THE ROLE OF CHOSEN CREATIVITY MEASUREMENTS IN OBSERVED RELATIONSHIPS TO PERSONALITY

Jeb S. Puryear, M.A.

Dissertation Prepared for the Degree of

DOCTOR OF PHILOSOPHY

UNIVERSITY OF NORTH TEXAS

May 2016

APPROVED:

Todd Kettler, Major Professor
Anne N. Rinn-McCann, Committee Member
Robin K. Henson, Committee Member
Miriam Boesch, Committee Member
Abbas Tashakkori, Chair of the Department of Educational Psychology
Jerry R. Thomas, Dean of the College of Education
Costas Tsatsoulis, Dean of the Toulouse Graduate School

Puryear, Jeb S. The Role of Chosen Creativity Measurements in Observed Relationships to Personality. Doctor of Philosophy (Educational Psychology – Gifted and Talented Education), May 2016, 76 pp., 7 tables, references, 86 titles.

Creativity is a complex construct that is conceptualized and measured in multiple ways. This study examined the relationship between creativity and personality taking this into account. It was hypothesized that applying different conceptions and measures would cause variation in the creativity-personality relationship. The participants (N = 224) were undergraduate students completed six creativity measures, a personality inventory, and a demographic questionnaire. Personality predicted more creative production (R^2 = .277) than creative potential (R^2 = .176) and more self-reported creativity (R^2 = .348) than that which was externally-rated (R^2 = .149). Personality predicted creativity beyond demographic and intellect variables, but the effects varied based on the creativity measure. Openness was most consistently and strongly related to creativity. Other personality factors demonstrated suppression effects in multiple models. Overall, the results suggest that despite relatively small effects of personality on creativity, it can help strengthen prediction in creativity models. Implications for educational settings and future research are discussed.

ACKNOWLEDGEMENTS

To Dr. Todd Kettler, thank you for sparking my interest in the line of creativity research on which this dissertation work falls. Thank you as well for your mentorship and for demonstrating far more grace than me throughout the doctoral process. To both Dr. Todd Kettler and Dr. Anne Rinn-McCann, thank you for your high expectations and for repeatedly believing in my abilities more than I ever have. I will carry the wisdom you have offered me throughout my career and life. To Dr. Robin Henson, thank you for fostering my inclination to ask precise questions and for always forcing explanations to be as non-opaque as possible. To Dr. Miriam Boesch, thank you for your service on my committee and fresh perspectives. To Dianna Mullett and Kristen Lamb, thank you for wading into this project to help score a mountain of divergent thinking tasks. Your donation of time was greatly appreciated. To my wife, Anna, and family, thank you for putting up with me and pressing me to finish this task.

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CHAPTER 1

INTRODUCTION AND LITERATURE REVIEW

1.1 Introduction

Psychologists have studied the connections between creativity and personality for decades. While the facets of personality that relate the two have been theorized, dissected, compared, re-theorized, and, ultimately, entrenched over time (e.g. Barron & Harrington, 1981; Eysenck, 1993a; Eysenck, 1993b; Feist, 1998), considering the creativity side of the relationship has been less common. This may be because theories of personality, though diverse, have largely coalesced over the past two decades in terms of assessment protocols (cf. Costa & McCrae, 2008). On the other hand, conceptions of the creativity construct and how best to measure it have remained clouded despite calls for consensus (e.g. Cropley, 2000; Plucker, Beghetto, & Dow, 2004; Zeng, Proctor, & Salvendy, 2011).

Generally accepted connections of creativity and personality are discussed through seminal and representative studies. Then, diverse conceptions of creativity and methods of creativity measurement are outlined, including both theoretical and practical implications. This study combines the issues by examining the extent to which the use of different creativity measures influences the relationship to personality. Personality factors may predict production measures (e.g. inventories of creative activities) better than ideation-based factors (e.g. divergent thinking tests) and predict self-reported measures better than externally-assessed measures (Puryear, Kettler, & Rinn, under review). Furthermore, different specific measures including subcomponents of divergent thinking seem to demonstrate different relationships to personality. The purpose of this study is to investigate the relationship between personality and creativity and how the relationship may change based on the type of creativity measure used.

1.2 Measuring the Creative Personality

1.2.1 The Role of Personality

As with other aspects of research on creativity, the origins of personality studies in creativity research can be traced back to J. P. Guilford's (1950) speech to the American Psychological Association in which he called for a more rigorous psychometric study of the construct. In initially outlining the purpose of the call, he put forth the already prevailing conception of creativity being related to personality characteristics. This was made clear by his desire for research in psychology to promote the development of "creative personalities" (p. 445). It was and is believed that the identification of intrinsic characteristics of (eminent) creators can help us better cultivate creative talent. The study of creative eminence (Big-C, cf. Kaufman & Beghetto, 2009) continues today though in diminished form and to a lesser extent. The work of Simonton (1994) and Gardner (1993) are two relatively recent examples. Simonton worked backward from the profiles of widely accepted eminent individuals in an effort to find underlying commonalities. Gardner chose eminent individuals across creative domains paralleling his earlier work in multiple intelligences (Gardner, 1983). The Guilford search for characteristics associated with creativity mirrors, in some ways, the earlier work of Terman (1925) and Hollingworth (1942) profiling the intellectually gifted. The lasting belief in a "gifted personality" is still prevalent and continues to influence the field of creativity research and the practice of gifted education (Baudson & Preckel, 2013).

Guilford's call led to a large swath of studies in the following decades (e.g. Barron, 1957; Domino, 1970; Hall & McKinnon, 1969; Helson, 1967; Shelton & Harris, 1979). So much so, in fact, that as early as the 1980s researchers and commentators in the field were already commenting that there were "few surprises" emerging in the study of personality and creativity

(Barron & Harrington, 1981, p. 453). One new type of creative personality testing emerged in the decade prior to Barron and Harrington's work: the use of scales developed based on the 300-item Adjective Check List (ACL; Gough & Heilbrun, 1965). Gough (1979) devised an abbreviated version of the ACL which he coined the Creative Personality Scale (CPS). Distilling from the 300-item version to the 30-item CPS was based on studies of creative achievements across domains. The instrument has wide use in practical psychology and counseling settings and is still commonly used as a means of assessing the convergent validity for new creativity measures.

While the research based on Gough's scale was common in earlier studies of personality and creativity, facet views of personality changed the way the relationship was examined. Rather than having many adjectives to sift through, conceptions of personality, centered on a handful of factors, brought more clarity. Eysenck wrote extensively about the links between his three-facet view (extraversion, psychoticism, neuroticism; see Eysenck & Eysenck, 1976) and creativity, particularly regarding the connection of psychoticism to creative achievement (1993a; 1993b; 1995a; 1995b). Later work has shown the psychoticism-creativity link to be heavily influenced by moderating factors (e.g. Acar & Runco, 2012). Eysenck (1995a) suggested personality as a factor that interacts with intelligence or intellect to generate creative output in addition to having a direct influence on its own. Eysenck (1995b) believed creativity and psychoticism had a strong relationship. His work (1993a) gave rich, detailed responses to criticisms of his theories, much of which was based on issues of his personality conception which was falling out of favor in lieu of Big Five models like that of Costa and McCrae (1992, 2008).

The Costa and McCrae Five Factor Model includes openness to experience, conscientiousness, extraversion, agreeableness, and neuroticism. Openness to experience relates to one's willingness to engage in new ideas, one's appreciation for aesthetics, for desire for depth

of discussion. It also suggests a natural curiosity, particularly in novel situations. Conscientiousness captures self-discipline, goal-setting, and personal reliability. Extraversion is associated with highly interactive and visible people. It also relates to people who "step out" and prefer a breadth of experiences over depth, if forced to choose. Highly agreeable individuals think more collectively and are flexible. They are typically more sympathetic and forgiving as well. Neuroticism is characterized by a lack of emotional stability including nervousness and having a high-strung nature.

Feist (1998) conducted a meta-analysis of creativity and personality in artistic and scientific domains. His analysis consolidated decades of work, including many early studies using measures based on the Adjective Check List. One of Feist's major contributions was making this connection from earlier research to the emerging use of a Big Five personality view in creativity studies. He meticulously coded measures in the ACL studies he examined into the five-factor conception. The comprehensive table of the coding scheme provides clarity for not only his study, but broader personality investigations as well (see Feist, 1998, p. 293). Since Costa and McCrae's Big Five Model now drives most research in personality and, by extension, research regarding personality and creativity, it is not surprising that the Feist work is considered seminal on the topic.

Feist (1998) reviewed 26 studies of scientists versus non-scientists, 28 studies of creative versus non-creative scientists, and 29 studies of artists versus non-artists. The most common positive influence on creativity was openness to experience. Extraversion was a close second. Both of these had been well-established in the literature and are still considered the primary personality drivers of creativity. Since a desire to explore ideas and new experiences relate so much to the concept of the creativity, this should not be surprising. Neuroticism and

agreeableness had the smallest effects and were generally negative. Perhaps the most striking findings related to conscientiousness. In two of Feist's three analyses, this facet of personality had the strongest influence on creativity. The noteworthy finding was that in the scientific domain, where creative productivity is typically assessed by the number of publications and prestige, conscientiousness had a positive effect. In the artistic domain where the productivity is measures in terms of novelty or divergent ideas, it showed the largest negative effect. These differences suggest that variation in how creativity is conceptualized and measured may influence the relationship between creativity and personality.

1.2.2 The Conception and Measurement of Creativity

The Plucker, Beghetto, and Dow (2004) definition of creativity, derived from an examination of 90 articles from two high impact factor journals in the field (*Creativity Research Journal* and the *Journal of Creative Behavior*), provides a solid starting point for discussing creativity conceptions:

> Creativity is the interaction among *aptitude, process, and environment* by which an individual or group produces a *perceptible product* that is both *novel and useful* as defined within a *social context*. (Plucker, et al., 2004, p. 90, original italics)

First, the authors themselves lamented the lack of concrete definitions in the articles they examined when only about one-third included such clarity. Second, their definition encapsulated a number of issues in the field that have direct impact on the measurement of creativity.

One issue highlighted by the definition is whether creativity should be thought of as idea-based or product-based or some combination thereof. Plucker et al.'s (2004) definition alludes to potential and innate talent (aptitude), but also to tangible outcomes ("perceptible product"). Runco (2003) and others have suggested focusing on both when possible in order to generate a

more complete picture. Plucker et al.'s definition also seems to indicate that some sort of interplay exists ("interaction among") leaving one to speculate what that might be. It is possible that personality might be part of such a connection, but explicit evidence is thin. Puryear (in press) suggested that internal cognitive filters may be a link. In an empirical study, Puryear (2015) found metacognition moderated ideation and production which suggests that even if we establish the relationship between the two sides, there are likely other factors to consider.

1.2.2.1 Ideation and Potential

Conceptions of creativity based on ideation and process conceptions of creativity differ, but have a common focus on the measurements of potential. The Runco Ideational Behavior Scale (Runco, Plucker, & Lim, 2001) requires individuals to rate the frequency with which they have moments of ideation in their everyday experiences. This measurement of creative potential as practical expression is unique in the field. Most self-report scales are related to production. Additionally, most measurements of ideation-potential involve abstract tasks or skill demonstrations.

Divergent thinking tests like the Torrance Test of Creative Thinking (Torrance, 1974) provide some stimulus to the subject and they generate responses (e.g. participants could be asked to come up with unusual uses for a paperclip). While, technically, these might be considered "products" since they are externalized, the purpose of the assessment is to measure potential of *other* creative endeavors. In these assessments, creative potential is characterized by aspects of the responses such as number (fluency) and uniqueness (originality).

While divergent thinking is far more commonly associated with creativity, one assessment, the Remote Associates Test (Mednick, 1962) is more related to convergent thinking. In the task, participants are given sets of three words and asked to find the common link. For

example, given “duck, fold, dollar,” the individual is supposed to come up with “bill” as the answer since it can be associated with all three. The idea here is that a more creative individual is more likely to make associations others will not see, particularly when presented more complicated (remote) sets of words. Some, like Lubart, Besancon, and Barbot (2011), suggest a balance of divergent and convergent tasks in assessing creative potential. Their Evaluation of Potential Creativity (EPoC) includes a battery of tests that balances the types of thinking tasks.

1.2.2.2 Production and Achievement

In contrast to the typically abstract ideation measurements of creativity which focus on what *might occur* are instruments aimed at rating products *already fashioned* or determining levels of achievement that have *already occurred*. As previously suggested, these are often self-report measures. They may either assess the quantity or quality of some outcomes deemed related to creativity. One production measure, the Biographical Inventory of Creative Behaviors (BICB; Batey, 2007) simply requires subjects to indicate whether they have, for example, given a speech or invented a product in the past twelve months. This reflects a conception of creativity that simply doing something deemed creative is the essence of being creative. It is not surprising that openness to experience (a willingness to try new things) and extraversion (a willingness to put oneself “out there”) would predict creativity when conceived this way. The Creative Behavior Inventory (Hocevar, 1979) adds a frequency component to items similar to those on the BICB. In this case, repeating a task is taken as the suggestion of a trend toward creativity.

Other production measures of creativity relate to the quality of the production, but the focus is still on tangible outcomes rather than potential. The Creative Achievement Questionnaire (Carson, Peterson, & Higgins, 2005) asks participants to note their own achievement against given levels of performance and prestige in various fields. Usage of the

measure demonstrates a view of creativity as domain-specific. This is different from measures of ideation and potential which are based on creativity as a general factor. Plucker and Beghetto (2004) discussed the domain-specificity issue at length concluding the distinction should be considered, but not dwelled upon. Diverse measures should be used to provide a more complete picture of an individual's creativity.

1.2.2.3 Self-Reported and Externally-Rated Creativity

Another common example of product-based creativity assessment is the Consensual Assessment Technique (CAT; Amabile, 1982). This is more of a technique for assessment than a specific measure. The CAT employs the "social context" spirit from the Plucker et al (2004) creativity definition. Multiple raters with an understanding of the task and its context carry out the scoring of products. Not surprisingly, the CAT has been shown to be increasingly reliable with increasing expertise of the raters (Kaufman, Baer, & Cole, 2009; Kaufman, Baer, Cole, & Sexton, 2008). This highlights another important concern in creativity measurement: Who is the best judge of creativity? The individual or someone else? Product assessments using the Consensual Assessment Technique and even evaluations of divergent thinking task outcomes (e.g., originality) place a premium on external evaluation.

This concern over who can judge creativity may stem from a belief in the importance of social context or a field's valuation of an individual's output. It may also result from a sense of perceived objectivity. Concerns regarding the reliability of self-report measures and the ability to "fake creativity" have been around since the times of ubiquitous Adjective Check List use (Barron & Harrington, 1981). Recent scholarship suggests these psychometric fears may be excessive (Silvia, Wigert, Reiter-Palmon, & Kaufman, 2012). Silvia et al found strong reliability

evidence even in more abstract evaluations of personal creativity such as those assessed in the Creativity Domains Questionnaire (Kaufman, et al., 2010).

1.3 Problem Statement

Despite the large amount of research relating creativity and personality, conceptions or measurements of creativity as an influence on this relationship has not been a common frame for studies. In a recent systematic review, Puryear and colleagues (under review) took this approach. The authors synthesized the results of 96 studies representing 188 total personality-creativity relationships. Differences were observed in the strength (and sometimes direction) of the relationship depending on the type of creativity measurement used. For example, ideation-potential measurements were generally less related to personality than production-achievement ones. Conscientiousness was positively related to production measures and negatively related to ideation ones. Openness to experience predicted twice as much variance in creative production as creative potential and neuroticism predicted four times as much. Additionally, self-reports were far more influenced by personality than external ratings. Conscientiousness again showed opposite influences depending on the type of measurement. Openness to experience and neuroticism again predicted twice the variance, as did extraversion, when creative *production* was measured. Different components of divergent thinking were also found to have varying relations to the facets of Big Five personality. Extraversion had more than three times the effect on fluency (R^2 = .034) than on the next most influenced facet (elaboration, R^2 = .010). The influence was four times greater than on originality (R^2 = .008) which is commonly most associated with creativity. Conscientiousness, agreeableness, and neuroticism showed conflicting (i.e., some positive, some negative) relationships to divergent thinking, depending on the facet under investigation.

These findings complicate the seemingly established relationship of personality to creativity. If the way we conceive creativity alters findings, and if the nature of the creativity measurements themselves influence the relationships we observe, further investigation is warranted. Doing so could add clarity to the use of creativity and personality measures in the evaluation of individuals in psychological and educational settings. For example, in the field of gifted education where personality and creativity often enter into identification decisions, understanding the interaction of creativity measures and personality would seem vital. Furthermore, an explicit consideration of these influences would help lend more credibility to the operationalized definitions used in creativity studies particularly those investigating personality.

1.4 Purpose and Research Questions

The purpose of the present empirical study is to build conceptually on the work of Feist (1998) by exploring the intersection of creativity measurement and conception questions and facets of personality. That is, the following overarching question was examined: does the type of creativity measurement used influence the relationships we see between creativity and personality. It also builds on the recent review by Puryear and colleagues which specifically looked at this issue, but does so using single set of individuals rather than meta-analytic approach. Four specific research questions drive this inquiry:

Research Question 1: How do the observed relationships between Big Five facets of personality and creativity differ when creativity is conceived as ideation, divergent thinking, or potential versus production or achievement?

Research Question 2: How do the observed relationships between Big Five facets of personality and creativity differ in self-reported creativity measures versus creativity assessed by external raters?

Research Question 3: How do the observed relationships between Big Five facets of personality and creativity differ when considering individual elements of divergent thinking (fluency, flexibility, originality, and elaboration)?

Research Question 4: How do the observed relationships between Big Five facets of personality and creativity differ depending on the specific creativity measures used when controlling for demographic and intellect variables?

CHAPTER 2

METHODS

2.1 Participants

Participants for the study were recruited from an undergraduate course in human development at a large public university in the southwestern United States. The university serves roughly 40,000 students at the undergraduate and graduate levels. The average age of the sample (N = 224) was 19.6 years (SD = 3.3). Using this age range, participants will have had time for personal experiences and expression to generate variance on the creativity inventories, but not be so locked in on a career path or routine as to limit future aspirations and daily ideation.

The course was chosen for recruitment because it fulfills the university core social sciences requirement. Thus, some measure of diversity with regard to background interests and majors was expected. That said, the majority of those that take the course are typically pursuing a development and family studies major or a path leading to an education degree. More than two-thirds of the sample (N = 159) were planning these majors. Given typical enrollment patterns, there was an expectation of a large proportion of females in the sample. The sample had the expected high number of females (85% female).

Other demographic information included race (59% White, 21% Hispanic, 14% Black, 6% Asian or other), self-reported SAT/ACT scores (SAT verbal M = 552, SD = 90; SAT math M = 540, SD = 72; ACT M = 23.5, SD = 3.5), self-reported GPA (M = 3.18, SD = .49), whether they were identified for gifted and talented services during their K-12 schooling (38%), and whether they had been members of the university's honors college (4%). Race and gender have some, albeit inconsistent, influences on creativity (Kaufman, et al, 2010). Using variables related to intelligence is commonplace in creativity studies (e.g. Feist & Barron, 2003; Hocevar, 1980;

Mednick & Andrews, 1967). Taking giftedness or school achievement into account is less common, but does occur (Kershner & Ledger, 1985; Sen & Hagyvet, 1993). Together these variables were used to evaluate the unique influence of personality and the other factors in the prediction of creativity. This follows the suggestion of Batey and Furnham (2006), in their review of the disparate personality/creativity/intelligence literature, to "take a multiple components perspective and examine the relative importance of the different constituents" (p. 410).

2.2 Materials

2.2.1 Creativity Inventories

Given the purpose of the study, diverse, multiple measures of creativity were used. Three self-report measures, the Runco Ideational Behavior Scale (RIBS; Runco, Plucker, & Lim, 2001), the Creative Behavior Inventory (CBI; Hocevar, 1979), and the Creative Achievement Questionnaire (CAQ; Carson, Peterson, & Higgins, 2005) assess levels of creative ideation, quantity of creative production, and level (quality) of creative achievement, respectively. The short-form RIBS contains 19 Likert-scale items that ask respondents to rate the frequency with which they have thoughts or ideas in real-world contexts (e.g. "I have ideas about I will be doing in the future" or "I have ideas about a new invention"). Respondents note their replies on a Likert scale range from "never" to "daily." Although a long form of the RIBS exists, the internal reliability of the short-form is high ($\alpha = .90$). A recent study suggested a high correlation between the forms ($r = .94$) and that using the short-form allows one to draw similar conclusions (Runco, et al., 2014). In the present study the reliability of the observed scores was in a similar range ($\alpha = .83$).

The 28-item version of the Creative Behavior Inventory asks participants to report the frequency with which they have completed different creative tasks (e.g. “did this once or twice” or “did this 5 or more times”). The scale is Likert-type. Some items specifically exclude creative activities that were completed as part of school requirements. This focuses on creative production more related to intrinsic creative interest rather than external factors. The vast majority of the CBI items (24 of 28) are direct measures of production quantity, applying the scale to such items as writing a poem, painting an original picture, or writing a speech. A handful of items do imply an aspect of quality (e.g. “received an award for an artistic accomplishment”), but these items were not removed. The observed scores for items in this particular study displayed high internal consistency ($\alpha = .88$).

The Creative Achievement Questionnaire (Carson, Peterson, & Higgins, 2005) focuses on the quality of creative production reported by participants. Participants check items off incremental lists of achievement across ten domains. Scores are generated in a domain by adding all the lines checked with a bonus for achievement at the highest levels. A total creativity score can be derived using the total of the domains. Some items require those completing the CAQ to include the number of times they have occurred meaning they can be counted multiple times. Since items are intended to be stratified, scores for the instrument tend to demonstrate large positive skew (Silvia, Wigert, Reiter-Palmon, & Kaufman, 2012). In this study, the skewness was 2.60. A square route transformation was used to reduce the skewness. The skewness on the transformed CAQ was much lower (.68). Additionally, the characteristics of the items mean the assumptions for reporting a typical reliability analysis are not met (i.e. items not independent and not weighted equally or tau-equivalent).

2.2.2 Divergent Thinking Tasks

External evaluations of creativity were carried out using three divergent thinking tasks. These types of tasks are ubiquitous measures of creative potential and are largely ideation-based though the evaluation of the responses for creativity could be considered an evaluation of production in line with other uses of the Consensual Assessment Technique (Amabile, 1982). In this study, one Alternate Uses Task (AUT; cf. Guilford, 1967), one Instances Task (IT; cf. Wallach and Kogan, 1965), and one Consequences Task (CT; cf. Christensen, Merrifield, P. R., Guilford, 1958) were used. In the instructions of each task, participants were explicitly instructed to be creative. This sort of instruction maximizes creative output and is particularly salient when using divergent thinking tasks (Nusbaum, Silvia, & Beaty, 2014).

In the Alternate Uses Task, participants were asked to come up with as many uses of a brick as they could. All three divergent thinking tasks had a time limit of three minutes. For the Instances Task, participants were asked to give as many examples of "round things" as possible. For the Consequences Task, participants were asked to suggest implications of people no longer needing to sleep. Recognizing the need to use divergent thinking tasks in combination is important because they each tap into different aspects of creative and cognitive processes (Silvia, 2011). Doing so also helps mitigate reliability problems that can arise from some scoring methods. Responses to the divergent thinking tasks were scored for fluency (i.e., number of responses), flexibility (i.e., number of types of responses), elaboration (i.e., what level of detail was given in the responses), and originality (i.e., how common was each response among the sample of study participants). In addition to these elements, three raters assigned an overall creativity rating (1-9) to each participant's set of responses on each task.

2.2.3 Personality Measures

The 50-item scale used in this study to evaluate personality traits was derived from the International Personality Inventory Pool (IPIP), a public domain database of nearly 2500 unique items (Goldberg, 1999; Goldberg, Johnson, Eber, Hogan, Ashton, Cloninger, & Gough, 2006). A pre-established scale was used with 10 items under each domain of the Big Five personality traits suggested by Costa and McCrae (1992; 2008). Participants responded to items related levels of neuroticism, extraversion, openness to experience, agreeableness, and conscientiousness on a five-point Likert scale from "very inaccurate" to "very accurate." Five items were indicative and five items were counterindicative in each domain. The counterindicative items were reverse-coded for scoring. Internal consistencies of the scales created with the IPIP have been previously reported in the Cronbach's alpha range of .79 to .86 (Goldberg, 1999). Reliability of observed scores was similar in this study (extraversion $\alpha = .86$; neuroticism $\alpha = .80$; openness $\alpha = .81$; agreeableness $\alpha = .70$; conscientiousness $\alpha = .79$)

2.3 Procedures

The data collection took place during and after scheduled course sessions after students had been recruited during the course meeting. Informed consent was discussed and acquired before proceeding with data collection. Participants were offered a $10 Amazon gift card as compensation for their time and effort. To control the timing, the divergent thinking tasks were completed first, in succession. The order of the tasks was rotated across different administrations in different classes as a validity and reliability check against mental fatigue in the process. The only statistically significant difference in divergent thinking totals ($p < .05$) was between CT/IT/AUT and AUT/IT/CT task orders. This was concerning, but since these same groups showed a similar pattern on the creativity self-reports, the differences were attributed to underlying differences in creativity and not the task order. Once the third divergent thinking task

was completed, the participants were instructed to complete the demographic information, creativity self-reports (RIBS, CBI, CAQ) and personality inventory (IPIP) at their own pace. The entire process took 30-40 minutes for each participant.

2.4 Score Generation

Data entry for all instruments other than the divergent thinking tasks was completed directly by the primary investigator. Item-level missing data for these individual scales were replaced using imputation based on items on that scale. A creative ideation self-report score was created based on the total of the 19 item scores on the Runco Ideational Behavior Scale. The five-option Likert scale generates scores of 0 to 76. A measure of creative production was taken from the total of the 28 item scores on the Creative Behavior Inventory. The scoring range of the scale with a four-option Likert scale is 0 to 84. Both domain scores and a total score for creative achievement were generated using the CAQ results. A square root transformation was performed on the CAQ scores.

Given the desire to combine some of these measures into categories (e.g., combine CBI and CAQ), the measures needed to be on equivalent scales. One way to achieve this is by standardizing the scores on each measure. As such, z-scores were calculated for each of these three measures for each participant. Similarly, z-scores were calculated for the five personality facets after the raw scores were generated using the ten associated items including reverse coding/scoring for the five contraindicative items in each facet.

The scoring of each divergent thinking task was completed by the primary investigator and two other individuals. The other individuals had completed a doctoral course in creativity theory and measurement. They also received scoring training from the primary investigator to ensure familiarity with the specific tasks.

For fluency, one point was awarded for each distinct response. Very high agreement among raters was expected and observed (Intraclass correlation coefficient = .99 for all three tasks). For flexibility, each rater made judgment as to the number of distinct *categories* present in the responses (e.g. "types of coins," "types of balls," for the Instance Task). These judgments led to slightly less, but excellent inter-rater agreement (.93 < ICC < .96). For elaboration, each response was scored as 0 (no detail), 1 (one detail), 2 (two or more details). For example, in the brick task (Alternate Uses), "doorstop" might receive 0, "doorstop to keep a door from slamming" might receive 1, and "doorstop to keep a door from slamming when the wind blows strongly" might receive 2. Inter-rater agreement using intraclass correlation coefficients ranged from .82 to .90 for elaboration.

Originality was computed for each task by the primary investigator. A composite list of responses was generated for each task and responses appearing less than 10% and less than 1% of the time were flagged. Each flagged response was assigned a value of 1 point or 2 points, respectively. Participant originality scores for each task were assigned based on the total of these points.

Finally, the three raters assigned a single creativity score (1-9) for each participant on each task based on a holistic judgment of the responses to that task. This is similar to the snapshot scoring method suggested by Silvia and colleagues (2009). There was the potential for some variation in the creativity scoring (as there was with elaboration and flexibility), but using multiple trained raters in a manner consistent with the Consensual Assessment Technique routinely provides robust scores. Inter-rater agreement (based on ICC) for these holistic judgements ranged from .79 on the Consequences Task to .86 on the Alternate Uses Task.

All raw scores from the three raters were averaged to create a single raw score for *each* participant on *each* element on *each* divergent thinking task. For analysis, composite scores were calculated across tasks *and* across elements of divergent thinking. First, z-scores were calculated for *each* of the four elements on *each* of the three tasks and well as for the rated creativity. Then, each participant received a total on *each* task (sum of z-scores for the four elements) and on *each* element (sum of z-scores for the three tasks). A single summative divergent thinking score was calculated from the total of all z-scores for a participant (12 total; 4 scores x 3 tasks). Table 3.1 represents the bivariate correlations among the creativity outcomes.

CHAPTER 3

RESULTS

3.1 Ideation-Potential versus Production-Achievement

Research Question 1 considered how observed relationships between facets of personality and creativity differed when creativity was conceived as either a matter of ideation or as a matter of production. The ideation-potential total (DT z-score + RIBS z-score) was regressed on the personality scores. The production-achievement total (CBI z-score + CAQ z-score) was regressed on the personality scores. Distinctions between the two analyses were made using a comparison of beta weights and structure coefficients. This provides a method to examine the zero-order correlations of each facet of personality and their contributions to the overall model of personality predicting creativity. Thereby, comparisons could more easily be made to previous literature while, at the same time, allowing for the observation of unique behavior in the data, such as suppression effects. Table 3.2 summarizes the comparisons related to Research Question 1. Overall, production-achievement was better predicted by personality than ideation-potential (R^2 = .277 versus R^2 = .176). Thus, personality was more than a 50% better predictor of creativity when production-achievement measures of creativity were used.

Table 3.1											
Correlations Among Creativity Variables											
	CBI	CAQ	AUT Total	CT Total	IT Total	Flu Total	Flex Total	Elab Total	Orig Total	DT Total	Rated Creativity
RIBS	.481**	.339**	.254**	.298**	.236**	.327**	.294**	.069	.287**	.305**	.351**
CBI		.540**	.310**	.265**	.317**	.303**	.326*	.149*	.353**	.349**	.370**
CAQ			.295**	.323**	.337**	.360**	.379**	.087	.368**	.372**	.372**
Alternate Uses Task Total				.591**	.656**	.811**	.822**	.422**	.800**	.881**	.807**
Consequences Task Total					.544**	.769**	.788**	.325**	.756**	.816**	.764**
Instance Task Total						.781**	.807**	.442**	.785**	.867**	.809**
Fluency Total							.921**	.149*	.871**	.920**	.825**
Flexibility Total								.250**	.852**	.941**	.880**
Elaboration Total									.211**	.467**	.522**
Originality Total										.912**	.790**
Divergent Thinking Total											.928**

Note: * $p < .05$; ** $p < .001$

Openness to experience was the strongest predictor of creativity in both analyses (β = .391; β = .465). In fact, the squared structure coefficients (r_s^2 = .763; r_s^2 = .823) suggest a large majority of the variance in creativity that personality can predict is predicted by openness alone. Openness was by far the most important facet of personality in predicting creativity, no matter the conception. Differences emerged between the analyses with respect to three facets of personality: extroversion, conscientiousness, and neuroticism. Extroversion was the *least* predictive in the ideation-potential analysis (β = .032, p = .631; r_s^2 = .028) and the second *most* predictive when considering production-achievement (β = .132, p = .034; r_s^2 = .227). A consideration of the structure coefficients suggests extroversion was over eight times as important when the measures were related to creative outcomes rather than potential. While conscientiousness was statistically significant when considering production-achievement (β = -.168, p = .006) and not in the ideational-potential analysis (β = -.085, p = .195), under both conceptions it negatively influenced creativity. While neuroticism was not statistically significant in either analysis, the direction of the influence was reversed (positive for ideation-potential; negative for production-achievement). There was also a relatively small overlap in the confidence intervals (β = .127 [95% CI, -.014 to .268]; p = .077 compared to β = -.081 [95% CI, -.212 to .052]; p = .230) suggesting a potential meaningful difference. That is, neuroticism may be beneficial for generating ideas, but have a negative influence on tangible creative outcomes.

Table 3.2

Comparison of Personality Effects on Ideation and Production Views of Creativity						
	Ideation-Potential			Production-Achievement		
	β [95% CI]	*p*	r_s^2	β [95% CI]	*p*	r_s^2
Openness	.391 [.265, .516]	<.001	.763	.465 [.345, .581]	<.001	.823
Conscientiousness	-.085 [-.213, .044]	.195	.038	-.168 [-.287, -.046]	.006	.024
Extroversion	.032 [-.099, .163]	.631	.028	.132 [.009, .256]	.034	.227
Agreeableness	-.076 [-.207, .055]	.255	.051	-.030 [-.151, .093]	.636	.001
Neuroticism	.127 [-.014, .268]	.077	.095	-.081 [-.212, .052]	.230	.044
Total Model R^2	.176			.277		

3.2 Self-Reported versus Externally-Rated

Research Question 2 dealt with who measures the creativity. Specifically, how the observed relationships between personality and creativity differ in self-reported creativity measures when compared to creativity assessed by external raters. The total divergent thinking score and the creativity ratings were considered external measures. The RIBS, CBI, and CAQ are self-reports. As with the Research Question 1, two regression models were generated. The first model regressed the sum of the total divergent thinking score and creativity ratings on the personality scores. The second model regressed a total self-report creativity score (sum of RIBS, CBI, CAQ z-scores) on the personality factors. Similar to Research Question 1, beta weights and structure coefficients were compared. The results of the analyses are found in Table 3.3. The overall influence of personality was even more striking in this analysis. Personality was far more important in the relationship to self-reported creativity. Variance in self-reported creativity (R^2 =

.348) was predicted by personality more than twice as much as variance in externally-rated creativity (R^2 = .149). The measurer of the creativity indeed mattered.

Table 3.3

Comparison of Personality Effects on Self-Reported and Externally Rated Creativity

	Self-Reported			Externally Rated		
	β [95% CI]	*p*	r_s^2	β [95% CI]	*p*	r_s^2
Openness	.553 [.441, .665]	<.001	.882	.355 [.227, .482]	<.001	.732
Conscientiousness	-.176 [-.290, -.063]	.003	.024	-.075 [-.205, .055]	.257	.041
Extroversion	.103 [-.013, .220]	.081	.148	.031 [-.102, .164]	.641	.026
Agreeableness	-.017 [-.135, .098]	.769	.002	-.080 [-.213, .053]	.240	.067
Neuroticism	-.033 [-.145, .048]	.604	.012	.126 [-.018, .268]	.086	.113
Total Model R^2	.348			.149		

Openness was again the most prominent predictor of creativity in both analyses (β = .553, r_s^2 = .882; β = .355, r_s^2 = .732, respectively). The 95% confidence interval for openness predicting self-reported creativity [.441 to .665] had a small overlap with that predicting externally-rated creativity [.227 to .482]. This indicates a high likelihood that the greater importance of openness when using in self-report measures is a meaningful finding. Again, the influence of extroversion differed depending on the type of creativity measurement. Calculated squared structure coefficients (.148 versus .026) suggested extroversion had five times the influence when considering self-reported creativity (relative to the overall effect of personality). Individuals with high extroversion were more likely to have that aspect of their personality influence their own creativity ratings than it influenced creativity ratings by others. When examining beta weights, conscientiousness had a negative influence on creativity in both

analyses, but a larger effect on self-reported creativity (β = -.176, p = .003) than externally-rated creativity (β = -.075, p = .257) though the squared structure coefficients of both were low (.024 and .041, respectively). This means the effect of conscientiousness while low by itself, can help boost the strength of the creativity-predicting model, especially with self-report measures. This is, by definition, a suppression effect. As in the previous analysis, the influence of neuroticism was positive in one case (externally-rated; β = .126 [95% CI, -.018 to .268]; p = .086) and negative in another (self-reported; β = -.033 [95% CI, -.145 to .048]; p = .086). Again, the overlap in the confidence intervals was quite small. High neuroticism individuals may score higher for creativity in the opinion of others than they would rating themselves.

3.3 Individual Elements of Divergent Thinking

Research Question 3 considered how observed relationships personality facets and creativity differ when considering individual elements of divergent thinking. Similar processes were used to examine this question, this time using the four element z-score totals across divergent thinking tasks (e.g. the sum of AUT fluency, CT fluency, and IT fluency to calculate an overall fluency score). An examination of beta weights and structure coefficients (see Table 3.4) was used to determine if there was differential influence of personality on fluency, flexibility, originality, and elaboration. Unlike the previous analyses, there was no drastic difference between the predictive power of personality observed across the elements. The values for R^2 ranged from .081 to .118 in the overall model.

Table 3.4

Comparison of Personality Effects on Elements of Divergent Thinking												
	Fluency			Flexibility			Elaboration			Originality		
	β [95% CI]	*p*	r_s^2	β [95% CI]	*p*	r_s^2	β [95% CI]	*p*	r_s^2	β [95% CI]	*p*	r_s^2
O	.267 [.135, .399]	<.001	.743	.316 [.186, .447]	<.001	.657	.230 [.098, .361]	.001	.633	.269 [.139, .399]	<.001	.612
C	-.036 [-.171, -.099]	.602	.015	-.110 [-.242, .023]	.104	.090	-.024 [-.160, .111]	.731	.015	-.060 [-.194, .074]	.377	.056
E	.051 [-.085, .188]	.466	.073	-.029 [-.164, .108]	.677	.002	.054 [-.085, .192]	.439	.032	.023 [-.114, .159]	.742	.014
A	-.097 [-.236, .041]	.165	.107	-.119 [-.255, .017]	.084	.131	.061 [-.079, .198]	.389	.003	-.091 [-.228, .046]	.191	.136
N	.068 [-.081, .216]	.068	.056	.043 [-.103, .188]	.561	.077	.186 [.036, .336]	.015	.210	.117 [-.030, .264]	.120	.182
Total Model R^2	.088			.118			.081			.097		

Openness to experience was still the strongest predictor of creativity. This held for all elements of divergent thinking. However, the degree to which it could predict the variance explained by personality by itself was lower. Instead of ranging from .732 to .882 as observed in the earlier analyses, squared structure coefficients for openness were lower here (.612 to .743). There were fewer outliers or noteworthy differences in this analysis than the previous two, but some were notable. Generally, personality facets did not have much differential effect across elements of divergent thinking. Agreeableness had roughly consistent squared structure coefficients (.107, .131, .136) except for elaboration (r_s^2 = .003). Additionally, the beta weight for agreeableness on elaboration was positive (β = .061) while all the others were negative and of greater magnitude (-.097, -.119, -.091). Together, this suggests something unique about the agreeableness-elaboration relationship and possibly suppression. As in other analyses neuroticism demonstrated varied effects though this time there were all positive. The greatest influence of neuroticism on divergent thinking related to elaboration (β = .186, *p* =.015; r_s^2 = .210) and originality (β = .117, *p* =.120; r_s^2 = .182). These elements of divergent thinking are most related to characteristics generally seen by others as creative. That puts these findings in line with the earlier observed positive relationship of neuroticism and externally rated creativity.

3.4 Effects of Personality, Demographics, and Intellect

Research Question 4 dealt with how relationships between personality and creativity may differ depending on the specific creativity measures used. This was investigated while controlling for demographic and intellect variables. Hierarchical multiple regression was used to examine the influence of personality of creativity outcomes beyond demographics and intellect. The six outcome variables were z-scores from the six creativity tasks and measures (Alternate Uses Task, Instances Task, Consequences Task, RIBS, CBI, and CAQ) with each of the

divergent thinking measures being represented by the task total (sum of 4 element z-scores). Table 3.5 shows the influence of each block of variables while Table 3.6 summarizes the effects of each individual variable in the final model.

Table 3.5

Hierarchical Regression Model Results – R^2 Changes for Variable Blocks

Variable	AUT	CT	IT	RIBS	CBI	CAQ
Block 1 – R^2 change (p)	<.001	.008	<.001	.035	.018	.007
Demographics	(.981)	(.428)	(.979)	(.019)	(.142)	(.463)
Block 2 – R^2 change (p)	.097	.184	.108	.217	.357	.175
Intellect	(.001)	(<.001)	(<.001)	(<.001)	(<.001)	(<.001)
Block 3 – R^2 change (p)	.042	.039	.055	.128	.121	.145
Personality	(.072)	(.066)	(.020)	(<.001)	(<.001)	(<.001)
Full Model R^2 (p)	.139	.230	.162	.381	.495	.327
	(.002)	(<.001)	(<.001)	(<.001)	(<.001)	(<.001)
% of personality explained R^2	30.2%	16.9%	34.0%	33.6%	24.4%	44.3%

Note: Demographics includes age and gender. Intellect includes GPA, GT identification, honors collect membership, SAT verbal scores, SAT math scores, and ACT scores. Personality includes openness, conscientiousness, extroversion, agreeableness, and neuroticism.

For each of the six outcomes, the full model was statistically significant (all $p < .002$), but the range of total variance explained was wide ($R^2 = .139$ for the Alternate Uses Task to $R^2 = .495$ for the Creative Behavior Inventory) meaning the choice of measure seemed to matter. The three largest full model R^2 were observed for the self-report instruments (CBI > RIBS > CAQ). Generally, the demographic block (age and gender) predicted a very small amount of variance (median $R^2 \sim .007$). The Runco Ideational Behavior Scale was the only instrument for which the demographic variables predicted a statistically significant amount of variance and this was small ($R^2 = .035$; p = .019). Since this instrument includes some items that could be influenced by life-

stage, it is logical that age would have had an effect. The intellect block of variables varied in predictive power beyond demographics, but consistently demonstrated statistical significance ($p < .001$). The largest R^2 change for intellect was observed for the CBI ($\Delta R^2 = .357$). Among the divergent thinking tasks, intellect had nearly twice as much of an effect on the consequences task ($\Delta R^2 = .184$) than on the other tasks ($\Delta R^2 = .097$ and $\Delta R^2 = .108$). Variables like SAT Verbal scores are often considered rough proxies for intelligence. Thus, it follows that these variables would contribute to the prediction of creativity given the established creativity-intelligence connection in the literature.

Personality explained a statistically significant amount of variance ($p < .05$) beyond demographics and intellect for four of the six measures (Alternate Uses Task, $p = .072$; Consequences Task, $p = .066$). Generally, then, personality had a relationship with creativity across the board, even when controlling for other variables in the study. Similar to the overall model, the self-report measures were predicted more strongly by personality with R^2 change values three times as high. Within each group the R^2 change values were similar: .042, .039, and .055 for divergent thinking; .128, .121, and .145 for the self-reports. These findings align with the earlier group analyses. Among the self-reports, the Creative Achievement Questionnaire had the smallest influence of intellect ($\Delta R^2 = .175$) and largest influence of personality ($\Delta R^2 = .145$). Given the overall model of R^2 of .327, this means nearly half (44.3%) of the variance of CAQ that could be predicted by all the study variables could be predicted by personality factors. The next highest value of this type was noticeably lower (instances task, 34.0%). This could suggest further differences in the production-achievement group of measures. Measuring levels of creativity achievement, as with the CAQ, may be more influenced by personality while the simple completion of creative activities could be more influenced by intellect.

Table 3.6

Hierarchical Regression Model Results – Standardized Betas and Squared Structure Coefficients

Variable	AUT		CT		IT		RIBS		CBI		CAQ	
	β	r_s^2	β	r_s^2	β	r_s^2	β	r_s^2	β	r_s^2	β	r_s^2
Age	.049	.001	-.101	.031	.023	.001	-.001	.074	.217**	.006	.064	.007
Gender	.004	<.001	-.038	.002	-.082	.001	.077	.019	-.191**	.030	.011	.014
GPA	.071	.006	-.055	<.001	-.010	<.001	.207*	.099	.350**	.178	.184*	.066
Honors College	.054	.095	.043	.077	.071	.174	-.138*	.001	-.216**	.001	-.099	.008
GT Identification	.043	.082	.063	.107	.090	.200	.045	.142	-.025	.060	.048	.166
SAT Verbal	-.085	.155	-.096	.341	-.015	.296	.366**	.548	.392**	.530	.271*	.475
SAT Math	-.294*	.029	-.204*	.114	.072	.338	-.096	.090	.021	.181	-.002	.215
ACT	.433**	.428	.497**	.605	.124	.424	-.064	.203	.025	.298	.034	.245
Openness	.128	.296	.221*	.465	.190*	.440	.345**	.622	.278**	.413	.187*	.456
Conscientiousness	-.060	.019	-.049	.014	-.066	.047	-.144*	.015	-.200**	.005	-.180*	.027
Extraversion	.131	.013	.016	.001	.105	.069	.097	.028	.131*	.037	.292**	.284
Agreeableness	-.045	.048	-.009	.017	-.076	.011	-.039	.001	-.151*	.004	-.091	.001
Neuroticism	.120	.085	.060	.050	.105	.083	.143*	.009	-.014	.013	-.017	.038

Note: All values for are based on the full multiple regression (Blocks 1-3); * $p < .05$; ** $p < .001$

Comparing beta weights and squared structure coefficients of the variables in the full model results in a number of noteworthy findings. Table 3.6 summarizes these comparisons. First, neither demographic variable (age or gender) had a statistically significant beta weight for the RIBS in the full model despite their effect as a block. In fact, the only time these variables were statistically significant ($p < .001$) was in the CBI analysis. However, the relative values of the beta weights and structure coefficients suggest that age ($\beta = .217$; $r_s^2 = .006$) and gender ($\beta = .217$; $r_s^2 = .006$) both acted as suppressor variables. These variables helped to predict creativity, but were themselves not related to the outcomes.

Second, reported GPA, honors college membership, and identification as gifted had varied effects across the measures. GPA had a negligible relationship with the divergent thinking tasks, but a statistically significant one ($p < .05$) with each self-report measure. Twice (with the RIBS and CBI) it was one of the top 3 predictors in the model. In the case of the Runco Ideational Behavior Scale ($\beta = .207$; $r_s^2 = .099$) and Creative Achievement Questionnaire ($\beta = .184$; $r_s^2 = .066$), the strength of the predictor may have been a result of suppression, but the structure coefficients were not so small as to make this obvious. Honors college membership showed a stronger suggestion of suppression effects in the RIBS ($\beta = -.138$; $r_s^2 = .001$) and CBI ($\beta = -.216$; $r_s^2 = .001$) analyses. Again, these variables helped in predicting creativity across a series of measures even though they were not directly related to the measures on their own.

Third, SAT and ACT scores generally contributed to the models in a statistically significant way, but their importance and function varied. In the divergent thinking tasks, ACT showed stronger predictive power than the SAT verbal which was two to three times less. Among the self-report measures, however, this pattern was reversed. Both SAT verbal scores and ACT scores had a consistent positive relationship to the creativity measures. For four creativity

measures, SAT math scores had a negative influence (based on beta weights). In two cases, the AUT ($\beta = -.294$; $r_s^2 = .029$) and CT ($\beta = -.204$; $r_s^2 = .114$), the relationship was statistically significant ($p < .05$) and the result supports SAT math as a suppressor variable in the analyses.

Lastly, personality factors had effects in line with previous analyses in the study. Openness to experience was the most common variable in the top three predictors (including intellect and demographics variables). The relationship of openness and creativity was highest on the self-report measures and highest on the RIBS ($\beta = .345$; $r_s^2 = .622$). A natural tendency to have ideas seems most strongly related to openness to ideas themselves. Again, extroversion was a better predictor on self-report measures, particular production-achievement. Extroversion was the best predictor in the full model of the Creative Achievement Questionnaire ($\beta = .292$; $r_s^2 = .284$). Extroversion likely exhibited suppression in the Creative Behavior Inventory ($\beta = .131$; $r_s^2 = .037$) and Alternative Uses Task ($\beta = .131$; $r_s^2 = .013$) analyses. Note that the CAQ is an achievement measure and the CBI involves just completing creative acts. Comparing these results suggests a far stronger influence of extroversion (7-8 times) on achievement as opposed to nominal production. Neuroticism displayed suppression in the RIBS model ($\beta = .143$; $r_s^2 = .009$) as did agreeableness in the CBI model ($\beta = -.151$; $r_s^2 = .004$). Conscientiousness had a statistically significant ($p < .05$) beta weight in the model of all three self-reports as well as exhibiting suppression in all three (RIBS, $\beta = -.144$, $r_s^2 = .015$; CBI, $\beta = -.200$, $r_s^2 = .005$; CAQ, $\beta = -.180$, $r_s^2 = .027$). Personality facets were consistently helpful in predicting creativity even though there were not always strong relationships directly between the facets and individual creativity measures.

3.6 Factor Analysis of Creativity Measures

Although the purpose and research questions of the study divided the creativity measures along theoretical lines based on previous literature, the recurring patterns of differential influences on the self-reports and divergent thinking tasks were difficult to ignore. As a check on the overall relationship of the creativity measures, a follow-up factor analysis was performed. Using the technique, it was hoped that further insight into whether the variance observed was more driven by the conception of the creativity (as in Research Question 1) or by the method used to assess the creativity (as in Research Question 2).

Principal axis factoring was selected over principal components analysis since there was already a concept of what the grouping might be rather than simply trying to consolidate variables (Tabachnick & Fidell, 2007). Because of the expectation that there was a latent, higher order relationship between all the measures (creative ability), direct oblimin rotation was used, allowing the factors to correlate (Fabrigar, Wegener, MacCallum, & Strahan, 1999). Since there was not a particular reason to allow more or restrict the amount of correlation between facotrs, the default setting of delta = 0 was used for the rotation.

A number of issues were considered when deciding on the number of factors to retain. An examination of the scree plot and the "eigenvalue greater than one" rule of thumb both suggested two factors. Parallel analysis did not seem to provide a meaningful suggestion because a comparison of the predicted 95th percentile values to the observed eigenvalues suggested keeping six factors. Running a Velicer's Minimum Average Partial test suggested retaining one factor. With such conflicting results, two factors were retained because the two-factor solution seemed interpretable. These two factors accounted for 54.8% of the variance which is just above the average typically observed in published literature (Henson & Roberts, 2006). The factors had a sizeable correlation (r = .534). The Table 3.7 summarizes the resulting pattern matrix and

structure matrix. Factor 1 related most to the divergent thinking tasks. Factor 2 related most to the self-reports. This suggests that a dominant contributor to variance in the study may have been a method effect based on how the creativity was measured. This would suggest the importance of considering this were choosing instruments in research.

One could interpret the loading for the RIBS on Factor 2 as closely aligned with the divergent thinking tasks, perhaps more so than with the self-reports. This suggests Factor 2 may be picking up variance related to the ideation-production distinction as well. The interpretation would be logical given it is the Runco *Ideational* Behavior Scale. Taking this into account the results of the factor analysis provide support for both means of classifying the creativity measures used in this study: an effect of method and an effect of creativity conception.

Table 3.7

Factor Structure of Creativity Instrument Scores – Direct Oblimin Rotation

	Pattern Matrix		Structure Matrix	
	Factor 1	Factor 2	Factor 1	Factor 2
AUT	.856	-.040	.835	.417
CT	.689	.044	.712	.412
IT	.765	.021	.776	.429
RIBS	.053	.522	.332	.551
CBI	-.122	.941	.380	.875
CAQ	.100	.571	.405	.624

Note: Correlation between factors, $r = .534$

CHAPTER 4

DISCUSSION

4.1 Research Question Findings

The research questions in this study focused on the extent to which creativity measurements can demonstrate different relationships to personality. The goal was to illuminate conceptions and measures of creativity as an influence on the relationships we observe between creativity and personality. The overall findings of the present study align with those found in previous research. For example, openness to experience to experience was routinely the most salient predictor of creativity among the personality factors. This can be explained by the openness construct which includes proclivity for imagination, aesthetics, novel ideas, and deep thinking. However, even with openness, there was fluctuation in its relative influence across types of creativity measures and specific instruments. These differences and those related to other personality factors could guide future research in psychological studies of creativity.

Importantly, since the frames used to examine the personality-creativity relationship here (e.g. self-report versus externally rated) have not been used expressly in previous studies, connecting the findings to the literature base requires a point by point examination. The substance of individual findings is evaluated using other studies that, while not examining with the same frames, used diverse creativity measures that can be juxtaposed for comparison. Unless otherwise stated, references provided in this section reflect these evaluations.

Research Question 1 related to conceiving of creativity as an issue of ideation-potential or production-achievement. Recent work suggests production-achievement measures are generally more influenced by personality (Puryear et al., under review). Although the magnitude of the difference was not as great in the present study, the difference in creativity variance

predicted was still sizeable (57% higher for production-achievement). Considering specific facets, extroversion was far more related to production-achievement measures than ideation-potential ones (previously observed in Beaty, Silvia, Nusbaum, & Vartanian, 2013; Furnham, Batey, Anand, & Manfield, 2008; Furnham, Batey, Booth, Patel, & Lozinskaya, 2011; Hezel & Hooley, 2014; Jauk, Benedek, Dunst, & Neubauer, 2013; Nusbaum, Silvia, & Beaty, 2014; Pretz & McCollum, 2014). Subsequent analysis suggested this was likely related to the influence of extroversion on the Creative Achievement Questionnaire. Additionally, the finding makes sense given that many of the studies cited above involved use of the CAQ. The observed link may be related to the nature of the CAQ itself on which each higher level of creative achievement likely requires putting oneself "out there" just a bit more. Openness was a more positive influence on production (previously observed in Batey, Furnham, & Safiullina, 2010; Beaty et al., 2013; Furnham et al., 2008; Furnham, et al., 2011; Hezel & Hooley, 2011; Jauk et al., 2013; Silvia, Nusbaum, Berg, Martin, & O'Connor, 2009). Of note, Furnham and Bachtiar (2008) found decidedly the opposite finding for both extroversion and openness. Neuroticism was a more negative influence in this study (previously observed in Batey, Funrham, & Safiullina, 2010; Furnham & Bachtiar, 2008; Pretz & McCollum, 2014). Though conscientiousness did not show the opposite sign as in the earlier systematic review (Puryear et al., under review), neuroticism did. Neuroticism had the smallest overlap in the beta weight confidence intervals suggesting it was the personality factor with the most differential influence on creativity when considering this grouping. Some previous studies have found a larger positive influence of neuroticism (Nusbaum, Silvia, & Beaty, 2014; Silvia, et al., 2009). Taken together this suggests further examination of neuroticism as a contributor to creativity. Findings in this study suggest a

consideration of creativity conceptions in future creativity-personality studies is highly appropriate.

The results associated with Research Question 2 also largely aligned with previous literature. Personality factors predicted creativity at more than twice the rate when the creativity was self-reported instead of externally-rated (roughly 35% to 15%). Extroversion and openness were far more related to self-reports. This aligns with findings in previous research. Conscientiousness showed a stronger (negative) relationship with self-reported creativity. Conscientiousness findings back to Feist (1998) have been mixed and the types of measurements used are often important. However, the finding that conscientiousness served as a suppressor variable in models of creativity is unique. There is fertile ground for future research on the function of conscientiousness on creativity both on the suppression and measurement issues.

Personality factors also showed differential effects on elements of divergent thinking providing meaningful answers for Research Question 3. Analysis of the structure coefficients suggests extroversion had the largest effect on fluency, which aligns with earlier research (Batey, Chamorro-Premuzic, & Furnham, 2010; Furnham, 2015; Jauk, et al., 2013; Pretz & McCollum, 2014; Puryear, et al, under review); the effects, however, were smaller across the board for the personality facet than typically observed. The finding that neuroticism seemed to have a much larger influence on elaboration and originality than on fluency and flexibility was novel as the literature is piecemeal or mixed on the issue. Though the beta weights were not statistically significant, the structure coefficients showed agreeableness to have a stronger effect on three of the four divergent thinking elements than those typically reported in the literature. Again, though these effects are mixed and typically not statistically significant in the extant literature. The present work provides a jumping off point for future investigations looking at individual

elements of divergent thinking. These could be in the context of personality or simply using the lens when relating any other psychological construct to divergent thinking.

In the Research Question 4 analyses, the stronger predictive power of personality on the self-report measures is in line with the analyses associated with the other research questions. It is also consistent with notion that there may be overlap between what people consider creative as they evaluate themselves. The strong influence of intellect variables on measures of creativity is consistent with previous literature in the field (see Barron, 1957; Barron & Harrington, 1981; Batey & Furnham, 2006; Feist & Barron, 2003; Hocevar, 1980). Other findings in the analysis of the variable blocks require further explanation and exploration. The demographic effect on the Runco Ideational Behavior Scale appears to have been related to a negative zero-order correlation between age and RIBS scores. Some items on the instrument deal with having ideas about future careers and similar items that older participants, more locked into life directions may not have as often. The much larger influence of intellect on the Consequences Task (compared to other divergent thinking tasks) may have to do with the counterfactual nature of the task that presses participants for higher order thinking.

4.2 Personality Suppression Effects

The high Creative Behavior Inventory variance explained by the full model brings to light what could be the most important finding of the study. Given the beta weights and structure coefficients, as many as six variables (age, gender, honors college membership, conscientiousness, extraversion, and agreeableness) acted as suppressors in this analysis. This means the variables support the predictive power of the model, but are not themselves highly related to the outcomes of interest. All of these variables had a statistically significant beta weights ($p < .05$) and an r_s^2 of less than 3.7% effect explained. In four other instances across the

models for each creativity measure, personality factors appeared to demonstrate suppression effects. Also, SAT math scores seemed to have a suppression effect in the model for the Alternate Uses Task and Consequences Task. This could be because the SAT math scores pulls out the logical-algorithmic thinking portion of the variance in other intellect variables since these tasks ask a person to consider new applications or strange situations. This explanation may be supported by the results of the Instance Task model in which SAT Math had a positive influence. This task gives a concrete category and simply asks participants for examples.

Future studies could focus on these suppression effects individually. This could be done using a commonality analysis of the variables in the multiple regression. Without doing so, we cannot say for sure whether or not suppression is occurring, nor can we describe the nature of the suppression. Obtaining negative values in such a commonality analysis has been suggested as evidence of suppression (Pedhazur, 1997). More importantly, commonality analysis provides a method to parcel out the unique and common predictive power of the variables in a model (Rowell, 1996). There are a number of hypothesis that could be specifically examined in the future. Conscientiousness could be examined to see if the suppression is a result of an influence on other personality variance (e.g. openness) or related to the intellect variables. There is also reason to believe a similar examination of extroversion could be warranted. Lastly, studying the differential effect of the suppression across measures using commonality analysis could itself give further insights into the importance of carefully considering creativity conceptions and measures in psychological research.

4.3 Limitations

There are some limitations and threats to validity in the present study. First, the age of the participants, while theoretically optimal for future ideation and past accomplishment, may limit

the applicability of the study for other groups. Perhaps precisely because of participant's ages, the present study may have more variance to parcel or explain than might be present with other samples. Future work could replicate the present study with participants of different ages (perhaps adolescents) or even look at these relationships longitudinally. Second, the large percentage of females in the sample may influence the observed relationships given recent work suggesting male-female differences in personality (three of the five factors had statistically significant differences in the present sample). Replication with a male-dominant sample or a large balanced sample that could be split to test for gender would be appropriate. A third limitation was the self-report and proxy natures of the intellect variables. For example, there was no verification of gifted identification or honors college membership or GPA. Memory (or other factors) may have led to inaccurate reporting of SAT/ACT scores. Future studies could use (and past studies have used) tests of cognitive ability directly. For example, using a math reasoning test and verbal IQ tests could measure the same constructs with more reliability and with more validity. Simplifying the variable structure might also allow for a more robust analytical technique such as structural equation modelling since there would be far fewer parameters to estimate.

4.4 Implications

This study has two related practical implications, one for creativity measurement and one for predicting creativity in settings such as schools. When considering the creativity measures one might use in a given study, one ought to consider the relationship of the measure to factors of intellect and personality. If cognitive ability and personality are differentially related to various measures of creativity, mindfulness about chosen instruments is imperative. One must decide whether they are more interested in creative potential or creative production. One must

also decide the means by which to evaluate creativity. Both of these are also considerations that educators have to take into account.

For example, in a gifted education program that wants to identify creatively gifted students, is that a creative potential or creative achievement issue? Most likely, the program will be seeking students with the ability to demonstrate those creative skills. However, in many cases, those gifted educators use divergent thinking tests as an indicator of creativity. In doing so, they are more likely to be testing for abstract potential rather than concrete production. As the present work and previous work suggests, the predictors and usefulness of creative potential measures are not necessarily the same as those for creative achievement. This study may also provide evidence to those educators that, just as they would use multiple measures and indicators for intellectual giftedness, they ought to do the same with creativity. Furthermore, it may be the case that using the creativity measures in concert with personality and intellect variables provides the best prediction because of both direct and suppression effects. Future research should investigate these practical applications. Even though the direct influence of personality on creativity may be small it may have powerful implications for practical settings in which every bit of prediction and achievement helps.

APPENDIX

SYSTEMATIC LITERATURE REVIEW

Differential Relationships of Personality to Elements of Creative Ideation and Creative Production: A Systematic Review

Creativity is a multifaceted construct. Conceptualization of the construct leads to a multitude of (conflicting) definitions. This diversity clouds the field, generates a persistent need for clarity, and may prevent the field from reaching its utmost potential (Plucker, Beghetto, & Dow, 2004). One way in which confusion arises stems from operationalizing the construct as either an issue of ideation (i.e. the ability to come up with ideas) or an issue of production (i.e. the generation of an externalized product). In the field of creativity research, this tends to be an either/or proposition.

If one views creativity as an issue of ideation, one typically leans toward measures such as divergent thinking tests. With the Torrance Test of Creative Thinking (Torrance, 1974), for example, the *fluency* and *flexibility* of a subject's responses to a given stimulus are taken as evidence of creative thinking. A self-report measure like the Runco Ideational Behavior Scale (RIBS; Runco, Plucker, & Lim, 2001) also investigates creativity from an ideation point of view – in this case by asking about how often study participants have ideas in everyday situations.

Two common production-based measures, the Creative Behavior Inventory (Hocevar, 1979) and the Creative Achievement Questionnaire (Carson, Peterson, & Higgins, 2005), ask participants to reflect on the quality and quantity of their creative efforts. Domains from writing to science to visual and performing arts are commonly included on such measures. These types of self-reports are more commonly used than ideation ones (e.g. RIBS) though both have a rich research base. In contrast to these measures, the Consensual Assessment Technique (Amabile, 1982), provides a reliable method for *external* evaluations of creative products. Its usefulness has been demonstrated across domains as well, so long as the external raters are well qualified.

These diverse methods of creativity assessment largely originated from seeds planted with Guilford's (1950) call for a more thorough research treatment of the topic during his address to the annual convention of the American Psychological Association. In addition to idea and product-based conceptions of creativity, theorists and researchers began to identify the characteristics of eminent creators in an effort to cultivate that talent. Some researchers, like Gough (1979), developed instruments to study the personality-creativity correlation in the general population. Gough's Creative Personality Scale was derived from his broader psychological use of the Adjective Check List (Gough & Heilburn, 1965). Similar investigations into the relationship of Big Five personality traits (Costa & McCrae, 1987, 1992, 2008) and creativity have been commonplace as well. Feist's (1998) meta-analysis, perhaps most seminally, reported effect sizes for various personality traits in group difference studies of creativity.

Measuring Creativity and Personality

Creativity as Ideation or Production

Measures of creativity reflect the manner in which creativity is conceived. Plucker et al. (2004) examined 90 articles between the years 1996 and 2002 which included "creativity" in the title. Their protocol included major creativity journals as well as journals in education, business, and psychology. Importantly, they were struck by the lack of construct definition. Only about one-third included an explicit definition of creativity. In an effort to provide clarity, they coded these 34 explicit definitions for common terms. They subsequently synthesized the following definition (italics used by original authors):

> Creativity is the interaction among *aptitude, process, and environment* by which an individual or group produces a *perceptible product* that is both *novel and useful* as defined within a *social context*. (p. 90)

This summative definition includes allusions to latent talent (aptitude, process) as well achievements and outcomes (perceptible product, usefulness). That these features of creativity are distinctly articulated suggests a difference between ideation and production in creativity – or at least an interplay of the two (i.e. "interaction among"). It follows then that we should consider the role of both ideation and production in the assessment of creativity. Recent scholarship (cf. Author, 2015) suggests there may be additional cognitive traits to consider and the study of innate traits and achievements should both be part of holistic investigations of creativity (Eysenck, 1993b; Piffer, 2012; Runco, 1993).

One is struck by the manner in which specific creativity measures focus on one side or the other of the ideation-production continuum so exclusively (Author, in press). Some measures of creativity focus on the issue of ideation directly. In completing the Runco Ideational Behavior Scale (Runco et al., 2001), individuals reflect on the frequency with which they are taken by ideas in everyday, real-world contexts (e.g. "I have ideas about a new business or product"). Others involve processes of connecting ideas together. The Remote Associates Test (Mednick, 1962) requires individuals to come up with a word that links three others together. For example given "cream, skate, water," the answer is "ice." This assessment differs from most other creativity assessments in that it relates to convergent thinking processes, rather than divergent ones. At least one creativity assessment battery, the Evaluation of Potential Creativity (EPoC; Lubart, Besancon, & Barbot, 2011), attempts to balance these elements to provide a more well-rounded assessment. This conception of "potential" runs through nearly all ideation measures of creativity to some degree.

On the other end of the ideation-production spectrum lie those instruments used to measure the quantity and/or quality of creative outcomes. The most straightforward of these is

the Biographical Inventory of Creative Behaviors (BICB; Batey, 2007), in which subjects are asked to respond as to whether or not they have participated in each act over the last 12 months (e.g. made a picture or given a speech). While the BICB quantifies the number of different creative acts, the Creative Behavior Inventory (CBI; Hocevar, 1979) asks respondents about the frequency of the acts (e.g. "never" or "once or twice"). Some of these items have a quality component (e.g. "received an award for an artistic accomplishment"), but quantity is generally the focus. The Creative Achievement Questionnaire (CAQ; Carson, Peterson, & Higgins, 2005) focuses on the quality of creative production by having participants check off levels of performance or achievement in various domains. It can thus provide both domain-specific scores and a total creativity measure. A final example of product-based creativity assessment also focuses on quality: the Consensual Assessment Technique (CAT; Amabile, 1982). As the name implies, this is not so much a *specific assessment* as it is a *way of assessing*. Individuals are collectively rated by others based on their creative output. The measure can be used holistically or to rate a specific aspect of the product such as novelty. The spirit of the technique comes through in the Plucker et al. (2004) definition including "social context." The raters should be trained and knowledgeable of the field and task context ("experts") to maximize reliability and predictability of the CAT (Kaufman, Baer, & Cole, 2009; Kaufman, Baer, Cole, & Sexton, 2008).

Potential construct measurement differences between the ideation and production conceptions are borne out in creativity assessment validity literature. Plucker's (1999) reexamination of Torrance Test data found some predictive validity for divergent thinking tests on lifetime creative achievement. However, the analysis left other unknown factors predicting more than two-thirds of achievement. Zeng, Proctor, and Salvendy (2011) suggested most

divergent thinking tests lack predictive power with respect to creative achievement. They also noted the low power of divergent thinking tests when predicting achievement across domains. The latter concern had been previously suggested by Feldhusen and Goh (1995), Okuda, Runco, and Berger (1991), and Treffinger (1995). Even the validity study of the Creative Achievement Questionnaire itself (CAQ; Carson et al., 2005) demonstrated differences. In terms of shared variance, the relationship of the CAQ to CAT evaluation scores was nearly twice that of CAQ to divergent thinking (R^2 = .42 versus R^2 = .22). Taken together these studies suggest that while there is a relationship between measures of ideation and production, meaningful differences exist.

Self-Reported and Externally-Rated Creativity

While the ideation-production issue is largely a question of *what* creativity is, there also exists an issue in creativity measurement of *who* does the assessment: the subject or someone else. Inventories like the Runco Ideational Behavior Scale (Runco et al., 2001) and Creative Achievement Questionnaire (Carson et al., 2005) rely on the individual to evaluate themselves. Remote Associates Test (Mednick, 1962) results or the number of responses on a divergent thinking test are quite person-centered, but ultimately get marked against external standards. The assessment of novelty in divergent thinking responses and any application of the Consensual Assessment Technique (Amabile, 1982) are wholly driven by external evaluation.

While there may be psychometric concerns regarding their use, Silvia, Wigert, Reiter-Palmon, and Kaufman (2012) demonstrated strong reliability evidence for a number of self-report creativity measures. They found the Creative Behavior Inventory (Hoecvar, 1981), the Biographical Inventory of Creative Behaviors (Batey, 2007), the Creativity Achievement Questionnaire (Carson et al., 2005), and the Creativity Domains Questionnaire (CDQ; Kaufman,

Waterstreet, Ailabouni, Whitcomb, Roe, & Riggs, 2010) to be highly interrelated. Even the CDQ, which asks individuals to rate their creativity more abstractly rather than with concrete examples of creative acts, showed similar relationships. Though the reliability evidence regarding self-reports has grown, validity concerns may still exist. Since self-report measures are more intrinsic to the person, as are judgments of personality, self-reported creativity may be more strongly influenced by facets of personality.

Elements of Divergent Thinking

Whether using an Alternate Uses Task (Guilford, 1967), an Instances or Consequences Task (Wallach & Kogan, 1965), the Torrance Test of Creative Thinking (Torrance, 1974), or any other divergent thinking (DT) task, the four commonly measured outcomes are the same. Fluency is the number of responses in the allotted time. Flexibility is the number of types or groups of responses in a given set. Elaboration refers to the level of response detail. Originality relates to the novelty of the responses, either individually or as a set. Some elements of DT are often confounded based on scoring. For example, more responses (fluency) lead to more categories (flexibility). Even accounting for these confounds, the elements of divergent thinking are correlated as a whole. However, conceptual differences between elements may be reflected in different relationships to personality.

Big Five Facets of Personality

The McCrae and Costa (1987) Five Factor Model (FFM) of personality is the most common conception presently used in the psychology literature making it apropos to use the model as the basis of this systematic review. The five facets of the model are openness to experience, conscientiousness, extraversion, agreeableness, and neuroticism. The model has a

basis in other five-factor conceptions that were emerging at the time with more robust use of factor analysis.

Openness to experience describes, among other things, one's willingness to engage in new ideas, one's level of vocabulary or intellect, and degree of curiosity, particularly in novel situations. Conscientiousness captures one's self-discipline and direction, goal-setting, personal reliability. Extraversion is associated with a highly interactive and visible person as well as one that might prefer a breadth of experiences over depth if forced to choose. High agreeableness individuals think more collectively and are flexible, sympathetic, and forgiving. Neuroticism is characterized by a lack of emotional stability including a nervous and high-strung nature.

Creativity and Personality

Creativity and personality have long been associated with each other in psychology. Guilford's (1950) influential call for more rich psychometric evaluations of creativity began with a discussion of creativity definitions. This discussion included references to the creativity-personality association including an explicit call for investigations regarding how to "promote the development of creative personalities" (p. 445). The work of MacKinnon (1965) suggested personality as a bridge from creative potential to achievement. Later, Gough (1979) extended on his earlier use of the general Adjective Checklist List with Heilbrun (1965) by streamlining the list down to the terms most related to creativity. This determination was based on evaluations of creative producers across domains. The Creative Personality Scale was quickly picked up and used as a diagnostic among psychologists and school personnel (Barron & Harrington, 1981).

Over a decade later, Eysenck, whose own three factor personality conception (extraversion, psychoticism, neuroticism) was being largely supplanted by Costa and McCrae's Five Factor Model, wrote extensively on the relationship of personality and creativity (1993a;

1993b; 1995). He wrote at length about the strong influence of personality on eminent creativity. He was particularly focused on the positive influence of psychoticism (roughly negative conscientiousness and agreeableness) on creative achievement. In a thoughtful rejoinder (1993a) to critics of his work, he teased out many issues still hotly contested 20 years later (e.g. creativity/psychopathology links, genetic predisposition to high creativity, and the relevance of discussing creativity as an intelligence/cognitive issue).

While many individuals have studied the influence of personality facets on creativity, Feist's (1998) meta-analysis of creativity in the artistic and scientific domains now serves as the seminal work on the topic. In Feist's own introductory literature review, he noted the relative lack of questioning of the specific influences personality has on creativity in recent time. He included a quote from Barron and Harrington (1981) in which they remarked that there had been "few surprises" in the area in the fifteen years prior to *their work* (p. 453).

Feist compared personality differences through the lens of the Costa and McCrae Five Factor Model. He reviewed 26 studies of scientists versus non-scientists, 28 studies of creative versus non-creative scientists, and 29 studies of artists versus non-artists. Each total sample size was on the order of four to five thousand. Openness to experience was the largest and most consistent predictor of creativity across his analyses. Extraversion was a close second in term of positive relation to the more creative group. Agreeableness and neuroticism were most commonly a negative influence on creativity, but their effects were the smallest of the five facets of personality. Lastly, Feist found strong relationships between conscientiousness and creativity, but the direction of the relationship depended on the domain. While in the artist versus non-artist analysis conscientiousness had the largest *negative* relationship to creativity, in the scientist versus non-scientist comparison it had the largest *positive* effect.

The purpose of the present study is to expand on this work by investigating the intersection of the ideation-production issue, the self-report-external-rating issue, and componential divergent thinking view with the personality-creativity relationship. More broadly, the goal is to look for patterns in the relationship that seem linked to the specific conceptualization and measurement of creativity employed in empirical studies. Three specific research questions were investigated utilizing a systematic review protocol:

RQ1: How do the observed relationships of Big Five facets of personality to creativity differ when creativity is conceived as ideation/divergent thinking/potential versus production/achievement?

RQ2: How do the observed relationships of Big Five facets of personality to creativity differ in self-reported creativity measures versus creativity assessed by external raters?

RQ3: How do the observed relationships of Big Five facets of personality to creativity differ when considering different elements of divergent thinking (fluency, flexibility, originality, and elaboration)?

Methodology

Data Collection

Databases searched. Since creativity research bleeds into many disciplines, multiple databases were used to search for potential articles. In total, seven databases were selected: Academic Search Complete, ERIC, PsycARTICLES, PsycCRITIQUES, Psychology and Behavioral Sciences Collection, PsycINFO, PsycTESTS. The inclusion of Academic Search Complete and ERIC was intended to capture studies published in the field of education. The other five psychology databases make up the system of indexing by the American Psychological Association and the broader field of psychology where much creativity literature lies.

Search terms, selection criteria, and sample creation. Since the nature of creativity and personality conceptions was to be scrutinized in the review, the search used the simplest, most unassuming terms: creativity and personality. Both "creativity" and "personality" had to be present in the database searches of titles, abstracts, and full texts. This generated 58,899 article records. Three specific criteria were then used to limit the search's scope. The articles had to be coded in the databases as peer-reviewed, as empirical studies, and as quantitative. These requirements were considered a priori of any text screening and reduced the number of records to 2,364.

Since measures of creativity are diverse, the process of article inclusion/exclusion needed to account for this. For an article to be included in the analysis, the authors of the study simply had to explicitly suggest that the measure being used was assessing creativity. Articles which used extensively studied measures like Torrance Tests of Creative Thinking (Torrance, 1974) or the Creative Achievement Questionnaire (Carson et al., 2005) were included, but also those in which the authors had created a measure of their own. However, author-created instruments that attempted to measure "creative personality" were excluded as were more formal assessments like derivations of the Creative Personality Scale (Gough, 1979). This approach allowed for diverse conceptions of creativity while not confounding the purpose of the review with any individual study author's own preconceptions regarding the relationship of creativity and personality.

The final requirement for inclusion was a reported effect size that quantified the size of the personality-creativity relationship. This left 96 articles for inclusion in the systematic review. The dramatic drop from the number of records is attributed to duplicate records and the nature of the full text search catching extraneous records (e.g. articles referencing *Creativity Research*

Journal and *Personality and Individual Differences*, no matter the specific topic of the empirical study).

Article Coding

Creativity measures. For each creativity measure in each selected study, characteristics of the measure were coded. First, each creativity measure was coded as primarily ideation-based or production-based. In some cases, such as the Runco Ideational Behavior Scale (Runco et al., 2001) or the evaluation of a tangible artifact, the coding process was straightforward. Some measures were not encompassed by this dichotomous classification. As such, the ideation conception was expanded to include measures of creative potential and results related to divergent thinking tests. While one could suggest divergent thinking tests do result in an outward product, they are typically intended as a measure of what a person *could* generally do. Thus, they were included in the ideation category. Alternatively, measures that related to creative behaviors and levels of creative achievement were included with the more explicit measures of production for analysis. For cases in which the creativity assessments used seemed to include a mixture of both categories, the measure was coded for inclusion based on majority of items. For example, an employer might complete a three-item scale including "shares many ideas," "translates ideas into actions," and "does creative work." Overall these items are more related to outcomes, so it would be coded as a production measure. When a majority determination could not be made based on an author's text, no coding was assigned. This was typically because the content of the items was not included in the publication. Consequently, not all creativity-personality relationships could be used in the analysis of RQ1.

Next, each was coded as either self-reported or externally-rated. Self-reports were generally inventories. Externally-rated measures included inventories filled out by others (such

as by an employer, instructor or co-worker). Evaluations of creative products or divergent thinking task results were also categorized this way. All measures in the study received one of these two designations and were used for RQ2.

To respond to RQ3, the creativity measures related to divergent thinking were coded as fluency, flexibility, originality, and elaboration. When only a holistic measure of divergent thinking was reported, this was not possible. In a small number of cases, the divergent thinking measure reported was a combination of two elements and was coded to reflect that (e.g. Benedek, Konen, & Neubauer, 2012 reported a combination of fluency and originality).

Personality measures. Since the review focused on the Big Five factors of personality, the creativity-personality relationship had to be coded as relating to one of these facets. In the studies explicitly using all or some portion of a Big Five personality inventory, coding was straightforward. For studies that employed a non-Big Five basis for personality screening, personality conceptions were logically mapped to some Big Five facet. Table A.1 shows the manner in which two common personality conceptions were coded in this study.

Samples and effect sizes. Each reported relationship between creativity and personality was recorded as if it was its own sample. For each, the number of participants was recorded for use in the meta-analysis. Some articles included the results of multiple studies using presumably different samples. In cases of a study using multiple creativity measures, some samples were effectively counted multiple times. Given this potential problem, two versions of the overall creativity-personality results were calculated: one including all samples and one which had condensed multiple measures on the same sample to a single set of relationships. No substantive difference was observed.

Effect sizes were recorded for each reported relationship in each study. Primarily these were Pearson *r* correlation coefficients. In the cases for which Pearson *r* correlations were not reported, but beta weights were, the reported beta weights were converted using the suggested conversion of Peterson and Brown (2005).

$$r = .98\beta + .05\lambda \ (\lambda = 1 \text{ if } \beta \text{ is nonnegative}, \lambda = 0 \text{ if } \beta \text{ is negative})$$

In that work, the authors suggested limiting the use of the technique to weights from -0.50 to +0.50. All articles which reported beta weights only in the systematic review met this criterion.

Results

Omnibus Creativity and Personality

While 96 articles met the inclusion criteria, some reported multiple studies. Additionally, some studies used multiple measures of creativity. Thus, a total of 188 effects were observed.

Per Lipsey and Wilson (2001) each effect (as a Pearson *r* correlation) was first converted using the Fisher's z-transformation to stabilize the variance.

$$Fisher's\ z = \frac{1}{2} * \ln(\frac{1+r}{1-r})$$

Since the effects were Pearson *r* values, inverse variance weights were calculated as follows and each effect size was subsequently multiplied by the associated inverse variance weight to give larger samples more weight in the calculation.

$$\omega = n - 3$$

The results were summed and divided by the sum of the inverse variance weights to generate the mean effect size which was converted back to a standard Pearson *r* correlation coefficient using the inverse Fisher's-z transformation below. Overall results are summarized in Table A.2.

$$\frac{e^{2z} - 1}{e^{2z} + 1}$$

In the omnibus analysis, all Big Five relationships with creativity were statistically significant, though the very large sample sizes (up to about 59,000) contributed to this outcome. Openness to experience (r = .237) was most strongly and positively correlated. This was in line with expectations given previous research as was the contribution of extraversion (r = .138). Conscientiousness had the smallest magnitude of correlation (r = .015) and only neuroticism showed a negative relationship (r = -.040).

Ideation and Production (RQ1)

All creativity-personality relationships in the systematic review (188) were coded for whether the creativity measurement was more ideation-based or production-based. Due to the prevalence of divergent thinking tests, more relationships fell in the ideation category (110 versus 64). With the exception of ideation-conscientiousness (p = .14), all calculated relationships were statistically significant (p < .01). As Table A.3 suggests, the same general pattern of relationships was observed with respect to the relative effect of the Big Five personality facets on creativity (e.g. the highest effects were for openness and extraversion and the only negative effect was neuroticism).

Despite these similarities with the omnibus tests, there were a number of noteworthy findings with respect to RQ1. While extraversion and agreeableness showed a large overlap in the confidence intervals in the ideation and production groups of creativity assessments, the other three facets did not. The upper bound of neuroticism-production and lower bound of neuroticism-ideation were the same value (r = .041). This suggests a more negative correlation of creativity and neuroticism when the evaluation is product-based.

Other facet comparisons showed further differences. Production-conscientiousness was higher than ideation-conscientiousness. An even larger difference was calculated when production-openness was compared to ideation-openness. When considering the openness difference in terms of creativity variance, production measures were explained by openness to experience at more than twice the rate of ideation measures (R^2 = .085 versus R^2 = .040).

Self-Reported and Externally Rated (RQ2)

For RQ2 creativity-personality relationships were coded as to whether the creativity was self-reported or externally-rated. Unlike the ideation-production coding, the determination was made for all relationships. Of the 188 reported relationships, 65 involved self-reported measures of creativity while 123 involved the rating of creativity by someone other than the subject. Openness to experience and extraversion showed the largest positive relationship with creativity while the effect of neuroticism was negative (see Table A.4). All personality-creativity correlations calculated in this portion of the meta-analysis were found to be statistically significant ($p < .05$).

For each of the Big Five facets, the confidence intervals involving self-reported and externally-rated creativity did not overlap. This indicates a differential influence of personality depending on how the creativity measure was recorded. Similar to the ideation-production analysis, the confidence intervals associated with neuroticism were distinct, but close with self-reported creativity being more negatively influenced. Agreeableness was more positively related to self-reported creativity but both effects were very small. Conscientiousness was positively related to self-reported creativity to a larger degree while being negatively related when considering only externally-rated correlations. Unlike in the ideation-production analysis, a difference was observed for extraversion depending on the type of measure with self-report

measures being more influenced. The difference between the calculated relationship of openness and creativity was even more pronounced. When comparing self-report measures to externally-rated ones, openness predicted nearly three times the variance (R^2 = .099 versus R^2 = .035).

Elements of Divergent Thinking (RQ3)

For the treatment of RQ3, articles in the systematic review that used divergent thinking measures were coded for the elements of divergent thinking reported. In some cases, the authors did not report elements specifically or only reported an overall measure. In these situations the relationships were included in the study for their ideation and externally-rated nature, but were not included in this portion of the analysis. Fluency and originality were the most investigated aspects of personality with respect to divergent thinking.

Openness to experience demonstrated a positive effect on divergent thinking, no matter the elements singled out (see Table A.5). These effects were larger than any other Big Five facet in each case. While the correlations for openness were varied, there were no elements for which confidence intervals suggested personality-creativity differences. Extraversion was the second most influential facet, but the effect on fluency was much higher than on other elements in terms of R^2 variance in divergent thinking explained. Additionally, the fluency-extraversion confidence interval did not overlap any of the other elements while the flexibility-extraversion, originality-extraversion, and elaboration-extraversion all showed significant overlap with each other.

Neuroticism showed the third highest correlations with divergent thinking elements. All but the originality-neuroticism relationship demonstrated statistical significance. Of note, the flexibility-neuroticism and elaboration-neuroticism correlations, the largest, were positive. In the case of flexibility, they were functionally equal to extraversion. This is distinct from other analyses in which neuroticism routinely showed a negative connection to creativity.

Agreeableness showed a very small, statistically significant positive correlation with fluency. This facet, along with conscientiousness showed a similar small negative effect on originality. The conscientiousness-originality relationship had the only statistically significant ($p < .05$) correlation between the facet and the elements of divergent thinking.

The Effects of Specific Creativity Measures

To add more context to the analyses and give more information regarding the specific creativity measures encountered in the systematic review, the same meta-analytic technique was applied to all measures that appears at least three times in the selected articles. Table A.6 summarizes the results of those analyses. Of the creativity measures included, openness to experience was found to have a statistically significant correlation with all nine of them. However, the range of relationship ($.164 < r < .403$) suggests the amount of creativity variance that can be explained by this personality facet can vary by a factor of six ($.026 < R^2 < .162$) depending how creativity is conceived and measured. Similarly, the usefulness of extraversion as a predictor of creativity varied. In that case, the variance explained by extraversion varied by a factor of five ($.009 < R^2 < .050$) when excluding the Remote Associates Test, which appeared to be an outlier. The other three Big Five facets (conscientiousness, agreeableness, and neuroticism) were related to three of the creativity measures. Each of these facets showed at least one positive and one negative relationship. Most striking was agreeableness: Runco Ideational Behavior Scale ($r = -.158$) and Remote Associates Test ($r = .158$). Even among conceptually similar yet differing divergent thinking tasks, these three facets of personality demonstrated both positive and negative correlations. In the case of neuroticism there were statistically significant findings of opposite sign (alternate uses task, $r = .028$; consequences task $r = -.063$).

Discussion

First and foremost, commonly accepted beliefs about the creativity-personality relationships were generally supported by this review. For example, the propensity for openness to experience and extraversion to predict creativity was buoyed by the results. However, the purpose here was more nuanced. The goal was to examine whether the nature of assessments on the creativity side of the relationship may influence the findings regarding the relationship to personality. In short, the present results suggest that influence is tangible. For example, the results here will not resolve debates over the ideation or production nature of creativity, but they should add to the importance of considering such issues. Although openness to experience is clearly related to creativity, the greater importance of it for production measures suggests a need to give it more consideration in product-based assessments. This might be further examined by distinguishing the quantity and quality of creative production.

The findings regarding conscientiousness on the ideation-production question contribute doubt that this aspect of personality undermines creativity. When conscientiousness is considered as an issue of self-discipline or follow through, it is logical that productive creativity would show a positive relationship. Additionally, this may be the mechanism underlying Feist's (1998) finding that the facet so strongly predicted scientific creativity since the outcomes of such studies involve publications and prestige in the field that require such characteristics. In this review, production measures were more related to conscientiousness in both the general analysis and the specific instrument findings. The CAQ and BICB were positively related to conscientiousness as was the Furnham Self-Assessment (cf. Furnham & Bachtiar, 2008) which asks for a holistic self-rating of production-based creativity. If conscientiousness does positively influence production, it may come from the transition of ideas to products. This would support the recent Cognitive-Creative Sifting Model (Author, in press), which suggests mental filters that distill ideas into

externalized products. Future research and analysis could similarly treat conscientiousness as a potential moderator of the ideation-production relationship.

The differences observed between self-reported (SR) and externally-rated (ER) creativity to personality suggest the nature of reporting personality and completing self-report creativity instruments may influence the findings presently observed. Some of the large difference observed between SR and ER with openness and extraversion could relate to subjects' implicit bias toward seeing these as elements of creativity. Biases might be even more explicit in situations where openness items on the personality assessment use wordings about creativity, ideas, and imagination. These biases reflect the reason Gough's Creativity Personality Scale (1979) and similar measures were excluded from this systematic review.

One might offer the observation that the self-report measures are largely production measures so differences observed could be attributed to being an artifact of those relationships. That seems short-sighted, however, since there was even less overlap of confidence intervals in the SR-ER analysis. Some difference may stem from ideation-production measurement, but much is left to explain. Moreover, the sample sizes for the SR-ER analysis were smaller meaning the confidence intervals were larger, increasing the likelihood of overlap. Clearly this brings up measurement issues to be clarified with further study. It also supports the concept of purposely assessing and using holistic assessment for creativity to account for these differences.

The last major finding of the study is that personality facets seem differentially related to divergent thinking depending on the element under review. Openness, as is typical, was the across-the-board, strongest predictor. It was also fairly consistent in magnitude across the elements. The rest of the relationships observed offer a great deal of fodder for future research. It seems consistent with an understanding of extraversion, that individuals who score high on this

facet would be willing to share their ideas and receive high fluency scores, but why is it far less related to flexibility and the other elements? Conversely, why do high neuroticism individuals score lower on fluency, but better on flexibility? And why is their elaboration similarly high? Is it possible that the variance explained in originality by conscientiousness and agreeableness is the same variance? One might also study the nature of specific divergent thinking tasks and how individuals react to them. For example, perhaps the negative relationship of neuroticism to the consequences task is related to the uneasiness the subject feels about a potential frightening situation and causes them to shut down lowering fluency and openness to novelty.

Overall, the findings in this systematic review add color to a rich history of studies involving the relationship between creativity and personality. As Feist's (1998) meta-analysis did for issues of domain-specificity, the present results tease out features of the personality-creativity association by digging into how the nature of creativity measurement itself may contribute more broadly to the sometimes varied and mixed results observed. The multitude of future research directions articulated are meant to re-open a conversation largely considered closed. It is hoped that future researchers will consider the issues illuminated here in both their choice of creativity measures and the level of thoughtfulness in the interpretation of their own findings.

Table A.1

Code Mappings of Personality

Big Five Inventory	Eysenck Personality Questionnaire	Myers-Briggs Type Inventory
Openness to Experience		Intuition-Sensing
Conscientiousness	Psychoticism (negative)	Judging-Perception
Extraversion	Extraversion	Extraversion-Introversion
Agreeableness	Psychoticism (negative)	Feeling-Thinking
Neuroticism	Neuroticism	

Table A.2

Omnibus Creativity-Personality Results – Weighted Mean Correlations and 95% CI

	Mean *r* [95% CI]	k	n
Openness to Experience	***.237*** [.229, .245]	167	57,019
Conscientiousness	***.015*** [.007, .024]	158	58,897
Extraversion	***.138*** [.129, .146]	152	58,804
Agreeableness	***.026*** [.018, .034]	148	57,068
Neuroticism	***-.040*** [-.048, -.032]	142	56,748

Note: CI = confidence interval; bold/italic/underline indicates statistically significant ($p < .05$)

Table A.3

Ideation versus Production Results – Weighted Mean Correlations and 95% CI

	Ideation Correlations			Production Correlations		
	Mean *r* [95% CI]	k	n	Mean *r* [95% CI]	k	n
Openness to Experience	***.201*** [.191, .212]	94	34,963	***.292*** [.278, .306]	60	19,637
Conscientiousness	-.007 [-.017, .002]	93	40,113	***.057*** [.042, .072]	52	14,696
Extraversion	***.135*** [.125, .145]	90	39,545	***.138*** [.122, .153]	49	16,171
Agreeableness	***.025*** [.015, .035]	88	38,894	***.023*** [.008, .039]	47	15,886
Neuroticism	***-.031*** [-.041, -.021]	84	38,689	***-.057*** [-.072, -.041]	46	15,937

Note: CI = confidence interval; bold/italic/underline indicates statistically significant ($p < .05$)

Table A.4

Self-Report Versus Externally-Rated Results – Weighted Mean Correlations and 95% CI

	Self-Report Correlations			Externally-Rated Correlations		
	Mean *r* [95% CI]	k	n	Mean *r* [95% CI]	k	n
Openness to Experience	***.314*** [.301, .328]	63	21,744	***.188*** [.177, .198]	104	35,275
Conscientiousness	***.076*** [.062, .090]	56	19,689	***-.015*** [-.025, -.005]	102	39,208
Extraversion	***.156*** [.142, .170]	56	19,737	***.128*** [.118, .138]	96	38,267
Agreeableness	***.046*** [.032, .060]	54	19,255	***.016*** [.005, .026]	94	37,813
Neuroticism	***-.056*** [-.070, -.042]	54	19,397	***-.031*** [-.042, -.021]	88	37,351

Note: CI = confidence interval; bold/italic/underline indicates statistically significant ($p < .05$)

Table A.5

Element of Divergent Thinking Results – Weighted Mean Correlations and 95% CI

	Fluency [95% CI] k; total n	Flexibility [95% CI] k; total n	Originality [95% CI] k; total n	Elaboration [95% CI] k; total n
Openness to Experience	***.186*** [.169, .204] 33; 13,247	***.125*** [.072, .178] 8; 1,382	***.184*** [.162, .206] 18; 7,948	***.169*** [.115, .224] 7; 1,274
Conscientiousness	-.007 [-.021, .007] 33; 20,487	.005 [-.058, .068] 7; 955	***-.058*** [-.080, -.036] 19; 7,656	-.034 [-.101, .033] 6; 864
Extraversion	***.184*** [.170, .198] 33; 20,382	***.080*** [.017, .143] 7; 955	***.092*** [.069, .114] 20; 7,729	***.102*** [.035, .169] 6; 864
Agreeableness	***.018*** [.004, .032] 30; 19,918	-.010 [-.073, .054] 7; 955	***-.052*** [-.075, -.030] 19; 7,656	.027 [-.040, .093] 6; 864
Neuroticism	***-.059*** [-.073, -.045] 30; 20,014	***.081*** [.017, .144] 7; 955	-.016 [-.039, .006] 18; 7,490	***.083*** [.009, .157] 5; 698

Note: CI = confidence interval; bold/italic/underline indicates statistically significant ($p < .05$)

Table A.6

Creativity-Personality Results for Specific Measures – Weighted Mean Correlations and 95% CI

	Openness	Conscientiousness	Extraversion	Agreeableness	Neuroticism
Alternate Uses Task	***.198***	-.017	***.107***	***.036***	***.028***
	[.174, .221]	[-.042, .008]	[.083, .132]	[.010, .061]	[.003, .053]
	44; 6910	40; 6226	40; 6,226	39; 5,964	40; 6,226
Consequences Task	***.187***	***-.027***	***.172***	-.003	***-.063***
	[.170, .203]	[-.040, -.014]	[.159, .186]	[-.016, .010]	[-.076, -.050]
	9; 14293	10; 22136	10; 22,136	10; 22,136	10; 22,136
Instances Task	***.164***	.001	***.126***	-.042	-.007
	[.105, .224]	[-.066, .068]	[.059, .192]	[-.109, .024]	[-.074, .059]
	6; 1,086	5; 859	5; 859	5; 859	5; 859
Runco Ideational Behavior Scale	***.278***	-.057	.096	***-.158***	.033
	[.178, .380]	[-.158, .044]	[-.005, .197]	[-.259, -.057]	[-.068, .135]
	2; 375	2; 375	2; 375	2; 375	2; 375
Remote Associates Test	***.170***	***.073***	.011	***.158***	-.031
	[.140, .201]	[.041, .104]	[-.023, .045]	[.125, .191]	[-.064, .003]
	3; 4,103	3; 3,806	2; 3,405	2; 3,405	2; 3,405
Biographical Inventory of Creative	***.303***	.041	***.223***	-.049	-.052
Behaviors	[.246, .361]	[-.017, .098]	[.165, .281]	[-.106, .009]	[-.110, .006]
	8; 1,154	8; 1,154	8; 1,154	8; 1,154	8; 1,154
Creative Achievement Questionnaire	***.339***	.043	***.140***	-.031	.027
	[.289, .389]	[-.014, .100]	[.083, .197]	[-.088, .026]	[-.030, .083]
	10; 1,560	8; 1,183	8; 1,183	8; 1,183	8; 1,183
Creative Behavior Inventory	***.403***	.001	***.109***	-.014	.060
	[.357, .448]	[-.072, .073]	[.037, .182]	[-.086, .059]	[-.018, .138]
	6; 1,849	4; 727	4; 727	4; 727	3; 636
Furnham Self-Assessment	***.286***	***.094***	***.154***	.020	***-.081***
	[.236, .335)]	[.044, .143]	[.105, .204]	[-.029, .070]	[-.130, .031]
	8; 1,572	8; 1,572	8; 1,572	8; 1,572	8; 1,572

Note: bold/italic/underline indicates statistically significant ($p < .05$)

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