COGNITIVE PROCESSES ASSOCIATED WITH CREATIVITY:
SCALE DEVELOPMENT AND VALIDATION

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ABSTRACT

DISSERTATION: Cognitive Processes Associated with Creativity: Scale Development and Validation

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Based on empirical evidence from numerous studies involving the cognitive components of creativity training, the Cognitive Processes Associated with Creativity (CPAC) scale was developed to efficiently and directly address the processes of brainstorming, metaphorical and analogical thinking, perspective-taking, imagery, incubation, and flow. An online pilot study (n = 226) and laboratory follow-up study (n = 120) collected responses to the newly created CPAC scale and a variety of other creativity measures. Overall, the results of this research indicate that the CPAC scale has many sound psychometric qualities, and the scale assesses creativity as a process variable. The data from both studies provide evidence for the construct validity of the scale, with a relatively stable factor structure reflecting the underlying theoretical subscales. A lack of relationships between the CPAC scale, social desirability, and several demographic variables suggested some evidence for divergent validity. There is mixed evidence for concurrent validity, as scores on the CPAC were not significantly correlated with product-focused measures of creativity but were significantly correlated
with other previously established self-report creativity instruments. Further investigation of these findings indicated that different conceptualizations and design issues may be the reason for the nonsignificant results, and additional research in this area is needed. A deeper exploration of the relationships between the various self-report subscales led to a more vivid description of each cognitive process included in the CPAC, laying the foundation for a theoretical understanding of the similarities and differences of these processes.
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CHAPTER I

INTRODUCTION

General Description

Creativity research, especially within the field of psychology, can encompass a broad range of issues and applications. As a response to research questions concerning the nature of creativity, such as “Who is creative?” and “How do we measure it?” a long list of instruments intending to measure this construct have been developed. However, there are many criticisms of these instruments, ranging from low reliability across time or raters, over-dependence on fluency rather than originality, and failure to predict future creative achievements (Plucker & Runco, 1998). Yet despite these arguments, a wide variety of instruments seeking to assess creativity, from a wide variety of perspectives, are essential components of the field of creativity research (Runco, 1999).

The empirical study of creativity has a long history in the field of psychology (Amabile, 1983; Csikszentmihalyi, 1988; Guilford, 1950; Runco, 2004; Sternberg & Lubart, 1996), but regardless of the large body of research many conflicts remain. On the most basic level, there is controversy concerning the very definition of creativity (Davis, 2004). While a foundational agreement that creative products must adhere to the requirements of novelty and appropriateness (Brown, 1989), much debate exists
concerning the quality and quantity of these products. Additionally, some researchers support placing restrictions on determining who should be classified as creative. This controversy over whether eminence and wide recognition, as in the case of world-renown scientists or artists, is needed for an individual to be categorized as creative is known as the “big C/little c” conceptualization of creativity (Davis, 2004). “Big C” creativity is that which is demonstrated by individuals that are well-known and eminent in their domain, while “little c” creativity is that which is demonstrated through everyday problem-solving by relatively ordinary people (Csikszentmihalyi, 1996). Further conflicts exist in terms of the manifestation of creativity. Some assert that an individual’s creativity is apparent only within certain domains, such as art, music, architecture, science, or mathematics to name a few (Baer, 1994) while others proclaim that creativity is more generalized and can be observed across multiple areas even within an individual (Plucker, 1998). This debate is of particular relevance to those interested in assessment of creativity.

Because so much research is available, it is useful to organize ideas about creativity according to four different, but not mutually exclusive, conceptualizations. The alliterative structure that is most often employed in the study of creativity is known as the Four P’s: Person, Process, Product, and Press (Davis, 2004). The “person” component refers to investigations of the personality attributes and behavioral characteristics that are associated with creative individuals, and the “process” component refers to the various cognitive processes that are involved in creative performance. The “product” component centers on the evaluation of products that are deemed creative and attempts to identify
more specific aspects that give the products their creative classification. Finally, the
“press” component focuses on the impact that an individual’s environment can have on
creative functioning. It is important to note that these Four P’s are not considered to be
separate types of creativity, but instead as potential lenses through which researchers can
design, explore, and interpret investigations of creativity.

Measuring Creativity

In applying this conceptual “Four P” structure to the measurement of creativity,
certain general patterns seem to emerge. The “person” component is most generally
assessed through self-report measures in which the individual reports the presence of
personality attributes associated with creativity (Gough, 1979; Kelly, 2004) or
participation in previous creative behaviors (Bull & Davis, 1980). Along these same
lines, some measures require other individuals, such as parents, peers, or teachers, to
report personality attributes and behaviors based on observations and interactions
(Renzulli, Smith, Callahan, & Hartman, 2001). Additionally, some instruments assess
creative personality characteristics indirectly by requiring individuals to note their
preference for certain aesthetic or sensory stimuli (Barron & Welsh, 1952; Frois &
Eysenck, 1995). Instruments aimed at the “process” component are less prevalent, since
the reality of assessing internal cognitions while they occur is rather complex. Most
creative processes are inferred based on actual creative outputs in response to a given
stimulus, which is the foundational aspect of most instruments that fall into the category
of “divergent thinking tests” (Torrance, 1998; Wallach & Kogan, 1965). These
instruments actually require the evaluation of several creative products, which are verbal
or figural responses to open-ended prompts, and the various characteristics of the products are assumed to suggest the presence of different processes that took place during their creation (Michael & Wright, 1989). Measures of creative products can also focus on the qualities of the products themselves, with the products either pre-existing or created in response to experimenter instruction (Amabile, 1996). Assessments of the “press” component generally take the form of self-report or observational checklists that center on different aspects of one’s environment that can either induce or reduce creative output (Basadur, Taggar, & Pringle, 1999).

The reliability, validity, and practicality of these creativity assessments vary to a large degree depending on the specific instrument. While self-report scales or observational checklists are the most efficient to administer, they are often criticized for a limitation in what can be measured. In creativity research, these types of measures are generally relegated to assessments of personality or press. On the other side of the spectrum, the open-ended tasks associated with divergent-thinking tests and evaluation of creative products can provide a wealth of information on the product and inferences about the underlying processes, but these types of measures are time-consuming to administer and score. Additionally, these assessments do not directly measure the creative processes that might take place not only during the assessment itself, but in everyday life as well.

*Cognitive Processes & Creativity*

While there may be issues surrounding the measurement of creative processes, many empirical studies have been conducted to explore these processes through testing
whether instruction in particular strategies is effective for increasing creativity. Training in cognitive strategies can impact creative processes in several different ways. From a more traditional perspective, “trainers” (i.e. teachers, employers) can incorporate pre-packaged programs known to increase creativity into their curriculum or educational programming. A wide variety of such programs are available, all of which are supported by empirical evidence demonstrating an impact on creative performance (Meador, Fishkin, & Hoover, 1999; Reis & Renzulli, 1999). Creativity training is not limited to these highly structured and extensive lessons, however; many simple strategies can be incorporated into daily lessons, activities, meetings, or projects as well. Open discussions, brainstorming and problem-solving activities, opportunity to manipulate materials, and guided imagery instruction are only a sampling of techniques that can be used to increase creative output (Baloche, 1994; Burns & Reis, 1991).

Overall, a meta-analysis of the literature on creativity training in educational settings suggests that students receiving creativity instruction in a variety of techniques outperform control groups by an average of one standard deviation (Pyryt, 1999). While several different cognitive techniques are recommended for increasing creativity in both children and adults, many of these empirical research studies focus on implementing a single strategy. These studies often provide evidence for the strategy’s effectiveness using a pre-test/post-test design with an experimental and control group (Rogers, 1999). A variety of creativity strategies have been investigated in this way, and the use of these strategies are the major focus of the current study. However, this study differs from previous investigations of strategies, as it incorporates several cognitive processes into
one instrument. To assess the use of multiple processes, the creation of a scale addressing these creative processes was necessary.

**Purpose of Current Study**

A review of creativity measures indicates problems and limitations concerning creative process assessments. However, research exploring the effectiveness of many different creativity training interventions suggests the potential for further investigations of cognitive strategies. Based on the results of past research, the purpose of the current study was centered on creating a self-report scale to assess the use of various cognitive processes associated with creativity. The creation of such an instrument eliminates the need for inference of processes based on products by directly assessing a variety of potential cognitive processes. Additionally, the scale was constructed in such a way as to address creative processes in more general “real world” situations, rather than the more specific and arbitrary tasks contained in many divergent thinking measures. Lastly, the scale retains the efficiency of a self-report measure, an advantage in comparison with other types of creativity assessments of the process component. In the research concerning the effectiveness of cognitive strategies, the experimental interventions and the evaluation of performance measures of creativity are both extremely time- and resource-consuming. Cognitive strategies vary in terms of their instructive qualities, as some are easily broken down into explicit directions while others are more experientially spontaneous, but all share the end result of increasing creativity. This scale combines information from previous empirical investigations into a single measure of cognitive
processes associated with creativity, focusing on the processes of incubation, perspective-taking, metaphorical and analogical thinking, brainstorming, imagery, and flow.

Major Research Questions

The central problem with many existing measures of creative processes is that they fail to directly assess these processes, and the central problem with much of the research on these processes is that the studies only focus on a single strategy. A new self-report measure was needed to overcome these limitations of the field. The development of a self-report scale aimed at the assessment of various cognitive techniques that might be used to result in creative output was a complex procedure. Numerous considerations and procedures were necessary to determine whether this new scale was a reliable and valid measure of creative processes. The content of the scale must be grounded in empirical research, and the psychometric qualities should further contribute to the confidence that the scale is not flawed and is adequate for use in a variety of situations. Therefore, on a very basic level, the main research question of the current study was as follows:

1) To what extent is this new scale (Cognitive Processes Associated with Creativity: CPAC) consistently and accurately assessing the degree to which people are employing the use of cognitive processes associated with creativity?

Additionally, a central aspect of the validation procedure concerned administering not only the new scale, but also other related measures that have been previously established. Therefore, this particular study needed to include other measures of creative personality characteristics, creative behaviors, and creative products to generate acceptable evidence
for the validity of the new scale. Given this procedural requirement for the validation of the scale, a second research question was in order:

2) How is the CPAC scale related to other measures of creative personality characteristics and creative products?

While it was expected that one measure of creativity should be related to other, previously established measures, a perfect relationship was not expected. Some differences were also expected, which would support the need for the scale, insofar as it assessed a perspective of the creativity construct that no other currently available instrument has been able to measure.

Definitions & Positions

To more directly address these research questions, it should be noted that in this particular study, certain operational definitions concerning creativity were employed. Creativity, or creative performance, was broadly defined as the production of a unique and appropriate response. This response is generally in the form of a tangible product, but the product was considered the end result of a thought-based process. Although other aspects of creativity (i.e. personality characteristics or environmental components) are equally important in the understanding of creativity, this study focused on the cognitive processes that precede the final “creative” product. Additionally, in reference to the “domain-generality” debate discussed above, creativity in this study was conceptualized on the “generality” end of the continuum. Because the CPAC scale was intended to measure creativity as processes that are applicable in a variety of situations, the various domains in which creativity could be manifested were not the major focus. Finally, as
the scale was intended to be widely used with any adult population, rather than only a few eminent individuals that are known for their creativity in a particular field, this study emphasized what is known as “little c” or everyday creativity (Davis, 2004).

Significance of Problem

If this newly developed scale assessing the use of cognitive processes associated with creativity is successfully validated, it can be an important measure for the field of creativity. As previously stated, it is efficiently administered, scored, and interpreted as a result of the self-report format. However, it does not rely on the inference of creative processes based on evaluation of products, as is done with many divergent thinking instruments currently in use. Instead, it is a direct measure of creative processes, and the broad format of the questions has an advantage, in terms of ecological validity, in the assessment of the strategies across a variety of situations. The CPAC scale can be effective for addressing a wide variety of research questions concerning the use of creative processes. It can be implemented in an experimental design that explores the effectiveness of training in cognitive processes for creativity, as in a pre-post test design with control groups. Ideally, scores on the measure would increase after participants are given direct, explicit instruction on how to utilize such procedures. Furthermore, the scale can be beneficial in educational or business settings. Instructors, employers, or mentors could administer the scale to identify strengths, weaknesses, and preferences for processes in students or employees. For instance, knowing which students or employees are resistant to the use of processes, and which ones prefer more spontaneous strategies could be important information for creating committees or work groups. A self-report
scale that directly assesses the use of cognitive processes associated with creativity has the potential for use in many different situations, and the validation of such a scale is the first step in this process.

**Basic Assumptions**

Because the CPAC scale was primarily validated using a population of college students, one assumption that was made throughout the course of the study is that potential creative processes are not drastically different across various adult populations. Although research does suggest creativity in adulthood is qualitatively different from creativity in childhood (Cohen, 1989; Cropley, 1999), within any given adult population there should be variation in the use of different creative strategies (Ward, 2007). Even within a population of individuals, such as artists or scientists, that are generally very high in creative characteristics or generate extremely creative products, a certain amount of variation in creative processes should be present (Csikszentmihalyi, 1996).

**Basic Limitations**

Although the assumption concerning variation in creativity may also be interpreted as a potential limitation of the study, it may not be the only problematic component. The validation of the scale required not only an administration to a particular sample (regardless of the representativeness), but also the administration of previously established measures of creativity and other related constructs. Because so many creativity measures are currently employed within the field, the new scale was not validated against ALL potential creativity measures. Therefore, only a small percentage of all available measures were administered in conjunction with the scale. These
measures were generally chosen based on their representativeness of the available measures, along with demonstrating acceptable reliability and validity themselves, but there were also constraints on the inclusion of particular measures. As many measures are extremely costly, there were limitations for financial reasons. Furthermore, as many measures are extremely time-consuming to administer and score, there were also limitations for more practical reasons. However, these limitations can be re-interpreted as future research questions concerning the continued validation of the scale with other creativity measures that were not currently accessible in the context of this particular study.

Summary

While a wide variety of definitions, conceptualizations, and means of assessment exist within the field of creativity research, the validation of this new scale can contribute to the creativity literature. The CPAC scale was based on empirical evidence from numerous studies involving the use of cognitive processes associated with creativity. Additionally, the format and content of the scale implement the efficiency of self-report measures while covering a broad range of potential processes. The scale does not rely on inferences from products to assess creative processes, but instead addresses their use in a direct manner. Although certain assumptions and limitations must be acknowledged, the potential knowledge that can be gained from the validation of the CPAC scale is advantageous. In order to more fully understand the context of the new scale within the array of existing creativity measurements, a further exploration of the types of assessments, along with the validation procedures for these previously established
instruments, is necessary. An additional examination of the cognitive processes that are the emphasis of the CPAC scale and theoretical connections between these processes and cognition in general is also beneficial for a more extensive comprehension of the usefulness of the newly developed scale.
CHAPTER II

REVIEW OF THE LITERATURE

The literature that best applies to the development of a scale of creative processes comes from several areas within creativity research. An inductive review of the literature will provide the support for the current study, beginning with the specifics of creativity instruments and validation, then building toward a more general discussion of various creative processes and their connection with cognitive functioning. In order to understand how a new self-report measure of cognitive processes fits into the current context of creativity assessment, a review of the various instruments intended to measure different aspects of creativity is essential. After gaining a familiarity with established creativity assessments, an exploration of the ways in which these instruments have been validated for use will provide additional information concerning the steps that will be necessary for the current study. This basic understanding of creativity assessment and validation procedures will be followed by a review of the literature on the effectiveness of cognitive processes associated with creativity. As empirical evidence concerning the use of different strategies will comprise the foundation for the creation of scale items, it is beneficial not only to identify the various cognitive techniques, but also to demonstrate support for their impact on creativity. Finally, connecting the results of this research to a
larger framework of human cognition will clarify how the development of the new scale addresses a more comprehensive understanding of creativity research as a whole.

**Current Measures of Creativity**

The measurement of creativity poses an array of potential problems. In addition to different interpretations of how creativity should be defined, the multiple instruments that are available can even further cloud the ability to discern appropriately this expansive construct. Although there are various approaches to the classification of creativity measures (Hocevar & Bachelor, 1989; Kirschenbaum, 1998; Runco, 1999), it is fitting to conceptualize the taxonomy of instruments as parallel with a broader structure for creativity research. The Four P’s perspective (person, process, product, and press) can be applied to the classification of creativity measures, categorizing a particular measure based on what aspect of creativity it is intended to measure (Davis, 2004).

While not all measures will fit neatly into one category or another, since the Four P’s in practice are not mutually exclusive and difficult to disentangle, using this system is still beneficial in clarifying what measures may be best suited for specific research questions and paradigms.

**“Person” Assessments**

Instruments intended to assess various aspects of the creative individual generally focus on personality traits and behaviors. Many of these measures are straightforward and rely on self-report methods to obtain responses. The How Do You Think (HDYT) test (Davis & Subkoviak, 1975) is one exemplar of this type of assessment. A five-point
Likert-type scale is provided, and respondents indicate the degree to which they agree or disagree with a collection of items concerning attitudes, motivations, interests, values, and other personality and biographical information. For the HDYT test, the age of respondents can range from elementary school students to adults (Lees-Haley & Sutton, 1982). In some cases, the self-report forms for these creative personality assessments are altered slightly to account for the age of the potential respondent. The Group Inventory for Finding Interests (GIFFI) I and II (Davis & Rimm, 1982), along with the Group Inventory for Finding Creative Talent (GIFT; Rimm & Davis, 1976) all consist of self-report Likert-type items tapping the construct of creative potential based on preferences and behaviors. These instruments focus on a variety of personality and biographical characteristics associated with creativity, such as “self-confidence, independence, high energy levels, adventurousness, risk-taking, curiosity, humor, artistic interests, interest in ideas, attraction to complexity and mystery, and one’s background of creative hobbies and activities” (Davis & Rimm, 1982, p. 50). However, the difficulty and complexity of the items varies according to the age of respondent, with the GIFT being most appropriate for students grades 1 through 6, the GIFFI I for those in grades 6 through 9, and the GIFFI II for those in grades 9 through 12.

Not all self-report instruments measuring creative personality and behavioral characteristics use Likert-type scales as response options. Some simplify the response process even further by limiting options to a dichotomous “Yes/No” or “True/False” format. Gough’s (1979) Creative Personality Scale, consisting of 30 items, requires respondents to affirm whether or not a particular adjective is descriptive of themselves.
These adjectives are appropriate for use with an adult population, but similar measures with dichotomous response options exist for younger populations. The Creative Attitude Survey (McKee, 1985) is intended for use with students in grades 4 through 6, and consists of items related to creative achievement that focus on confidence in ideas, appreciation of fantasy, aesthetic orientation, openness, and desire for novelty. The Preconscious Activity Scale (Holland & Baird, 1968), another self-report dichotomous response instrument, is intended for adults and includes statements about preferences and attitudes. Respondents indicate whether a statement concerning attitudes and preferences for behaviors is True or False, receiving one point for each answer that corresponds with a creative characteristic.

Some self-report instruments assess creative personality characteristics by presenting items concerning characteristic behavioral approaches to problematic situations. The Kirton Adaptor-Innovator Inventory (KAI-I; Kirton, 1976), originally developed for use within organizations and other work settings, examines whether respondents tend to adapt to the structure of a given problem, or attempt to challenge the structure itself. A self-report Likert-type scale, this instrument has been extended into numerous settings and age ranges (Hammerschmidt, 1996; Selby, Treffinger, Isaksen, & Powers, 1993). This concern for stylistic approaches has been incorporated into the development of other recent creativity measures as well. The Scale for Creative Attributes and Behaviors (SCAB; Kelly, 2004), while an overall self-report Likert-type assessment of creative personality characteristics, includes a subscale of items that explore the creative cognitive styles of respondents. More specifically, these items
emphasize abilities to process situations in certain ways, such as holistically or associatively.

Rather than phrasing items as hypothetical statements about personality characteristics and potential behaviors that are associated with creative individuals, some self-report measures instead focus entirely on previous creative behaviors. The Creative Achievement Questionnaire (Carson, Peterson, & Higgins, 2005) is an instrument designed in such a manner. This self-report scale assesses creative achievement across multiple domains, as respondents indicate in which areas they feel self-perceived accomplishment, and then further indicate the degree to which they feel successful in those particular areas. The State of Past Creative Behaviors (SPCA; Bull & Davis, 1980) relies on a similar format, but with slight alteration. For this measure, respondents are required to list creative activities in which they have been involved, within the categories of artistic, literary, technical, performing arts, inventions, designs, crafts, or managerial activities. After the respondents complete the instrument, their self-reported behaviors are then scored by outside raters for the degree to which the reported activities are creative.

Some measures of the creative personality require other individuals, such as parents, peers, teachers, or supervisors to report personality attributes and behaviors based on observations and interactions (Renzulli et al., 2001). The rating scales can be informally developed for the purposes of particular research studies (Houtz, Lewis, Shaning, & Denmark, 1983), but there are more formal instruments available as well. In most situations, respondents are given a set of items concerning personality
characteristics or past behaviors and asked to indicate whether the target possesses the attributes or engages in the behaviors (Hocevar & Bachelor). The instruments can either take the form of dichotomous “Yes/No” response options, or they can be ordinally arranged in a Likert-type scale indicating degree of agreement.

Whether dependent on self-report or reports of others, many of these assessments of creative “person” components are relatively direct and straightforward. This ease of assessment, however, is sometimes criticized on a methodological basis (Whitley, 2002), as it can be argued that self-report measures have a vulnerability to social desirability response bias. Contrasting with these more direct measures of the creative personality are those that indirectly assess this quality by requiring individuals of varying ages to note their preference for certain aesthetic or sensory stimuli. On the Barron-Welsh Art Scale, respondents indicate their preference for 62 different visual figures, with more creative individuals demonstrating preferences for complex and asymmetrical figures compared to simpler and more symmetrical figures (Fekken, 1985a). The Percept-Genetic Test (Smith & Carlsson, 1987) functions in a similar manner, and respondents are shown a picture with increasing, then decreasing brightness and illumination, and are required to indicate the levels at which the image appears to “change.” The creators of this instrument assert that these individual differences are indicative of varying abilities to tolerate ambiguity and subjective situations. Frois and Eysenck (1995) make a similar argument in investigations of the Visual Aesthetic Sensitivity Test (VAST), in which respondents are instructed to express a preference for 50 pairs of nonrepresentative drawings, with the more complex preferences suggesting a more creative personality.
These perceptual instruments not only indirectly assess creative personality aspects, but one might also suggest that they indirectly assess some underlying creative processing. Although not necessarily occurring in conscious awareness, an individual must engage in some basic perceptual processing to make decisions about the various figures incorporated into these assessments.

“Product” Assessments

Another popular perspective of creativity measurement is a focus on the level or degree of creativity that a product or performance output appears to possess. The appeal of this approach lies in the argument that while self-report or perceptual preference measures may be subject to social desirability bias or other dishonest responses, an assessment of a product relies on the judgment of actual, tangible output. As will be discussed throughout the upcoming section, another argument for the utility of creative product measures relates to inferences that may be made on the basis of these product evaluations. While many assessments of creative products require output for evaluation, regardless of whether the output is in response to direct stimuli and instructions or self-motivated spontaneous situations, these assessments also rely on inferences concerning the creative processes in which the individual engages while creating the product in question. Therefore, many creative product assessments make claims about aspects of the creative process as well (Guilford, 1986). However, it should be noted that these instruments are indirect, rather than direct, measures of creative processes, based on inferences about the characteristics of the products.
Divergent thinking tests are probably the most widely-used type of creative product assessment (Hocevar & Bachelor, 1989). Generally, these measures consist of verbal or figural responses to open-ended prompts, and the various characteristics of the products are assumed to suggest the presence of different processes that took place during their creation. Multiple instruments of this nature exist, and are available for an extremely wide range of ages. In addition, many of these assessments have undergone extensive developmental procedures, with rigorous research to create reliable and valid psychometric properties, standardized scoring procedures, and adequate norming samples (Chase, 1985).

Perhaps the most respected and well-known divergent thinking assessment is the Torrance Tests of Creative Thinking (TTCT; Torrance, 1998). The test was initially designed by E. Paul Torrance and his colleagues, and has undergone some revisions in the 50 years since it was first introduced (Torrance, 1962; Torrance, 1965). The TTCT is currently used with children as young as kindergarten age up through the 12th grade; however, an abbreviated adult version of the instrument also exists (Cramond, Matthews-Morgan, Bandalos, & Zuo, 2005). The TTCT consists of two batteries of tests: Verbal and Figural. The Verbal test contains seven subtests: Asking, Guessing Causes, Guessing Consequences, Product Improvement, Unusual Uses, Unusual Questions, and Just Suppose (Davis, 2004). In nearly all of these subtests, the respondent is given a verbal or visual prompt, and then asked to generate an unlimited number of open-ended verbal responses. For the Figural tests, there are three subtests: Picture Construction, Picture Completion, and Parallel Lines or Circles (Torrance, Ball, & Safter, 1992). For all three
subtests, the examinee is presented with an incomplete or abstract sketch and asked to complete the drawing by making the picture into something meaningful and imaginative. The administration of the TTCT is timed and can be done separately with individual students or with a larger group. The clear and concise instructions are easy to follow, and the tests are game-like and generally capture the interest of the test takers (Chase, 1985; Treffinger, 1985). However, obtaining scores is a more complex process. Scoring can be extremely time-consuming, and this lengthy individualized scoring process is one of the major drawbacks of the use of the test.

Although the TTCT is extremely well-known and researched, a variety of other divergent thinking assessments have been implemented in creativity research as well. Based on his Structure-of-Intelllect theory, Guilford (1986) developed a battery of divergent thinking subtests that involve the generation of alternatives and making transformations in production. The Comprehensive Ability Battery (CAB-5), based on the Structure of Intellect theory, is another standardized divergent thinking instrument (Guastello, Bzdawka, Guastello, & Rieke, 1992). Wallach and Kogan (1965) are also linked to the creation of a divergent thinking test, with subtests such as Instances, Alternate Uses, Similarities, and Line Meanings used to generate unlimited numbers of responses to open-ended prompts. Getzels and Jackson (1962) describe their own divergent thinking assessment, incorporating Word Associations, Uses, Hidden Shapes, Fables, and Make-Up Problems, as subtests that, like many others described, require participants to generate responses to open-ended questions or statements.
Some creative product-focused instruments incorporate the traditional aspects of divergent thinking instruments while also assessing other types of information or using slightly altered response formats. The Creativity Assessment Packet (CAP) measures the divergent thinking aspects of creativity through an examination of the fluency, flexibility, originality, and elaboration of responses to prompts; however, this instrument also assesses what are termed the “divergent feeling” aspects of creativity, including curiosity, imagination, complexity, and risk-taking (Fekken, 1985b). This divergent feeling assessment is very similar to the self-report creative personality assessments; in fact, the instrument also includes an optional parent or teacher rating scale, as it was developed for use primarily with children. Thus, the CAP attempts to incorporate multiple types of creativity assessments, with aspects of person, product, and implied process all being elements of this measure. The Abedi-Schumacher Creativity Test also puts a slight twist on the more traditional measures of divergent thinking by attempting to assess this construct with a multiple choice format (Auzmendi, Villa, & Abedi, 1996). On this instrument, respondents have three options per item, and each of these options has varying degrees of creativity. The creators cite the ease of administration and scoring as advantages of the multiple choice format, but it could also be argued that this negates the entire purpose of divergent thinking assessments.

Other divergent thinking assessments must deviate from the traditional format in order to accommodate the developmental levels and limitations of the respondents. While preschool children are certainly capable of creative thought and behaviors, their limited linguistic and fine motor skills may keep them from responding appropriately to
verbal or figural prompts. Thinking Creatively in Action and Movement (TCAM) is designed for preschool children and involves the assessment of their improvisational psychomotor behavior (Evans, 1986). Children are measured on their ability to move through space, pretend, invent alternative uses, and improvise with a common object. A similar measure, the Multi-dimensional Stimulus Fluency Measure (MSFM), also adapts to the specific developmental level of preschool children by requiring verbal responses to verbal and visual-tactile stimuli (Tegano, Moran, & Godwin, 1986). Both the TCAM and the MSFM allow the children to interact with an actual stimulus object, rather than simply asking them to imagine the objects during the instructional prompts.

Although divergent thinking tests are widely used in a variety of formats, across a range of ages, these measures of creative products and inferred processes are not without their criticism (Plucker & Runco, 1998). In addition to the practical criticisms concerning the lengthy administration and scoring time requirements, some researchers have pointed out potential flaws in the scoring procedures themselves (Runco, Okuda, & Thurston, 1987). For instance, an over-reliance on the fluency and flexibility, or number of responses generated and the categories of responses generated, can diminish the instrument’s ability to predict later creative achievements. The differences in scoring methods for scoring divergent thinking tests can cloud the interpretation and usefulness of these instruments. Additionally, divergent thinking tests have been admonished for a lack of ecological validity, with critics citing that the testing prompts are too arbitrary and the testing situations too artificial (Okuda, Runco, & Berger, 1991). Some researchers instead recommend the use of “real-world problem finding” as a divergent thinking
measure, in which respondents are required to generate a personally relevant problem and then generate responses to this problem (rather than to a pre-determined prompt).

Another type of creativity measure that involves the evaluation of output as an inference of the utilized processes is based on an associative theory of creativity. The Remote Associates Test (RAT; Mednick, 1962) was developed with the theoretical foundation that creativity occurs when unique associations are formed into new combinations that are both novel and appropriately useful. In the RAT, respondents are given three words which on the surface appear unrelated but all contain a particular association in common. For instance, the correct response to the item “rat/blue/cottage” would be the word “cheese.” Multiple versions of this instrument have been developed, with some choosing to focus on more functional, or concept based, associations rather than antonym or linguistic based associations (McFarlin & Blascovich, 1984; Worthen & Clark, 1971). This type of instrument is unique, insofar as it requires divergent thinking and allows for open-ended (rather than multiple choice) responses yet has pre-determined correct responses for ease and objectivity in scoring.

While divergent thinking measures rely on the evaluation of products to make inferences about creative processes, other methods for assessing creativity by means of product judgments focus more heavily on the primary element of interest: the products themselves. The Lifetime Creativity Scales (Richards, Kinney, Benet, & Merzel, 1988) is one such example. The administration of this instrument involves extensive interviews with participants concerning original activity and output at work and leisure, and the content of these interviews is then rated for creativity. Although the procedures for
interviewing and then applying the scale in rating the creative products of the interviewees are highly standardized, this is time-consuming for both the respondents and the researchers. The Creative Achievement Scale (Ludwig, 1992) employs similar methodology, but instead examines the creative accomplishments of deceased individuals based on biographical sources. The Creative Achievement Scale also attempts to incorporate more than one “P” of creativity, and in addition to items concerning the creativity of products, some items address aspects of creative personality and social influence, or press. While this instrument can be efficiently used, it is entirely reliant on the availability of post-mortem biographical information and is based on a limited conceptualization of creativity, as only individuals achieving creative eminence (or “Big C”) can be measured with this particular assessment.

Another assessment of creative products for a wide range of ages can be broadly defined as the Consensual Assessment Technique (Amabile, 1982). This measure does not take the form of a specific instrument, but rather embodies certain procedural requirements. Respondents are provided with basic materials, such as scissors, paper, and glue for creating a collage, or with a basic verbal prompt to a stimulus, such as to write a poem on a generic theme (“Happiness” or “Joy”) or a short story in response to a provided picture. The generated products are then rated for creativity by judges (Amabile, 1983). This assessment procedure is often used in experimental manipulations of the social environment, so this type of product evaluation can be found in laboratory investigations of the “press” aspect of creativity. Although the description of the Consensual Assessment Technique might imply that it is vulnerable to a large amount of
subjectivity in judgments of products, much of the research incorporating this type of measure suggests adequate agreement among those judging the products (Amabile, 1996). However, to combat this criticism of vagueness and subjectivity in product evaluation, O’Quin and Besemer (1989) created the Revised Creative Product Semantic Scale. This measure is utilized in the judgment of creative products, providing evaluators with more specific and standardized dimensions on which to rate the creativity of products.

“Press” Assessments

Assessments of creativity incorporating the press perspective are far less prevalent, compared to those based on the person and product components. Press is sometimes inferred based on other measures of creativity. Instruments such as the Scale for Rating the Behavioral Characteristics of Superior Students (Renzulli et al., 2001) that require teachers or parents to respond can be loosely interpreted from the press perspective, as others in the target individual’s environment are responsible for completing these, and in turn, their opinions and attitudes could have an outside influence on the creativity of the target. However, it is extremely difficult, if not impossible, to disentangle the press influence of the parent or teacher from the actual creative personality aspects of the individual who is being rated. A similar argument can be made for instruments like the Detroit Public Schools Creative Product Scales (Parke & Byrnes, 1984), that require others in the target’s direct environment to report on creative products. The press aspect of creativity can be inferred from the target’s product, but can never be completely disentangled.
Some more generic measures of press are available, such as the Ideal Child Checklist (Torrance & Sisk, 1997), which lists 66 different characteristics that parents or teachers indicate are desirable or undesirable. If the respondent reports that characteristics associated with creative individuals are highly desirable, one might infer that this respondent creates an environment for students or children that is supportive of creativity, and vice versa. Other measures of press in the form of self-report instruments can be found for use with employment settings. Basadur, Taggar and Pringle (1999) developed three separate scales designed to measure divergent thinking attitudes in organizations. Participants, who are employed within a particular organization, respond to sets of items concerning their own personal attitudes (person component) and their employers’ attitudes (press component) toward creative thinking and expression.

The most comprehensive instrument intended to measure both positive and negative aspects of press currently available is KEYS: Assessing the Climate for Creativity (Amabile, Conti, Coon, Lazenby, & Herron, 1996), a revised version of what was previously known as the Work Environment Inventory (Amabile & Gryskiewicz, 1989). This self-report inventory examines perceived creativity supports and impediments within an organizational environment, with subscales assessing organizational encouragement, supervisory encouragement, work group supports, freedom, sufficient resources, challenging work, organizational impediments, and workload pressure. Press is often incorporated into creativity research as a controlled experimental variable (Amabile, 1996), and assessments can also be inferred, take the
form of broad-level self-report instruments, or gleaned from the investigation of biographical information of creative individuals (Csikszentmihalyi, 1996).

“Process” Assessments

Currently, the field of creativity research is generally lacking in the availability of direct measures of the creative process. Divergent thinking instruments are a method for indirectly assessing creative processes through the scoring of creative products, which are made in response to provided verbal or visual prompts. In addition to only indirectly assessing the creative processes through inferences, these instruments are extremely time consuming to administer and score. Lacking in practical efficiency and an inability to directly address the construct of interest, a self-report measure of creative processes might be an alternative to this problem. For researchers interested in direct measurement of creative processes, few avenues are available.

One beneficial instrument already in existence is the Creativity Styles Questionnaire- Revised (Kumar, Kemmler, & Holman, 1997). This measure incorporates several different “P” components into a 78-item, 5-point Likert-type scale, with subscales of Belief in Unconscious Processes (person), Superstition (person), Final Product Orientation (product), Environmental Control (press), Use of Techniques (process), Use of Other People (process), and Use of Senses (process). As some of the subscales are directly related to creative processes, this scale takes the field one step closer to a more efficient and direct measurement of this component. However, if particular techniques used in creative processing could be assessed in a direct and efficient manner, this could even further revolutionize creativity research. Therefore, the development of a new
scale, specifically addressing cognitive strategies used during creative processing would be a justifiable endeavor and a great contribution to the field. Since the various “product” assessments that make inferences about the use of creative processes indicate the presence of multiple processes (Torrance et al., 1992), then it only follows that a scale addressing several different processes would provide more information than one focusing on a single process. Exploring the potential use of many different creative processes through items assessing many techniques for increasing creativity can expand the availability of “process” measurements to researchers interested in this topic.

Validation of Creativity Measures

Validity, in reference to the development and use of measurement strategies, is a complex concept. It generally refers to the accuracy of a measure, as a “perfectly valid measure assesses the trait it is supposed to assess, assesses all aspects of the trait, and assesses only that trait” (Whitley, 2002, p. 124). However, validity is relative to the measure’s intended purpose: what is considered a valid measure of one construct, such as intelligence, may not be a valid measure for another construct, such as temperament. Additionally, there are different types of evidence for a measure’s validity, and determining the validity of a measure involves an examination of how the measure reflects the construct it is intended to measure, how it is related to other measures assessing the same construct, and how it is internally and externally related to the meaning of the construct (DeVellis, 2003; Reynolds, Livingston, & Wilson, 2006). While attempts to measure or quantify creativity have often been criticized for a failure to
capture completely the elusive “essence” of creativity (Piirto, 2004; Plucker & Runco, 1998), this criticism fails to consider the fact that most instruments designed to measure creativity have undergone the same extensive and rigorous validation procedures as many other respected tools of psychological and educational assessment.

“Person” Assessments: Validation

Item review. Many instruments designed to assess the personality characteristics and typical behaviors of creative individuals are self-report measures, and respondents indicate agreement or disagreement with item statements on a dichotomous or Likert type scale. While some reviews and technical reports concerning these instruments do not mention the specific procedures used in the development of the items themselves, others do demonstrate that expert evaluations, suggestions, and agreement among experts were a vital aspect in decisions concerning items for revision and inclusion (DeVellis, 2003). Additionally, many other authors indicate that revision and elimination of initial items were reliant on information involving the internal consistency of the items (Kelly, 2004). Although this strategy is primarily related to the reliability, rather than the validity, of a particular measure, it can also be interpreted as an important step in the validation process since a measure that is not reliable cannot be considered valid (Whitley, 2002).

Concurrent validity. Once the self-report measures are developed and administered to respondents, other types of evidence for validity can be obtained as well. Evidence for concurrent validity, the relationship of a measure to other measures intended to address similar constructs, is a popular strategy for those creating self-report person-based assessments of creativity (Stangor, 1998). To demonstrate validity in this
form, the target instrument is administered in conjunction with other creativity assessment tools. These “other” instruments are often in similar formats of self-report personality scales with dichotomous or Likert-type response options (Gough, 1979; Holland & Baird, 1968; Kelly, 2006; Kirton, 1976; Rimm & Davis, 1980), but can also take the form of descriptions of past creative behaviors and activities (Holland & Baird, 1968; Lees-Haley & Swords, 1981) and ratings or nominations from teachers, parents, or peers (Davis & Rimm, 1982; Gough, 1979; Rimm & Davis, 1976; Rimm & Davis, 1980).

Evidence for concurrent validity can also be assessed with the use of measures focusing on other conceptualizations of creativity. Assessments of creative products are indicators of validity for person-based measures, and these product assessments can take the form of formal or informal divergent thinking tests (Davis & Subkoviak, 1975; Gelade, 1995; Rimm & Davis, 1976) and the evaluation of products generated through a Consensual Assessment Technique (Davis & Rimm, 1982; Davis & Subkoviak, 1975; Puccio, Treffinger, & Talbot, 1995; Rimm & Davis, 1976; Rimm & Davis, 1980; Zhou & Oldham, 2001). As personality self-report measures and product assessments of divergent thinking or product generation are the most prevalent types of creativity measurements, using the various instruments to establish evidence for validity is a logical practice in the field. As self-report formats differ greatly from those requiring the creation of a product or open-ended generation of divergent responses, demonstrating a relationship between the types of measures provides more robust evidence that creativity is the construct underlying the various measures.
Assessments of the creative person that rely on reports from others and descriptions of past creative activities follow similar validation procedures. Teacher and parent rating scales have been validated against student or child performance on divergent thinking tests and have shown a lack of relationship between academic achievement and IQ scores (Houtz, Lewis, Shaning, & Denmark, 1983). Statements about previous engagement in specific creative behaviors have been compared with self-report measures of creative personality characteristics, tests of divergent thinking, and evaluations of creative products (Bull & Davis, 1980; Carson et al., 2005).

A more indirect assessment from the creative person perspective are those measures that require respondents to indicate a preference for certain aesthetic or sensory stimuli. Although structurally and procedurally quite different from self- or other-report indices of creative personality characteristics and past behaviors, these perceptually-focused assessments rely on similar validation techniques. Responses on these instruments are related to responses on personality characteristics self-report measures, past artistic achievements, teacher and faculty ratings, divergent thinking tests, and creative product evaluations (Fekken, 1985a; Frois & Eysenck, 1995; Smith & Carlsson, 1987).

Predictive validity and generalization. Self-report inventories focused on the creative person aspect have also been validated with examinations of their predictive ability and use with a range of populations. For instance, the Kirton Adaption-Innovation Inventory is successful in predicting group creative success rates in laboratory simulations (Hammerschmidt, 1996). Additionally, the generalization of instruments to a
wide variety of respondents, while still retaining evidence for reliability and validity, is another important component in the development of an assessment tool. Many measures that were originally intended for use with adult populations have been extended for use with younger respondents as well (Davis & Rimm, 1982; Lees-Haley & Sutton, 1982; Lees-Haley & Swords, 1981; Selby, Treffinger, Isaksen, & Powers, 1993). This same logic has been applied to the generalization of measures that were originally developed with American middle-class students, as these measures have been extended for use with various grade levels, rural and urban students, racial/ethnic minorities, and translated versions for cross-cultural populations (Davis & Rimm, 1982; Rimm & Davis, 1980).

Divergent and discriminant validity. While the previously discussed methods for validation focus on the presence of relationships among creativity measures, either across instruments or between populations, evidence for validity can also be obtained through a lack of relationship or demonstrated group differences. Divergent evidence of validity, or the idea that a measure should not be related to measures of dissimilar constructs (Reynolds et al., 2006), is available for many self-report instruments of creative personality characteristics. As the differentiation between creativity and intelligence is an essential concept in the field of creativity (Coleman & Cross, 2005), exploring the possibility of a relationship between these two variables is often a part of the validation process. The relationship between creativity and intelligence is often described using a threshold concept, as a “base level of intellectual ability is essential for creative productivity; above that threshold, however, there is virtually no relationship between measured intelligence and creativeness” (Davis, 2004, p. 83). Based on this
conceptualization, there should be little to no relationship between creativity instruments and intelligence, and demonstrating this idea is central to much of the evidence for divergent validity of creative person self-report assessments (Carson et al., 2005; Fekken, 1985a; Frois & Eysenck, 1995; McKee, 1985). Additionally, as many self-report instruments have been criticized for the potential for social desirability bias, indications that the creative person inventories are not related to social desirability indices provide further evidence of the instrument’s validity (Kelly, 2004). A final consideration of how differences can further the validation process lies in the contrasted groups approach (Reynolds et al., 2006), and finding that different groups, such as those that are predetermined to be higher in creative abilities (Fekken, 1985a; Frois & Eysenck, 1995; Holland & Baird, 1968) or those that differ in their exposure to creativity training (McKee, 1985), significantly differ in their scores on the instrument strengthens one’s argument concerning the discriminant validity of a measure.

*Construct validity.* Another approach to providing evidence for the validity of an instrument is internally, rather than externally, focused. In other words, in addition to looking at how a measure is related or unrelated to other measures, this technique expands to also address how the items of the self-report instrument are related to one another (DeVellis, 2003). While construct validity is not limited to this conceptualization, it is useful to incorporate this information in the development of measures with hypothesized subscales insofar as the internal structure of the assessment should be consistent with the literature concerning the internal structure of the construct (Messick, 1989). A basic attempt to take this idea into consideration is to examine inter-
item correlations: if responses on items that theoretically measure the same construct of creative person characteristics are correlated with one another, this suggests that the items are empirically measuring the same construct (Gough, 1979; Rimm & Davis, 1976). A more sophisticated approach to this same conceptual idea lies in factor analysis, which determines how many latent (as opposed to observed) variables are underlying a set of items (DeVellis). This technique is an increasingly popular approach to demonstrate evidence for construct validity, especially if the self-report instrument contains theoretical subscales (Carson et al., 2005; Kelly, 2004; Kirton, 1976). A technique known as multidimensional scaling analysis, which also groups items on the basis of relationships, can be used as an alternative if a small sample size does not permit factor analysis (Davis & Subkoviak, 1975) but is generally not recommended for such a situation (W.H. Finch, personal communication, January 30, 2008).

“Product” Assessments: Validation

Divergent thinking assessments incorporate the creative product perspective because they require verbal or figural responses to open-ended prompts, and these generated “products” are assumed to suggest the presence of different processes that took place during their creation. Many of the procedures for validation are similar to those used with the creative person assessments previously discussed. However, some tests of divergent thinking have undergone a greater degree of validation, and thus some have more evidence for the instrument’s validity than other tests that are conceptually and structurally synonymous.
**TTCT validation.** The Torrance Tests of Creative Thinking (TTCT; Torrance, 1998) are arguably the most prevalent divergent thinking tests available in the field, and this may be largely explained by the extensive validation procedures that were, and still are, an important component in the development of this assessment tool. The instrument was first introduced nearly 50 years ago, and results of longitudinal studies have provided the greatest wealth of information concerning the validity of the TTCT (Cramond et al., 2005). Scores on the TTCT are better predictors of quantity and quality of creative achievement (as measured by self-report questionnaires and checklists) than intelligence, high school achievement, and peer nominations. TTCT performance is also linked to measures of creative motivation, number of high school creative achievements, number of post-high school creative achievements, number of “creative style of life” achievements, quality of highest creative achievements, and creativeness of future career image. Investigations of the TTCT have revealed evidence for the concurrent validity of the instrument as well. High scorers on the TTCT are more likely to produce highly original drawings, produce original imaginative stories, have high teacher ratings of student creative thinking and activities, and be involved in creative hobbies and leadership activities (Davis, 2004; Treffinger, 1985).

*Other divergent thinking validation.* Other divergent thinking measures, while not as extensively utilized as the TTCT, follow validation procedures in somewhat similar ways although the focus may shift depending on the particular test. Divergent thinking tests based on the Guilford Structure-of-Intellect theory (Guilford, 1986) rely on factor analysis as a primary means of validating the various subtests that are intended to
correspond with the various components of the theory (Guastello, Bzdawka, Guastello, & Rieke, 1992). Other more traditionally structured tests of divergent thinking have obtained evidence for validity by demonstrating relationships with self-report measures of creative personality characteristics, past creative activities, ratings of teachers or parents, and even the TTCT (Auzmendi et al., 1996; Fekken, 1985b; Guastello et al., 1992; Runco et al., 1987). Additionally, these traditional divergent thinking tests have explored the potential relationship between creativity and intelligence and found evidence to differentiate the two variables as separate constructs (Getzels & Jackson, 1962; Runco et al., 1987; Wallach & Kogan, 1965).

Not all divergent thinking measures conform to the traditional structure of generating multiple verbal or figural responses to open-ended prompts. Divergent thinking tests developed for use with preschool children that are developmentally not capable of responding in writing incorporate psychomotor behavior assessments and the use of concrete, rather than abstract, stimuli. These measures have been validated through investigations of their relationship to teacher and parent ratings of creative personality characteristics (Evans, 1986) and with other measures of divergent thinking in preschool-age children (Tegano et al., 1986). Additionally, these instruments are not related to intelligence, cooperation, educational attendance, and socio-economic status, providing evidence for divergent validity (Evans; Tegano et al.). Other non-traditional divergent thinking assessments, such as the technique of “real-world problem-finding” that requires respondents to provide a personally relevant problem and then generate responses to this problem, have also been validated with the investigation of relationships
to traditional divergent thinking tests and self-reports of creative personality characteristics (Okuda et al., 1991).

*Other product validation.* More structured assessments of creative products, such as the Remote Associates Test that involves generating a common link to seemingly unrelated words (Mednick, 1962), and the evaluation of creative products and achievements over extended periods of time, all incorporate very similar validation procedures. Exploring relationships between these instruments and assessments of creative personality and past activities, teacher, peer, and independent observer ratings of creative characteristics, along with weak or nonexistent relationships with intelligence and lines in biographies (for assessing creative products of deceased individuals) and the use of factor analytic techniques demonstrate a wide variety of evidence for the validity of these measures (Ludwig, 1992; Mednick, 1962; Richards et al., 1988; Worthen & Clark, 1971).

*Reliability as validation.* Assessments of creative products can also incorporate the use of the Consensual Assessment Technique, in which respondents create some type of product, such as a collage, short story, or poem, in response to an experimenter’s instructions, and the products are then evaluated for creativity by expert judges (Amabile, 1983). The initial movement for the utilization of this type of assessment in creativity research was grounded on several arguments that relate to the validity of the procedure as a whole. The high inter-rater reliability that is often found with this type of measure indicates that the judges are identifying the same underlying construct in their ratings of the products (Amabile, 1996). Additionally, there is support for the generalization of this
type of assessment, as it simulates the creation of actual products, rather than the isolated verbal or figural responses of divergent thinking tests, and the procedure has been successfully replicated with variations in age of respondents and instructions provided to respondents (Amabile, 1982). Sometimes more specific rating systems are utilized with this technique, and there is additional evidence for validity based on factor analytic studies (Amabile, 1983; O’Quin & Besemer, 1989).

“Press” and “Process” Assessments: Validation

As fewer direct measures utilizing the press and process perspectives are available, there is in turn relatively less information concerning the validation procedures for these instruments. Although the press component of creativity is readily incorporated into experimental research as a manipulated independent variable (Amabile, 1996), there are some self-report instruments that address the issue of environmental impact on creativity. Factor analytic procedures demonstrate evidence for the validity of these measures, suggesting that there are related latent factors underlying the items intended to assess environments supportive or suppressive of creative expression (Amabile et al., 1996; Basadur et al., 1999). Additionally, a discriminant groups approach indicates that these instruments are sensitive to interventions intended to increase creativity (Basadur et al).

One self-report measure of press, the KEYS: Assessing the Climate for Creativity (Amabile et al., 1996), has undergone an extremely rigorous validation procedure, incorporating expert interviews and focus groups to revise previous editions (Amabile & Gryskiewicz, 1989), confirming latent variables through factor analysis on an extremely
large sample (i.e. over 3,000 responses), and establishing evidence for concurrent and divergent validity by assessing relationships between conceptually similar and dissimilar measures. Additionally, the KEYS instrument has been validated through the utilization of the Consensual Assessment Technique, confirming that real-life work products rated as highly creative are indicative of work environments that are supportive of creativity according to the KEYS instrument, and conversely that products rated low in creativity are indicative of work environments that are suppressive of creativity (Amabile et al.).

The process component of creativity is generally measured indirectly, as scores on divergent thinking tests infer the use of certain creative processes. However, the Creativity Styles Questionnaire-Revised (Kumar et al., 1997) does incorporate some direct assessment of creative processes with the inclusion of certain subscales. This self-report Likert type scale consists of items pertaining to each of the four P’s, and is one of the few measures to rely on self-report methods to measure the process aspect. This scale was validated with many of the procedures common to other self-report measures of creativity. Results of validation studies indicate a relationship between this scale and other self-report measures of creative personality characteristics, and factor analysis confirms the latent variables suggested by the subscales theoretically intended to measure different “P” components. Additionally, if respondents are divided into high and low creativity groups based on their reports of personality characteristics, the scale is able to discriminate between these two separate groups (Kumar et al.).
Validation Critique

A wide variety of methods for validating the numerous types of creativity measures suggests that the assessment of this construct is plausible and scientific. In general, the more evidence for validity one obtains, the “better” the measure (Reynolds et al., 2006). However, this may be easier said than done. Choices must be made concerning what types of evidence for validity are best suited to one’s instrument and how to interpret the evidence once it has been obtained. Overall, the assessments that demonstrate relationships between other measures of the overarching construct of creativity that exist in different formats designed for different perspectives seem to hold stronger arguments for validity. In other words, validating a creative personality self-report instrument using only other creative personality self-report instruments is not as sound an approach as validating a creative personality self-report instrument with assessments of divergent thinking and creative products.

While most of the studies reviewed here had strong evidence for concurrent validity once the assessments had been created, very few explicitly clarified the beginning stages of item development (Kirton, 1976). As this is also an important component of the validation process (DeVellis, 2003) further elaboration on these procedures could be beneficial in the evaluation of the effectiveness of the instruments. Expert review of items, and how this and other procedures are used in the revision and elimination of items are essential information to provide to readers and other potential researchers. Reynolds and colleagues (2006) suggested that evidence for validity can be obtained by gathering information concerning the response processes of the examinee.
Although this technique may have been used with some of the creativity instruments reviewed here, it was only mentioned in the written report for one study (Amabile et al., 1996). Therefore, a need for greater elaboration on the creation, evaluation, and revision of items in these creativity instruments is an opportunity to improve on the current state of creativity assessment and validation.

It should also be noted that validation of any instrument is an ongoing procedure. While many of the creativity measures, from all four “P” perspectives, demonstrate multiple types of robust evidence for the validity of the instrument, continued research with the psychometric and applied properties of these assessments is still necessary. A majority of the validation evidence is presented not only by the researchers that initially created the instrument, but by others interested in advancing the field through the exploration of an instrument’s validity across ranges of situations and populations. Once a measure has been adequately developed, it is the responsibility of all researchers in the field to further the generation of evidence for its validity. Therefore, examinations of an assessment’s validity cannot be limited to a single study from a single researcher, but are rather an extensive collaboration that has no definitive end.

Effectiveness of Creative Processes

If a scale is to accurately assess the different cognitive processes associated with creativity, then the content of the scale itself should be based on empirical research findings. The effectiveness of creative processes, whether spontaneously generated or learned as a result of an explicit training program, is a central question within the area of
creativity research. If the use of such processes actually does have an impact on creative performance, then the implications are far-reaching for a variety of populations. Assuming that creativity is a desirable quality in society, the knowledge that certain strategies can be implemented that result in creative output is essential for enhancing business and educational settings as well as improving the functioning of individuals in their everyday lives. Given this goal of increasing creativity within society, it is imperative to consider the different types of processes that are involved in creativity, and whether suggestions or interventions concerning these processes can have an impact on creative output.

There is not a single “best” process that is guaranteed to result in creativity. The creative process is generally likened to a heuristic, rather than algorithmic, technique for addressing the situation (Amabile, 1996) and therefore a prescription for successful creative output is not akin to following a structured, step-by-step procedure and expecting instantaneous results. Despite this uncertainty, many different cognitive strategies related to creativity have been observed and developed. Some attempts at training in creativity focus on improving singular strategies, while others include multiple techniques within complex pre-packaged programs, and yet others rely on making suggestions for improving the use of spontaneously generated processes that have been observed in highly creative individuals.

Regardless of the particular format of the training, researchers have a key interest in investigating the effectiveness of these processes. Overall, the research suggests that creativity training is effective (Birdi, 2005; Osburn & Mumford, 2006). Some have made
this conclusion based on reviews of the research, exploring the results of individual studies by looking at success rates and the absence or presence of statistical significance (Feldhusen & Clinkenbeard, 1986; Mansfield, Busse, & Krepelka, 1978; Torrance, 1972). More recently, researchers have also explored the effectiveness of these training interventions through the statistical technique of meta-analysis, which not only considers whether or not the training was effective in increasing creativity, but the degree to which creativity increased across several studies (Pyryt, 1999). These investigations have also demonstrated the effectiveness of creativity training in general, with most meta-analyses indicating a moderate degree of improvement as a result of exposure to training (Ma, 2006; Rose & Lin, 1984; Scott, Leritz, & Mumford, 2004). As some of the studies included in the reviews and meta-analyses involved the use of several different processes, it is also important to consider the effectiveness of individual processes. Rather than examine the research from the perspective of which particular programs are more effective than others, the current focus will now explore which particular processes, based on essential definitive components, have research support.

**Brainstorming**

Brainstorming is a popular term, even outside of the creativity literature, and on the most basic level refers to the attempt to generate as many potential responses or solutions as possible, regardless of the plausibility. This process has also been called “ideational fluency” (Clapham, 1997), and emphasis is placed on sheer volume of ideas, with criticism or evaluation deferred until all ideas are generated (Davis, 2004). Although the term brainstorming can carry the connotation of group use, an attempt to
produce a large quantity of ideas while deferring judgment on their quality can be applied on the individual or group level. Brainstorming, in its essential form, is often effective for increasing creativity. Students trained in brainstorming techniques via computer software outperformed a control group on follow-up measures of creativity (Bonk, 1988). The brainstorming technique has also been effective for increasing creativity in business settings (Basadur, Wakabayashi, & Graen, 1990), and Clapham even suggested that the ideational skills component of creativity training programs was the most critical element, accounting for a majority of the improvements in creativity.

As a key component of some pre-packaged creativity training models, the results for the effectiveness of brainstorming are not always clear. While Bonk (1988) found overall support for a computer software program that taught brainstorming skills to students, his results did not indicate statistically significant differences between experimental and control groups on all creativity outcome measures. Similarly, Gordon and Shaver (1985) found that the Talents Unlimited program, in which teachers incorporate elements into their curriculum to enable students to produce more alternatives, only accounted for a small amount of differences in creativity scores. However, more positive results have been found through investigations of the Creative Problem Solving (CPS) program. Originally developed by Osborn (1963), CPS involves the components of understanding the problem, generating ideas, and planning for action, with brainstorming techniques being closely associated with the generating ideas phase. Additionally, there are convergent and divergent components for each of these CPS steps. This program, widely used in both business and educational settings, has been
demonstrated to be effective in increasing creativity (Fontenot, 1993), especially when used in the context of training for transfer of the technique to real-life problems (Cramond, Martin, & Shaw, 1990; Glover, 1980).

**Metaphorical & Analogical Thinking**

While brainstorming techniques generally focus on the quantity of ideas generated, other strategies place more of an emphasis on the qualitative aspects of the ideas that are generated. The use of metaphorical and analogical thinking is an example of this distinction, as it involves taking “ideas (or words) from one context and applying them in a new context, producing the new idea combination, new transformation, [or] new theoretical perspective... to ‘make a connection’ between our current problem and a similar or related situation” (Davis, 2004, p. 146). Metaphorical and analogical thinking are often used in conjunction with brainstorming strategies as individuals are instructed to generate many possible responses to questions designed to elicit the metaphorical or analogical procedures, such as “Why is a calendar like a mirror?” (Davis, p. 164). This particular type of strategy is often incorporated into direct training that involves explicit instructions to think about potential connections between ideas or objects that might initially seem unrelated.

This technique has been successful across a variety of settings, with children even as young as six years old (Cropley & Feuring, 1971). In addition to increasing creative performance, research also suggests that training in metaphorical and analogical thinking can increase middle school students’ abilities to create concept maps, with the explanation for this success placed in terms of the development of metaphorical and
analogical thinking as an increase in metacognitive strategies (Russell & Meikamp, 1994). The combination and reorganization processes involved in this technique can be influenced by the initial relationships between the categories of ideas and the instructions provided (Mobley, Doares, & Mumford, 1992), but the effectiveness of this process as a whole has been demonstrated in multiple studies (Scott et al., 2004).

The essence of metaphorical and analogical thinking is contained in what is known as “synectics,” a program specifically designed to promote the use of this strategy through training individuals to solve problems by “making the strange familiar” and “making the “familiar strange” (Meador et al., 1999, p. 392). The word *synectics* itself comes from the Greek root *syn*, meaning “to bring together” (Weaver & Prince, 1990). Making the strange familiar entails gaining a complete understanding of the problem, while making the familiar strange is a conscious attempt to change perspective and look at a problem or situation in a new way. Before a fresh viewpoint can be taken, one must have a understanding of the current viewpoint.

In addition to these two foundational elements, synectics also directly promotes the use of four specific types of analogies (Gordon, 1961). *Direct analogy* is the most basic method of synectics, and this method asks the problem solver to think of ways that related problems have been solved. On a similar level of processing, *personal analogy* directs the solver to imagine him or herself as part of the problem itself. The *fantasy analogy* approach instructs individuals to think of far-fetched, fantastic, or seemingly implausible ideas that can eventually lead to practical solutions. Finally, the most abstract method is that of *symbolic analogy*, which presents a compressed conflict, or
oxymoron, such as “healthful destruction” that is intended to stimulate creative ideas in the description of such a situation (Davis, 2004, p. 163).

Similar to other research concerning the direct instructions used in this technique, the creator of this approach cites that an important aspect of the program lies in the development of an explicit training program that is based on processes that intuitively appear to be implicit (Gordon, 1972). Over the past four decades, several training programs have been developed using the synectics methods (Gordon, 1961). This training can take a variety of formats, with teacher-based lesson plans, interactive business workshops, and workbooks or textbooks intended for individualized instruction (Davis, 2004). Instruction based in the synectics method not only allows for individuals to increase their creative output, but sheds light on the nature of the creative process itself. Awareness of these techniques is an important step in the goal of increasing creativity in a potentially infinite number of areas through direct instruction in synectics. Both quantitative experiments and qualitative action research indicate the effectiveness of the synectics program, from kindergarteners to undergraduates (Meador, 1994; Stark, 1987).

**Perspective-taking**

The process of perspective-taking can be found both directly and indirectly in a variety of creativity training research. Perspective-taking can be likened to the popular colloquial phrase “thinking outside the box,” as it essentially directs one to change his or her current perspective or framework in order to acquire a unique and appropriate solution or response to a problematic situation. This process could be described as an
intentional attempt at perceptual transformation (Davis, 2004), with the shift in perspective allowing the individual to conceptualize or understand the situation in a different way. Training in this technique is often linked to the ability to solve insight problems, which require the solver to “overcome the familiar way of looking at the problem and invent a novel approach” (Dow & Mayer, 2004). While it could be argued that insight problems have a convergent, rather than divergent, solution and do not qualify as creative, the processes involved in their solutions are conceptually quite similar to the creative process of perspective-taking.

The technique of perspective-taking is somewhat difficult to disentangle from metaphorical and analogical thinking, as both can involve the recombination of familiar concepts in novel ways. For instance, it could be argued that the previously discussed synectics program could also be classified as a means to take different perspectives in addition to incorporating metaphorical and analogical thinking (Meador et al., 1999). Furthermore, some of the literature concerning creativity training effectiveness is unclear about the specific types of processes used in the experimental interventions as a result of space constraints in the methodology sections (Cliatt, Shaw, & Sherwood, 1980). Other training programs are extremely clear about the contents of the manipulations, but it is the programs themselves that overlap in implemented strategies (Ma, 2006). The SCAMPER technique is one example of this overlap. An acronym for Substitute, Combine, Adapt, Modify/Magnify/Minimize, Put to other uses, Eliminate, and Reverse/Rearrange, this strategy directs one to use the verbs that create the acronym to generate ideas for solving problems or improving objects and situations (Davis, 2004).
As the different verbs suggest the incorporation of multiple creative processes, the SCAMPER program does not exclusively fit into one type of cognitive process but instead encompasses many. Research on the use of this technique indicates that it is effective in increasing creativity, being particularly effective for verbal measures of creativity (Mijares-Colmenares, Masten, & Underwood, 1993).

**Other “Combination” Programs**

As mentioned above, many creativity training programs incorporate multiple cognitive processes. The Purdue Creativity Training Program (PCTP; Feldhusen, Treffinger, & Bahlke, 1970) is a curriculum-based training program, pre-packaged for teachers to use in the classroom. The PCTP consists of audio tapes and exercises that explicitly instruct students on improving creativity through brainstorming, metaphorical and analogical thinking, and perspective-taking strategies, then allow students to practice the new strategy in the context of a content-based lesson (Feldhusen & Clinkenbeard, 1986). Research on the PCTP suggests that this program is effective for increasing creativity of students, even when used as self-instructional material (Huber, Treffinger, Tracy, & Rand, 1979) and with learning disabled and behavior disordered students (Jaben, 1983; Jaben, 1986; Jaben et al., 1982).

Another creativity program that involves a variety of processes is the Six Hats technique, which directs individuals to generate creative solutions to problems, either alone or in groups, by changing perspectives and wearing different “hats” in order to provide a broad range of insights (Davis, 2004). The hats are labeled as White (informative), Green (generating ideas), Yellow (optimism), Black (critical), Red
(emotional and intuitive), and Blue (metacognitive). The creator of this program believes that thinking can be directly taught as a skill, and creativity can result from developing the ability to see things differently (de Bono, 1983). This program emphasizes different cognitive strategies based on the different hats or perspectives. Perspective-taking is a key component of this program, as it is required to move from one hat to another, but brainstorming and metaphorical and analogical thinking are useful processes for specific hats as well. While elaborate uses of this technique exist, the research is somewhat mixed, with most studies finding only small effect sizes (Scott et al., 2004). There are also several other similar programs from the same creator (for additional information, see deBono, 1970; deBono, 1986; deBono, 1991).

Finally, creativity training can involve the use of multiple cognitive processes that take the form of divergent thinking exercises used with students in educational settings. These programs involve the direct teaching of creativity strategies, but are not necessarily associated with a content-based or curricular program design like the PCTP. The New Directions in Creativity program is designed to help increase fluency (i.e. brainstorming), flexibility, originality, and elaborative (i.e. can fall under metaphorical and analogical thinking, and perspective-taking) skills, and is effective for increasing creativity in elementary and middle school students (Fleith, Renzulli, & Westberg, 2002; Lowery, 1982). Similarly, research on the Khatena method, which trains children in the use of perspective-taking and metaphorical and analogical thinking through engagement in exercises with direct instructions, has also demonstrated the effectiveness of creativity training programs (Khatena & Dickerson, 1973).
**Imagery**

Although there is still disagreement among psychologists about the precise functional aspects of imagery, internal visualization is often cited as an important element of the creative process (Daniels-McGhee & Davis, 1994). The voluntary control over this internal visualization is the most relevant aspect in the argument for the use of imagery training to increase creativity. However, to more fully connect imagery with creativity a broader conceptualization of imagery as not only internal mental sensations of a visual nature, but of any type of sensory modality, may be beneficial (Morris & Hampson, 1983). Since creativity is not only expressed in a visual form, connecting imagery with the creative process should extend to auditory, tactile, kinesthetic, and other sensory outlets as well. As research indicates that most people do not effectively or purposefully utilize imagery in everyday life (Kosslyn, Seger, Pani & Hillger, 1990), explicit training in imagery use is warranted.

The effectiveness of imagery as a cognitive strategy to increase creativity is most often investigated with creative writing as an outcome variable. Individuals are generally exposed to numerous guided imagery sessions, in which a teacher or experimenter guides the group through a mental visualization of a narrative, and participants are instructed to focus on the sensory descriptions in the narratives by attempting to recreate the sensations internally. This process is effective in increasing the creativity found in subsequent writing samples (Hershey & Kearns, 1979; Jampole, Konopak, Readence, & Moser, 1991; Jampole, Matthews, & Konopak, 1994). Much of the research exploring this strategy involves gifted populations (Hershey & Kearns; Jampole et al., 1991;
Jampole et al., 1994), but the effectiveness of imagery for increasing creativity has been demonstrated in cross-cultural populations as well (Nelson & Lalemi, 1991). Although imagery as a cognitive process is frequently used in conjunction with creative writing, this is not the only domain in which imagery is effective; research indicates that it can be used with mathematical problem-solving and visual spatial representation (van Garderen & Montague, 2003).

**Incubation**

Incubation is a cognitive process associated with creativity, but unlike the others discussed thus far, it is less related to direct instruction and more related to a relatively passive suggestion of use. It can be conceptualized as a “period of preconscious, fringe-conscious, off-conscious or perhaps even unconscious mental activity” that takes place while the thinker is engaged in other (usually routine) activities (Davis, 2004, p. 122). Wallas (1926) first suggested the term incubation as one of the phases of the creative process. Phase one consists of *preparation*, or the initial encounter of the problem. Then, in phase two, the thinker moves on to the *incubation* stage. In this phase, the individual puts aside the problem and allows for “unconscious testing or rehearsal of associations of ideas which may be relevant to the problem” (Houtz & Frankel, 1992, p. 183). *Illumination* is the third stage of the creative process, and it is in this phase that the person has a sudden insight to the solution. Finally, the thinker moves into the *verification* phase, in which he or she applies the new idea to the problem. The importance of incubation as a cognitive process associated with creativity, therefore, lies...
not in direct instructions on how to incubate but instead in the suggestion of taking time away from explicit work on the problem or situation.

While the true underlying functioning of incubation is arguable (and perhaps may never be known due to the implicit nature of the process), support for the effectiveness of incubation as a strategy is somewhat easier to interpret. Anecdotal evidence of problem solving through incubation is abundant. Science and math discoveries appeared in the minds of scientists when they least expected it; for instance when stepping onto a bus, as with Poincaré’s insight of an expression for the Fuchsian functions, or during a midnight drive through the mountains, as with Kary Mullins’ discovery of the technique to produce DNA samples (Finke, Ward, & Smith, 1992; Olton, 1979). While it is difficult to investigate empirically the use of incubation, the research paradigm usually consists of presenting individuals with a problem, allowing work for a designated time period, then requiring an incubation period for experimental groups, and finally comparing outcomes when allowed to resume work on the problem (Olton). The results of research employing this paradigm are mixed at best, as structured laboratory investigations often fail to find support for the use of incubation (Browne & Cruse, 1988; Dreistadt, 1969; Otlon & Johnson, 1976) but those occurring in more realistic and ecologically valid settings with open-ended tasks find that incubation can be effective (Segal, 2004).

However, the results of research specifically focusing on creativity, rather than general problem-solving, as the outcome variable are more promising for demonstrating the effectiveness of incubation. Experiments that use personally relevant and open-ended problems often find support for incubation (Barrett, 1993; Houtz & Frankel, 1992;
White & Taytroe, 2003). When participants are allowed to select their own life problem or were given an ill-defined and realistic problem, which are both relevant for creativity research (Okuda et al., 1991), incubation seems to aid in solutions. Therefore, in lieu of creating a training program with specific instructions to “incubate,” the practicality of incubation as a cognitive process for increasing creativity is generally found in suggestions for activities to facilitate potential processes (Cropley, 1997; Torrance, 1979).

**Flow**

The idea of flow as a cognitive process is, like incubation, more related to suggestions and characteristics of use rather than explicit exercises and training instructions. Flow is generally defined as an “almost automatic, effortless, yet highly focused state of consciousness” (Csikszentmihalyi, 1996, p. 110) that occurs when an individual is engaged in intense work, often of a creative nature. While some might consider it less of a cognitive strategy and more of an experience, the processing aspects are core to the connection between flow and creativity (Csikszentmihalyi, 1996). A certain amount of expertise and practice in the activity is necessary before flow can take place; it is therefore highly specific to the individual experiencing it (Csikszentmihalyi, 1991). Based on this aspect of the construct, it is not very plausible to create a training program with direct instructions on how to flow. Despite this problem, the idea of flow is still important to consider in a review of cognitive processes associated with creativity. While it might not be a strategy that can be directly taught, it is an effective aspect of the creative process (Csikszentmihalyi, 1991).
Also similar to incubation, flow is considered much more elusive and difficult to demonstrate empirically. The experience is easiest to document in qualitative studies, and interviews with highly creative individuals from a variety of domains suggest that flow is a common element of their creative processing (Csikszentmihalyi, 1996; Nelson & Ralwings, 2007; Nesbit, 2006; Reynolds, 2004). There is also research on flow using more quantitative methods of data collection. The Experience Sampling Method (ESM), in which participants are asked to carry beepers that go off at random times, and upon this signal they must then complete a self-report questionnaire, has been utilized with hierarchical linear modeling to confirm flow theory and the necessity of concentration in various activities (Moneta & Csikszentmihalyi, 1996; Moneta & Csikszentmihalyi, 1999). Recent advances in neuropsychology have also allowed for the exploration of flow from an information-processing framework through the measurement of brainwaves. This research indicates that certain brain structures are related to the cognitive experience of flow, and that interactions between implicit and explicit systems of processing are responsible for the flow experience (Dietrich, 2004). While mainly descriptive rather than predictive in nature, taken together this research provides support for the effectiveness of flow for increasing creativity. Based on this research, suggestions for incorporating flow in an attempt to enhance creativity often take the form of lists for nurturing the flow experience and reminders to avoid potential situations that could inhibit flow (Csikszentmihalyi, 1991; Barry, 1997).
Creativity and Cognition

According to the Four P’s conceptualization (Davis, 2004), one can view creativity from several different perspectives. Each perspective maintains a slightly different focus, depending on the “P” that is selected. As this study is primarily concerned with a process perspective of creativity, more specifically the various cognitive experiences that take place during the creative process, it is beneficial to extend the explanation of the cognitive processes into the field of cognitive psychology. As many theoretical models emphasize the cognitive processes that contribute to a creative output (Feldhusen & Goh, 1995), exploring the underlying cognitive constructs that not only play a role in creativity, but in general human functioning, can offer a less esoteric and more parsimonious explanation for the possibility of creativity in all individuals.

In what has come to be known as the “creative cognition approach” to the study of creativity, Thomas Ward (2007) asserted the need to connect a scientific understanding of cognitive psychological structures with a scientific understanding of creativity. In the creative cognition approach, Ward made the following assumption:

The cognitive capacity to behave creatively is a normative characteristic of humans, and [this approach] seeks to advance our understanding of creativity through precise characterization and rigorous scientific study of the cognitive processes that lead to creative and noncreative outcomes” (Ward, 2007, p. 28)

The field of cognitive psychology already possesses a wealth of knowledge concerning the areas of conceptual organization, memory retrieval, and information processing abilities and constraints, and the creative cognition approach attempts to apply these
theoretical models and empirical evidence to explain creative cognitive processing as well (Ward, Smith, & Vaid, 1997).

As a central tenet of the creative cognition approach concerns the possibility of creativity in all people, rather than a select few, this approach can be compared with the “little c” conceptualization of creativity (Csikszentmihalyi, 1996). This distinction cites that “Big C” creativity is demonstrated by individuals that are well-known and eminent in their domain, while “little c” creativity is demonstrated through everyday problem-solving by relatively ordinary people. The creative processes of those talented individuals achieving creative eminence in a particular field, from a “Big C” conceptualization, could also be explained through the creative cognition approach, but overall it is not limited to these individuals only. Therefore, this approach can also be placed toward the more general end of the “domain-general” continuum of creativity. Establishing general cognitive principles of creativity that can apply across several domains is one of the cited goals of this approach (Finke, Ward, & Smith, 1992), and the proponents of the creative cognition approach assert that “cognitive strategies that promote creativity” can be extended to other domains “as long as the strategies are sufficiently flexible to accommodate changes in context or structure and as long as the person could recognize when an idea in the new domain was truly important” (p. 6).

Based on the “little c” focus and the generality assertion, the creative cognition approach is an appropriate one for this particular research study, which maintains a similar orientation concerning the conceptualization of creativity as a variable construct that is potentially present in many individuals.
The creative cognition approach, like many other descriptions and theoretical explanations of creativity, does not present creativity as a single unitary construct (Finke et al., 1992). Instead, creativity is understood as an outcome derived from many types of cognitive processes that interact with one another. Rather than “trying to define creativity and creative cognitive processes in an explicit, absolute way” (p. 3), this approach attempts to explore the various routes to creativity and identify those which are more successful than others. This presentation of creativity as a multidimensional construct is also consistent with the research assumptions of the current study, which explores a variety of cognitive strategies and experiences that are associated with creativity. The multiple routes to creativity that are investigated within the creative cognition approach can be paralleled with the use of multiple strategies directed toward creative processing that are the focus of the new scale. Given the creative cognition explanations of creativity as a process variable involving access, expansion, and combination, this approach is well-suited to the current study’s conceptualization of cognitive processes associated with creativity.

Conceptual Access and Expansion

The field of cognitive psychology has generated empirical evidence and theoretical models concerning the formation and use of concepts and categories, which are comprised of multiple concepts, in mental functioning (Reisberg, 2001), and the creative cognition approach relies on much of this framework to explain the basic processes of creativity. Although within this area of cognitive research there are several competing theories regarding the exact description of concepts and development of
categories, these specific details are not directly addressed in the application of concepts and categories to creative processes. Instead, the creative cognition approach employs the assumption that humans have a basic capacity to form, modify, extend, and combine simple and complex concepts, and these processes are utilized during creative thinking (Ward et al., 1997).

How exactly do concepts and categories play a role in creative cognitive processing? There are several ways in which the relationship between concepts, categories, and creativity can be manifested. Category selection, or the type of concept that is chosen for use in creative processing, plays a role in the initial stages of creative thought (Mumford, Supinski, Threlfall, & Baughman, 1996). Research indicates that when individuals were given novel and ill-defined problems and asked to select between types of categories that would assist them in solving the problems, selection based on long-term goals rather than evaluation from others leads to more creative solutions (Mumford et al., 1996). This finding is consistent with creativity research that indicates an expectation of evaluation of one’s work can decrease creative performance (Amabile, 1996), which is usually interpreted as representative of a decrease in intrinsic motivation. In addition to the role of goals and motivations in the selection of concepts for creative cognitive processing, memory retrieval can also impact these primary steps in creative thought. In divergent thinking tasks, in which participants reported their strategies used in generating novel uses for familiar objects such as a brick or a barrel, most reported that they initially began the task by relying on retrieval from long-term memory before later switching to strategies that focus on the objects themselves (Gilhooly, Fioratou, Anthony,
Overall, the selection of categories that will be used in the creative process is an important initial step, and this provides essential information on the utilization of these categories.

The selection of concepts for use in creative processing, which may be impacted by motivational goals or long-term memory store, can also be related to the connectionist models of cognitive psychology (Reisberg, 2001). These models explain how one gains access to concepts and categories that may be selected for use in creative processing. As sets of associations are activated in response to a problem or situation, this activation spreads to other “nodes” (or concepts) that are connected in memory. This “spreading activation” allows each activated node to serve as source for further activation (Reisberg, 2001, p. 237). The retrieval of a novel response could be interpreted as the result of an association between concepts that is not present in most people’s networks (Martindale, 1995). This connectionist explanation of conceptual access can also be extended to incorporate the functioning of incubation, as the spreading activation can take place outside of awareness, as implicit processing (Stokes, 2007). An idea that on the surface just seems to “appear out of nowhere” could actually be the result of spreading activation that is implicitly occurring outside the realm of conscious awareness (Yaniv & Meyer, 1987).

Regardless of whether the explanation of conceptual access is attributed to motivational goals, long-term memory, or more descriptive connectionist models, one underlying aspect of concepts and categories is the role of existing knowledge. As many theories of creativity acknowledge that a certain amount of relevant knowledge on the
topic of interest must be present before a novel and appropriate response can be made (Amabile, 1996), existing knowledge provides a foundation for all of the cognitive processing that takes place in creative thought. The creative cognition approach recognizes the importance of one’s knowledge base, citing that “without some meaningful link to what has come before... novel ideas are unlikely to be of much use and therefore are unlikely to be deemed creative” (Ward et al., 1997, p. 19). Broader knowledge frameworks are necessary before concepts can be accessed, selected, and processed, which speaks to the “appropriateness” component in most definitions of creativity (Ward, 1995). A large amount of knowledge, concerning a variety of topics and experiences, can contribute to creative processing and the likelihood of producing a creative idea. This knowledge can impact the structure of goals, the long-term memory store, and the strength of associations between concepts, all of which in turn impact the concepts and categories that are utilized in creative thought.

Conceptual Combination

Once concepts have been accessed and selected for use in the initial stages of processing, these concepts may be subjected to various changes, recategorization, or scrutiny. Research on concept combination in the classification of objects and the understanding of language indicates that a focus on the characteristics of a concept, which can be broken down in a variety of ways according to different theoretical explanations, is key in the comprehension of novel phrases and ideas (Rips, 1995). Similarly, this information can be applied in the creative cognition approach, as the combination of categories can result in a novel and appropriate response (Ward et al.,
As categories generally contain some type of integration of concepts, combining categories requires attending to various characteristics in ways that may or may not be obvious, depending on the relatedness of the categories (Mumford, Baughman, Maher, Costanza, & Supinski, 1997). Cognitive processing may result in a unique and useful combination of categories, and therefore it is beneficial to explore the various ways in which concepts can be combined in order to more fully understand creative thought.

The functioning of conceptual combination may be impacted by the specific characteristics and relationships of the accessed concepts or categories that have been selected for utilization in processing. Research suggests that when participants are instructed to combine closely related categories, an optimal route to a creative response involves an emphasis on the various features that compromise the concepts and subsequently combining these based on similarity of function; however, when participants are instructed to combine distantly related categories, an emphasis on the abstract functions or connotations of the concepts is more likely to lead to creative output (Mumford et al., 1997). Similarly, other research indicates that in divergent thinking tasks that require the generation of novel uses for familiar objects, once strategies that access long-term memory have been exhausted then an imagined disassembly of the target object into sub-components can lead to further novel responses (Gilhooly et al., 2007).

The creative cognition approach provides an interpretation for these findings by presenting a phrase to describe this process of breaking down a concept into various parts and then reproducing or restructuring these parts in the generation of a novel combination
Once the concepts are scrutinized for their foundational components, there may be what are termed “emergent properties” to provide a basis for the combination of two or more seemingly dissimilar concepts or categories (Ward et al., 1997, p. 14). These properties serve as a catalyst for the combination process, allowing the individual to unite the concepts based on a similarity in emergent properties that may not be obvious when the focus remains on the concept as a whole, rather than as individual pieces. The understanding of emergent properties is essential in the explanation of how and when metaphorical thinking is often effective in increasing creativity (Glucksberg, Manfredi, & McGlone, 1997). Connecting two concepts based on an emergent property that is realized once the concepts are disassembled allows for a creative response, since the two concepts are superficially unrelated.

**Constraints on Creative Processing**

The creative cognition approach not only explores the cognitive functions that are conducive to creative responses, but it also attempts to identify potential constraints that may decrease the likelihood of a creative response (Ward, 2007). Research from this perspective has investigated the potential of a conformity hypothesis— that when examples are provided prior to engaging in a creative task, the ideas produced are likely to conform to the examples (Smith, Ward, & Schumacher, 1993). More specifically, when participants were asked to generate ideas for new toys or imaginary creatures living on another planet, those participants shown examples generated fewer and less creative ideas, as evaluated by independent raters, than those that were not shown examples, and this conformity persisted even when participants were explicitly instructed to generate
ideas that were very different from the examples (Smith et al., 1993). These findings illustrate the constraining impact of examples on creative processing, which can be linked to the previously discussed information on conceptual access and selection. Examples can constrain access to concepts, and when they are provided, they block the selection of other concepts that are more likely to result in a creative response.

In addition to the negative consequences that specific examples can have on creative output, further constraints may be attributed to the more general presence of prior knowledge. In the creative cognition approach, existing knowledge can be described figuratively as a double-edged sword, insofar as it is necessary for generating an appropriate response, but it can also place limitations on one’s ability to effectively access or combine concepts in novel ways (Ward, 1995). The potential effect of existing knowledge has been termed “structured imagination,” as the prior information provides a foundational structure that is implicitly imposed during the generation of novel ideas (Finke et al., 1992). For instance, structured imagination is often found when studying the responses of participants that are instructed to generate novel ideas like the imaginary creatures from other planets (e.g. Smith et al., 1997). Although never explicitly mentioned in the directions, most participants constrain themselves to generating creatures that have symmetry of appendages and sensory organs (Ward, 1995). Since these characteristics are nearly always found on Earth animals, this existing knowledge placed a constraint on the types of creatures imagined to live on other planets. Based on this research, it appears that prior information can aid in creative processing by providing
a wider variety of appropriate concepts to access, but it can also place unnecessary structure on an attempt to generate novel ideas.

The impact of constraints on creative processing can also be examined through an exploration of processing in which these constraints are decreased or removed. Understanding the presence of novelty that occurs in dreams, which are a universal aspect of cognitive functioning, can provide insight on the ways in which the reduction of constraints can enhance creative processing (Mandler, 1995). Dreams are constructed from a variety of mental contents that are activated and organized by mental structures, which makes them similar to everyday experience; however, dreams are not continually bound to the reality of the distracting sensory world, which makes them a canvas for the exploration of unconstrained processing (Mandler, 1995). In addition to the anecdotal connection between creativity and dreams (DeAngelis, 2003), this conceptualization is consistent with the spreading activation of the connectionist models. The lack of constraints that are normally present in everyday experience (i.e. continual sensory input) allows for dreams to process through the access and combination of concepts and categories, potentially resulting in novel responses that are highly memorable and sometimes appropriate enough to lead to creative solutions.

**Individual Differences**

**Cognitive control.** Although the creative cognition approach attempts to gain information on creative processing through a developed understanding of general cognitive processes that are present in all human functioning, this perspective can also be used to acknowledge how individual differences in cognitive functioning lead to
differences in creative processing. Research indicates that cognitive control, an attentional mechanism that allows an individual to maintain control over varying information in conscious awareness, is positively related to creativity (Groborz & Necka, 2003). Individuals that scored higher on divergent thinking assessments of creativity also showed superior performance on measures of cognitive control, specifically the Navon and Stroop tasks (Groborz & Necka, 2003). Balancing appropriateness and novelty in the access, selection, and combination of concepts or categories requires simultaneous processing, and the need to attend to multiple aspects of one’s thoughts is a hallmark of cognitive control.

Need for cognitive closure. While cognitive control is a mechanism that appears to enhance creative processing, the need for cognitive closure is another individual difference in functioning that may inhibit creative processing. A high need for cognitive closure, which is a need to resolve ambiguities and seek definite answers, is negatively related to creativity, and research indicates that the individuals high in need for cognitive closure, who prefer order and generally do not consider cognitive alternatives in decision-making, are less likely to engage in creative processing (Wai-man Ip, Chen, & Chiu, 2006). This individual difference in functioning can be interpreted through the creative cognition approach as well, in that a need for cognitive closure results in decreased access and fewer associations between concepts, along with an avoidance of combining distantly related concepts.

Giftedness and creativity. Individual differences in cognitive processing that impact creative processing can also be attributed to much of the research and theory
linking creativity and giftedness. Gifted populations often outperform general populations in research grounded in the creative cognition approach, such as in studies that methodologically require the generation of imaginary creatures (Ward, Saunders, & Dodds, 1999), suggesting that the cognitive processing of gifted individuals is more likely to result in creative thought. Within the gifted literature, many theoretical models cite creativity as a central component in describing giftedness from both general and domain-specific perspectives. In Renzulli’s (1986) Three-Ring Model, giftedness is presented as an interaction of three attributes: above-average ability, task commitment, and creativity. According to this model, all three components must be present before the criteria of giftedness can be met. Sternberg’s (2003) Triarchic Theory of Intelligence also addresses the connection between creativity and giftedness. Within this theoretical model, giftedness is present when an individual demonstrates high levels of intelligence, of which there are three types: analytic, creative, and practical. While the Three-Ring Model (Renzulli, 1986) asserts the need for an interaction among the components of giftedness, the Triarchic Theory (Sternberg, 2000) characterizes giftedness as a high level of performance in any or all types of intelligence with different combinations of strengths and weaknesses leading to various patterns of giftedness.

Other models of giftedness that introduce additional levels of complexity are also consistent with the creative cognition approach, incorporating creativity to describe high levels of cognitive functioning. Tannenbaum’s Star Model (2003) defines giftedness as abilities to produce thoughts or tangibles, or perform staged artistry or human services in ways that are creative or proficient. This model is arranged in a star pattern to suggest
interaction, and addresses the antecedents and concomitants of demonstrated giftedness through the identification of five elements: superior general intellect, distinctive special aptitudes, nonintellective requisites, environmental supports, and chance (Tannenbaum, 1986). Creativity in this model falls under the “nonintellective requisites,” and is grouped with motivation and self-concept. While these models address giftedness on a more general level of functioning, other models increase their complexity of information through a focus on the development of specific domains, such as artistic and musical giftedness (Winner, 2000). According to this theory, giftedness is defined by precocity, intense motivation, and qualitative differences in learning and understanding the information in the domain (Winner & Martino, 2003). Additionally, this model posits that all children that are gifted within a domain show “little c” creativity, but very few make the transition to “Big C” creativity as adults, for reasons related to available space in the field, skills of mastery vs. creation, and recognition of the field at the appropriate time (Winner & Martino, 2000).

A final model of creativity that can be partially interpreted from a creative cognition approach is Gagné’s (2008) Differentiated Model of Giftedness and Talent (DMGT). This model makes a distinction between giftedness, considered to be aptitude domains; talents, considered to be fields in which these aptitudes are expressed; and learning and practicing processes, considered to be the connecting path between the abilities of giftedness and their expression as talents (Gagné, 2003). Additionally, this model acknowledges how intrapersonal characteristics and environmental factors can also influence different aspects of the process. Within the DMGT conceptualization,
creativity falls within the realm of giftedness, or natural abilities. However, the DMGT is especially relevant to the creative cognition approach with its acknowledgment of the importance of process, the directional link between abilities and their expression.

This review of the literature provides an elaboration on the purpose and significance of the current study. While there are numerous creativity measures currently available, there is a lack of direct and efficient assessments of multiple creative processes. However, the development of creativity measures should be held to the same high standards of validation that are present for other educational and psychological instruments. A need exists for a self-report measure of creative processes that differentiates among various types, and the focus of this new scale is the use of cognitive processes associated with creativity. A wide variety of research demonstrates that it is possible to impact creativity through the use of different cognitive processes. The direct strategies of brainstorming, metaphorical and analogical thinking, perspective-taking, and imagery, along with the more intuitive and spontaneous techniques of incubation and flow, are all routes to creativity. This empirical evidence provides foundational content for the creation of the new scale, and theories of cognition can place the cognitive strategies that are the basis of the new scale within a larger framework for interpreting creative processing as part of general functioning.
CHAPTER III

METHODOLOGY

Overview

The validation of the newly created Cognitive Processes Associated with Creativity (CPAC) scale took place in two separate studies. The first study mainly addressed the first research question:

1) To what extent is this new scale consistently and accurately assessing the use of cognitive processes associated with creativity?

This question was initially addressed through an exploration of the scale items themselves. It was hypothesized that the grouping of the scale items would correspond to the proposed subscales based on the different cognitive processes identified in the literature. This could provide potential evidence for the construct validity of the scale. It was also hypothesized that the scale would demonstrate adequate levels of internal consistency, both as an entire scale and within each identified subscale. This could provide potential evidence for the reliability of the scale.

After determining the internal consistency and identifying potential subscales, the second study then addressed the second research question:
2) How is the scale related to other measures of creative personality characteristics and creative products?

This question was addressed through the administration of the CPAC scale in conjunction with other previously established measures of creativity. Although the first study partially addressed this question as well through the administration of the scale in conjunction with two person-based self-report measures of creativity, the second study more fully addressed this question. It was hypothesized that the CPAC scale would be significantly related to other creativity measures across various perspectives and formats. Responses on the process-based scale were compared with person-based self-report measures, a product-based consensual assessment measure, product-based divergent-thinking measures, and a self-report measure that addressed multiple perspectives. However, the degree of these relationships was expected to be low to moderate, rather than strong, as the new scale is not intended to measure the exact same conceptualization of creativity as the other instruments that have been included. This could provide potential evidence for the concurrent validity of the scale. It was also hypothesized that the CPAC scale would be unrelated to a self-report measure of social desirability, self-reported academic achievement, and demographic characteristics. This could provide potential evidence for the divergent validity of the scale.

Study 1

Preliminary Scale Development

Based on the different cognitive processes associated with creativity that are represented in the literature, an initial pool of 45 items was generated. Seven to nine
items were created for each of the following processes: Incubation, Perspective-taking, Metaphorical and Analogical Thinking, Brainstorming, Imagery, and Flow. To assess the adequacy of the initial items and to gather evidence for content validity, the 45-item draft of the scale was sent to two experts for review. The experts were selected based on their knowledge of creativity, as both have conducted and published experimental investigations on the topic. The scale included labels for reverse coding items and proposed subscales. Each expert then rated each item on a 1 to 5 Likert-type scale, with 1 indicating that the item was not at all representative of the process construct and 5 indicating that the item was extremely representative of the process construct. Any item marked with a 1 or 2 was revised based on expert suggestions. Experts also provided general feedback on the scale, which resulted in the addition of two items, therefore changing the scale to 47 items. Additionally, one expert expressed a concern that the items may be inducing a desirability bias. To further investigate this possibility, a short version of the Marlowe-Crowne Social Desirability Scale (see description below; Ray, 1984) was located for inclusion in the data collection.

After revising the scale items based on the expert feedback, an online focus group was conducted with graduate students in an internet-based course on the development of creative thinking. Students participating in the focus group were able to provide objective feedback on the scale in terms of the clarity of the items and instructions, but could also use their recently gained knowledge of creativity to make suggestions about how representative the items were for each proposed subscale. Based on the focus group feedback, some of the items underwent revision for unclear phrasing. After the expert
review and focus group suggestions were incorporated, the revised 47-item scale was ready for administration (see Appendix A).

Participants

Participants were 226 undergraduate students from the Educational Psychology department subject pool at a Midwestern public university with predominantly traditional age Caucasian students. Ages of the sample ranged from 18 to 43 ($M = 20.87$, $SD = 3.07$). There were 57 males (25.2%) and 169 females (74.8%) in the sample. Information on the ethnicity, class status, or grade point average of participants was not collected for Study 1. These age and gender breakdowns are consistent with those of the Educational Psychology subject pool, based on informal observations of class enrollments. No exclusion criteria were present, as all students in the subject pool had the opportunity to participate. Data were collected through an online administration, and those completing the assessment in less than three minutes were eliminated from any analyses. This decision was made in an attempt to reduce random error from the data. Given the total number of items in the entire test battery, it was highly unlikely that a participant completing the study in less than three minutes was actually reading the content of the items and investing thought in selecting a response. Completing 115 total items in less than 180 seconds leaves approximately 1.56 seconds to read and respond to each item.

Materials

In addition to the newly created CPAC scale and basic demographic information, participants also responded to two self-report person-based measures of creativity. As this study was primarily focused on the CPAC scale items themselves, these two
additional measures were chosen for their brevity and their similarity in format to the CPAC scale. These measures were chosen to address preliminary evidence for concurrent validity of the CPAC scale, an issue which was more fully addressed in the second study.

*Scale of Creative Attributes and Behaviors (SCAB).* This scale is a person-based self-report creativity measure (Kelly, 2004). This 20-item non-timed scale instructs participants to indicate their level of agreement with statements about typical attitudes, characteristics, and behaviors using a 7-point Likert-type scale ranging from 1 = “Strongly Disagree” to 7 = “Strongly Agree.” The SCAB contains five subscales: Creative Engagement, Creative Cognitive Style, Spontaneity, Tolerance, and Fantasy. Each subscale contains 4 items. These subscales are described as follows:

Creative engagement refers to enjoying creative activities and routinely spending time working on something creative. Creative cognitive style refers to the cognitive aspect of creativity which has often been linked with intelligence (divergent thinking and problem solving). Spontaneity is a style characterized by impulsivity and excitement seeking. Tolerance is the attitude of flexibility and openness to ideas and experience. And finally, fantasy is a mental activity of creativity, namely daydreaming and imagination.” (Kelly, 2004, p. 594)

Responses are summed to create a total score and subscale scores. Higher scores indicate higher levels of creativity.

Kelly (2004) reported adequate internal consistency (α = .75 total scale; α = .69 to .82 for subscales) and test-retest reliability after one month (r = .80 total scale; r = .70 to
.90 for subscales). Factor analysis confirmed the five hypothesized components, providing support for the construct validity. Additional validity studies indicated a significant positive relationship with the personality trait of Openness to Experience ($r = .51$ total scale), and this similarity to findings using other creativity measures provides evidence of concurrent validity (Kelly, 2006).

The Preconscious Activity Scale (PAS). This scale is a person-based self-report creativity measure (Holland & Baird, 1968) designed to assess originality in individuals based on their responses. This 38-item non-timed scale instructs participants to answer True or False to a set of statements about their preferences for activities and attitudes. Participants receive one point for each answer that corresponds with a creative characteristic. Higher scores indicate higher levels of originality.

Holland and Baird (1968) reported estimated reliability for large samples of college freshman and sophomores (K-R 20 = .70 to .77) and adequate test-retest reliability after nine months ($r = .71$ for men; $r = .77$ for women). Evidence for predictive validity was obtained, as higher scores on the instrument were positively related to later production of original, artistic products, while evidence for concurrent validity was provided by positive significant correlations between the PAS, perceptual preference creativity measures, and personality characteristics of tolerance for ambiguity, complexity, and risk-taking (Holland & Baird).

Marlowe-Crowne Social Desirability Scale- Short Version. This scale is a self-report measure (Ray, 1984) designed to assess social desirability. This 8-item non-timed scale instructs participants to respond with “Yes,” “Not sure,” or “No” to a set of
statements concerning undesirable social behaviors. Higher scores indicate high levels of social desirability. Ray reported adequate internal consistency for the shortened 8-item scale ($\alpha = .77$).

**Procedure**

Data for the first study was collected entirely online using InQsit software. Participants in the subject pool were given access to the web address, and after giving informed consent completed the battery of measures in one testing session. Once responses had been submitted, participants were linked to a page with debriefing information.

**Study 2**

**Participants**

Participants were 120 undergraduate students from the Educational Psychology department subject pool at a Midwestern public university with predominantly traditional age Caucasian students. The ages of the participants ranged from 18 to 31 ($M = 20.37$, $SD = 2.119$). There were 17 males (14.2%) and 103 females (85.8%) in the sample. There were 112 Caucasians (93.3%), 2 African-Americans (1.7%), 1 Hispanic (0.8%), 1 Asian-American (0.8%), 1 Native American (0.8%), and 2 reported mixed ethnicity (1.7%) and 1 reported “other” (0.8%). In terms of class status, there were 21 first-year students (17.5%), 47 second-year students (39.2%), 28 third-year students (23.3%), 22 fourth-year students (18.3%), and 2 reporting “other” as class status (1.7%). The mean reported grade point average was 3.342 ($SD = .426$). A large majority of the participants (87, or
72.5%) were education majors, and of the 33 (27.5%) that were non-education majors, 18 (15.0%) were nursing majors and 7 (5.83%) were speech pathology majors. These demographic breakdowns are consistent with those of the Educational Psychology subject pool, based on informal observations of class enrollments. Data were collected in a laboratory session that includes online data collection. None of the participants completed the online portion of the assessment in less than three minutes, and therefore no data were eliminated based on this rationale.

**Materials**

In addition to the CPAC scale, which was revised based on the results from Study 1, and basic demographic information, participants also responded to the following measures:

*Scale of Creative Attributes and Behaviors (SCAB).* This scale is a person-based self-report creativity measure (Kelly, 2004), and was described above.

*Marlowe-Crowne Social Desirability Scale- Short Version.* This scale is a self-report measure (Ray, 1984) designed to assess social desirability, and was described above.

*Remote Associates Test- Short Version (RAT).* This 10-item product-based measure of creativity (McFarlin & Blascovich, 1984) is based on an associative explanation of creativity. Participants are shown three words (e.g. “Surprise, Line, Birthday”) and have one minute to indicate the common association between the three words (e.g. “Party”). Ten sets of words are shown for one minute each, and participants
are instructed to write down their responses, which are later scored by assigning one point for each correct response. Higher scores indicate higher levels of creativity.

Research on longer versions of the RAT (Mednick, 1962; Worthen & Clark, 1971) indicates high reliability (Spearman-Brown = .91 to .92). Scores on the RAT are positively correlated with instructor and peer ratings \((r = .49\) to .70 for instructors; \(r = .43\) for peers), as well as with scores on an ideational fluency task \((r = .38)\), providing evidence for concurrent validity. Research utilizing this shortened version of the RAT does not report evidence for validity (McFarlin & Blascovich, 1984).

**Abbreviated Torrance Test for Adults (ATTA).** This product-based divergent thinking assessment (Goff & Torrance, 2002) is a shortened version of the Torrance Tests of Creative Thinking (Torrance, 1998). Administered in 9 minutes, it contains one verbal section (Just Suppose) and two figural sections (Incomplete Figures and Triangles). Each section is scored for fluency, flexibility, originality, and elaboration and additional creative strengths. A total creativity index and scores for each section are available. Higher scores indicate higher levels of creativity.

In the technical manual, Goff and Torrance (2002) report adequate reliability (KR-21 = .84 to .90) for the norming sample, and inter-rater reliabilities for the scoring instructions ranging from .95 to .99. Multiple studies have explored the validity of the original version of the Torrance Tests of Creative Thinking (Torrance, 1998), citing ample evidence for predictive and concurrent validity of the measure (Cramond et al., 2005; Treffinger, 1985). The abbreviated version of the instrument has been a successful assessment of creativity intervention, indicating evidence for discriminant groups validity.
(Goff & Torrance, 2002). For this study, practice scoring procedures between two independent scorers resulted in a high estimate of inter-rater reliability ($r = .994$). Therefore, the instructions provided in the scoring manual were determined to be sufficient for a single rater to complete the scoring procedures.

**Creativity Styles Questionnaire-Revised (CSQ-R)**. This scale is a self-report creativity measure (Kumar & Holman, 1997) that addresses multiple creativity perspectives. This 78-item non-timed scale instructs participants to indicate their level of agreement with statements using a 5-point Likert-type scale. Responses are averaged to create subscale scores. Higher scores indicate higher levels of creativity. There are eight subscales for the CSQ-R, which address person, product, process, and press conceptualizations of creativity. The Global Creative Capacity subscale addresses the extent to which a person perceives him or herself to be creative, while the Belief in Unconscious Processes subscale targets the degree to which a person believes that the creative process is insightful and inspirational. The Use of Techniques subscale assesses the use of specific strategies or techniques to facilitate work, and the Use of Other People subscale specifically address the degree to which people believe that consulting, working with, or sharing ideas with other people facilitates their creative work. The Final Product Orientation subscale focuses on whether individuals are motivated to create by the development of a final product, while the Environmental Control / Behavioral Self-Regulation subscale addresses the degree to which people set up discriminative stimuli to self-regulate or facilitate work. The Superstition subscale measures the degree to which people engage in superstitious behavior to facilitate their creative work, and the Use of
Senses subscale assesses whether individuals rely on the use of the five senses to facilitate their creative work (Kumar & Holman, 1997).

Kumar and colleagues (1997) found evidence for adequate internal consistency ($\alpha = .74$ total scale; $\alpha = .45$ to .81 for subscales). Evidence for discriminant groups validity was obtained, as the scale is able to differentiate between groups of high and low creativity individuals, as determined by other creativity assessments. Positive significant correlations with other self-report measures of creativity ($r = .17$ to .47 for subscales) indicate evidence for concurrent validity.

**Consensual Assessment Technique (CAT).** This is a product-based assessment of creativity that consists of general guidelines for implementation (Amabile, 1983) but the specifics of the task can be altered based on the constraints and conditions of the testing situation. Generally, participants are asked to create a product in response to a brief open-ended set of instructions, and the products are then evaluated for creativity by a set of independent raters. For this study, participants were asked to generate a short narrative story in response to the presentation of a picture. The stories were then judged by a set of four independent raters on a 1 to 9 scale. These raters were recruited from a graduate-level creative writing course, and these raters were financially compensated. The instructions given to the judges concerning appropriate rating procedures (Appendix B) are an adaptation of a previously established judging protocol (Baer, 1993). Previous research indicates that the inter-rater reliability is usually quite high, ranging from .71 to .90 (Amabile, 1983; 1996). For this study the generalizability coefficient, estimated using the GENOVA software, was .817, suggesting good inter-rater reliability for this
measure. Therefore, the scores assigned by each rater were averaged to compute an overall CAT score.

*Procedure*

Data for the second study were collected in a laboratory session that also contained an online component. Students in the subject pool had the opportunity to participate in the session, which consisted of the manual administration of the Remote Associates Test and the Abbreviated Torrance Test for Adults, and the online administration of the Cognitive Processes Associated with Creativity scale, the demographic information, the Marlowe-Crowne Social Desirability Scale-Short Form, the Scale for Creative Attributes and Behaviors, the Creativity Styles Questionnaire-Revised, and the Consensual Assessment Technique story task using InQsit software.

As the RAT and the ATTA are timed measures with more complex instructions and materials, these two assessments took place under the guidance of the experimenter. The RAT had a time limit of 10 minutes, while the ATTA had a time limit of 9 minutes. The online portion did not have an overall time limit, but generally took participants approximately 30 minutes to complete. After completing the laboratory and online components of the session, the participants were given debriefing information.

Once all of the data were collected, all measures were uploaded or entered into the data file, and the short stories were judged by the raters. The raters did not have access to participants’ scores on any of the other measures. The judges were instructed to read all of the stories, and then use the instructions (Appendix B) to rate the stories for creativity relative to the entire set.
CHAPTER IV

RESULTS

Study 1

Reliability and Factor Structure

Initially the factor structure of the 47-item scale was examined. Cronbach’s alpha, the internal consistency for the 47-item total scale was $\alpha = .862$, suggesting adequate overall reliability. The Kaiser-Meyer-Olkin statistic for the 47 item scale was .684, indicating that the factorability of the item set was “mediocre” and would preferably have been higher (Kaiser, 1974, p. 35). The items were next subjected to an exploratory factor analysis using the Principal Axis Factoring extraction method. A Varimax rotation was selected, choosing an orthogonal rather than oblique rotation because the factors did not appear to be highly correlated. A Promax rotation was initially conducted, but this indicated that there were low to moderate correlations between the factors ($r = -.240$ to .301). The proposed six-factor solution corresponding to the subscales of brainstorming, incubation, imagery, flow, metaphorical/analogical thinking, and perspective-taking was not interpretable based on an examination of the factor loadings. Six factors were chosen based on the conceptual foundation of the six cognitive processes utilized in the creation of the items.
Further investigation of the rotated factor matrix indicated that a majority of the reverse-coded items, although distributed evenly among the proposed subscales, were loading on a common factor. This suggested the presence of a method effect for the data, indicating the possibility that the responses were due to the direction (positive or negative) of the items, rather than due to any latent variable (DiStefano & Motl, 2006). Of the 47 original items included in the factor analysis, 17 were reverse-coded. Because there were fewer negatively worded items than positively worded items, all reverse-coded items were removed from the data set.

The remaining 30 items were subjected to a separate exploratory factor analysis, again using Principal Axis Factoring and a Varimax rotation with the same sample. The six-factor solution can be interpreted as generally aligning with the proposed subscales. The six factors, after rotation, accounted for 49.01% of the variance. A cut-off factor loading of .30 was used to determine whether items were considered to be loading on a factor (Kline, 1994). The first ten initial eigenvalues are reported in Table 1, and the rotated factor matrix appears in Table 2.
Table 1

*First 10 Initial Eigenvalues: 30-item CPAC Scale (Study 1)*

<table>
<thead>
<tr>
<th>Component</th>
<th>Total</th>
<th>% Variance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>6.412</td>
<td>21.375</td>
</tr>
<tr>
<td>2</td>
<td>2.209</td>
<td>7.364</td>
</tr>
<tr>
<td>3</td>
<td>1.643</td>
<td>5.478</td>
</tr>
<tr>
<td>4</td>
<td>1.571</td>
<td>5.237</td>
</tr>
<tr>
<td>5</td>
<td>1.450</td>
<td>4.834</td>
</tr>
<tr>
<td>6</td>
<td>1.417</td>
<td>4.723</td>
</tr>
<tr>
<td>7</td>
<td>1.223</td>
<td>4.077</td>
</tr>
<tr>
<td>8</td>
<td>1.175</td>
<td>3.918</td>
</tr>
<tr>
<td>9</td>
<td>1.106</td>
<td>3.685</td>
</tr>
<tr>
<td>10</td>
<td>1.009</td>
<td>3.363</td>
</tr>
</tbody>
</table>
Table 2

*Rotated Component Matrix: 30-item CPAC Scale (Study 1)*

<table>
<thead>
<tr>
<th>Item</th>
<th>Factor 1: Flow</th>
<th>Factor 2: Sensory</th>
<th>Factor 3: Perspective-taking</th>
<th>Factor 4: M/A thinking</th>
<th>Factor 5: Multiple Ideas</th>
<th>Factor 6: Incubation</th>
</tr>
</thead>
<tbody>
<tr>
<td>41. I can completely lose track of time if I am intensely working</td>
<td>.752</td>
<td>.107</td>
<td>.012</td>
<td>.072</td>
<td>-.034</td>
<td>.185</td>
</tr>
<tr>
<td>42. When I am intensely working, I don’t like to stop</td>
<td>.603</td>
<td>.061</td>
<td>-.113</td>
<td>.129</td>
<td>.023</td>
<td>.124</td>
</tr>
<tr>
<td>40. While working on something, I try to fully immerse myself in the experience</td>
<td>.558</td>
<td>.339</td>
<td>.131</td>
<td>.092</td>
<td>.131</td>
<td>.172</td>
</tr>
<tr>
<td>45. While working on something I enjoy, the work feels automatic and effortless</td>
<td>.502</td>
<td>.021</td>
<td>.065</td>
<td>.063</td>
<td>.088</td>
<td>.037</td>
</tr>
<tr>
<td>36. Imagining potential solutions to a problem leads to new insights</td>
<td>.438</td>
<td>.313</td>
<td>.099</td>
<td>.262</td>
<td>.092</td>
<td>.095</td>
</tr>
<tr>
<td>32. While working on a problem, I try to imagine all aspects of the solution</td>
<td>.396</td>
<td>.235</td>
<td>.207</td>
<td>.236</td>
<td>.192</td>
<td>-.142</td>
</tr>
<tr>
<td>46. If I am intensely working, I am fully aware of “the big picture”</td>
<td>.393</td>
<td>.080</td>
<td>.143</td>
<td>.123</td>
<td>.153</td>
<td>-.134</td>
</tr>
<tr>
<td>31. If I get stuck on a problem, I ask others to help generate potential solutions</td>
<td>.314</td>
<td>.089</td>
<td>.095</td>
<td>.268</td>
<td>.222</td>
<td>-.086</td>
</tr>
<tr>
<td>38. I try to act out potential solutions to explore their effectiveness</td>
<td>.258</td>
<td>.626</td>
<td>.059</td>
<td>.135</td>
<td>.105</td>
<td>-.036</td>
</tr>
<tr>
<td>34. While working on something, I often pay attention to my senses</td>
<td>.190</td>
<td>.557</td>
<td>.163</td>
<td>.204</td>
<td>.003</td>
<td>-.122</td>
</tr>
<tr>
<td>22. If I get stuck on a problem, I make connections between my current problem and a related situation</td>
<td>.220</td>
<td>.467</td>
<td>.103</td>
<td>.225</td>
<td>.300</td>
<td>.109</td>
</tr>
<tr>
<td>39. Becoming physically involved in my work leads me to good solutions</td>
<td>.370</td>
<td>.431</td>
<td>.003</td>
<td>.037</td>
<td>.219</td>
<td>.070</td>
</tr>
<tr>
<td>33. If I get stuck on a problem, I visualize what the solution might look like</td>
<td>.186</td>
<td>.417</td>
<td>.275</td>
<td>.397</td>
<td>-.125</td>
<td>.073</td>
</tr>
<tr>
<td>3. I get solutions to problems through my dreams</td>
<td>-.085</td>
<td>.307</td>
<td>-.062</td>
<td>-.109</td>
<td>.008</td>
<td>.128</td>
</tr>
<tr>
<td>Item</td>
<td>Factor 1: Flow</td>
<td>Factor 2: Sensory</td>
<td>Factor 3: Perspective-taking</td>
<td>Factor 4: M/A thinking</td>
<td>Factor 5: Multiple Ideas</td>
<td>Factor 6: Incubation</td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>----------------</td>
<td>-------------------</td>
<td>-------------------------------</td>
<td>------------------------</td>
<td>------------------------</td>
<td>----------------------</td>
</tr>
<tr>
<td>11. Looking at a problem from a different angle can lead to a solution</td>
<td>.046</td>
<td>.117</td>
<td><strong>.665</strong></td>
<td>.047</td>
<td>.057</td>
<td>.004</td>
</tr>
<tr>
<td>9. A good way to solve a difficult problem is to stop working and reflect</td>
<td>.031</td>
<td>-.048</td>
<td><strong>.571</strong></td>
<td>.100</td>
<td>.108</td>
<td>.191</td>
</tr>
<tr>
<td>10. If I get stuck on a problem, I try to take a different perspective of the situation</td>
<td>.006</td>
<td>.206</td>
<td><strong>.549</strong></td>
<td>.126</td>
<td>.081</td>
<td>.091</td>
</tr>
<tr>
<td>13. Changing perspectives is a good way to “think outside the box”</td>
<td>.122</td>
<td>-.039</td>
<td><strong>.455</strong></td>
<td>-.131</td>
<td><strong>.342</strong></td>
<td>-.060</td>
</tr>
<tr>
<td>18. If I get stuck on a problem, I try to apply previous solutions to the new situation</td>
<td>.119</td>
<td>.096</td>
<td>.100</td>
<td><strong>.658</strong></td>
<td>.128</td>
<td>.047</td>
</tr>
<tr>
<td>20. Incorporating previous solutions in new ways leads to good ideas</td>
<td>.183</td>
<td>.214</td>
<td>.298</td>
<td><strong>.598</strong></td>
<td>.221</td>
<td>.131</td>
</tr>
<tr>
<td>26. In the initial stages of solving a problem, I try to hold off on evaluating my ideas</td>
<td>.137</td>
<td>-.011</td>
<td>-.084</td>
<td><strong>.392</strong></td>
<td>.092</td>
<td>.060</td>
</tr>
<tr>
<td>23. Joining together different elements can lead to good ideas</td>
<td>.236</td>
<td>.204</td>
<td>.019</td>
<td>.138</td>
<td><strong>.569</strong></td>
<td>.189</td>
</tr>
<tr>
<td>30. Combining multiple ideas can lead to effective solutions</td>
<td>.284</td>
<td>.092</td>
<td>.173</td>
<td>.276</td>
<td><strong>.482</strong></td>
<td>-.062</td>
</tr>
<tr>
<td>14. Thinking about more than one idea at the same time can lead to a new understanding</td>
<td>.080</td>
<td>-.029</td>
<td><strong>.390</strong></td>
<td>-.001</td>
<td><strong>.446</strong></td>
<td>.014</td>
</tr>
<tr>
<td>25. While working on something, I try to generate as many ideas as possible</td>
<td>.164</td>
<td>.229</td>
<td>-.091</td>
<td>.187</td>
<td><strong>.389</strong></td>
<td>.072</td>
</tr>
<tr>
<td>6. If I get stuck on a problem, I look for clues in my surroundings</td>
<td>.048</td>
<td>.228</td>
<td>.120</td>
<td>.182</td>
<td><strong>.276</strong></td>
<td>-.112</td>
</tr>
<tr>
<td>16. If I get stuck on a problem, I look for details that I normally would not notice</td>
<td>-.035</td>
<td>-.011</td>
<td>.098</td>
<td>.034</td>
<td><strong>.255</strong></td>
<td>.064</td>
</tr>
</tbody>
</table>
Based on the results of the exploratory factor analysis with the 30 positively worded items, the factors were interpreted as follows: Factor 1 - Flow; Factor 2 - Sensory; Factor 3 - Perspective-taking; Factor 4 - Metaphorical/Analogical thinking; Factor 5 - Multiple ideas; and Factor 6 - Incubation. Items that did not meet the cut-off criteria, that cross-loaded on any factor, or that could not be conceptually justified for inclusion on the new factor were temporarily removed, leaving a 22-item scale. This shortened version of the scale, including subscale names and subscale item placement changes, appears in Appendix C. The internal consistency for the new shortened scale was adequate (α = .814), slightly smaller than for the 47-item scale but still relatively high. This finding is expected based on the Spearman-Brown Prophecy formula (DeVellis, 2003), because the new Cronbach’s alpha value was calculated from the same sample. A third exploratory factor analysis, with Principal Axis Factoring, a Varimax rotation, and a six-factor solution replicated the structure of the shortened scale, even with the removal of the eight items. The six factors, after rotation, accounted for 54.21% of the variance. However, this reduction in items resulted in only three to five items per factor, which may be
problematic for future use. Given the potential problems stemming from the method effect, the removal of all eight items might be premature.

Concurrent and Divergent Validity Analyses

A total score was calculated for the new 22-item shortened version of the CPAC scale by summing responses to all items ($M = 75.77$, $SD = 7.88$). Total scores for the Preconscious Activity Scale (PAS; Holland & Baird, 1968) and the Scale for Creative Attributes and Behaviors (SCAB; Kelly, 2004) were also calculated according to author instructions (PAS: $M = 21.6$, $SD = 5.96$; SCAB: $M = 99.99$, $SD = 15.42$). To examine potential evidence for concurrent validity, bivariate correlations were calculated for the CPAC scores, scores on the PAS and scores on the SCAB. There was significant positive correlation between scores on the CPAC scale and scores on the PAS; $r = .295$, $p < .001$. Additionally, there was a significant positive correlation between scores on the CPAC scale and scores on the SCAB; $r = .392$, $p < .001$. Furthermore, there was a significant positive correlation between scores on the PAS and scores on the SCAB; $r = .680$, $p < .001$. The correlations between the CPAC scale and the other measures are significant, but the relationship is moderate (Cohen, 1988). This finding suggests that while the three scales may be measuring similar constructs overall, there are still differences in the precise constructs assessed by the various instruments.

Further analyses were also included to examine for preliminary evidence of divergent validity. These analyses were not expected to be significant, as divergent validity indicates that the scale is not measuring conceptually unrelated variables. A bivariate correlation was calculated for the CPAC scores and scores on a measure of
social desirability (Ray, 1984). Scores on the social desirability scale were not significantly correlated with scores on the original 47-item CPAC scale ($r = -0.020$, $p = 0.760$) or with scores on the shortened 22-item CPAC scale ($r = -0.012$, $p = 0.858$). Social desirability scores were compared to both 47-item and 22-item versions of the CPAC scale to explore whether the positively worded items were inducing a desirability bias, as this was a concern for one of the expert reviewers. However, these results suggest that participants were not responding to either positively or negatively worded items based on a desire to provide socially desirable responses, and provide initial evidence for divergent validity. Furthermore, a bivariate correlation was calculated for the CPAC scores and the demographic variable of age. The age of participants was not significantly correlated with scores on the original 47-item CPAC scale ($r = 0.088$, $p = 0.186$) or with scores on the shortened 22-item CPAC scale ($r = 0.086$, $p = 0.199$), providing initial evidence for the divergent validity of the CPAC scale.

To continue the preliminary examination for divergent validity, the demographic variable of gender was also investigated. An independent samples $t$-test was used to compare the means of CPAC scores for men and women. There were no significant differences in CPAC scores based on gender for either the original 47-item CPAC scale; $t(224) = 1.294$, $p = .197$, or the 22-item shortened CPAC scale; $t(224) = 1.273$, $p = .204$. This suggests that men and women do not respond significantly differently on the CPAC scale, providing preliminary evidence for divergent validity.
Limitations

This initial study provided preliminary evidence for content, construct, and concurrent validity based on expert reviews, focus group responses, exploratory factor analyses, and correlations with previously established self-report creativity measures. Also, an examination of the data provided evidence for divergent validity based on a lack of relationships between the scale, social desirability, and demographic variables. However, there were some methodological and statistical limitations throughout the initial study. Due to the online mode of data collection, only self-report measures could be utilized. Therefore, evidence for concurrent validity was limited in scope, given the wide variety of creativity measures that are available. Furthermore, while multiple exploratory factor analyses that were included after the suspicion of a method effect do not present an inflated risk of Type I error because there is not an associated \( p \) value for Principal Axis Factoring, simply removing the reverse-coded items from the additional analyses is a limitation and may not completely remove their impact on the data. Participants were still exposed to the reverse-coded items when responding to the entire scale, and the presence of these items may have had an impact on their responses to the positively worded items as well. Also, the removal of cross-loading items or items that did not load resulted in a low number of items per subscale. Perhaps without the potential impact of the reverse-coded items, more of these positively worded items could have been kept on the scale. Multiple exploratory factor analyses also takes advantage of sampling variation in the data set, which may result in misleading conclusions about the factor structure. The second study attempts to address these limitations by removing
reverse-coded items before the data were collected, as well as including creativity measures in a variety of formats.

Study 2

Reliability and Factor Structure

With the 30 positively worded items administered without the impact of the negatively worded items (see Appendix D), the factor structure of the scale was examined once again. The internal consistency of the 30-item total scale was acceptable ($\alpha = .852$), suggesting good overall reliability. The Kaiser-Meyer-Olkin statistic for the 30 item scale was .703, indicating that the factorability of the items was “middling” and an increase from the factorability of the data from Study 1 (Kaiser, 1974, p. 35). The 30 items were next subjected to an exploratory factor analysis, which was more appropriate than a confirmatory factor analysis due to the fact that this was the first administration of this version of the scale, with the reverse-coded items removed. Principal Axis Factoring was the chosen extraction method. A Varimax rotation was selected, choosing an orthogonal rather than oblique rotation because the factors did not appear to be highly correlated. A Promax rotation was initially conducted, but this indicated that there were only low to moderate correlations among the factors ($r = .032$ to .410).

To determine the appropriate number of factors, several sources were examined. The Principal Axis Factoring resulted in ten components with eigenvalues greater than one (see Table 3), but the loading tables for this solution were not interpretable due to single item loadings for many factors. The minimum average partial (MAP) method
indicated that three factors had the lowest average squared correlations (Velicier, 1976). However, the parallel analysis method identified that as many as seven factors might be viable when comparing the raw data eigenvalues to the percentiles for random data eigenvalues (Thompson & Daniel, 1996). As the MAP method tends to underestimate while the parallel analysis method tends to overestimate (Kline, 1994; Thompson, 2004), a six-factor solution was determined to be the most appropriate for the data based on the loadings. The six-factor solution was not only statistically plausible but also conceptually consistent with the creative cognitive processes that comprised the scale based on the factor loadings which appear in Table 4.

Similar to the findings from Study 1, the six-factor solution can be interpreted as generally aligning with the proposed subscales. The six factors, after rotation, accounted for 52.23% of the variance. A cut-off factor loading of .30 was used to determine whether items were considered to be associated with a factor (Kline, 1994). All items met the cut-off criteria for at least one factor. For the four items that cross-loaded onto two factors, the decision was made to keep the item with a conceptually consistent factor. In all cases but one (item #23), the conceptually consistent factor also had a higher loading for the item (see Table 4).
Table 3

*First 10 Initial Eigenvalues: 30-item CPAC Scale (Study 2)*

<table>
<thead>
<tr>
<th>Component</th>
<th>Total</th>
<th>% Variance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>6.257</td>
<td>20.855</td>
</tr>
<tr>
<td>2</td>
<td>2.317</td>
<td>7.725</td>
</tr>
<tr>
<td>3</td>
<td>2.160</td>
<td>7.200</td>
</tr>
<tr>
<td>4</td>
<td>1.773</td>
<td>5.911</td>
</tr>
<tr>
<td>5</td>
<td>1.646</td>
<td>5.488</td>
</tr>
<tr>
<td>6</td>
<td>1.514</td>
<td>5.047</td>
</tr>
<tr>
<td>7</td>
<td>1.385</td>
<td>4.616</td>
</tr>
<tr>
<td>8</td>
<td>1.205</td>
<td>4.017</td>
</tr>
<tr>
<td>9</td>
<td>1.076</td>
<td>3.588</td>
</tr>
<tr>
<td>10</td>
<td>1.024</td>
<td>3.412</td>
</tr>
</tbody>
</table>
### Rotated Component Matrix: 30-item CPAC (Study 2)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>15. Joining together different elements can lead to good ideas</td>
<td>.738</td>
<td>.068</td>
<td>.191</td>
<td>.217</td>
<td>.018</td>
<td>-.024</td>
</tr>
<tr>
<td>18. Combining multiple ideas can lead to effective solutions</td>
<td>.666</td>
<td>-.029</td>
<td>.019</td>
<td>.085</td>
<td>.224</td>
<td>.285</td>
</tr>
<tr>
<td>8. Looking at a problem from a different angle can lead to a solution</td>
<td>.491</td>
<td>.102</td>
<td>.146</td>
<td>.191</td>
<td>.182</td>
<td>.188</td>
</tr>
<tr>
<td>10. Thinking about more than one idea at the same time can lead to a new understanding</td>
<td>.474</td>
<td>.166</td>
<td>.112</td>
<td>.297</td>
<td>.056</td>
<td>.067</td>
</tr>
<tr>
<td>23. Imagining potential solutions to a problem leads to new insights</td>
<td>.391</td>
<td>.379</td>
<td>.118</td>
<td>.159</td>
<td>.169</td>
<td>.091</td>
</tr>
<tr>
<td>24. I try to act out potential solutions to explore their effectiveness</td>
<td>.265</td>
<td>.710</td>
<td>.024</td>
<td>.038</td>
<td>.027</td>
<td>.138</td>
</tr>
<tr>
<td>25. Becoming physically involved in my work leads me to good solutions</td>
<td>-.092</td>
<td>.649</td>
<td>.333</td>
<td>.213</td>
<td>-.086</td>
<td>.341</td>
</tr>
<tr>
<td>21. If I get stuck on a problem, I visualize what the solution might look like</td>
<td>.105</td>
<td>.559</td>
<td>-.007</td>
<td>.170</td>
<td>.348</td>
<td>.023</td>
</tr>
<tr>
<td>11. If I get stuck on a problem, I look for details that I normally would not notice</td>
<td>.417</td>
<td>.480</td>
<td>.126</td>
<td>.096</td>
<td>.166</td>
<td>-.066</td>
</tr>
<tr>
<td>22. While working on something, I often pay attention to my senses</td>
<td>-.067</td>
<td>.476</td>
<td>.187</td>
<td>.324</td>
<td>.128</td>
<td>.252</td>
</tr>
<tr>
<td>26. While working on something, I try to fully immerse myself in the experience</td>
<td>.077</td>
<td>.369</td>
<td>.272</td>
<td>.227</td>
<td>.151</td>
<td>.347</td>
</tr>
<tr>
<td>6. A good way to solve a difficult problem is to stop working and reflect</td>
<td>.178</td>
<td>-.300</td>
<td>.252</td>
<td>.126</td>
<td>.199</td>
<td>.130</td>
</tr>
<tr>
<td>------</td>
<td>---------------------------</td>
<td>----------------------------</td>
<td>----------------</td>
<td>------------------------</td>
<td>--------------------------</td>
<td>---------------------</td>
</tr>
<tr>
<td>28. When I am intensely working, I don’t like to stop</td>
<td>.063</td>
<td>.035</td>
<td>.826</td>
<td>-.001</td>
<td>.082</td>
<td>-.022</td>
</tr>
<tr>
<td>27. I can completely lose track of time if I am intensely working</td>
<td>.193</td>
<td>.252</td>
<td>.577</td>
<td>-.049</td>
<td>-.193</td>
<td>-.005</td>
</tr>
<tr>
<td>29. While working on something I enjoy, the work feels automatic and effortless</td>
<td>.287</td>
<td>.129</td>
<td>.458</td>
<td>-.055</td>
<td>.212</td>
<td>-.051</td>
</tr>
<tr>
<td>9. Changing perspectives is a good way to “think outside the box”</td>
<td>.231</td>
<td>-.173</td>
<td>.443</td>
<td>.204</td>
<td>.058</td>
<td>.071</td>
</tr>
<tr>
<td>30. If I am intensely working, I am fully aware of “the big picture”</td>
<td>-.001</td>
<td>.148</td>
<td>.430</td>
<td>.029</td>
<td>.162</td>
<td>.069</td>
</tr>
<tr>
<td>12. If I get stuck on a problem, I try to apply previous solutions to the new situation</td>
<td>.176</td>
<td>.199</td>
<td>-.015</td>
<td>.746</td>
<td>.212</td>
<td>-.080</td>
</tr>
<tr>
<td>13. Incorporating previous solutions in new ways leads to good ideas</td>
<td>.293</td>
<td>.035</td>
<td>.129</td>
<td>.588</td>
<td>-.037</td>
<td>.105</td>
</tr>
<tr>
<td>14. If I get stuck on a problem, I make connections between my current problem and a related situation</td>
<td>.248</td>
<td>.109</td>
<td>-.159</td>
<td>.573</td>
<td>.149</td>
<td>.078</td>
</tr>
<tr>
<td>5. If I get stuck on a problem, I look for clues in my surroundings</td>
<td>.014</td>
<td>.146</td>
<td>.085</td>
<td>.332</td>
<td>.238</td>
<td>.072</td>
</tr>
<tr>
<td>20. While working on a problem, I try to imagine all aspects of the solution</td>
<td>.057</td>
<td>.295</td>
<td>.060</td>
<td>.140</td>
<td>.694</td>
<td>-.147</td>
</tr>
<tr>
<td>16. While working on something, I try to generate as many ideas as possible</td>
<td>.195</td>
<td>.090</td>
<td>.241</td>
<td>.014</td>
<td>.536</td>
<td>-.018</td>
</tr>
<tr>
<td>7. If I get stuck on a problem, I try to take a different perspective of the situation</td>
<td>.121</td>
<td>.054</td>
<td>.249</td>
<td>.273</td>
<td>.392</td>
<td>.153</td>
</tr>
<tr>
<td>2. I get good ideas while doing something routine, like driving or taking a shower</td>
<td>.173</td>
<td>-.048</td>
<td>-.089</td>
<td>-.005</td>
<td>.357</td>
<td>.241</td>
</tr>
<tr>
<td>19. If I get stuck on a problem, I ask others to help generate potential solutions</td>
<td>.089</td>
<td>-.001</td>
<td>.086</td>
<td>.214</td>
<td>.317</td>
<td>-.064</td>
</tr>
</tbody>
</table>
Based on the results of the exploratory factor analysis, the factors were interpreted as follows: Factor 1- Idea Manipulation; Factor 2 - Imagery / Sensory; Factor 3 - Flow; Factor 4 - Metaphorical/Analogical Thinking; Factor 5 - Idea Generation; and Factor 6 - Incubation. Two items (#6 and #9) were removed from the scale. Item #6 was negatively loading on Factor 2, and based on the problems presented in Study 1 as a result of reverse-coded items it was removed from the subscale. Furthermore, this item had a relatively low loading of -.300, which falls exactly at the cut-off criteria that was selected. Item #9 (“Changing perspectives is a good way to ‘think outside the box’”) was conceptually inconsistent with Factor 3 (Flow). This item does not fit the descriptions and definitions of flow that are utilized in the literature (Csikszentmihalyi, 1996) and was therefore removed from this subscale. The 28-item version of the scale, including subscale names and subscale item placement changes, appears in Appendix E.

The internal consistency for the new 28-item scale was $\alpha = .855$, which is a slight increase from the 30-item scale. The internal consistency for each subscale was also
examined. The Cronbach’s alpha coefficients are as follows: Idea Manipulation (5 items, \( \alpha = .736 \)); Imagery / Sensory (6 items, \( \alpha = .738 \)); Flow (4 items, \( \alpha = .729 \)); Metaphorical/Analogical Thinking (4 items, \( \alpha = .684 \)); Idea Generation (6 items, \( \alpha = .602 \)); and Incubation (3 items, \( \alpha = .378 \)). The alpha levels were above .60 for all but the Incubation subscale. The low number of remaining items for this particular subscale may be problematic, as there were originally six items written for this subscale.

**Concurrent Validity Analyses**

Based on the results of the exploratory factor analyses, a total score for the CPAC scale was computed by summing scores for all 28 items. Additionally, factor scores for each subscale were computed by averaging scores for the items on each subscale, as identified in Appendix E. Descriptive statistics for these scores, as well as scores for all measures used in Study 2, are available in Table 5. Bivariate correlations between the CPAC total score and the total scores for the other creativity assessments are presented in Table 6. The CPAC total score was not significantly correlated with the creativity index for the Abbreviated Torrance Test for Adults (ATTA), which was scored according to the specifications in the scoring manual (Goff & Torrance, 2002). CPAC scores were not significantly correlated with the ATTA scaled scores for Fluency, Flexibility, Originality, or Elaboration (\( r = -.109 \) to .108). Furthermore, the CPAC total score was not significantly correlated with scores for the Consensual Assessment Technique (CAT) short story task, another product-based measure included in the study. The CPAC total score was also not significantly correlated with the Remote Associates Test, which was scored by summing the number of correct responses. The Remote Associates Test was
**Table 5**

<table>
<thead>
<tr>
<th>Description</th>
<th>Mean</th>
<th>SD</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
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Table 6

*Concurrent Validity- Multiple Formats (Study 2): Bivariate Correlations*

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<td>.072</td>
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*p < 0.05

**p < 0.01

not significantly correlated with any other creativity measure used in the study, but the ATTA and the CAT were significantly positively correlated.

Comparisons between the CPAC total score and the other person-based self-report measures of creativity were also conducted. The CPAC was significantly positively correlated with the total score for the Scale for Creative Attributes and Behaviors (SCAB). The CPAC total score was not significantly correlated with the 2-item Global Measure of Creative Capacity for the Creativity Styles Questionnaire-Revised (CSQ-R), but was significantly correlated with several other CSQ-R subscales (see below). Furthermore, there was a significant positive correlation between the SCAB total score and the CSQ-R Global Creativity score. Additionally, the SCAB and the CSQ-R Global scores were significantly correlated with scores on the ATTA, but not scores on the CAT.
These results indicate some evidence for concurrent validity, but the evidence is primarily limited to creativity measures of similar format (self-report scales).

Table 7

Concurrent Validity- Self-Report Format SCAB (Study 2): Subscale Bivariate Correlations

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<td>.195*</td>
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</table>

*p < 0.05

**p < 0.01

To further examine the relationship between the CPAC and the other self-report creativity measures, correlations among subscales on the various instruments were computed (Tables 7 and 8). It was expected that many, if not all, of the CPAC subscales would be correlated with the SCAB Creative Cognitive Style subscale and the CSQ-R Use of Techniques subscale. The Creative Cognitive Style subscale is the most cognitively oriented dimension of this person-based instrument, and is therefore the most
similar to many of the CPAC subscales. The CSQ-R Use of Techniques addresses a variety of processes that are included in the CPAC, but combines multiple processes into a single score while the CPAC differentiates among the various processes. Subscale scores for the CPAC and CSQ-R were computed by averaging the responses for all items in each subscale, while SCAB items were summed. The CPAC subscale of Idea Manipulation was significantly correlated with the SCAB subscales of Creative Engagement, Creative Cognitive Style, and Tolerance, and with the CSQ-R subscale of Use of Techniques. The CPAC subscale of Imagery/Sensory was significantly correlated with the SCAB subscales of Creative Engagement, Creative Cognitive Style, and Tolerance, and with the CSQ-R subscales of Belief in Unconscious Processes and Use of Techniques. The CPAC subscale of Flow was significantly correlated with the SCAB subscales of Creative Engagement, Spontaneity, and Tolerance, and with the CSQ-R subscale of Use of Techniques and Use of Senses. The CPAC subscale of Metaphorical and Analogical Thinking was significantly correlated with the SCAB subscales of Creative Engagement and Tolerance, and with the CSQ-R subscale of Use of Techniques. The CPAC subscale of Idea Generation was significantly correlated with the SCAB subscales of Creative Engagement, Creative Cognitive Style, and Tolerance, and with the CSQ-R subscales of Belief in Unconscious Processes, Use of Techniques, and Use of Other People. Finally, the CPAC subscale was significantly correlated with the SCAB subscale of Fantasy, and with the CSQ-R subscales of Belief in Unconscious Processes, Use of Techniques, and Superstition. None of the correlations had a coefficient of above .40, indicating that while significant, the correlations were not high (Cohen, 1988).
### Concurrent Validity - Self-Report Format CSQ-R (Study 2): Subscale Bivariate Correlations

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</table>

*p < 0.05

**p < 0.01

One pattern of correlations that is of particular importance to the validation of the CPAC scale can be found in the eighth column of Table 8. These results indicate that every single CPAC subscale was correlated with the CSQ-R Use of Techniques subscale. The Use of Techniques subscale is assessing a very similar construct to the CPAC total scale, insofar as both address the use of a variety of processes for facilitating creative output. However, the individual CPAC subscales differentiate among the various processes, providing more specific descriptions of each process or technique.
To determine whether or not some of the subscales were significantly more correlated with other subscales, several additional comparisons were made. To examine whether some of these significant correlations among CPAC subscales and CSR-Q subscales were significantly different from each other (i.e. having a difference not equal to zero), a test of the null hypothesis $\rho_1 = \rho_2$ for dependent samples was used (Hinkle, Wiersma, & Jurs, 1988). Because all CPAC subscales were correlated with CSQ-R subscale Use of Techniques, it was possible that this subscale was “more” related to the CPAC subscales than other CSQ-R subscales. Five comparisons were selected to further explore this possibility (Table 9).

Table 9

Tests of Correlation Coefficient Comparisons

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<th>CSQ-R subscale #2</th>
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<th>df</th>
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<td>Use of Techniques</td>
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<td>111</td>
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<td>.382</td>
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<td>Incubation</td>
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<td>Use of Techniques</td>
<td>.445</td>
<td>112</td>
<td>&gt;.01</td>
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</table>

These five comparisons were selected based on the theorized conceptual differences among the subscales. The Bonferroni correction was used, resulting in a
testwise alpha level of .01. However, none of these comparisons were significant. The results of these comparisons indicate that while the CPAC subscales may be significantly correlated with multiple CSQ-R subscales, none of the CSQ-R subscales are contributing a significantly greater amount to the explained variance of the CPAC subscales.

*Divergent Validity Analyses*

To examine evidence for initial divergent validity, similar to the procedures used in Study 1, a bivariate correlation was calculated for the CPAC total score and the social desirability score. Scores on the social desirability scale were not significantly correlated with scores on the CPAC scale; \( r = .102, p = .290 \). This result, which was also found in the first study, suggests that participants were not responding to items based on a desirability to provide socially appropriate responses. Furthermore, a bivariate correlation was calculated for the CPAC scores and the demographic variable of age. The age of participants was not significantly correlated with scores CPAC scale \( (r = -.050, p = .597) \), providing some evidence for the divergent validity of the CPAC scale. However, there was a significant positive correlation between CPAC scores and participant self-reported GPA; \( r = .224, p = .022 \).

To continue the preliminary examination for divergent validity, the nominal demographic variables of gender, year in school, and ethnicity were also investigated. An independent samples \( t \)-test compared the mean CPAC scores for men and women. There were no significant differences in CPAC scores based on gender; \( t(110) = .706, p = .482 \). An independent samples \( t \)-test compared the mean CPAC scores for Caucasian and non-Caucasian participants. Although the ethnicity of participants was reported with a
potential seven categories, there were not a sufficient number of non-Caucasian participants to conduct comparisons among the different groups. There were no significant differences in CPAC scores based on ethnicity; \( t(110) = -0.902, p = .369 \). Furthermore, there were no significant differences in CPAC scores based on year in school; \( F(4, 107) = .287, p = .886 \). This suggests that participants do not respond differently on the CPAC scale based on their gender, ethnicity, or year in school, providing further evidence for divergent validity.
CHAPTER V

DISCUSSION

Much of the literature that examines creativity as a process variable focuses on the effectiveness of single cognitive processes as a means to increasing creative output. However, there are very few creativity assessments that have been developed with a process-based conceptualization of the construct, as most rely on a person- or product-based understanding. Researchers utilizing process-based conceptualizations of creativity generally focus on the creative process as an independent variable, exploring the effectiveness of training in various processes (Pyryt, 1999). While the empirical evidence supports a variety of cognitive processes that are associated with creativity (Ma, 2006), there is no current instrument available that directly and efficiently assesses multiple creative processes as a dependent variable. Yet regardless of the conceptualization (person, product, press, or process) incorporated into the variety of existing creativity measurements, most of these assessments have undergone extensive validation procedures to ensure the instrument’s quality and appropriateness for use in research and practice (e.g., Goff & Torrance, 2002; Kelly, 2004). Given this stringent precedence in measurement validation but a lack of process-based assessments, the purpose of Study 1 and Study 2 was to develop and validate an efficient and direct
A self-report instrument was developed to measure the cognitive processes of brainstorming, metaphorical and analogical thinking, perspective-taking, imagery, incubation, and flow. After making revisions based on expert review and focus group feedback, the scale was then administered online to a sample of undergraduates, in conjunction with two other previously established self-report creativity measures. This provided initial evidence for reliability, factor structure, and concurrent and divergent validity. However, a second study was needed to address the limitations of the pilot, so an additional administration of the scale, in conjunction with a variety of previously established creativity measures in multiple formats, took place with undergraduates in a laboratory setting. The second study provided further evidence for the reliability, factor structure, and divergent validity of the scale, and correlations with other creativity measures indicated clearer definitions of the conceptual basis for each of the subscales. Overall, the results of these studies indicate that the newly created Cognitive Processes Associated with Creativity (CPAC) scale is a psychometrically sound and factorially stable measure that represents multiple creative processes, utilizing a process-based conceptualization of the creativity construct.

Factor Structure and Reliability

The hypothesized subscales for the CPAC were based on a comprehensive review of the literature, with the defining characteristics for each cognitive process identified prior to the exploratory analyses. A method effect appeared for the initial factor analysis conducted in Study 1, with a majority of the reverse-coded items loading onto a single
factor. The presence of method effects with the inclusion of negatively worded items is somewhat controversial in the measurement literature (DiStefano & Motl, 2006) because some researchers cite the need for reverse-coded items to prevent a response set, while others argue that these negatively worded items overpower the content of the items, interrupt efficient cognitive processing, and reduce internal consistency (Barnette, 2000). However, the factor loadings indicated a method effect for the data in Study 1. Therefore, all reverse-coded items were removed from subsequent factor analyses on the data from Study 1. An additional exploratory factor analysis suggested a six-factor solution for the data that generally aligned with the hypothesized subscales. However, if items were removed based on a cut-off criteria (.30 or below) for factor loadings or cross-loading items of this factor structure, the scale would need to be shortened substantially. Also, the names of some subscales were tentatively altered to reflect the results obtained from this sample.

Conducting multiple exploratory factor analyses with the data from Study 1 presented a major limitation. Although the problematic reverse-coded items could be removed from subsequent analyses, these items were nonetheless present when the participants were responding to the remaining positively worded items. Therefore, a major question addressed in Study 2 was the “behavior” of the positively worded items without any influence of the negatively worded items, as these were not present while participants responded to the CPAC scale during Study 2. An exploratory factor analysis of the positively worded items administered during Study 2 provided support for a six-factor solution that generally aligned with the hypothesized subscales. These subscales
were the same as those hypothesized and identified during Study 1, and the similar factor structures for both sets of data are promising in terms of evidence for construct validity of the scale. Based on the results of this factor analysis a 28-item scale was determined.

Item #6 ("A good way to solve a difficult problem is to stop working and reflect") was dropped from the Imagery/Sensory subscale because of a negative factor loading. Negative loadings indicate that the item should be reverse-coded to be consistent with the other items on the same factor, but the problematic reverse-coded items from Study 1 resulted in a decision to keep all items affirmative in their representation of the subscale constructs. Item #9 ("Changing perspective is a good way to ‘think outside the box’") was also excluded from the Flow subscale because of a conceptual inconsistency. All of the other items for the Flow subscale refer to the experience of the flow state itself (e.g. “I can completely lose track of time if I am intensely working”), but item #9 is not congruous with the overall understanding of the experience of flow. The removal of these “problem” items left 28 total items for the CPAC scale, with each subscale containing three to six items.

The names of the Brainstorming, Perspective-taking, and Imagery subscales were altered to accommodate the results of the factor analysis. Although still conceptually consistent, based on an examination of the definitions of each cognitive process used in the literature, the subscale name changes reflect a broader conceptualization of the processes. The originally named “Perspective-taking” subscale, described as making a change to one’s current framework to acquire a unique solution (Davis, 2004), was renamed “Idea Manipulation.” This decision was made when the factor analysis
indicated that item #15 (“Joining together different elements can lead to good ideas”) and item #18 (“Combining multiple ideas can lead to effective solutions”) showed high factor loadings with the other items initially created for the Perspective-taking subscale. These items (#15 and #18) were initially created for the Metaphorical/ Analogical Thinking and Brainstorming subscales, respectively, but are consistent with the concept of taking an existing idea and changing or manipulating it in some way. For instance, item #8 (“Looking at a problem from a different angle can lead to a solution”) and item #11 (“If I get stuck on a problem, I look for details that I normally would not notice”) were originally written for the Perspective-taking subscale and loaded on this factor. Both of these items address ways to change one’s current understanding through a conscious manipulation of the present situation.

Additionally, the originally named “Brainstorming” subscale, described as generating a large quantity of ideas while withholding judgment (Davis, 2004), was renamed “Idea Generation.” This decision was a result of item #20 (“While working on a problem, I try to imagine all aspects of the solution”), item #7 (“If I get stuck on a problem, I try to take a different perspective of the situation”), and item #2 (“I get good ideas while doing something routine, like driving or taking a shower”) loading on a factor with other items originally created for the “Brainstorming” subscale. These items (#20, #7, and #2) were initially created for the Imagery, Perspective-taking, and Incubation subscales, respectively, but are consistent with the concept of searching for different methods of generating ideas in response to a lack of available solutions. For instance, item #16 (“While working on something, I try to generate as many ideas as possible”)
and item #19 (“If I get stuck on a problem, I ask others to help generate potential solutions”) were originally written for the Brainstorming subscale and loaded on this factor. Both of these items directly address the generation of ideas as the goal of the process. Several of the items that were originally written for Brainstorming, Perspective-Taking, and Metaphorical / Analogical Thinking subscales ended up loading on another of these three subscales. While these three processes are conceptualized as containing different elements, it should be noted that in the creativity training literature, these processes are often not distinguished from one another. The Purdue Creativity Training Program (Feldhusen & Clinkenbeard, 1986) and the Six Hats technique (de Bono, 1983), among many others, incorporate aspects of all three of these processes together. These three processes may be more similar to each other in function than other processes, such as incubation, and therefore the items may have loaded on subscales not originally hypothesized.

Finally, the originally named “Imagery” subscale, described as exerting voluntary control over internal sensations (Daniels-McGhee & Davis, 1994), was expanded to the name “Imagery / Sensory.” This decision resulted from item #26 (“While working on something, I try to fully immerse myself in the experience”) loading on this factor. Although originally intended for the Flow subscale, this item (#26) can be interpreted as an immersion in the sensory aspects of the work experience, and is therefore conceptually consistent. For instance, item #24 (“I try to act out potential solutions to explore their effectiveness”) and item #22 (“While working on something, I often pay attention to my senses”) were originally written for the Imagery subscale and loaded on this factor. Both
of these items address the internal experiences of the senses, and thus the expansion of this subscale name to encompass sensory elements is appropriate to encompass a broader description of the process.

The original names of the remaining subscales were not altered, as nearly all items loading on these subscales were consistent with the hypothesized subscales for which they were originally created. For the Incubation and Flow subscales, only items that were initially intended for these subscales loaded onto the factor. For the Metaphorical / Analogical Thinking subscale, item #5 ("If I get stuck on a problem, I look for clues in my surroundings"), which was originally created for the Incubation subscale, loaded onto this factor. However, the name was not changed because using situational cues to make connections between situations can also be considered a component of metaphorical and analogical thinking. Overall, the exploratory factor analysis conducted with the data collected from Study 2 are supportive of the assertion that the different cognitive processes associated with creativity are somewhat related but should still be considered conceptually distinct from one another. In addition to the low correlations among factors that were reported with the initial oblique rotation of the factor analysis for both Study 1 and Study 2, the six factor solution was the most interpretable given the existing literature on the various cognitive processes. The relatively high percent of explained variance of the six factor solution (52.23%), along with the pattern of factor loadings which generally conformed to theory, provide evidence for the construct validity of the CPAC scale.
There is also evidence for the reliability of the CPAC scale, in terms of the internal consistency of the items. For both Study 1 and Study 2, all reliability analyses yielded a Cronbach’s alpha of .80 or above. Furthermore, looking at the internal consistency of each subscale, through additional calculations of Cronbach’s alpha, indicated acceptable reliability levels for all of the subscales but one (Incubation). The low reliability of this subscale ($\alpha = .378$), particularly in comparison with those of the total scale and other subscales, is a cause for concern. Further investigation of the internal consistency of this subscale is needed with a larger sample, particularly because this was the smallest subscale, containing only three items.

**Divergent Validity**

To ensure that the CPAC scale was not measuring unintended variables, such as age, gender, ethnicity, class status, or social desirability, additional analyses incorporating demographic information were also conducted. The results of these analyses provide preliminary support for the divergent validity of the scale. Because the “little c” conceptualization of creativity was the basis for the development of the scale, it was therefore assumed that creativity, and the use of cognitive processes associated with creativity, would be normally distributed in the population of the subject pool. Given this conceptualization of creativity, it was important to determine that scores on the CPAC scale were not related to other, conceptually unrelated variables. Tests of group means suggested that the CPAC scores of men and women did not differ in either Study 1 or Study 2, nor did the CPAC scores of first-year, second-year, third-year, fourth-year, or those students with “other” class status for Study 2. After condensing the reported
ethnicity of the participants to “Caucasian” and “minority” categories (based on low numbers in non-Caucasian ethnic groups), a test of these group means indicated no differences in CPAC scores based on ethnicity for the participants in Study 2.

Correlation analyses also provided initial support for the divergent validity of the scale. There was not a significant correlation between scores on the CPAC scale and the age of the participants. Furthermore, there was not a significant correlation between scores on the CPAC scale and scores on a measure of social desirability in either Study 1 or Study 2. This finding was of particular importance for the divergent validity of the scale, as one of the experts that reviewed the initial items of the scale expressed a concern that the scale items might introduce a social desirability bias. Since the expert suggested the addition of more negatively worded items, but the results of the factor analysis in Study 1 led to the removal of all reverse-coded items, the lack of a significant relationship between CPAC scores and social desirability scores for Study 2 was especially encouraging.

A correlation analysis between the CPAC scores and the self-reported grade point average of the participants did show a significant positive relationship, although the correlation coefficient was low ($r = .224$). Interpreting the correlation coefficient in terms of the explained variance indicates that the $R^2$ value was quite low, with only five percent of the variance on CPAC scores attributed to the variable of GPA. Although this correlation was not expected, it is consistent with one strain of creativity research concerning the relationship between intelligence as a general cognitive ability and creativity. A commonly accepted resolution to the question about this relationship is the
threshold concept, which states that “a base level of intellectual ability is essential for creative productivity; above that threshold, however, there is virtually no relationship between measured intelligence and creativeness” (Davis, 2004, p. 83). While the relationship found in this study was between a tendency for the use of creative processes and self-reported GPA, not intelligence, this correlation is consistent with the research that supports the threshold concept. Participants in the study that were more intelligent may have also been more successful at school, which is a commonly accepted notion, and this may also be related to their use of creative processes. While this finding was not expected, it is understandable that an increased use of creative cognitive processes may be beneficial in helping students study for courses and complete high quality assignments and projects, which would in turn increase the grades they receive. However, the low percent of explained variance indicates that only a small amount of influence between these variables exists.

**Concurrent Validity**

*Product assessments.* In order to address a limitation of the online design of Study 1, which resulted in the sole use of self-report measures of creativity, Study 2 included several “product-based” assessments. One of these product-based assessments was a shortened version of the Remote Associates Test (RAT; McFarlin & Blascovich, 1984). This instrument consisted of ten sets of three seemingly unrelated words, for which participants were supposed to find a common conceptual link. Not only were scores on the RAT not correlated with scores on the CPAC, but scores on the RAT were not significantly correlated with any of the other previously established creativity
measures. Although longer versions of the RAT have a documented history of validation with past creative achievements and peer and instructor ratings (Mednick, 1962), the particular RAT items used with the current study may not have been an optimal measure of creativity. There may have been several reasons for this result. Although there was a potential high score of 10 (all items answered correctly), the highest score was only a 7, with a much lower mean ($M = 2.85$, $SD = 1.83$). Therefore, the low and nonsignificant correlation coefficient may have been the result of a truncated range, rather than the lack of a relationship between the variables (Spatz, 2008). Another potential problem with the items appears when examining some of the item statistics based on item response theory (DeVellis, 2003). To further address this issue, item difficulty and item discrimination indices were calculated and it appeared that even the “easiest” item had only 57.5 percent of participants providing a correct response (Item 7: Widow / Bite / Monkey [Spider]). Furthermore, only four of the items showed good discrimination between the top and bottom third of the participants (see Appendix F for indices). Given these potential problems with the RAT used in Study 2, the lack of significant correlation between the RAT and CPAC scores may not be due to a lack of validity for the CPAC.

The CPAC scores were also compared with the product-based Abbreviated Torrance Test for Adults (ATTA; Goff & Torrance, 2002). This instrument is accompanied by an extensive scoring manual, and practice scoring procedures between two independent scorers resulted in a high estimate of inter-rater reliability ($r = .994$). Therefore, the instructions provided in the scoring manual were determined to be sufficient for a single rater to complete the scoring procedures. Although inconsistent
scoring is not an issue for this assessment, the results of a bivariate correlation indicated that the creativity index score for the ATTA was not significantly related to scores on the CPAC. Additionally, CPAC scores were not significantly correlated with the ATTA scaled scores for Fluency, Flexibility, Originality, or Elaboration. While it was expected that a positive significant correlation would result from this analysis, it is important to point out that the ATTA is based on a product-focused conceptualization of creativity. The processes of fluency, flexibility, originality, and elaboration are only inferred based on participants’ responses to the verbal and figural prompts. Furthermore, the processes of fluency, flexibility, originality, and elaboration do not entirely match the definitions of the processes that were incorporated into the items of the CPAC scale.

A third product-based assessment of creativity was also included in Study 2. This was the Consensual Assessment Technique (CAT; Amabile, 1983). For the current study, the participants were instructed to write a short story in response to a picture that was projected on a screen at the front of the room. The short stories were later rated for creativity on a one to nine scale by “expert” raters (four English graduate students that had recently completed a creative writing course). Inter-rater reliability estimates for this measure, calculated with GENOVA software based on generalizability theory, indicated very high reliability for the raters (.817). Therefore, it was assumed that the measure was not flawed in terms of reliability. Furthermore, the CAT average rating score had a significant positive relationship with the creativity index for the ATTA. However, the CAT scores were not significantly correlated with scores on the CPAC. Although a positive correlation was expected between these two variables, the CAT, like the ATTA,
is also based on a product-focused conceptualization of creativity. Perhaps the different “P’s” of creativity have less overlap than was originally hypothesized for this study, or the inferences made from the ATTA concerning the processes utilized in the generation of responses are not adequately assessing multiple creative cognitive processes. More validity testing with other creativity measures is needed to further address this issue. It might be useful to investigate a potential relationship between the CPAC scale and the full version of the Torrance Tests of Creative Thinking, rather than the abbreviated one. Since the full version yields both a figural score and a verbal score, which are only moderately correlated (Chase, 1985), it could be that some subscales of the CPAC are more related to a verbal score on the TTCT while others are more related to a figural score. However, the results of this study provide further support for the classification of creativity research into different areas based on the underlying conceptualizations of the construct.

The various classifications of creativity are essentially related to the debate in the field of creativity research over the definition of the construct itself. The lack of a single operational definition of creativity, which is often combined with other higher-order cognitive constructs such as intelligence and critical thinking, can be extremely problematic in the utilization of subsequent assessment tools (Williams, 1999). Many creativity assessments are criticized for their failure to represent adequately all of the facets and interpretations of creativity (Piirto, 2004). It is generally recommended that when using assessments for diagnostic purposes, as opposed to research, multiple measures of creativity (which employ multiple definitions of the construct) be
incorporated (Fishkin & Johnson, 1998). Kaufmann (2003) suggests that in definitions of creativity, a distinction should be made between proactive and reactive creativity, and further asserts that many assessments of creativity which require participants to “create” in response to an artificial prompt (reactive) are not addressing the type of creativity that is self-motivated and occurs in more natural settings (proactive). This position is consistent with the findings of this study, as the CAT and ATTA would be considered assessments of reactive creativity, while the CPAC and other self-report instruments generally include items that assess one’s behaviors and attitudes in everyday functioning.

A longitudinal design that compares CPAC scores with assessments of creative products in a more realistic setting could yield additional support for the classification of the CPAC as a proactive measure of creative process.

Another reason that the CPAC scores may not have been related to the CAT or ATTA scores might be found in the design of the measures. The ATTA and CAT are both timed tasks. Each prompt (one verbal and two visual) for the ATTA allots only three minutes for a response, as specified in the instruction manual. While time limits for the CAT vary depending on the type of task and developmental level of the participants, it is a timed task as well. For Study 2, participants were given a time limit of 15 minutes to complete their stories. These time limits contrast with the phrasing of many of the items on the CPAC. For instance, the item “While working on something, I often pay attention to my senses” does not refer to working on a timed or untimed activity. Most of the processes that are addressed in the CPAC items are phrased in general “working” terms, alluding to activities that are carried out over a lengthier amount of time than
either 3 or 15 minutes. Had participants had a longer amount of time to complete the ATTA or the CAT, they may have been able to incorporate some of the processes included in the CPAC scale. However, the time limits inherent in these assessments may have put a strain on their cognitive resources, preventing their use of processes that they might otherwise utilize on a project without the presence of time constraints.

Furthermore, the strict time limits may have had differential impacts on the various processes. A follow-up analysis of the data indicated a significant negative correlation between CAT score and the CPAC subscale Incubation ($r = -0.269, p = 0.003$). This relationship is not surprising given the importance of time for incubation, as an individual must have adequate time to set the task aside before resuming work. This contrasts with the requirement of the CAT task, in which participants were required to begin working immediately. Perhaps a research design that allowed for a longer time span on a CAT task might yield different results.

The issue of time constraint has generally been explored in the creativity literature from a “press” conceptualization. Research in both educational and organizational settings suggest that a curvilinear relationship exists between creative performance and time pressure (Amabile, 1996). Under very high or very low amounts of time pressure, creativity performance tends to suffer; however, under moderate amounts of time pressure, creativity performance rises to an optimal level (Amabile, Hadley, & Kramer, 2002). The impact of time pressure on creativity can also be moderated by individual differences in the personality trait of openness (Baer & Oldham, 2006) and the need for closure (Chirumbolo, Livi, Mannetti, Pierro, & Kruglanski, 2004). Sufficient time to
complete the task at hand is recognized as an environmental stimulant for creativity, while constraint and time pressure are perceived as environmental obstacles to creativity because they interfere with a search of memory and the immediate environment to generate a response (Amabile, 1996). This assertion exemplifies how the various “P’s” of creativity all have bidirectional influences on one another. In this case, the “press” variable of time pressure impacts the “process” variable of response generation, which in turn decreases the “product” outcome variable.

The negative impact of extreme time pressure on creativity is also consistent with the cognitive psychology literature, which suggests that the negative impact of environmental stressors such as time pressure may be greater for complex cognitive processes such as creativity and decision-making, as these require more cognitive resources (Shanteau & Dino, 1993). Research in the area of social cognition suggests that under extreme time pressure individuals tend to rely on automatic, rather than effortful, responses (Kunda, 1999). Perhaps in the product-based laboratory tasks, participants were more reliant on easier to access responses, such as those related to personality variables. Further examination of the correlation data (Table 6) indicates that the SCAB total score, a person-based assessment was significantly positively correlated with the ATTA creativity index. This relationship can be interpreted in the context of the time limits for the ATTA task, and since participants did not have sufficient time to employ effortful cognitive processes, they instead relied on more automatic responses based on personality preferences.
Self-report assessments. In addition to the CPAC, both Study 1 and Study 2 included other self-report assessments of creativity. The Preconscious Activity Scale (PAS; Holland & Baird, 1968) and the Scale for Creative Attributes and Behaviors (SCAB; Kelly, 2004) were administered in Study 1. The positively worded CPAC items, along with the shortened version of the CPAC derived from Study 1 analyses, were significantly positively related to both the PAS and the SCAB. These correlations were significant, which provided preliminary evidence for concurrent validity of the CPAC. However, these correlations were not extremely large and therefore the percentages of explained variance indicated that the CPAC was measuring some unique constructs as well. For the Study 1 data, only total scores for the CPAC, PAS, and SCAB were examined with correlation analyses. Since the factor structure of the CPAC was questionable due to the method effect of the negatively-worded items and the PAS did not contain any subscales, potential subscale correlations were not examined for the pilot study data.

After the factor structure was determined based on the exploratory factor analysis conducted from the data for Study 2, subscale scores were calculated. Bivariate correlations using these subscales, along with subscales from the SCAB and the Creativity Styles Questionnaire-Revised (CSQ-R; Kumar & Holman, 1997), were then calculated. The SCAB consists of both a total score and five subscale scores, while the CSQ-R consists of eight different subscales but no total score. Examinations of the correlations among the various subscales provides a clearer understanding of the CPAC subscales themselves, further defining and describing the constructs used in the creation
and revision of the subscales. The SCAB contains five subscales: Creative Engagement, Creative Cognitive Style, Spontaneity, Tolerance, and Fantasy. All subscales of the CPAC were significantly correlated with at least one subscale from the SCAB. These correlations tended to appear in a pattern, with the SCAB subscales of Creative Engagement, Creative Cognitive Style, and Tolerance all showing positive correlations with the CPAC subscales of Idea Manipulation, Idea Generation, and Imagery. Furthermore, the SCAB subscales of Creative Cognitive Style and Tolerance were positively correlated with the CPAC subscale of Metaphorical / Analogical Thinking. These CPAC subscales are defined by more deliberate cognitive processes, and therefore it is not surprising that these SCAB subscales, which also involve more active and purposeful thoughts and behaviors (Kelly, 2006), were positively related.

The CPAC subscales of Incubation and Flow can be described as more spontaneous and less deliberate, insofar as it may not be feasible to provide instructions on “how” to incubate or to “make” oneself flow. However, research does connect these processes with increased creative performance, so these should also be further investigated as routes to creativity (Barrett, 1993; Csikszentmihalyi, 1991). The CPAC subscale of Flow was positively correlated with the SCAB subscales of Creative Engagement and Tolerance, as were several other subscales. However, the Flow subscale was also positively correlated with the SCAB subscale of Spontaneity. As the state of flow is often described in the literature as an automatic and effortless experience that cannot always be planned (Csikszentmihalyi, 1996), the relationship between these two subscales only further supports this characteristic of flow. The CPAC subscale of
Incubation was correlated with only one SCAB subscale: Fantasy. Given the indefinite aspects of both Fantasy and Incubation, this relationship is not surprising either. Both daydreaming, which is a main element of fantasy, and incubation involve an uncontrollable component of loose associations that occur outside of active processing (White & Taytroe, 2003). Whether the success of incubation is due to recovery from mental fatigue, forgetting inappropriate mental sets, or unconscious work, this process is functionally quite different from the more active strategies incorporated in idea generation or manipulation, for instance (Piirto, 2004).

Comparisons were also made between the CPAC subscales and those of the CSQ-R. The CSQ-R contained eight different subscales, and together these subscales addressed multiple “P” perspectives (person, process, product, and press). The subscales were Global Creative Capacity, Belief in Unconscious Processes, Use of Techniques, Use of Other People, Final Product Orientation, Environmental Control / Behavioral Self-Regulation, Superstition, and Use of Senses (Kumar & Holman, 1997). The CSQ-R subscale Use of Techniques was positively and significantly correlated with every single subscale of the CPAC. This result was not surprising, as the primary focus of the CPAC items was the various processes utilized in creativity. In fact, the Use of Techniques subscale could be conceptualized as a global measure of cognitive processes associated with creativity, while the CPAC subscales serve to break down this construct into more detailed components. The relationships among the Use of Techniques subscale and all of the individual CPAC subscales provide support for the assertion that the CPAC total scale does address the overall use of various creative processes.
While all of the CPAC subscales were related to the CSQ-R Use of Techniques subscale, there were other CSQ-R subscales that showed differential patterns of relationships with the CPAC subscales. The CSQ-R subscale Belief in Unconscious Processes was positively correlated with the CPAC subscales of Incubation, Imagery, and Idea Generation. These CPAC subscales could be considered as insightful and inspirational, particularly Incubation and Imagery, and these adjectives were essential in defining the Belief in Unconscious Processes subscale. Furthermore, the CSQ-R subscale Use of Senses was positively correlated with the CPAC subscale Flow. Although it was also expected that Use of Senses would correlate with the Imagery subscale, it is conceptually consistent that an intense immersion into one’s creative work, as occurs with flow, would rely on the use of all five senses. The CSQ-R subscale Use of Other People was significantly correlated with the CPAC subscale of Idea Generation. As was previously noted, Idea Generation was also related to Use of Techniques and Belief in Unconscious Processes, which suggests that creative ideas can generate from a variety of sources, both internal (Unconscious Processes) and external (Other People). Finally, the CSQ-R subscale of Superstition was significantly correlated with the CPAC subscale of Incubation. This finding is conceptually consistent as well. Superstitious behavior is often based on spontaneous rather than rational thought processes, and the process of incubation takes place outside of one’s conscious and rational awareness.

Because such a variety of CSQ-R subscales had positive and significant relationships with the CPAC subscales, tests of significance between several of the correlations were conducted. None of these tests, which utilized a formula converting the
various correlations into a $t$ statistic, resulted in test statistics that were larger than the critical values. Therefore, the null hypotheses that the correlations, while significant in their relationship to the CPAC subscales, were not significantly different from one another were retained. This finding indicates that none of the CSQ-R subscales were contributing significantly more explained variance to any of the CPAC subscales. Those CPAC subscales that had correlations with more than one CSQ-R subscale were receiving an equal contribution from each CSQ-R subscale.

*Theoretical Conceptualizations*

The correlations between the CPAC subscales and the previously established SCAB and CSQ-R subscales are beneficial in describing the various processes of the CPAC scale. Based on a broad interpretation, the relationship between the CPAC subscales and CSQ-R Use of Techniques indicates that all of the processes included in the CPAC subscales are ways to facilitate creative work. However, patterns of correlations among the specific CPAC subscales and the SCAB and CSQ-R subscales can be interpreted to support a varying degree of cognitive control for the CPAC subscales. The cognitive processes can be conceptualized along a continuum, with deliberate activity that involves a high degree of cognitive control on one end and spontaneous activity that involves a low degree of cognitive control on the other end (Figure 1). The processes of idea manipulation, idea generation, imagery, and metaphorical and analogical thinking require more active cognitive involvement to carry out, while the processes of incubation and flow are more spontaneous in their functioning. However, even among the more intentional processes, there are varying degrees of deliberate
cognitive activity required, and the same statement can be made concerning the more spontaneous processes.

While there is currently no data available to directly support this conceptualization of the various cognitive processes as falling along a continuum from low to high degree of cognitive control, it is consistent with the creativity training literature. Many of the empirical studies that incorporate a creativity training program in educational or laboratory settings find success with the more controlled processes (Pyryt, 1999; Scott et al., 2004). Furthermore, many of the “pre-packaged” creativity programs that are available for classroom use are geared more toward the utilization of idea manipulation, idea generation, imagery, and metaphorical and analogical thinking. Because these processes require more active and purposeful techniques of cognitive control, it is also easier to teach these strategies through explicit instruction. The research concerning incubation shows mixed results, in terms of the success rates of incubation for laboratory settings (Browne & Cruse, 1988). Research in more ecologically valid settings indicates greater success with both incubation and flow, which may be attributed to the less controlled nature of these processes. It might not be possible to teach people how to incubate or how to flow, but suggestions can be made for placing oneself into situations conducive to these processes. For instance, successful reports from the literature indicate that incubation occurs by taking a break and distracting oneself with routine activities like cleaning or taking a walk (Finke et al., 1992) or with meditation (Piirto, 2004). Additionally, qualitative reports cite that a state of flow can be facilitated by first acquiring a great deal of background knowledge in the domain of interest and
then by setting up an environment with few distractions and many resources (Csikszentmihalyi, 1996).

Figure 1

Continuum of Cognitive Processes

Limitations

Although the results of Study 1 and Study 2 are promising for the future use of the CPAC scale, there are some limitations that should be kept in mind. Both studies used data collected from convenience samples of undergraduate subject pools. Because the samples in this study had a disproportionate number of females compared to males, caution should be used when generalizing the results to a larger population of both genders. It might be that the factor structure of the scale, along with the other results, are only appropriate for a female population. Additional research should include a more equal number of men and women to explore potential differences in factor structure for male respondents. Furthermore, the number of participants (226 for Study 1 and 120 for
Study 2) would ideally be larger with future use of the scale. Caution also should be made when attempting to generalize the results of this study to populations outside of undergraduate college students. More research is needed to determine whether the scale is appropriate for use with other populations.

While the design of Study 2 tried to overcome Study 1’s limitation of only using other self-report measures of creativity to search for evidence of concurrent validity, only a small sample of other previously established creativity measures was used in the follow-up study. Study 2 incorporated both person-based and product-based measures of creativity, but even among these categorizations many others were not included. Additionally, the study was not designed to assess any type of evidence for predictive validity with any type of creativity measure. All of the data were collected in a single session, and longitudinal tracking of participants was not a feasible option. Simply because participants reported their use of cognitive processes associated with creativity does not mean that they are actually using these processes to facilitate creative work. This assertion could only be supported through another round of data collection that incorporated some sort of “real-world” measure of creativity, indicating evidence for the predictive validity of the CPAC scale.

Future Directions

The results of this study indicate that the CPAC is a reliable and valid measure for this group of participants. Future research should expand the use of the scale to a wider range of populations and settings. Administration of the scale to gifted populations, or populations known for their creative output such as professional artists or scientists,
could provide evidence for the discriminant groups validity of the CPAC scale. Comparisons of these scores to populations of “normal” adults might indicate that these specialized populations rely more heavily on the various processes addressed in the scale. Furthermore, administration of the scale to a larger sample would allow for the implementation of more sophisticated statistical procedures, such as confirmatory factor analyses and path analyses, which could provide additional support for the factor structure and use of the subscales.

Items on the scale were initially written for an adult level of reading comprehension. However, there are multiple applications of the scale in educational settings, and the development of another version of the scale, intended for use with younger populations, could be very beneficial for educational researchers and practitioners. The adapted scale could be useful in the identification of students for a gifted program that serves those with higher creative thinking skills. Additionally, it could be utilized in the evaluation of gifted programs that claim to serve students in creative thinking. Use of the scale with this type of research design, in a pre-test / post-test with control group paradigm, can be applied to any type of creativity training course or program. The program utilized in such a study could be one currently in use with a gifted education program, or a more elaborate research design might create a creativity training program based specifically on the principles of cognitive processes included in the CPAC subscales. If the CPAC scores of those that receive the creativity training increase significantly from pre-test to post-test, in comparison with those of a control group, this would provide evidence that the training is effective for increasing the use of
creative cognitive processes.

A previously mentioned limitation of the study was that it was not designed to generate evidence for the predictive validity of the CPAC scale. Therefore, it would be beneficial for future research to address this question. A longitudinal design could be implemented to investigate the use of the cognitive processes addressed through the CPAC scale. This study could be focused on a particular population of creative individuals, such as students in an arts or entrepreneurship program, and responses to the scale could be compared with later creative output. The generation of a creative product, which could be rated for creativity by experts similar to the procedures implemented in the Consensual Assessment Technique (Amabile, 1983), could incorporate the laboratory rigor of the CAT into a more naturalistic setting that addresses some of the design limitations that were previously discussed. Although the CPAC scale was not related to CAT performance in Study 2, this may have been because of the time constraints and artificial context of the task. A longitudinal study that collects initial data with the CPAC, then allows adequate time for the creation of a more ecologically valid outcome measure, might provide evidence for the predictive validity of the CPAC scale as well as more generalizable information about the use of creative cognitive processes in real-world settings.

Overall, the results of this research indicate that the Cognitive Processes Associated with Creativity scale has many sound psychometric qualities, and directly and efficiently assesses creativity as a process variable. The data collected from Study 1 and
Study 2 provided evidence for the construct validity of the scale, with a relatively stable factor structure reflecting the underlying theoretical subscales. A lack of relationships among the CPAC scale, social desirability, and several demographic variables suggested evidence for the divergent validity of the scale. There is mixed evidence for the concurrent validity of the scale, as scores on the CPAC were not significantly correlated with product-focused measures of creativity but were significantly correlated with other previously established self-report creativity instruments. Further investigation of these findings indicated that different conceptualizations and design issues may be the reason for the nonsignificant results. A deeper exploration of the relationships among the various self-report subscales led to a more vivid description of each cognitive process included in the CPAC, laying the foundation for a theoretical understanding of the similarities and differences of these processes. While there were some limitations to the study, many of these issues could be addressed with future research incorporating different populations, settings, and paradigms.
References


creative time pressure and creativity: Moderating effects of openness to experience and support for creativity. *Journal of Applied Psychology, 91,* 963-970.


Barnette, J.J. (2000). Effects of stem and Likert response option reversals on survey internal consistency: If you feel the need, there is a better alternative to using those negatively worded items. *Educational and Psychological Measurement, 60,* 361-370.


Appendix A: 47-item Cognitive Processes Associated with Creativity scale* (Study 1)

Following is a series of statements about personal preferences and behaviors. Please indicate how frequently you engage in each behavior.

Response Options:

(1) Never  (2) Rarely  (3) Sometimes  (4) Often  (5) Always

**Incubation**

1. When I get stuck on a problem, a solution just comes to me when I set it aside.
2. I get good ideas while doing something routine, like driving or taking a shower.
3. I get solutions to problems through my dreams.
4. I get solutions to problems when my mind is relaxed.
5. R- My mind must be completely active and focused to generate effective solutions.
6. If I get stuck on a problem, I look for clues in my surroundings.
7. R- If I can’t come up with a good solution right away, I quickly settle for a less effective one.
8. R- If I get stuck on a problem, I keep trying to solve it even if no solutions come to me.
9. A good way to solve a difficult problem is to stop working and reflect.

**Perspective-taking**

10. If I get stuck on a problem, I try to take a different perspective of the situation.
11. Looking at a problem from a different angle can lead to a solution.
12. R- I find it hard to look at something familiar in a new way
13. Changing perspectives is a good way to “think outside the box.”
14. Thinking about more than one idea at the same time can lead to a new understanding.
15. R- I find it difficult to make myself aware of my own subjectivity.

16. If I get stuck on a problem, I look for details that I normally would not notice.

**Metaphorical/Analogical thinking**

17. R- Looking for unusual uses of everyday objects is a waste of time.

18. If I get stuck on a problem, I try to apply previous solutions to the new situation.

19. R- While working on something, I can get bogged down on the irrelevant details of the situation.

20. Incorporating previous solutions in new ways leads to good ideas.

21. R- I find it difficult to transfer ideas from one situation to a new context.

22. If I get stuck on a problem, I make connections between my current problem and a related situation.

23. Joining together different elements can lead to good ideas.

**Brainstorming**

24. R- I generate few good ideas rather than many.

25. While working on something, I try to generate as many ideas as possible.

26. In the initial stages of solving a problem, I try to hold off on evaluating my ideas.

27. R- I rule out ineffective ideas as soon as they come to me.

28. R- Generating more solutions than I need is a waste of my time.

29. R- Wild and crazy ideas are a waste of time.

30. Combining multiple ideas can lead to effective solutions.

31. If I get stuck on a problem, I ask others to help generate potential solutions.
Imagery

32. While working on a problem, I try to imagine all aspects of the solution.

33. If I get stuck on a problem, I visualize what the solution might look like.

34. While working on something, I often pay attention to my senses.

35. R- It is difficult for me to imagine things that have not yet happened.

36. Imagining potential solutions to a problem leads to new insights.

37. R- Unique perceptions rarely inspire good ideas.

38. I try to act out potential solutions to explore their effectiveness.

39. Becoming physically involved in my work leads me to good solutions.

Flow

40. While working on something, I try to fully immerse myself in the experience.

41. I can completely lose track of time if I am intensely working.

42. When I am intensely working, I don’t like to stop.

43. R- It is difficult for me to become fully immersed in my work.

44. R- I am easily distracted, even while working on something I enjoy.

45. While working on something I enjoy, the work feels automatic and effortless.

46. If I am intensely working, I am fully aware of “the big picture.”

47. R- Even while working on something I enjoy, I am worried about failure.

*R indicates reverse coded items
Appendix B: Instructions Given to Judges

There is only one criterion in rating these stories: creativity. I realize that creativity does not exist in a vacuum, and to some extent creativity probably overlaps other criteria one might apply—sensory appeal, organization, use of details, novelty, complexity, or technical goodness, for example—but I ask you to rate the stories solely on the basis of your thoughtful-but-subjective opinions of their creativity. The point is, you are the expert, and you need not defend your choices or articulate a definition of creativity. What creativity means to you can remain a mystery—what I want you to do is use that mysterious expert sense to rate the stories for creativity. (Baer, 1993)

Given this information, please read all of the stories. Then rate each story in creativity, relative to the entire set. Use a 1 to 9 scale, with 1 indicating “no creativity” and 9 indicating “extreme creativity.”
Appendix C: 22-item Cognitive Processes Associated with Creativity scale (Study 1)

Response Options:

(1) Never   (2) Rarely   (3) Sometimes   (4) Often   (5) Always

**Perspective-taking**

9. A good way to solve a difficult problem is to stop working and reflect.

10. If I get stuck on a problem, I try to take a different perspective of the situation.

11. Looking at a problem from a different angle can lead to a solution.

13. Changing perspectives is a good way to “think outside the box.”

14. Thinking about more than one idea at the same time can lead to a new understanding.

**Flow**

41. I can completely lose track of time if I am intensely working.

42. When I am intensely working, I don’t like to stop.

45. While working on something I enjoy, the work feels automatic and effortless.

46. If I am intensely working, I am fully aware of “the big picture.”

**Sensory**

3. I get solutions to problems through my dreams.**

32. While working on a problem, I try to imagine all aspects of the solution.

34. While working on something, I often pay attention to my senses.

38. I try to act out potential solutions to explore their effectiveness.

**Metaphorical/Analogical thinking**

18. If I get stuck on a problem, I try to apply previous solutions to the new situation.

20. Incorporating previous solutions in new ways leads to good ideas.
22. If I get stuck on a problem, I make connections between my current problem and a related situation.***

**Multiple ideas****

23. Joining together different elements can lead to good ideas.

25. While working on something, I try to generate as many ideas as possible.

30. Combining multiple ideas can lead to effective solutions.

**Incubation**

1. When I get stuck on a problem, a solution just comes to me when I set it aside.

2. I get good ideas while doing something routine, like driving or taking a shower.

4. I get solutions to problems when my mind is relaxed.

*Originally named “imagery” subscale
**Originally item included with incubation subscale
***Item conceptually placed with this subscale, but did not load
****Originally named “brainstorming” subscale
Appendix D: 30-item Cognitive Processes Associated with Creativity scale (Study 2)

Response Options:

(1) Never  (2) Rarely  (3) Sometimes  (4) Often  (5) Always

**Incubation**

1. When I get stuck on a problem, a solution just comes to me when I set it aside.
2. I get good ideas while doing something routine, like driving or taking a shower.
3. I get solutions to problems through my dreams.
4. I get solutions to problems when my mind is relaxed.
5. If I get stuck on a problem, I look for clues in my surroundings.
6. A good way to solve a difficult problem is to stop working and reflect.

**Perspective-taking**

7. If I get stuck on a problem, I try to take a different perspective of the situation.
8. Looking at a problem from a different angle can lead to a solution.
9. Changing perspectives is a good way to “think outside the box.”
10. Thinking about more than one idea at the same time can lead to a new understanding.
11. If I get stuck on a problem, I look for details that I normally would not notice.

**Metaphorical/Analogical thinking**

12. If I get stuck on a problem, I try to apply previous solutions to the new situation.
13. Incorporating previous solutions in new ways leads to good ideas.
14. If I get stuck on a problem, I make connections between my current problem and a related situation.
15. Joining together different elements can lead to good ideas.
Brainstorming

16. While working on something, I try to generate as many ideas as possible.

17. In the initial stages of solving a problem, I try to hold off on evaluating my ideas.

18. Combining multiple ideas can lead to effective solutions.

19. If I get stuck on a problem, I ask others to help generate potential solutions.

Imagery

20. While working on a problem, I try to imagine all aspects of the solution.

21. If I get stuck on a problem, I visualize what the solution might look like.

22. While working on something, I often pay attention to my senses.

23. Imagining potential solutions to a problem leads to new insights.

24. I try to act out potential solutions to explore their effectiveness.

25. Becoming physically involved in my work leads me to good solutions.

Flow

26. While working on something, I try to fully immerse myself in the experience.

27. I can completely lose track of time if I am intensely working.

28. When I am intensely working, I don’t like to stop.

29. While working on something I enjoy, the work feels automatic and effortless.

30. If I am intensely working, I am fully aware of “the big picture.”
Appendix E: 28-item Cognitive Processes Associated with Creativity scale (Study 2)

Response Options:
(1)Never  (2)Rarely  (3)Sometimes  (4)Often  (5)Always

Idea Manipulation*

15. Joining together different elements can lead to good ideas.**
18. Combining multiple ideas can lead to effective solutions.***
8. Looking at a problem from a different angle can lead to a solution.
10. Thinking about more than one idea at the same time can lead to a new understanding.
11. If I get stuck on a problem, I look for details that I normally would not notice.

Imagery / Sensory

24. I try to act out potential solutions to explore their effectiveness.
25. Becoming physically involved in my work leads me to good solutions.
21. If I get stuck on a problem, I visualize what the solution might look like.
22. While working on something, I often pay attention to my senses.
23. Imagining potential solutions to a problem leads to new insights.
26. While working on something, I try to fully immerse myself in the experience.****

Flow

28. When I am intensely working, I don’t like to stop.
27. I can completely lose track of time if I am intensely working.
29. While working on something I enjoy, the work feels automatic and effortless.
30. If I am intensely working, I am fully aware of “the big picture.”
Metaphorical/Analogical thinking

12. If I get stuck on a problem, I try to apply previous solutions to the new situation.

13. Incorporating previous solutions in new ways leads to good ideas.

14. If I get stuck on a problem, I make connections between my current problem and a related situation.

5. If I get stuck on a problem, I look for clues in my surroundings.*****

Idea Generation******

20. While working on a problem, I try to imagine all aspects of the solution.******

16. While working on something, I try to generate as many ideas as possible.

7. If I get stuck on a problem, I try to take a different perspective of the situation.*******

2. I get good ideas while doing something routine, like driving or taking a shower.*****

19. If I get stuck on a problem, I ask others to help generate potential solutions.

17. In the initial stages of solving a problem, I try to hold off on evaluating my ideas.

Incubation

1. When I get stuck on a problem, a solution just comes to me when I set it aside.

3. I get solutions to problems through my dreams.

4. I get solutions to problems when my mind is relaxed.

*Originally named “perspective-taking” subscale
**Originally item included with metaphorical/analogical thinking subscale
*** Originally item included with brainstorming subscale
****Originally item included with flow subscale
*****Originally item included with incubation subscale
******Originally named “brainstorming” subscale
*******Originally item included with imagery subscale
**********Originally item included with perspective-taking subscale
## Appendix F: Item Difficulty and Discrimination Indices for Remote Associates Test

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<th>p for top third</th>
<th>Item Discrimination (d)</th>
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<td>.857</td>
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