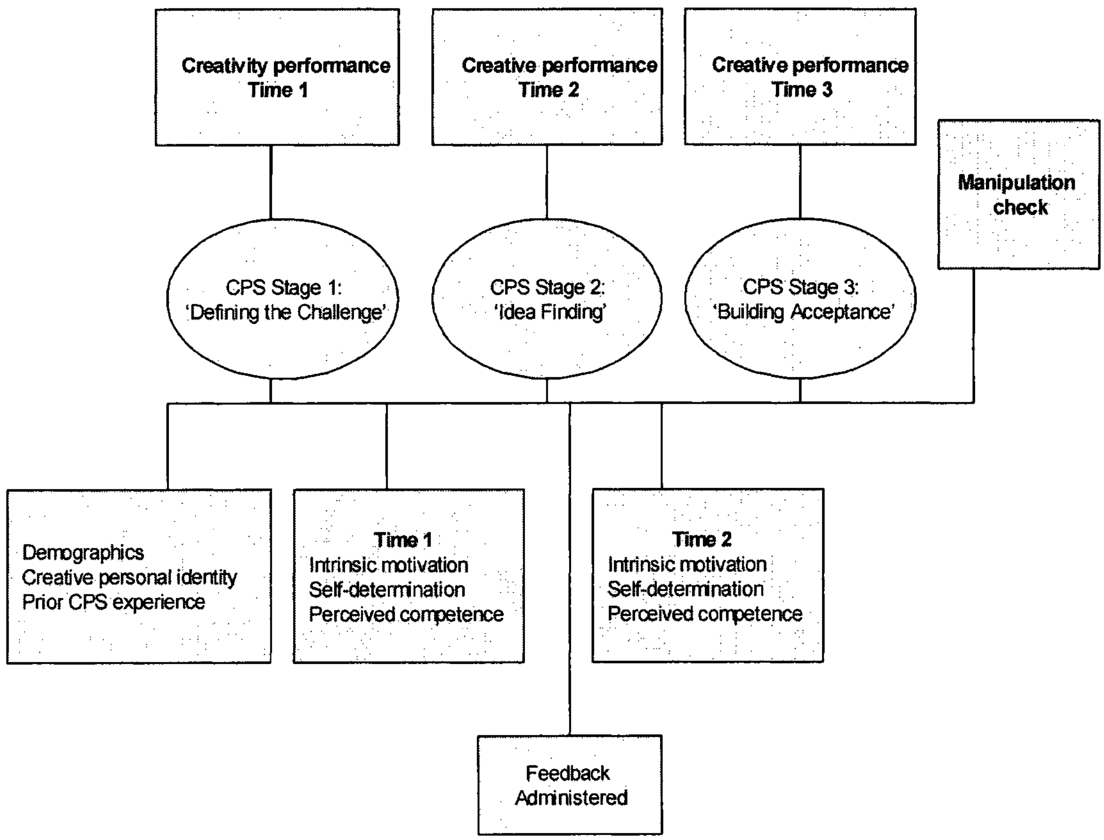


Figure 6. Training Menu.

Figure 7. Choice of example in learner control conditions.

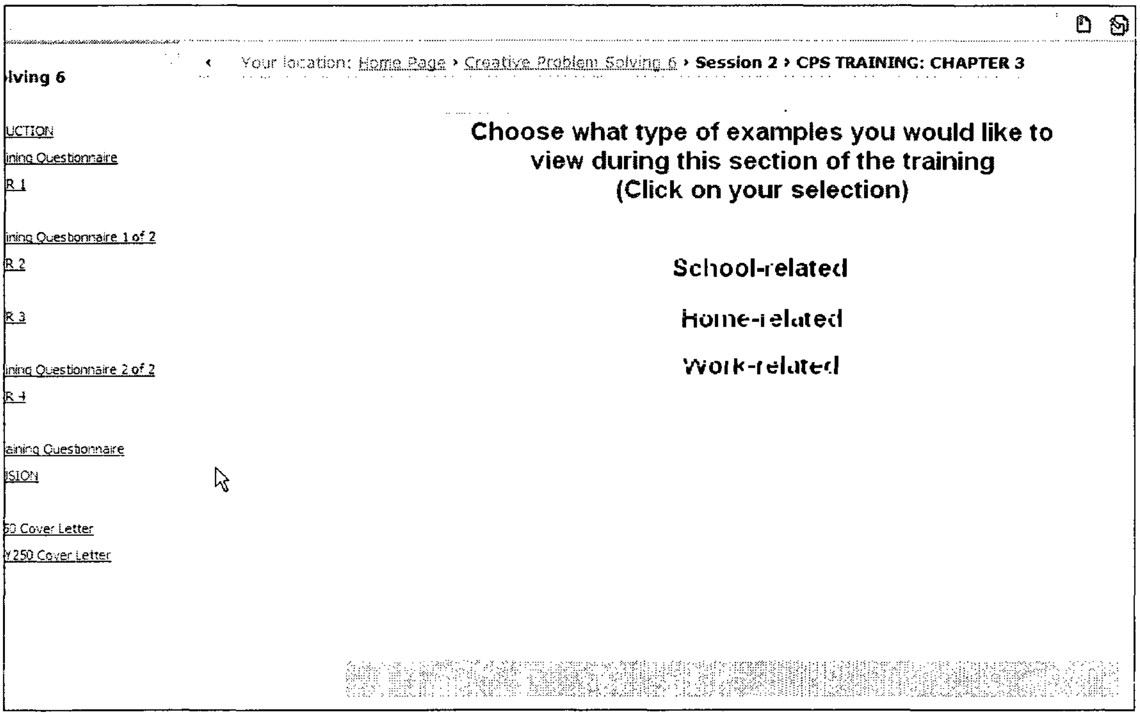


Figure 8. School-related CPS exercise example from stage two.

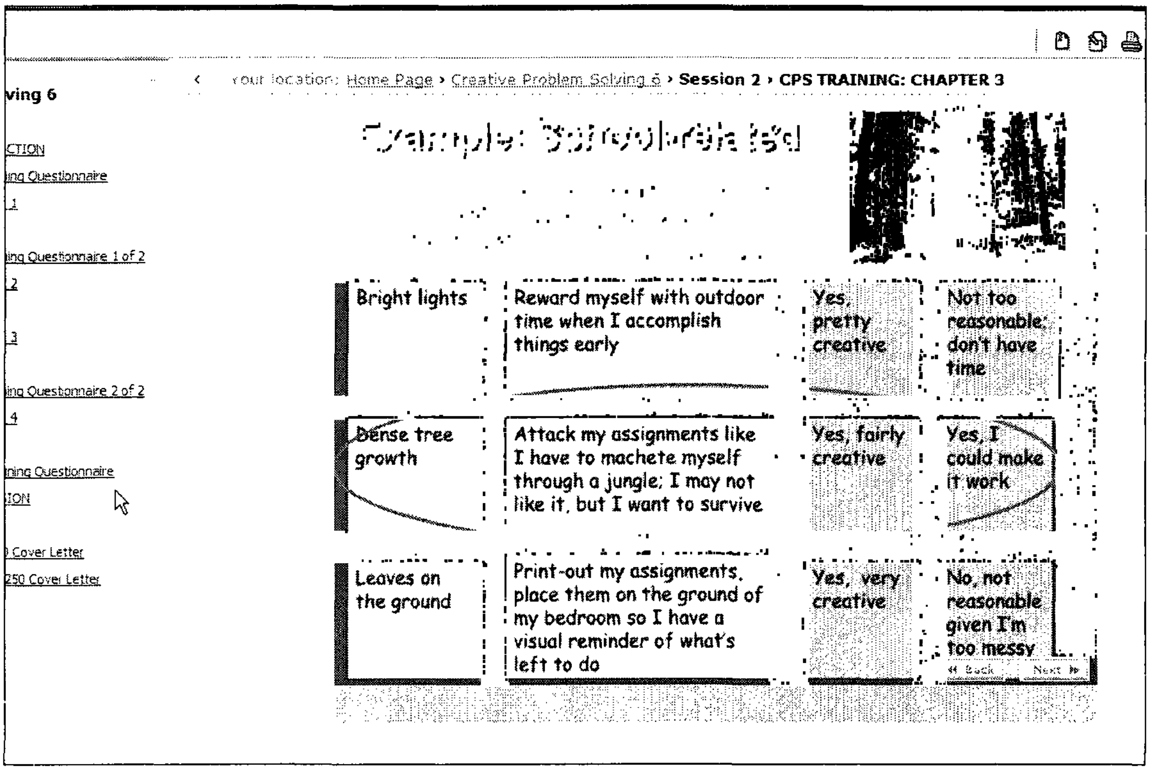


Figure 9. Transition from training slides to creative performance exercise two.

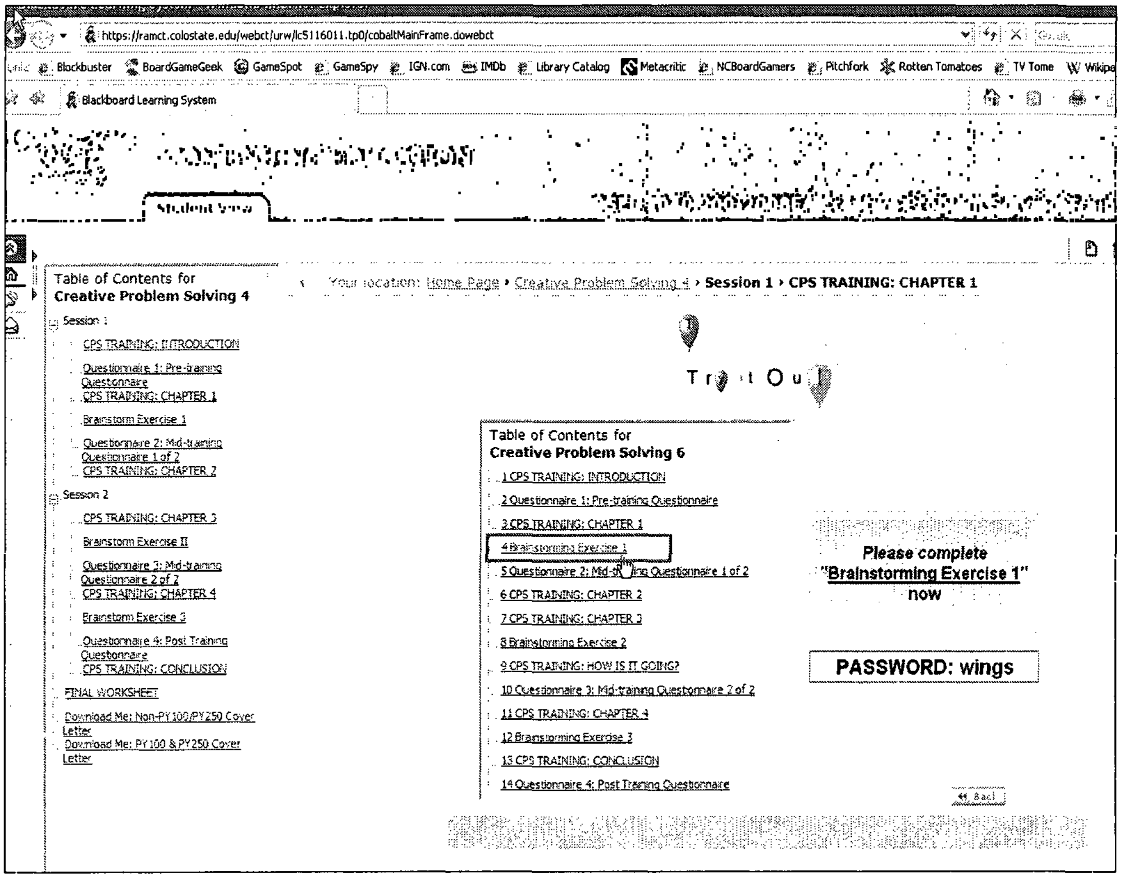


Figure 10. Creative performance exercise one.

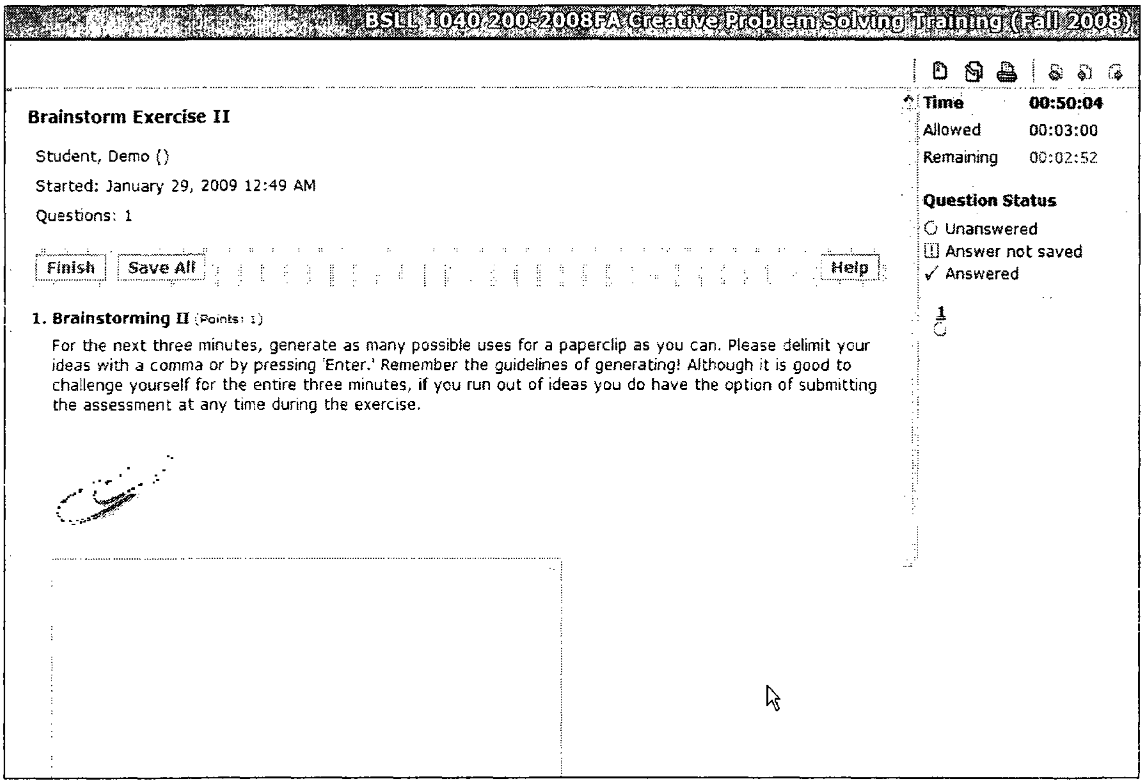
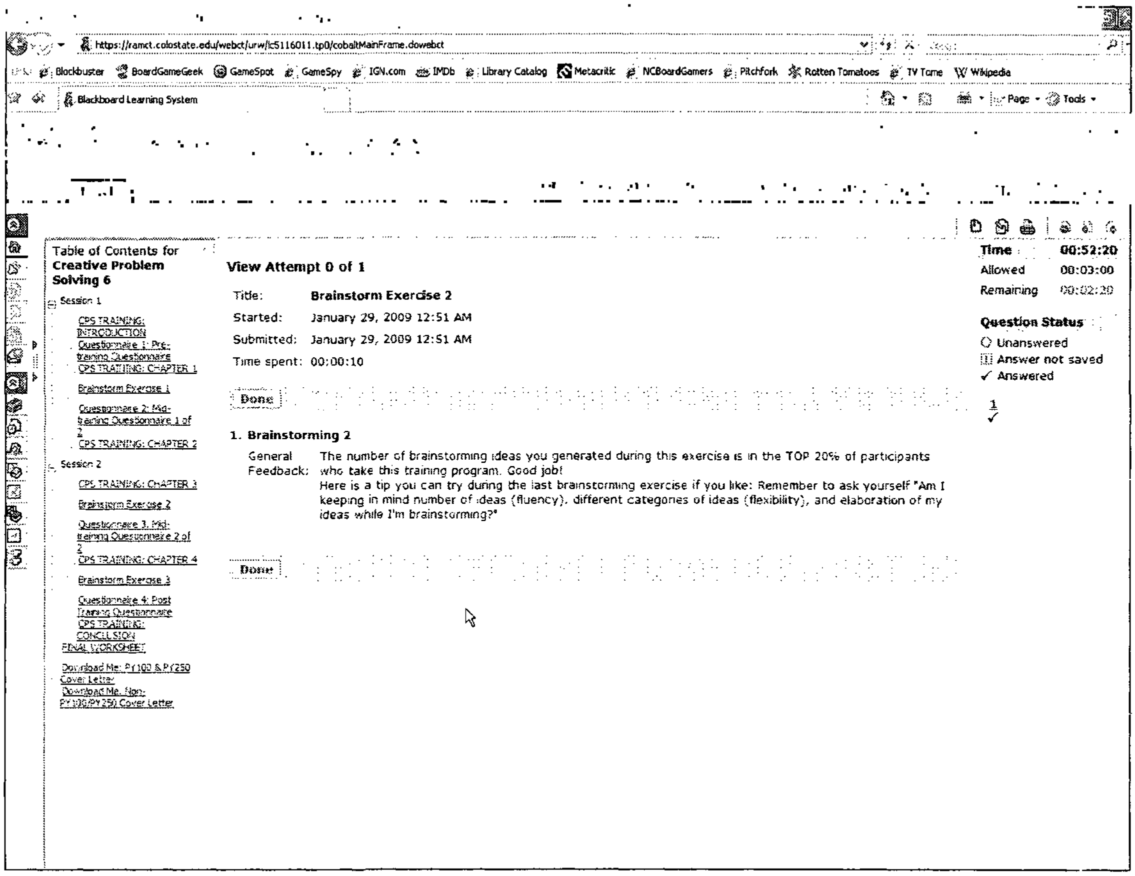


Figure 11. Performance feedback delivered after creative performance exercise two.



APPENDIX A

Study Measures
(*Note*: R = reverse coded item)

Creative Personal Identity (Jaussi, Randel, & Dionne, 2007)
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.

Perceived Self-determination (Deci & Ryan, 2005)
1. I believe I had some choice about doing this activity.
2. I felt like it was not my own choice to do this task. (R)
3. I didn't really have a choice about doing this task. (R)
4. I felt like I had to do this. (R)
5. I did this activity because I had no choice. (R)
6. I did this activity because I had to. (R)

Perceived Competence (Deci & Ryan, 2005)
1. I think I am pretty good at this activity.
2. I think I did pretty well at this activity, compared to other trainees.
3. After working at this activity for awhile, I felt pretty competent.
4. I am satisfied with my performance at this task.
5. I was pretty skilled at this activity.
6. This was an activity that I couldn't do very well. (R)

Intrinsic Motivation, Involvement sub-dimension (Elliot & Harkiewicz, 1996)
1. During the brainstorming exercise, I was totally absorbed in the task.
2. During the brainstorming exercise, I lost track of time.
3. During the brainstorming exercise, I concentrated on the exercise.

Intrinsic Motivation, Enjoyment sub-dimension (Deci & Ryan, 2005)
1. I enjoyed doing this activity very much.
2. This activity was fun to do.
3. I thought this activity was quite enjoyable.

Intrinsic Motivation, Interest sub-dimension (Deci & Ryan, 2005)
1. I thought this was a boring activity. (R)
2. I would describe this activity as very interesting.

Learner Control manipulation check items:

During the training, I actively used control, when available, to....

1. ...change the pace of the training course (e.g., spent more time on a more complicated topic and proceeded more quickly through basic topics).
2. ...go back to previously viewed training slides.
3. ...choose the type of examples that I viewed during the training.

Feedback manipulation check items:

1. I received feedback on how I did on the brainstorming exercises.
2. I received feedback regarding how I did on the brainstorming exercise that also provided advice on how to improve my performance on the exercises.

Overall manipulation check item:

1. What do you think was the purpose of the study?

Perceived Challenge items:

1. For me, the exercises were too easy.
2. For me, the exercises were too difficult.
3. I felt that the exercises were at an adequate challenge level.

Perceived Utility of training items:

1. The examples provided during the training were useful.
2. I liked this training.
3. This training was useful for me.
4. I will use something from this training in the future.

APPENDIX B

Scoring Categories for the Creative Performance Exercises

1. **Exercise 1** (Generate as many uses for a brick as possible)
    a. **Weight**
        i. (e.g. serving as a paper weight, barrier, filling a hole)
    b. **Adding height**
        i. (e. g. prop up something, create a chair, stool, steps)
    c. **Put things within it**
        i. (e.g. plant flowers in the holes, pencil holder, food dish for pet)
    d. **Building/adding structure**
        i. (e.g. build houses, roads, structures)
    e. **Landscaping**
        i. (e.g. use as garden edging, decorative walkway. Differentiated from building/adding structure category by primary purpose being decorative rather than truly structurally necessary).
    f. **Smashing/applying force with it**
        i. (e.g. weapon, use to break a window, protection)
    g. **Heat conductance**
        i. (e.g. heat up and create a sauna, use as a hot plate, build a fire)
    h. **Arts & crafts**
        i. (e.g. projects, art, ruler, write on it)
    i. **Games/play/toy/sports**
        i. (e.g. play, shotput, entertainment, throw (unless specified 'at someone'—then placed within the smashing category))
    j. **Aesthetic**
        i. (e.g. sculpture, decoration, art piece (but if only 'art' was stated, this was placed in arts & crafts))
    k. **Other**
        i. Not fitting within one of the other categories sufficiently. Four columns of 'Other' were included within the coding sheet because some participants had up to four uses that fit within four separate 'Other' categories (e.g. make noise or music, hat, shoe, sharpening tool, ant farm)

2. **Exercise 2** (Generate as many uses as possible for a paperclip)
    a. **Fastening things together**
        i. (e.g. hold papers together, staple, hairpin, add length to necklace)
    b. **Weighting down things**
        i. (e.g. paper weight, as an anchor, wedging a door open)
    c. **Tool**
        i. (e.g. screwdriver, key, push a small button)
    d. **Scratching**
        i. (e.g. scratching, engraving, cutting tool)
    e. **Jabbing/poking**
        i. (e.g. tack, needle, sword, fish hook)
    f. **Cleaning/removing debris**
        i. (e.g. clean fingernails, toothpick, clean a tight space)
    g. **Hanging things on it**
        i. (e.g. key chain, Christmas ornament hook, hang picture)
    h. **Jewelry/adornment**
        i. (e.g. necklace, bracelet, earrings)
    i. **Toy**
        i. (e.g. unfold into triangle for "popping" toy, slingshot, pretend)
    j. **Stationary uses**
        i. (e.g. bookmark, highlight a line on a book page, write)
    k. **Aesthetic**
        i. (e.g. sculpture, art)
    l. **Other**
        i. Three columns of 'Other' categories were necessary for this exercise (e.g. coffee stir, flint, magnet)

3. **Exercise 3** (Generate as many uses for a piece of paper as possible)
    a. **Writing**
        i. (e.g. write, sign, flyer)
    b. **Toys/games**
        i. (e.g. paper boats or dolls, throw (unless specifies 'at someone'—then it is place in the weapon category))
    c. **Place keeper**
        i. (e.g. bookmark, separate documents, mark a place on the ground)
    d. **Scooper**
        i. (e.g. scoop up dog poop, pick up trash, cup)
    e. **Funnel**
        i. (e.g. funnel, sieve, straw)
    f. **Clothes**
        i. (e.g. hats, shoes, clothes)
    g. **Weapon**
        i. (e.g. weapon, give paper cuts, spitball)
    h. **Wrapping**
        i. (e.g. wrapping paper, book cover, envelope)
    i. **Arts & crafts**
        i. (e.g. drawing, painting, cut, origami)
    j. **Aesthetic**
        i. (e.g. decoration, sculpture, poster)
    k. **Fire**
        i. (e.g. light on fire)
    l. **Shelter**
        i. (e.g. tent, block out light, insulate from elements)
    m. **Wiping**
        i. (e.g. place mat, tissue, soak up spill)
    n. **Eating**
        i. (e.g. eat the paper)
    o. **Other**
        i. Four columns of 'Other' were necessary for coding Exercise 3 (e.g. stress relief, keep door from locking, fan, recycle).