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THE RELATIONSHIPS AMONG CREATIVITY, GRIT, ACADEMIC MOTIVATION, AND ACADEMIC SUCCESS IN COLLEGE STUDENTS

Joanne P. Rojas

University of Kentucky, joanne.rojas@uky.edu

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Joanne P. Rojas, Student

Dr. Kenneth M. Tyler, Major Professor

Dr. Kenneth M. Tyler, Director of Graduate Studies

THE RELATIONSHIPS AMONG CREATIVITY, GRIT, ACADEMIC MOTIVATION,
AND ACADEMIC SUCCESS IN COLLEGE STUDENTS

DISSERTATION

A dissertation submitted in partial fulfillment of the
requirements for the degree of Doctor of Philosophy in the
College of Education
at the University of Kentucky

By

Joanne Patricia Rojas

Lexington, Kentucky

Director: Dr. Kenneth M. Tyler, Associate Professor of Educational Psychology

Lexington, Kentucky

2015

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ABSTRACT OF DISSERTATION

THE RELATIONSHIPS AMONG CREATIVITY, GRIT, ACADEMIC MOTIVATION, AND ACADEMIC SUCCESS IN COLLEGE STUDENTS

Creativity research is an underdeveloped area of educational psychology. For example, studies of students' creativity as a predictor of academic achievement are uncommon in the field. Moreover, perseverance—which is an integral part of the definition of creativity (Sternberg, 2012)—is not typically measured in creativity research. To address these issues, the current study sought to discern within an academic context whether perseverance serves as a mediating factor between creativity and academic achievement. Two undergraduate student samples ($N = 817$; $N = 187$) participated in a survey measuring their creativity and perseverance. This multiple manuscript dissertation sought to examine the psychometric properties of a measure of creativity: the Runco Ideational Behavior Scale (RIBS) and a measure of perseverance: the Grit Scale and to explore the relationships between creativity, perseverance, academic motivation, and academic achievement. Study 1 found that the RIBS had a correlated two-factor structure with two subscales: the Scatterbrained Subscale and the Divergent Thinking Subscale. Grit had a correlated two-factor structure reflecting interest and effort, and this reinforced previous findings regarding this scale. These two scales hold promise as measures of the creative process. Study 2 found that although traditional motivation measures consistently predicted grades, grit only predicted grades in one sample, and creativity had no relationship with grades. Creativity appears to be orthogonal to academic achievement as measured by grades. There was evidence that grit can mediate the relationships between motivation and grades, but only in one sample. This research shares the limitations of other self-report surveys, but the psychometrics behind the measures were strong. Future research should continue to examine creativity and perseverance as important noncognitive constructs in academic contexts especially among diverse populations.

KEYWORDS: Creative Ideation, Grit, Investment Theory of Creativity,
Psychometrics, Academic Success

THE RELATIONSHIPS AMONG CREATIVITY, GRIT, ACADEMIC MOTIVATION,
AND ACADEMIC SUCCESS IN COLLEGE STUDENTS

By

Joanne Patricia Rojas

Dr. Kenneth M. Tyler

Director of Dissertation

Dr. Kenneth M. Tyler

Director of Graduate Studies

This work is dedicated to my husband, Hender Rojas, and my children, Miranda, Sebastian, and Veronica Rojas.

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Chapter 1: Introduction

This dissertation research examines the relationships of creativity, grit, and academic motivation among college students. These constructs are among the so-called "noncognitive factors" that are not measured by standardized IQ or achievement tests. Other noncognitive factors include motivation, values, interests, and goals (Duckworth, 2009), and are sometimes explored as predictors of school outcomes (Farrington et al., 2012). Although motivation constructs such as self-efficacy (Bandura, 1997) and perseverance (Duckworth, Peterson, Matthews, & Kelly, 2007) are in the mainstream, creativity typically lies at the fringes of educational psychology research (Plucker, Beghetto, & Dow, 2004). However, creative thinking is considered a higher-order cognitive skill that requires development (Perkins, 1990; Yang, Wan, & Chiou, 2010), and one of several important educational outcomes for 21st century learning (McWilliam & Dawson, 2008; Sternberg, 2006). It may be that the complexities of creativity and the multiple ways of defining and measuring it have kept it outside of the central foci of educational research.

For example, there are numerous competing definitions of creativity (Hennessey & Amabile, 2010); these definitions will be explored more in the literature review. The theoretical framework that guides this research examining aspects of creativity's conceptualization is the investment theory of creativity (Sternberg & Lubart, 1995). This theory is based on an economic metaphor of buying low and selling high. First, those individuals who are creative invest in (i.e., work on) novel ideas that others have not identified (buying low). Second, these individuals sell these ideas and their products back to a market that had not previously seen their value (selling high). This description

has two components: 1. creative ideation to generate novel ideas that are worthy of "investment"; that is, they are both new and valuable; 2. perseverance to "sell" these ideas to others; that is, to persuade others that these new ideas are worthy of "buying."

Sternberg and his collaborators have expounded this framework in order to support its theoretical underpinnings (Lubart & Sternberg, 1995; Sternberg, 2012; Sternberg & Lubart, 1996; Zhang & Sternberg, 2011). In the initial research supporting the theory (Sternberg & Lubart, 1996), extensive test batteries were administered to two small samples ($N = 44$ in each study). These test batteries included items asking about implicit understanding of the sources of creativity and the production of creative essays and drawings in response to a prompt. These full batteries are not readily available to researchers, and this type of testing is reported to be time-intensive and cumbersome to administer to large samples (Zhang & Sternberg, 2011), thereby limiting an efficient measurement of creativity. Some additional research has continued to explore the implicit understanding of the sources of creativity, but not sought to measure creativity psychometrically (Zhang & Sternberg, 2011).

Although these findings gave support to the larger investment theory of creativity, they did not provide psychometric measurement that is efficient for survey research. This dissertation research, then, seeks to address this problem by selecting two measures to be used together as a means of measuring creativity: a measure of creative ideation, the Runco Ideational Behavior Scale (RIBS; Runco, Plucker, & Lim, 2001) and a measure of perseverance, the Grit Scale (Duckworth et al., 2007).

Organization of the Dissertation

This dissertation is submitted in a multiple manuscript format. Chapter 1 provides an overview of the research, the statement of the problem, and the overarching research questions that guided the two independent quantitative studies conducted. Chapter 2 describes the theoretical framework that provided the context for the studies. Chapters 3 and 4 are both full, stand-alone manuscripts describing two separate studies based on the data collected. Chapter 5 is a summary and discussion of the overall findings of the entire body of research.

Background and Statement of the Problem

Creativity, often thought of as the generation of new ideas, has been a particular focus of research since the middle of the 20th century. It is explored in many diverse areas including but not limited to education (Plucker et al., 2004). However, because it is a broad construct, there are many competing definitions. There are three defining elements of creativity within this research. The first is that creativity must be a combination of novelty and usefulness/value (Hennessey & Amabile, 2010). The second is that perseverance plays an important role in the creative process. Although it is not typically measured, it is nonetheless an integral part of persuading others of the value or usefulness of the novel idea. Third, creativity is an important developing skill that contributes to successful intelligence, a combination of creative, practical, and analytical skills that enable individuals to achieve their goals (Sternberg, 2006).

An example to illustrate these defining elements is provided here. Specifically, the inventor and innovator Thomas Edison, the "Wizard of Menlo Park," is famously credited with the invention of the phonograph. He was not the first to tinker with the

design of a phonograph, but he was the most successful at the phonograph's development/creation and was determined to get one in every home (DeGraaf, 2013). Phonographs began as a scientific novelty, but Edison saw the potential to persuade ordinary families of the desirability of owning one for themselves. Although this technology was at first perceived as too complex for the ordinary office workers who used it for dictation, Edison continued to refine and perfect the technology while finding ways to market its entertainment value to ordinary families. Edison commented, "It is an easy matter to get some men to...produce goods, but it requires a considerably higher type of man to successfully sell the goods" (DeGraaf, 2013, p. 97). The combination of creativity and perseverance led to Edison's technological revolution. Edison's creativity was demonstrated by his investment in an idea pursued by few others and his imaginative development of important innovations in the design; however, it was arguably his perseverance that made the difference. A similar story played out in the 21st century with Steve Jobs and the Apple iPod. It was not the first mp3 player, but the iPod mp3 player was the one that made the leap to popular usage because of a combination of creative innovation and perseverance (Johnson, 2014).

Alongside creativity within popular culture, within the field of education, creativity is a significant characteristic of cognitive development. Specifically, creativity has been identified as the highest cognitive process in Bloom's Revised Taxonomy (Krathwohl, 2002). Some psychologists look at the development of creativity as a higher-level process that develops in tandem with critical thinking (Perkins, 1990) and post-formal operations in a Piagetian framework (Wu & Chiou, 2008; Yang, Wan, & Chiou, 2010). As such, it should be integral to higher education contexts and educational

psychology. There are some efforts to emphasize creativity in higher education. For example, the Association of American Colleges and Universities (AACU) includes creative thinking as one of its core values and encourages institutions of higher education to assess creative thinking as a student learning outcome among undergraduates (AACU, 2015). Some of the emphasis on creativity as a learning outcome is connected to economic realities. Creativity and innovation are among the top priorities for a 21st century workplace and economy (Florida, 2004; Florida & Goodnight, 2005). Future leaders in business and industry must be able to exhibit creativity in order to succeed in a global economy (Amabile, 1998; Amabile & Khaire, 2008).

Finally, because creativity and grit were being examined within an academic context, academic motivation was also included within this study. Two 5-item scales were selected from the PALS Inventory (Midgley et al., 2000): Academic Self-Efficacy and Avoiding Novelty. Academic self-efficacy is the belief in one's ability to succeed in academic tasks (Bandura, 1997). High levels of academic self-efficacy are correlated with positive learning behaviors and strategies (e.g., Patrick, Ryan, & Kaplan, 2007). In contrast, avoiding novelty is a negative coping strategy that indicates a preference to avoid new learning, and it has been correlated with academic self-handicapping and the avoidance of help-seeking behaviors (Shih, 2009; Turner et al., 2002).

The two manuscripts within this dissertation are based on data collected in Fall 2014 from two undergraduate student samples that participated in a survey measuring their creative ideation, grit, academic motivation, and self-reported grades. The first sample was a multi-campus sample from several different states and was ethnically diverse ($N = 187$), and the second sample was predominantly White and recruited from

one Mid-Southern public research university ($N = 817$). Study 1 examined the psychometric properties and factor structure of RIBS and Grit and examined group differences among students on these two scales. Study 2 examined the predictive validity of RIBS and Grit as academic measures and explored the possibility of grit as a mediator among RIBS, Academic Self-Efficacy, Avoiding Novelty, and self-reported student grades. All of these constructs were presented within the theoretical framework of Sternberg's investment theory of creativity (Sternberg & Lubart, 1995, 1996; Zhang & Sternberg, 2011) that posits that perseverance is central to creativity, despite not having been operationalized in that research as a contributor to the creative process. It may be that perseverance is so implicit in definitions of creative work that it does not tend to be recognized as an integral aspect requiring measurement.

Therefore, this research seeks to address the importance of creativity in educational psychology through an examination of its association with performance outcomes and their cognitive antecedents and advance creativity research by specifically examining the association between perseverance and creativity between two university student samples.

Chapter 2: Literature Review

Creativity is a recognizable but slippery concept that often wriggles out of the constraints of clear-cut definitions; you know it when you see it, but it can be difficult to get your hands on for closer examination. Commonly people think of creativity as the generation of new ideas, particularly in artistic domains. However, creativity exists across many different domains (Hennessey & Amabile, 2010). Creativity researchers tend to agree on two basic requirements for defining creativity: novelty and usefulness/value (Hennessey & Amabile, 2010; Mayer, 1999; Mednick, 1962; Peterson & Seligman, 2004; Plucker, Beghetto & Dow, 2004; Sternberg & Lubart, 1996). The focus of creativity research may be on the person, the product, the process, or the press/environment; these are the Four P's of creativity research (Plucker et al., 2004; Rhodes, 1961). Historically, the majority of creativity research focused primarily on one aspect such as the products of divergent thinking (e.g., Guilford, 1950; Kim, 2006; Torrance, 1972) or characteristics of the creative person (e.g., Gough, 1979; MacKinnon, 1965). More systemic attempts at creativity research include social psychological research that examines the context of creativity for everyday individuals (Amabile, 1996; Hennessey & Amabile, 1998) and historical analyses of eminent creativity in conjunction with larger social and cultural factors (Csíkszentmihályi & Wolfe, 2000; Simonton, 1999).

The relevance of creative thinking to educational research has grown more evident as creativity has grown in importance as a learning outcome for higher education (AACU, 2011; McWilliam & Dawson, 2008). There are at least three reasons why it should be a focal point of research in educational psychology.

First, cognition itself can be viewed as a creative process, particularly from a constructivist viewpoint (Plucker, Beghetto & Dow, 2004). For example, in Piaget's theory of knowledge construction, the individual creates mental schemas to organize learning (Piaget, 1950); this meets the baseline criteria for creativity of novelty and usefulness. Schema development springs from learners' innate passion for knowledge and expresses itself through the creative work of learning and problem solving (Feldman, 1982; Runco, 1996). The Piagetian stages themselves can be seen as novelties to the learner: "If there are novelties, then, of course, there are stages. If there are no novelties, then the concept of stages is artificial" (Piaget, 1971, p. 194). Piaget's constructivism is a sophisticated conceptualization of the creative transformation of an individual's impressions of the world into learning; children invent their new ideas and ideational structures, they do not simply discover or receive them wholesale (Sawyer, 2003). Some developmental psychologists point to humans' innate passion for knowledge as the impetus of the creative work of learning and problem solving (Feldman, 1982; Runco, 1996). Developmental psychologists such as Vygotsky, who view growth from a sociocultural perspective, would point to the importance of mentoring, instruction, and play in the formation of all learning including creativity (van Geert, 1998). The intricate accumulation and organization of knowledge is one of the distinguishing characteristics of human development and is a combination of both the Piagetian focus on a learner's growth as a schema creator and the Vygotskian focus on the assistance of more advanced learners in this process (van Geert, 1998).

Second, creativity is a developing skill that should be nurtured as an integral part of intelligence (Sternberg, 2006). Much psychological and educational research places

creative thinking at the summit of cognitive processes. Creativity is explicitly identified as the highest level of thinking, according to Bloom's Revised Taxonomy (Krathwohl, 2002). Perkins (1990) points to creative thinking as a higher-level process that works in conjunction with critical thinking. Although traditional Piagetian views of cognitive development stop at formal operations, post-Piagetian perspectives point to higher-order, post-formal thinking such as relativistic thinking and dialectical thinking as correlates to creative thinking (Ross, 1976; Wu & Chiou, 2008; Yang, Wan, & Chiou, 2010). For example, in a study of 454 Taiwanese adults, ages 23 to 40 years old, positive correlations emerged between dialectical thinking scores and overall scores of divergent thinking, a common proxy measure for creativity (Yang, Wan, & Chiou, 2010).

Third, creativity is a requirement for innovation and real-world problem solving. In life, individuals face open-ended and challenging situations that require new strategies and solutions (Treffinger, 1995). The imaginative mind spews new and unusual ideas, whereas the evaluative mind decides which ones will serve a valuable purpose; these two complementary processes are the basis for creative problem solving (Treffinger & Isaksen, 2005). Problem solvers tend to either innovate or adapt, and they prefer to operate primarily within one of these two modalities (Brophy, 1998); only the most cognitively advanced problem solvers can switch back and forth easily (Brophy, 1998). Openness to experience, a need for cognition, and tolerance for ambiguity help individuals to generate new ideas, while their evaluative thinking abilities help them to determine which ideas would be successful (Sternberg, 2006). Along with these factors, some argue that the ability to identify a real-world problem may be the most creative aspect of problem-solving (Okuda, Runco, & Berger, 1991).

Creativity research is not new to education, but it has taken place primarily among highly gifted or artistic populations. Some researchers focus on "Big-C" or eminent creativity (Csíkszentmihályi & Wolfe, 2000; Simonton, 1999, 2009). Simonton, for example, has conducted numerous studies that have focused on the psychological factors that contribute to the creative development of luminaries such as classical composers (1991), US presidents (1986), Picasso (2007), and successful scientists and inventors (1992). Other researchers focus on "little-c" or everyday creativity (Kaufman & Beghetto, 2009; Runco, 1996; Runco & Chand, 1995; Ruscio, Whitney, & Amabile, 1998; Ward, 2007). Notable examples of research into little-c creativity include divergent thinking tests (Guilford, 1967; Silvia et al., 2008; Torrance, 1974), surveys of creative behavior (Hocevar, 1979), inventories of creative accomplishments (Carson, Peterson, & Higgins, 2005), and rater-assessed creative production tasks of collages or poems (Ruscio, Whitney, & Amabile, 1998).

Within higher education, creativity has not typically been measured as a student learning outcome. However, just as creativity research has begun focusing more on "little-c" creativity, universities have also begun focusing on creativity and innovation as important learning outcomes (Berrett, 2013; McWilliam & Dawson, 2008). Creativity is seen as a necessary requirement for students who must face the challenging problems of the world. Long-standing issues such as climate change and income inequality will not be solved by a simple solution or a single discipline. Instead, new and useful solutions require the combination of learning across disciplines and recombining ideas in unexpected ways. Some universities that acknowledge this as a priority have begun requiring creative thinking as part of the curriculum for undergraduate students (Berrett,

2013). Indeed, creative thinking is considered a 21st century skill that is critical to the education of students (AACU, 2011). Thus, if creativity is a central process of cognition, and if higher-level thinking is a desirable educational outcome, particularly at the post-secondary level, then creativity should be in the mainstream of educational research and practice.

Investment Theory of Creativity

One reason that creativity research is outside of the mainstream of educational psychology is the definitional fuzziness of the construct. In a literature review of 90 articles with the term creativity in the title, only 38% provided an explicit definition, 41% provided an implicit definition, and 21% did not define the construct at all (Plucker et al., 2004). Definitional clarity of creativity is an important prerequisite to research on this topic.

One theoretical framework of creativity that does provide a clear definition is the investment theory of creativity (Sternberg & Lubart, 1995). This theory defines creativity with an economic metaphor: buying low and selling high (Sternberg & Lubart, 1995, 1996). Creativity occurs when a person decides to "buy low" by investing in unusual ideas that are undervalued in the marketplace; the individual then "sells high" by persuading the marketplace of the value of these ideas. The investor must persevere in order to sell these ideas to a resistant market and must consistently seek new ideas to pursue. At the heart of this theory is a pairing of creativity with long-term perseverance.

Being creative or engaging in the process of creating novel ideas is also a decision (Sternberg, 2002). The individual person must make a decision to invest in novel approaches that may not be immediately popular; this requires perseverance and the

ability to sell the value of these new ideas to others (Sternberg & Lubart, 1995). Creative people habitually find unusual ways to solve problems, are willing to take risks, are able to defy the predominant ideas of the crowd, and are motivated to overcome obstacles that others would not attempt to surmount (Sternberg & Lubart, 1996). Although deciding to be creative does not guarantee creativity, without this initial decision, creativity cannot occur (Johnson-Laird, 1988; Sternberg, 2012). When the decision to pursue new and unusual ideas is made regularly, the individual develops the habit of creativity and must show a willingness to defy convention in spite of difficulties (Sternberg, 2012). Habits are also related to perseverance. Being habitually novel in one's thinking and problem solving promotes creative perseverance because new ideas are consistently pursued as a regular practice (Sternberg, 2012). Indeed, all levels of creativity can be studied through the lens of the investment theory—from the developing creativity of a young student to the paradigm shifting creativity of an eminent practitioner in a domain.

Six resources of creativity must come together in sufficient amounts in order for creativity to occur, according to Sternberg (2012). These resources include 1. a mix of the intellectual abilities of *successful intelligence* (including analytical, creative, and practical intelligence); 2. the right amount of knowledge (neither too little nor too much); 3. flexible thinking styles; 4. personal attributes that are predisposed to creativity (e.g., openness, tolerance for ambiguity); 5. motivation (particularly intrinsic); and 6. a supportive environment. The amounts of these resources that vary within the system affect the development of creativity. For example, without a certain level of domain knowledge in mathematics, an individual cannot operate creatively within that domain (Jeon, Moon, & French, 2011). These resources also can interact with one another and

multiply their effects. For example, a highly intelligent and motivated creator might be capable of greater creativity than someone of average intelligence and motivation might be. Each of these six resources will be discussed below as correlates of creativity.

Intellectual Abilities

Within the investment theory, intellectual abilities are understood within the context of the triarchic components of successful intelligence. Sternberg defines successful intelligence as a mixture of analytical, creative, and practical intelligence (Sternberg, 1998; Sternberg & Grigorenko, 2004; Sternberg & Rainbow Project, 2006). Successful intelligence enables an individual to succeed in life in a personally meaningful, culturally appropriate way. Individuals rely on their personal strengths in order to correct or compensate for their weaknesses and choose to interact with their environments through a combination of analytical, creative, and practical abilities (Sternberg, 1997a, 1997b, 1999). The individual must have the creative intelligence to see problems in new ways, the analytical intelligence to decide which ideas should be pursued, and the practical intelligence to persuade others of the value of these new ideas (Sternberg, 2012).

Knowledge

Knowledge has both benefits and drawbacks for creativity. There must be a solid base of knowledge for an individual to be able to create within a field or domain (Amabile, 1996; Baer, 2012; Csikszentmihályi, 1996; Kaufman & Beghetto, 2006; Sternberg, 2012) especially at the highest levels (Ericsson & Charness, 1994). This is important for the relevance of creativity in educational psychology because it means that learning and knowledge acquisition are an integral part of creativity.

Intellectual Styles

Sternberg defines an intellectual or thinking style as distinct from either ability or personality (Sternberg, 2006; Zhang & Sternberg, 2005). For example, two individuals could be highly skilled in mathematics (ability) and be very conscientious (personality), but because of their differing intellectual styles, one might choose accounting and the other might choose higher-level mathematics as a career. For his own theory of learning styles, Sternberg used an extended analogy of mental self-government (Zhang & Sternberg, 2005). Sternberg (2012) found that the thinking styles of creative individuals include a preference for cognitive flexibility: thinking in new ways and an ability to switch between global and local thinking, as well as the perseverance necessary to rebel against constraints and insist on doing things their own way. These findings suggest that the types of problems and tasks preferred by creative thinkers may also require those individuals to exhibit both cognitive flexibility and perseverance in the pursuit of their goals.

Other theorists echo these findings because the importance of cognitive flexibility and perseverance is present in nearly every conception of creativity. Guilford's (1950) idea of divergent thinking as the basis for creativity was the first and most influential basis for flexible thinking. Runco (1985) built on this foundation to develop the idea of ideational flexibility as a basis for his later research in creative ideation (Runco et al., 2001). An unusual take on this idea of ideational flexibility as a contributor to creativity is the dual pathway model; this model views creativity as a function of either cognitive flexibility or cognitive persistence (Nijstad, De Dreu, Rietzschel & Baas, 2010). In a series of experiments, students were primed for either approach or avoidance motivation

conditions with instructions. For example, for an idea generation task, those students in the approach condition were instructed: “By generating ideas, you can gain time. The more ideas you generate, the more time you gain for the second task, making it easier to do that task well.” Those in the avoidance condition were instructed: “By generating few ideas, you can lose time. The fewer ideas you generate, the more time you lose for the second task, making it harder to do the task well.” Their creative tasks were rated for originality as well as for flexibility and persistence. To assess cognitive flexibility, the numbers of categories that were generated were counted and those with more categories of ideas were judged to exhibit more cognitive flexibility. To assess cognitive persistence, the number of times that students switched categories was counted, and those who switched less were judged to exhibit more persistence. It was found that individuals placed in the approach motivation condition accomplished creative tasks with cognitive flexibility, whereas those who were placed in the avoidance motivation condition accomplished creative tasks with cognitive persistence (Roskes, De Dreu, & Nijstad, 2012).

Personal Attributes

An important underlying assumption for personal attributes in the investment theory is that the individual can choose to nurture and exercise those attributes that lead to creativity (Sternberg, 2012). The attributes that Sternberg finds important for creative functioning include openness to experience, risk taking, willingness to overcome obstacles, tolerance of ambiguity, and creative self-efficacy (Sternberg, 2012). The positive correlation between openness to experience and creativity is among the most robust findings in the literature (Dollinger, Urban, & James, 2004; Feist, 1998; Griffin &

McDermott, 1998; McCrae, 1987, Silvia, Nusbaum, Berg, Martin, & O'Connor, 2009). It seems logical that in order to become creative, one needs to be open to new experiences and ideas.

Motivation

Central to the investment theory of creativity is the motivation that makes an individual decide to pursue creativity (Sternberg, 2002; Sternberg & Lubart, 1995). The individual decision to be creative springs most often from intrinsic motivation (Amabile, 1996; Hennessey & Amabile, 2010; Shalley & Perry-Smith, 2001; Zhou, 1998). For example, within Amabile's (1996) componential view of creativity, intrinsic motivation is a critical aspect that must be present along with domain-specific creativity and general creativity. Hennessey and Amabile (1988) found that "the sustaining delights of the creative process" (p. 11) and the experience of flow--sustained attention to the creative process that seems to take place out of time (Csíkszentmihályi, 1996) promote creativity through the intrinsic rewards of the process itself.

Environment

Environmental support also plays the important role of either rewarding creative ideas or devaluing them (Csíkszentmihályi & Wolfe, 2000; Sternberg & Lubart, 1995). Creativity does not occur in a vacuum; the cultural context determines whether the idea or product is indeed novel and useful (Moran, 2010). History tells us that creative ideas are not always accepted by the gatekeepers of the creative domain (Csíkszentmihályi & Wolfe, 2000). The individual must often persevere in the face of a resistant environment in order to sell the new idea to those who prefer status quo. An environment that is particularly nurturing of creativity can cause a flowering of creativity, such as the Italian

Renaissance. However, a resistant environment that hinders the creative thinker can be the impetus for creative efforts as well. The need for long-term perseverance in the making of creative work is one of the reasons why intrinsic motivation is supportive of creativity (Hennessey & Amabile, 1988, 2010). The creator is an agent who shapes and selects environments that are conducive to the creative process (Sternberg, 2000).

However, it is his or her endurance in either a receptive or a recalcitrant environment that determines, in part, the outcome of his or her creativity process.

Effects of Creativity

The outcome of creativity is the production of something that is novel and useful in some way. This may be an idea, a product, a business, an experiment, a solution to a problem, a great meal, or a work of art, among many other things. These creative products may not be immediately valued in the existing environment, and the creator must find, persuade, or create a market for the useful new thing. As the magnitude of the creativity increases and the sphere of influence increases, scientific, artistic, technological, and social breakthroughs can take place (Sternberg & Lubart, 1996).

The resources that make an individual creative also have negative effects. In school settings, teachers may dislike the presence of creative students in the classroom because they can be seen as defiant, nonconformist, and difficult (Beghetto, 2007; Sawyer, 2006; Scott, 1999; Torrance, 1963; Westby & Dawson, 1995). The intrinsic motivation that leads to creative perseverance may also lead to the neglect of more mundane tasks (Csíkszentmihályi, 1996). In settings where standardization and conformity are expected, the intense focus of creative perseverance can be perceived as obnoxious or aggressive (Torrance, 1963).

Self-Report Scales of Creativity

One of the biggest challenges of creativity research is sorting through the morass of measures. This diversity occurs because of the complexity of creativity and the many ways to define it (Hocevar & Bachelor, 1989; Plucker et al., 2004). For the purposes of this research, creativity will be measured as a self-reported behavior via the RIBS. An efficient way to find out whether or not individuals are creative is to ask them to report their creativity (Kaufman, 2006).

In a seminal review of creativity measurement, Hocevar (1981) stated:

Perhaps the most easily defensible way of identifying creative talent is in terms of self-reported creative activities and achievements. Although there is a problem in deciding which activities and achievements should be designated as creative, most of the lists that have been used in research have a reasonable degree of face validity. (1981, p. 455)

Self-report checklists of characteristics include the Creative Personality Scale for the Adjective Checklist (Gough, 1979) and the Khatena-Torrance Creative Perception Inventory (KTCPI; Khatena & Torrance, 1976). As part of a larger battery of psychological strengths, there is a Likert-scale creativity survey from the Values in Action Survey (VIA; Peterson & Seligman, 2001). Additional measures include creative behavior inventories (Hocevar, 1979) and inventories of creative accomplishments (Carson, Peterson, & Higgins, 2005).

The Runco Ideational Behavior Scale (RIBS)

The Runco Ideational Behavior Scale (Runco et al., 2001) is a self-report survey instrument that measures divergent thinking. There are 23 items on the scale that assess

the individual's skill level with and use and appreciation of ideas. This creative ideation scale has been used to measure everyday creativity among both adult and adolescent populations (e.g., Ames & Runco, 2005; Benedek, Könen, & Neubauer, 2012; Cohen & Ferrari, 2010; Doyle & Furnham, 2012; Kim & VanTassel-Baska, 2010; Plucker, Runco, & Lim, 2006). The first published psychometric analysis of this scale (Runco et al., 2001) was based on two samples of undergraduate students from different U.S. universities ($N = 97$; $N = 224$). The researchers initially generated a large pool of 100 items in order to reflect a broad diversity of creative ideational behaviors. However, during development, this list was pared down to a final pool of 23. Cronbach's alphas on both samples were strong (.92 and .91, respectively). An exploratory factor analysis on the first sample extracted four eigenvalues greater than .9 (8.5, 1.7, 1.0, and .91). However, a visual check of the scree plot indicated that a one-factor solution was adequate. A confirmatory factor analysis on the second sample and several goodness of fit measures provided mixed results, slightly favoring an interpretation of two correlated factors with correlated uniqueness over a one-factor solution. However, a uni-dimensional solution was selected based on the difficulty of interpreting the second factor and on the theoretical basis for the scale.

Recently, an exploratory factor analysis of the RIBS was conducted by von Stumm, Chung, and Furnham (2011) as part of a larger latent class analysis of creative achievement among university students in Great Britain ($N = 656$). Correlational analysis was conducted on all items on the RIBS Scale. The researchers excluded two RIBS items with factor loading values below .25 and five items with extracted communalities below .25. Exploratory factor analysis for the remaining 16 items found

three factors with eigenvalues greater than 1 accounting for 54.95% of the variance. A visual examination of the scree plot also supported a three-factor solution. The factors were identified as 1) quantity of ideas, 2) absorption, and 3) originality. This research also found significant correlations between ideational fluency (number of ideas) and originality as measured by subscales on another divergent thinking test. The conflicting findings on the factor structure of the RIBS Scale in the original study (Runco et al., 2001) and in this more recent analysis (von Stumm et al., 2011) merit further examination.

Additional research has used the RIBS as an indicator of creative potential and found correlations with other creativity measures. Plucker et al. (2006) administered divergent thinking tests and the RIBS to one sample of American undergraduate students ($n = 95$) and one sample of Korean undergraduate students ($n = 117$). Of particular interest were the findings that originality significantly predicted scores on the RIBS, and that there were no significant cultural differences between samples. This provided evidence that the RIBS is an indicator of individual creativity that is useful cross-culturally. Other studies have also provided evidence of construct validity with statistically significant correlations between scores on RIBS and scores on other creativity tests such as the Torrance Tests of Creative Thinking and the Scales for Rating the Behavioral Characteristics of Superior Students (Kim & Hull, 2012; Kim & VanTassel-Baska, 2010).

Perseverance and Creativity

Another important arc of the current research is the examination of the role of perseverance as an integral part of creativity. Although perseverance is an integral part

of the definition of creativity as presented in the theoretical framework of the investment theory of creativity (Sternberg & Lubart, 1996), its association with creativity has not been empirically examined.

Grit

Grit is a relatively new motivation construct articulating the idea that an individual combines perseverance and passion to accomplish his or her long-term goals (Duckworth et al., 2007). Duckworth (2007) developed and validated the Grit Scale through multiple administrations of the scale among several different populations including (a) adults older than 25 collected via website ($N = 1,545$ and $N = 706$), (b) undergraduates at an elite university ($N = 139$), (c) two incoming classes of West Point Cadets ($N = 1,218$ and $N = 1,308$) and (d) children who were Spelling Bee Champions ($N = 175$).

The initial pool of items for the Grit Scale included 27 items designed to reflect the characteristics of high-achieving individuals. After examining item-total correlations, reliabilities, and overlap of items, this pool was then reduced to 17 items. An exploratory factor analysis was run on a random selection of half of the observations ($N = 772$). The scree plot was examined, and factors with loadings greater than .40 were retained. A two-factor oblique solution was selected as the best fitting structure for the scale, and a final pool of 12 items was retained. Six items indicated consistency of interest and six items indicated perseverance of effort. These subscales were tested as predictors of outcomes, and the two together were more predictive than either subscale alone so the researchers chose to use total scores from the 12-item scale as their measure of grit rather than using the subscales (Duckworth et al., 2007).

Grit has been shown to be more predictive of achievement than intelligence alone in samples of high achievers (Duckworth et al., 2007; Duckworth & Quinn, 2009). For example, in the study of West Point cadets, Duckworth et al. (2007) found that grit predicted retention after controlling for SAT scores, high school academic performance, and conscientiousness. Grit is related to conscientiousness, but its emphasis on stamina sets it apart from that construct, according to Duckworth et al. (2007). Individuals with high levels of grit pursue long-term goals even without positive feedback (Duckworth et al., 2007; Duckworth & Quinn, 2009). In studies of elite groups such as Ivy League undergraduates and National Spelling Bee champions, grit has been shown to be predictive of achievement above and beyond IQ (Duckworth & Quinn, 2009).

Group Differences in Creativity and Grit

Group differences in creativity and grit based on gender and ethnicity have been examined within the literature. Within creativity research, for example, there is some indication that differences exist, such as one study that found that women's verbal creativity was higher than men's (DeMoss, Milich, & DeMers, 1993). However, a literature review by Baer and Kaufman (2006) concluded that differences tend to be inconsistent, and suggests that the differences based on gender may be minimal. However, it is not clear whether these differences are not reported in studies because they are not significant, or because they are not examined. For these reasons, creativity was examined for differences in gender.

Research also has not consistently examined gender differences in grit. For example, when Duckworth and Quinn (2007) examined gender and grit, they did not find any significant differences. However, there are several closely related constructs related

to grit in which there are clear gender differences. For example, women tend to have higher levels of conscientiousness (Eilam, Zeidner, & Aharon, 2009) and the ability to delay gratification (Silverman, 2003). Because measures of these other constructs indicate gender differences, this research explored the possibility of gender differences in grit.

There has also been some research into creativity and grit that indicates that there might possibly be differences based on ethnicity. For example, in some early seminal research into divergent thinking, Torrance (1971, 1973) found that African American children tended to score higher on tests of divergent thinking than European American children. There have also been differences found between European Americans and Hispanic Americans but these have varied by the type of test. For example, when divergent thinking tests were verbal, they favored European Americans, but when they were figural, these differences were not significant (Argulewicz & Kush, 1984). In addition, bilingual Hispanic Americans tended to have a slight advantage in non-verbal assessments of creativity (Kessler & Quinn, 1987). However, a more recent review of the literature indicates that ethnic differences tend not to be found based on ethnicity (Kaufman, 2006).

Grit has not been examined very much among diverse populations. Although early research into grit did not find ethnic differences (Duckworth et al., 2007; Duckworth & Quinn, 2009), a recent study among African Americans has indicated that grit is a particularly strong predictor of college grades among male African American college students in predominantly White institutions (Strayhorn, 2014). Although Strayhorn's study did not compare African American students to students of other

ethnicities, the strength of the findings does prompt the question of whether or not there might be ethnic differences in grit.

Other Relevant Academic Constructs

Motivation

To date, creative ideation and grit have not been studied together with traditional academic motivation variables. For the purposes of this research, two subscales were selected from the well-established PALS Inventory (Midgley et al., 2000): Academic Self-Efficacy and Avoiding Novelty. These two self-perception variables were selected in order to provide construct validity for creative ideation and grit. By examining the interaction of these traditional academic constructs alongside creative ideation and grit, it was hoped that a fuller picture of the role of creativity within an academic context would emerge.

Academic Self-Efficacy. First, academic self-efficacy, or the belief in one's ability to succeed in academic tasks, (Bandura, 1997) was selected because of its conceptual similarity to grit. Both of these self-perceptions are linked to positive academic outcomes (Duckworth et al., 2007; Ryan & Shin, 2011). The Academic Self-Efficacy Scale taken from the PALS Inventory is a measure of academic self-efficacy. This scale has been shown to be unidimensional and to exhibit acceptable levels of internal consistency and validity (Kaplan & Midgley, 1997; Midgley et al., 2000; Ryan et al., 1998). Among early adolescents, academic self-efficacy has been found to positively correlate with two important student engagement variables, self-regulation strategies and task-related interaction (Patrick, Ryan, & Kaplan, 2007) as well as to correlate with

appropriate help-seeking behaviors (Ryan, Patrick, & Shim, 2005; Ryan & Shin, 2011). A sample item is "Even if the work is hard, I can learn it."

Avoiding Novelty. Second, avoidance of novelty, or the preference to avoid new learning, was selected because of its contrast to creative ideation, the active pursuit of new ideas. It was expected that avoidance of novelty would negatively correlate with creative ideation; those who enjoy engaging in creative ideation are necessarily pursuing novelty, not avoiding novelty. The Avoiding Novelty Scale asks students to report on their preference for avoiding academic work that is novel or unfamiliar. The avoidance of novelty has been significantly correlated with academic self-handicapping and the avoidance of help-seeking behaviors (Shih, 2009; Turner et al., 2002). The Avoiding Novelty Scale has been shown to be unidimensional and exhibits acceptable levels of internal consistency and validity (Midgley et al., 2000; Shih, 2009). A sample item is "I prefer to do work as I have always done it, rather than trying something new."

Summary of Dissertation Research

This present research explores creativity as a construct within educational psychology. Two scales were proposed as a means to measure creativity within the context of the investment theory. Creativity is operationalized as creative ideation and is measured by the RIBS Scale. In addition, perseverance, an integral part of the creative process, is measured by the Grit Scale. These two scales were given to two samples of undergraduate students along with two traditional measures of academic motivation: the Academic Self-Efficacy and Avoiding Novelty Scales. Study 1 examined the factor structure and psychometric properties of the RIBS Scale and the Grit Scale. In addition, both samples were examined for group mean differences in creativity and grit.

Study 2 examined the predictive validity of all four scales as academic predictors of grades. Grit was tested as a potential mediator of the relationship between creative ideation and grades because of the integral role of perseverance in the creative process in the investment theory. This research has proposed to measure creativity by combining creative ideation and grit. Testing grit as a mediator is a means of testing this hypothesis in an exploratory manner. Also, because of the presence of other academic variables within the research, it was decided to extend this question to these additional variables. Therefore, grit was also examined as a potential mediator between the two motivation measures and self-reported grades. The working hypothesis guiding the testing of grit as a mediator is that a steady perseverance to accomplish goals could possibly be the process by which creative thinking, academic self-efficacy, and avoidance of novelty lead to positive academic outcomes.

Chapter 3: Study 1

Measuring the Creative Process:

A Psychometric Examination of Creative Ideation and Grit

Joanne Rojas

University of Kentucky

Abstract

Within the investment theory of creativity (Sternberg & Lubart, 1996), creativity is defined as a two-part process of *buying low* by investing in unusual ideas and then *selling high* by convincing others of the value or usefulness of these new ideas. The first part of this process requires creative ideation: an appreciation and enjoyment of working with new ideas. The second part of this process requires perseverance to persuade others of the value of these novelties. The purpose of this research was to examine the psychometric properties of instrumentation proposed to assess the two underlying constructs in this definition: the creative ideational behavior required to buy low and the persevering behavior required to sell high. In particular, psychometric properties of the creativity ideation measure, the Runco Ideational Behavior Scale (RIBS Scale: Runco, Plucker, & Lim, 2001) and the perseverance measure, the Grit Scale (Duckworth, Peterson, Matthews, & Kelly, 2007) were examined in this study. Two samples of undergraduate students ($N = 187$; $N = 817$) completed a survey including these two scales and demographic information. Factor analyses were performed on the RIBS and Grit Scales. In addition, a MANOVA was performed on both scales to detect any differences according to sample, gender, and ethnicity. No significant differences emerged based on sample. However, there were significant mean differences based on gender in creative ideation and ethnicity in grit. These findings and their implications are discussed.

Psychometric Examination of Two Measures of the Creative Process

Determining effective ways to measure creativity is an ongoing pursuit of creativity research. Creativity is a complex construct; and researchers search for an elegant and efficient means to measure the construct. There are a handful of psychometric creativity measures that are used regularly by researchers. However, the psychometric efficacy of these measures is somewhat ambiguous. In addition, these measures tend to focus only on the production of unusual ideas, and this only represents one slice of creativity. Another important aspect of creativity that should also be measured is perseverance. This research seeks to examine the psychometric properties of two measures that have not been used together to measure creativity previously: the Runco Ideational Behavior Scale (RIBS Scale, Runco et al., 2001) and the Grit Scale (Duckworth, Peterson, Matthews, & Kelly, 2007). These two measures are explored within the context of the investment theory of creativity (Sternberg & Lubart, 1996).

Creativity has been a focus of psychological research since the middle of the 20th century (Guilford, 1950). However, due to the complex nature of the construct, there has been difficulty developing psychometric instruments that are concise enough to be practical and to represent the full process of creativity (Hocevar & Bachelor, 1989; Plucker, Beghetto, & Dow, 2004). Creativity research receives attention in a variety of domains, especially psychological and educational. However, the field of creativity research has suffered from a lack of precision in definition and measurement (Plucker & Makel, 2010). Although there are many definitions of creativity, there are two aspects of consensus for the construct: novelty and usefulness/value (Barron, 1955; Hennessey & Amabile, 2010; Mayer, 1999; Mednick, 1962; Peterson & Seligman, 2004; Plucker et al.,

2004; Sternberg & Lubart, 1996). If only one of these two aspects is present, then something cannot be defined as creative. For example, a novel idea might be unusual and unexpected, but if it serves no valuable purpose or brings no aesthetic value of any kind, then it is not creative. Similarly, there are things of value that serve a purpose or solve a problem, but if they are not new in some way, they would not be defined as creative.

Thus, an interaction between novelty and value must take place in order for something to be considered creative, and this interaction is central to formal definitions of creativity (Plucker et al., 2004). However, various theoretical frameworks are built around this consensual definition, and, for the sake of clarity, it is important to identify which framework will be used. For the purposes of this research, the theoretical framework is the investment theory of creativity (Sternberg & Lubart, 1996).

Within the investment theory, creativity is defined as a two-part process of *buying low* by investing in *novel* and unusual ideas and then *selling high* by convincing others of the *value* or usefulness of these new ideas (Sternberg & Lubart, 1996). The first part of this process (buying low) requires the generation of novel ideas through creative ideation: an appreciation and enjoyment of working with new ideas. The second part of this process (selling high) requires perseverance to persuade others of the value of these novelties. Creative people habitually find unusual ways to solve problems, are willing to take risks, are able to defy the predominant ideas of the crowd, and are motivated to overcome obstacles that others would not attempt to surmount (Sternberg & Lubart, 1996). Although deciding to be creative does not guarantee creativity, without this initial decision, creativity cannot occur (Johnson-Laird, 1988; Sternberg, 2012). When the decision to be creative is made regularly, the individual develops the habit of creativity

(Sternberg, 2012). Being habitually novel in one's thinking and problem solving promotes a sort of mindfulness about creativity that becomes a life attitude (Sternberg, 2012).

Perseverance is required to develop these creative habits, but it is not typically measured within creativity research. The creator is an agent who shapes and selects environments that are conducive to the creative process and who decides how to respond to any obstacles present in the environment (Sternberg, 2006). The creator's endurance determines, in part, the outcome of his or her creative process. This is why, for example, intrinsic motivation is supportive of creativity. In order to persevere through a challenging process, the creator must be driven to engage in the task because of positive challenge, enjoyment, or personal interest (Hennessey & Amabile, 1988, 2010).

Creativity can be viewed as a function of cognitive flexibility and cognitive persistence as in the dual pathway model (Nijstad, De Dreu, Rietzschel & Baas, 2010). In experimental research based on this model, those who were primed in a performance approach condition tended to use cognitive flexibility to accomplish creative tasks, and those primed for a performance avoidance tended to use cognitive persistence to accomplish creative tasks (Roskes, De Dreu, & Nijstad, 2012). In other experimental research, perseverance has been measured by time on task as an indication of intrinsic motivation in accomplishing creative tasks (Hennessey & Amabile, 1998). In general, however, the tendency to persevere is not usually explicitly measured in creativity research.

Perseverance is necessary for creativity within the investment theory because investing is a long-term strategy. First, new ideas must be found that are not currently

popular within the mainstream marketplace of ideas. Then these ideas must be sold to this marketplace. All of this requires the expenditure of cognitive resources and energy; to continue to persist in these efforts requires perseverance (Sternberg & Lubart, 1996).

Sternberg and Lubart articulated this model as follows:

Buying low means pursuing ideas that are unknown or out of favor but that have growth potential. Often when these ideas are first presented, they encounter resistance. The creative individual persists in the face of this resistance and eventually *sells high*, moving on to the next new or unpopular idea. Sometimes creativity is thwarted because a person puts forth an idea prematurely or holds an idea so long that it becomes common or obsolete. (1996, p. 683, emphasis in original)

In fact, the entire investment model requires the ongoing interplay between creative ideation and long-term perseverance to understand how and when to persuade others that a new idea is worthy.

Developing a psychometric measurement of creativity has been an ongoing pursuit in the literature with the primary mode of assessment across studies being self-report (Hocevar, 1981; Kaufman, 2006). There are a limited number of scales that have been used extensively. Self-report checklists of characteristics include the Creative Personality Scale for the Adjective Checklist (Gough, 1979); this scale was originally generated as one aspect of assessing leadership potential in business contexts. The Khatena-Torrance Creative Perception Inventory (KTCPI; Khatena & Torrance, 1976) was used decades ago as an aspect of assessing schoolchildren for gifted programs, but the measure itself has fallen out of use almost completely and is not readily available to

researchers. There are also inventories that include creative behavior checklists (Hocevar, 1979) and lists of possible creative accomplishments (Carson, Peterson, & Higgins, 2005). For a recent literature review of self-report scales of creativity, see Silvia, Wigert, Reiter-Palmon, & Kaufman (2011).

Researchers have also used the RIBS Scale (Runco et al., 2001), a 23-item scale that describes the individual's skill level with and use and appreciation of ideas. This scale asks participants to self-report on their thinking habits. Although developed some time ago, the RIBS Scale continues to be a relatively common creativity measure for both adults and adolescents. One study found that creative high school students from low-income families were more likely to drop out of school when they perceived their school settings to be unsupportive of creativity (Kim & Hull, 2012). Another study with Korean elementary and high school students indicated that gifted underachievers with high creative ideation had more behavior problems in school (Kim & VanTassel-Baska, 2010).

Despite increased usage of the RIBS Scale, psychometric research with the scale has not shown a clearly defined factor structure. As mentioned, the original validity study on the scale determined a uni-dimensional solution to the factor structure for theoretical reasons (Runco et al., 2001), but the factor loadings indicated as many as two or three separate factors. The most recent exploratory factor analysis (von Stumm, Chung, & Furnham, 2011) found three factors: quantity of ideas, absorption, and originality. However, they also reduced the scale to 16 items. The conflicting findings on the factor structure of the RIBS Scale in the original study (Runco et al., 2001) and in this more recent analysis (von Stumm et al., 2011) merit further examination.

As mentioned earlier, it is the interplay between creative ideation and perseverance that is being explored in this research. The RIBS Scale will be examined as a measure of creative ideation. Perseverance will also be measured.

One recent measure of perseverance is the Grit Scale (Duckworth et al., 2007). Grit is the perseverance and passion to pursue long-term goals, and as such, fits well conceptually into the idea of investing in unusual ideas in spite of opposition. Duckworth's team reported a correlated two-factor structure (consistency of interest and perseverance of effort) for the scale (Duckworth et al., 2007). The current study represents an independent examination of this construct among diverse college students. The original research on the construct was conducted on predominantly White samples (Duckworth et al., 2007).

The purpose of this research was to examine the psychometric properties of instrumentation proposed to assess these two underlying constructs in the following definition of creativity: the creative ideational behavior required to buy low and the persevering behavior required to sell high. In particular, psychometric properties of the creative ideation measure, the RIBS Scale (Runco et al., 2001) and the perseverance measure, the Grit Scale (Duckworth et al., 2007) were examined in this study. Two samples of undergraduate research participants ($N = 187$; $N = 817$) completed these two scales. In addition, mean scores on the RIBS and Grit Scales were examined for any differences based on sample, gender, or ethnicity. Previous findings on group differences in creativity and grit will be discussed below.

There have been mixed findings regarding gender differences in creativity and grit. Although a recent literature review has found that in general there are no consistent

differences in creativity based on gender (Baer & Kaufman, 2006), there are some indications that there might be some. For example, women tend to score higher than men on verbal creativity (DeMoss, Milich, & DeMers, 1993). There are also some indications that different aspects of creative thinking may operate differently according to gender. For example, in a study of Spanish schoolchildren, girls' creative elaboration was related to academic achievement, but boys' creative flexibility was related to academic achievement (Ai, 1999). In another study, girls' creativity decreased when placed in an extrinsic motivation condition, but boys' creativity did not (Baer, 1997).

There is not an indication of gender differences in grit, although there are gender differences in constructs closely related to grit such as delay of gratification (Silverman, 2003) and conscientiousness (Eilam, Zeidner, & Aharon, 2009); women and girls tend to be higher in these related traits than their male counterparts. However when Duckworth and Quinn (2007) examined gender and grit, they did not find any significant differences.

As far as ethnic differences in creativity and grit, there have been some indications that there may be group differences. In some early creativity research focused on divergent thinking, African American children tended to score higher on tests of divergent thinking than European American children (Torrance, 1971, 1973). There have also been differences found between Hispanic American and European Americans on divergent thinking tests. Verbal divergent thinking tests favored European Americans, but figural divergent thinking tests showed no significant differences (Argulewicz & Kush, 1984). However, bilingual Hispanic Americans tended to have a slight advantage in non-verbal assessments of creativity (Kessler & Quinn, 1987). A more recent review of the literature indicates that differences tend not to be found on the basis of ethnicity

(Kaufman, 2006), but much of creativity research is done with predominantly White samples. Due to the significant portion of this sample that is Hispanic and African American, the examination of group differences took place in this research.

There are also inconsistent results regarding grit research and ethnicity. Although early research into grit did not find differences based on ethnicity (Duckworth et al., 2007; Duckworth & Quinn, 2009), some recent research into African American samples has indicated that grit is a particularly strong predictor of college grades among African American college students in predominantly White institutions (Strayhorn, 2014). Although Strayhorn's study did not compare African American students to students of other ethnicities, it does hint that there might be some differences based on ethnicity. This provided the impetus to explore ethnic differences in this research as well.

Research Questions and Hypotheses

The overarching research questions that guided this research were as follows: (R1) What is the underlying factor structure of the RIBS Scale? The question was answered through an exploratory factor analysis because of conflicting results in previously published literature on the factor structure. (R2) Does the Grit Scale have a correlated two-factor structure based on consistency of interests and perseverance of effort? The question was answered through a confirmatory factor analysis because of the clarity of previous results published in the literature. (R3) Do scores on the RIBS and Grit Scales vary by gender, ethnicity, or sample? This question was answered through a multivariate analysis of variance.

Methods

Procedure

IRB approval of this research as an exempt study was provided by the University of Kentucky, Office of Research Integrity. Permission was granted to recruit college students and to offer incentives to students for participation in the study. Some students were offered extra credit or research participation credit by their instructors in their introductory courses in educational psychology, family studies, sociology, or psychology. Instructors did not receive any information regarding individual student survey responses, but did receive notification when a student participated in the research. Other students were recruited via email invitation sent out by their college instructors. These students were placed in a drawing for one of three \$25 gift cards as an incentive to participate.

All students completed an electronic version of the survey in Qualtrics regardless of the incentive offered. The study was piloted in the Summer of 2014 by six students attending summer classes in educational psychology at the research university site. This group acted as a pilot for the study procedures including electronic data collection. No changes were made to the survey after this pilot, so those data were included in the present research. The majority of the student participants responded to the survey in October and November 2014, and all data collection was completed in December 2014.

Instrumentation and Measures

Participants completed a questionnaire including demographic information and Likert-scale responses to these two scales as part of a larger data collection project. The scales of interest for this research were the 23-item RIBS Scale (Runco et al., 2001), and

the 12-item Grit Scale (Duckworth et al., 2007) Demographic information included gender, ethnicity, and grades.

Participants

The first sample was taken from several different campuses in 10 states across the United States with the majority coming from one public university in California. The sample was primarily Hispanic/Latino (42.2%) followed by European American (26.6%), Black/African American (9.6%), Asian (5.9%), multiracial (7.4%) with the remaining percentages listing "other" or not providing information; the second sample was taken from one research institution in the Southeastern United States and was primarily European American (73%). The MC sample was 71.4% female, and the RU sample was 82.5% female. The multi-campus (MC) sample included 187 students, which was slightly lower than the minimum target N for each sample of 230 based on a 10:1 subject to items ratio (Everitt, 1975; Kunce, Cook, & Miller, 1975; Osborne, Costello, & Kellow, 2008) for the longest scale, the 23-item RIBS Scale. However, it is close at about 8:1 ratio, and this is still higher than the often cited Gorsuch (1983) guideline of 5:1 for conducting factor analysis with sufficient power (Osborne & Costello, 2004). Although the first sample size was small but adequate, the research university (RU) sample of 817 was more generous and fit the criteria for conducting factor analysis. Each campus sample was analyzed separately and then compared in order to determine if the scales operate similarly among different college student samples. All students completed an electronic version of the survey.

Runco Ideational Behavior Scale

The first published psychometric analysis of this scale (Runco et al., 2001) was based on the initial development of the scale with two samples of undergraduate students from different U.S. universities ($N = 97$; $N = 224$). The final 23-item scale was determined. A sample item from the scale is "I am good at combining ideas in ways that others have not tried." Cronbach's alphas on both samples were strong (.92 and .91). An exploratory factor analysis on the first sample extracted four eigenvalues greater than .9 (8.5, 1.7, 1.0, and .91). However, according to the researchers, a visual check of the scree plot indicated a one-factor solution was adequate. A confirmatory factor analysis on the second sample and several goodness of fit measures provided mixed results, slightly favoring an interpretation of two correlated factors with correlated uniqueness over a one-factor solution. However, a unidimensional solution was selected based on the difficulty of interpreting the second factor and on the theoretical basis for the scale. Although the researchers did not explicitly name this factor, it presumably represents the construct of creative ideation.

Recently, an exploratory factor analysis of the RIBS Scale was conducted by von Stumm et al. (2011) as part of a larger latent class analysis of creative achievement among university students in Great Britain ($N = 656$). Correlational analysis was conducted on all items on the RIBS Scale. The researchers excluded two RIBS items with values below .25 and five items with extracted communalities below .25 (specific factor loadings for these items were not reported by the original authors). Exploratory factor analysis for the remaining 16 items found three factors with eigenvalues greater than 1, which accounted for 54.95% of the variance in RIBS scores. A visual

examination of the scree plot also supported a three-factor solution. These three factors were identified as 1) quantity of ideas, 2) absorption, and 3) originality (specific eigenvalues were not reported by the authors.) This research also found significant correlations between fluency and originality as measured by subscales from the classic unusual uses test of divergent thinking (Guilford, 1967). In this often-used test, participants think of unusual uses for common objects and have a brief time to list as many uses as possible.

Slightly different versions of this scale have been used to measure creative ideation among both adult and adolescent populations (e.g., Ames & Runco, 2005; Benedek et al., 2012; Cohen & Ferrari, 2010; Doyle & Furnham, 2012; Kim & VanTassel-Baska, 2010; Plucker, Runco, & Lim, 2006). These multiple versions seem to be due to the questionable factor loadings from previous validity studies. For example, Cohen and Ferrari (2010) used a 24-item version, Kim and VanTassel-Baska (2010) translated a longer 56-item version of the scale into Korean, and Ames and Runco (2005) used a longer, 37- item version of this scale with items that were excluded from the original RIBS version published by Runco et al. in 2001. Benedek et al. (2012) used a German translation of a briefer version of the scale based on the 17 items that Runco et al. (2001) reported loading on the first factor.

Additional research has used the RIBS Scale as an indicator of creative potential and found correlations with other creativity measures. For example, Plucker et al. (2006) administered divergent thinking tests and the RIBS to one sample of American undergraduate students ($N = 95$) and one sample of Korean undergraduate students ($N = 117$). Of particular interest were the findings that originality significantly predicted

scores on the RIBS, and that there were no significant cultural differences between samples. This provided evidence that the RIBS is an instrument that 1) assesses individual creativity and 2) can be useful in examining creativity cross-culturally. Other studies have also provided evidence of construct validity. Specifically, Kim and colleagues found statistically significant correlations between scores on RIBS and scores on other creativity tests such as the Torrance Tests of Creative Thinking and the Scales for Rating the Behavioral Characteristics of Superior Students (Kim & Hull, 2012; Kim & VanTassel-Baska, 2010).

Grit Scale

Grit was measured using the Grit Scale developed by Duckworth et al. (2007). The scale was developed and validated through multiple administrations among several different populations (Duckworth et al., 2007): adults older than 25 who completed the scale via website ($N = 1,545$ and $N = 706$), undergraduates at an elite university invited via email to an online survey ($N = 139$), two incoming classes of West Point Cadets ($N = 1,218$ and $N = 1,308$) who filled out scales as part of their orientation and spelling bee champions in the upper elementary and middle school grades ($N = 175$) who elected to participate prior to the final competition. In each of these studies, grit predicted success among already high-achieving individuals. For example, grit was found to predict ranking in the finals of the spelling bee, higher GPA among Ivy League undergraduates, and retention of cadets at the United States Military Academy (Duckworth et al., 2007). Along with its ability to predict an important conceptually associated criterion variable, the Grit scale has also demonstrated evidence of internal consistency, with estimates ranging from .77 to .85 across six samples. Additionally, factor analysis by Duckworth

and colleagues in the initial scale validation study indicated two factors: consistency of interests and perseverance of effort (Duckworth et al., 2007). Reliabilities for each subscale were as follows: consistency of interests ($\alpha = .84$) and perseverance of effort ($\alpha = .78$). "I often set a goal but later choose to pursue a different one." is a typical item from the consistency of interests subscale, and "I have overcome setbacks to conquer an important challenge." is a typical item from the perseverance of effort subscale. Duckworth et al. (2007) reported that the model fit indices supporting this two-factor solution were adequate (CFI = .83 and RMSEA = .11). There was not a psychometric analysis on these scales that examined differences according to gender or ethnicity.

Statistical Analyses

Two separate exploratory factor analyses were conducted (one with each sample) to determine the factor structure of the RIBS Scale because previously published studies (Runco et al., 2001; von Stumm et al., 2011) have reported differing factor structures. Both samples were analyzed separately using principal axis factoring with oblimin rotation, in order to allow for violations of sample normality and correlated factors (Costello & Osborne, 2005; Osborne, Costello, & Kellow, 2008). Researchers often use principal components analysis as their default factor analysis procedure because of its familiarity and default status in statistical software such as SPSS (Osborne et al., 2008). However, it is best practice to make decisions regarding the type of factor analysis on the data, not based on convenience of software available. A visual inspection of the items showed approximate normality with the exception of several skewed items, so there were some violations of sample normality. In addition, any factors present within the data would be expected to correlate. This is why principal axis factoring was selected.

Similarly, two separate confirmatory factor analyses were conducted on the Grit Scale in each sample to determine whether the two-factor correlated structure for grit as reported by Duckworth et al. (2007) was the same in the current study. These analyses were done using AMOS modeling software. The previous research regarding the Grit Scale reported a two-factor correlated structure (Duckworth et al., 2007). For that reason, a confirmatory factor analysis was planned for this scale. Confirmatory factor analysis has several advantages over exploratory factor analysis, according to guidelines put forth by Marsh and Hocevar (1985). First, confirmatory factor analysis is conducted upon covariance matrices from the two samples rather than correlation matrices; this means that the comparison of the hypothesized model to the model fitting the data uses the same parameters, and these two models can be compared with chi-square tests and goodness of fit indicators. Exploratory factor analysis does not allow for the same control of model comparisons. This will provide evidence of the utility of these scales among diverse undergraduate populations.

Finally, a multivariate analysis of variance was conducted on the larger combined dataset after deleting those cases with missing data ($N = 989$) in order to determine if scales varied across sample, gender, and ethnicity.

Results

R1. What is the underlying factor structure of the RIBS Scale?

A visual examination of the scree plots for both samples indicated the presence of at least two distinct factors. The first eigenvalues (9.54 and 9.14), and the second eigenvalues (2.05 and 2.30) were similar for the RU and MC samples respectively. According to the "Gorsuch rule" (Gorsuch, 1983), when the first eigenvalue is more than

three times the value of the second eigenvalue, the scale may be treated as a unidimensional scale. The examination of the scales continued to determine the underlying factor structure.

Results from the principal axis factoring of the RIBS Scale are in Table 1. The larger research university (RU) sample produced two factors with loadings above .40 and the smaller multi-campus (MC) sample produced three factors with loadings above .40. This indeterminate factor structure between two separate samples in the same study reflects the initial validity research on the scale that reported problematic noise in the data (Runco et al., 2001). The only item that loaded on Factor 3 in the MC sample was 13 ("I try to exercise my mind by thinking things through.") This factor also had a loading of .55 on Factor 1 and .49 on Factor 2, so it was determined to load on the first factor based on the greater value. This eliminated the third factor as noise in the data, and further examination of the factor structure in both samples looked at a possible two-factor solution. It was determined that 19 items had clear loadings on the first factor in both samples, so the second factor was carefully examined by factor loadings as well as an examination of the wording of items.

The remaining four items had loadings above .40 on two factors in both of the samples. These items were 19 ("Sometimes I get so interested in a new idea that I forget about other things that I should be doing."), 21 ("When writing papers or talking to people, I often have trouble staying with one topic because I think of so many things to write or say."), and 23 ("Some people might think me scatterbrained or absentminded because I think about a variety of things at once.") Item 22 ("I often find that one of my ideas has led me to other ideas, and I end up with an idea and do not know where it came

from.") loaded on two factors in the MC sample, but only on the first factor in the RU sample. However, it did load at .39 on the second factor in the RU sample; although this value is slightly below the .40 cutoff, it was included because it was so near the cutoff and because it reflected the factor structure in the other sample.

All four of these items had conceptual similarities in their wording. Each item described an aspect of creative ideation that reflected becoming lost in one's thoughts. Forgetfulness, getting off topic while writing, being perceived as absentminded, and arriving at an idea that comes out of nowhere are all indicators of a thinking process that seems outside of the control of the thinker. These four items were considered as a subscale called the Scatterbrained Subscale. This descriptive word was chosen because it was used in item 23, and it seemed to sum up the similarities in the wording of these four items. The other 19 items that had loadings on the first factor were called the Divergent Thinking Subscale. When the scale was initially developed, it was considered a self-report of divergent thinking, so this wording seemed appropriate. See Table 2 for psychometrics regarding the subscales.

By exploring the factor structure across these two samples, there was a clear consistency in the structure between these two groups. In addition, although previous research either has found the multiple factors to lack interpretability or has eliminated a large portion of the scale in order to interpret the factors, this research was able to keep the original scale intact while interpreting two distinct factors. First, factor loadings were interpreted for clear loadings on the first factor. After interpreting a few cross-loaded items based on both factor loadings and theory, it was determined that the scale items loaded on two correlated factors.

Internal consistency estimates were calculated for the 23-item RIBS Scale, the 4-item Scatterbrained Subscale, and the 19-item Divergent Thinking Subscale; correlations between the two subscales were also calculated (see Table 2). The MC sample and RU sample results were similar. Cronbach's alphas for the 23-item RIBS Scale (.93 and .94), the 19-item Divergent Thinking Subscale (.92 and .93), and the 4-item Scatterbrained Subscale (.85 and .84) were all strong providing evidence of similarity among the items and reliability of the scales. The subscales were also significantly ($p < .01$) and positively correlated in both the MC sample (.57) and the RU sample (.62).

Ultimately, factor analysis uses statistical processes that provide evidence for an existing factor structure that must then be evaluated on theoretical and conceptual grounds. Based on the factor loadings, consistency estimates, and correlations, as well as a theoretical examination of the items on the scale, the RIBS Scale is considered to be a robust, correlated two-factor scale across both study samples. This scale includes both the positive aspects of divergent thinking (e.g., "I would rate myself highly in being able to come up with ideas.") as well as the distracted aspects of being lost in thoughts (e.g., "Some people might think me scatterbrained or absentminded because I think about a variety of things at once.") The evidence from these data for a correlated two-factor structure of the RIBS Scale is strong both statistically and theoretically. This clearer factor structure provides new insight into creative ideation as a combination of generating new ideas (thinking divergently) and also sometimes getting distracted (being scatterbrained). These two aspects bring a clearer definition to creative ideation as represented by the RIBS Scale. The predictive validity of these two subscales can be examined in future research.

R2. Does the Grit Scale have a correlated two-factor structure based on consistency of interests and perseverance of effort?

The previously published validity evidence for the Grit Scale (Duckworth et al., 2007) concluded that the scale had a clear two-factor correlated structure with Factor 1 representing consistency of interest, and Factor 2 representing persistence of effort (Duckworth et al., 2001). Items numbered 1 through 6 in this research have loaded on Factor 1, while items 7 through 12 have loaded on Factor 2. This correlated two-factor structure of grit was modeled using AMOS software (see Figure 1). This hypothesized model was tested separately using data from each of the two samples and was examined for fit using multiple criteria. When examining goodness of fit, multiple measures were used because there is not one single test that best summarizes the strength of a given model. The criteria of good fit used for these analyses included a non-significant chi-square value, CFI $>.9$, RMSEA $<.05$, GFI $>.9$, RMR $>.05$, and TLI $>.95$ (Byrne, 2001).

Because of the dangers of using confirmatory techniques to over-fit the model, confirmatory factor analysis should be based on existing theory and previous empirical evidence (Lowry & Gaskin, 2014). This research is validating the original model previously theorized and validated by Duckworth et al. (2007). Within this confirmatory approach, covariates are treated as constructs so that the measurement error can also be modeled (Lowry & Gaskin, 2014). When seeking to find an appropriate model, it was determined in advance to examine modification indices and to only consider making limited adjustments to the model in order to fit the model. The only adjustments that were considered were those that allowed error terms to vary between items that were hypothesized to be within the same factor. Due to the correlated nature of the items on

the individual factors of the scale, the covariance of error terms within theoretical factors was not judged to be an overuse of the modification indices or overfitting of the model.

In the MC sample, the initial model fit indices were unsatisfactory for the hypothesized model. The chi-square value was significant, and the other indices (CFI, RMSEA, GFI, RMR, and TLI) were also indicative of poor fit. After reviewing the modification indices, it was determined that several of the error terms (e1 and e2; e1 and e5; e3 and e4; e5 and e6) were covarying. The model was changed to allow those error terms to covary because these occurred within the hypothesized factor (see Figure 2). Once these changes were made, the model exhibited satisfactory fit indices (see Table 3).

Similarly, in the RU sample, the initial model fit indices consistently indicated poor fit. Modification indices showed several covarying error terms. All of the factors that covaried within the expected factor were allowed to covary (e8 and e10; e11 and e12) as in the MC sample, (see Figure 3). Although the chi-square value remained significant, there was considerable improvement in the chi-square statistic ($\chi^2 = 112.06$) when compared to the initial model ($\chi^2 = 480.953$). All other indices showed satisfactory fit (see Table 3).

Table 4 shows all variances, covariances, and correlations for the scale in both samples, and Table 5 shows all pattern and structure coefficients. Cronbach's alphas, means, and correlations were calculated for the subscales, see Table 6. These subscales were significantly and positively correlated in the MC and the RU samples at $p < .01$ (.33 and .32, respectively). The evidence is strong for a correlated two-factor structure for the Grit Scale in both samples, and this replicates the earlier findings (Duckworth et al., 2007).

R3. Do scores on the four scales vary by sample, gender, and ethnicity?

A multivariate analysis of variance (MANOVA) compared mean scores on RIBS and Grit Scales across sample (RU or MC sample), gender (female or male), and ethnicity (European American/White, Hispanic, Black/African American, and other). (See Table 7). MANOVA was chosen because it takes into account the potential intercorrelations among the variables and allows for the analysis of the measures simultaneously based on three distinct groupings. According to Grice and Iwasaki (2007), one of the advantages in running a MANOVA is examining the linear combinations of multiple quantitative variables. In this study, for example, female and male students were examined for differences in creativity and perseverance according to sample and ethnicity. Examining multivariate linear combinations increases the chance to uncover meaningful underlying differences among students including interaction effects (Stevens, 2002; Tabachnick & Fidell, 2006). The omnibus null hypothesis is that RIBS and Grit are equal with regard to their population means on every possible linear combination of these variables according to sample, gender, and ethnicity. If the differences are found to be statistically significant, then there are differences based upon this multivariate combination.

First, the Levene's statistics was examined to check for homogeneity of variance among the scales. This statistic was not significant for the RIBS Scale: $F(13,977) = .669$, $p = .80$, but it was significant for the Grit Scale: $F(13, 977) = 1.830$, $p < .05$ so between-group homogeneity could not be assumed for grit. To examine variable correlations between groups, the Box's M statistic was examined. This statistic was not statistically

significant, so homogeneity of covariances could be assumed for both scales, and MANOVA should be able to detect significant differences without error.

Further examination of the multivariate tests included examination of the test statistic Pillai's Trace because it is robust in cases when assumptions are violated. A factorial MANOVA revealed significant multivariate main effects for gender and ethnicity, but no significant differences on RIBS or Grit mean scores according to sample, $V = .006$, $F(4, 959) = 1.394$, $p = .23$.

There was a significant between-subjects effect by gender for the 23-item RIBS Scale, $F(1, 988) = 12.338$, $p < .001$. Male students reported higher levels of creative ideation, $M = 3.48$ (.62), than female students, $M = 3.21$ (.63). Additional tests of between-subjects effects indicated significant differences in ethnicity on grit, $F(6, 988) = 2.167$, $p < .05$. (See Table 8).

Discussion

Creativity can be a fuzzy construct. This research sought to apply psychometric rigor to two measures purported to assess the descriptive aspects of the creative process, namely the RIBS Scale and the Grit Scale. Although the factor structure for the RIBS Scale has been contradictory in previous research (Runco et al., 2001; von Stumm et al., 2011), this research had the advantage of two different samples for a factor analysis of the scale. In addition, this research includes one sample that is primarily Hispanic, and there is a significant proportion of Black/African American participation. This participant diversity may provide new insights into how the scale performs.

The finding across both samples that there was a correlated two-factor structure is new. The first factor was represented by 19 items and is called the Divergent Thinking

Subscale, and the second factor was represented by 4 items and is called the Scatterbrained Subscale. These two subscales were significantly correlated. Thus, with the correlation of the two factors that reflect the conceptualization of the creative process, it is recommended that the RIBS be used as a total scale representing creative ideation. Although some researchers might use the factors to calculate scores for subscales, this is not recommended because the two factors are highly correlated (Grice, 2001). In addition, an examination of the eigenvalues indicated that the highest eigenvalue is three times the second eigenvalue, and, as such, the scale should be treated as unidimensional (Gorsuch, 1983). The underlying factor structure is clear for these two samples, and this brings much more clarity to the underlying construct measured by this scale. This should provide confidence to researchers regarding the efficacy of the RIBS Scale as a measure of creative ideation.

The Grit Scale has recently been used extensively, especially in research in education, e.g., as a predictor of novice teacher effectiveness (Robertson-Kraft & Duckworth, 2014) and in psychology, e.g., as a predictor of psychological well-being (Salles, Cohen, & Mueller, 2014). The correlated two-factor structure of the Grit Scale, as hypothesized based on previous findings (Duckworth et al., 2007), was replicated here. Just as in the initial validity study (Duckworth et al., 2007), this score should be treated as a total scale and not as subscales because of the correlation between the factors. Theoretically, grit is a combination of interest and effort and to measure grit, both factors should be included. In addition, it does make theoretical sense as a scale to use in conjunction with the RIBS as a more comprehensive means of measuring the perseverance that is inherent in an understanding of creativity. The primary impetus

behind this research was to operationalize the two parts of the investment theory of creativity (Sternberg & Lubart, 1996) that includes both creative ideation and perseverance.

Finally, there were some interesting group differences based on gender and ethnicity. Because there were no differences based on group, the sample could be combined to examine gender and ethnic differences in a combined sample. Previous research has indicated that there are no consistent gender differences found in scores on a wide variety of creativity assessments (Baer & Kaufman, 2008; Kaufman, 2006), so gender differences were not necessarily expected. However, male students reported significantly higher scores on the RIBS Scale across the entire sample with a mean that was .26 points higher than female students reported. This is statistically significant, but is a relatively small difference in practical terms. The SDs for both groups was nearly identical as well. There were no differences in creative ideation based on ethnicity, but there were ethnic differences in grit.

Within the current research, Black students had significantly higher levels of grit than White, Hispanic, or other students. Most previous research examining grit has been conducted with predominantly White samples, and grit has not been examined extensively among racially and culturally diverse populations. One notable exception is an examination of Black college students attending predominantly White institutions that found that grit accounted for higher grades among Black students even after controlling for high school GPA, ACT scores, and educational aspirations (Strayhorn, 2014). Future research should focus on the measurement of grit, particularly using the Grit Scale among Black, Latino, Asian, and mixed ethnicity populations. These ethnic differences in grit

may point to important cultural differences in motivation that could help to target specific social psychological interventions for college student success (Yeager & Walton, 2011).

Limitations and Future Research

This research sought to examine the psychometrics and the factor structure of the RIBS and the Grit Scales as a possible means of operationalizing the investment theory of creativity. Although self-report scales have limitations, they are one way of trying to succinctly identify important psychological differences among students. The psychometric analysis and factor analyses indicated that these scales can be used with confidence.

First, the exploratory factor analysis of the RIBS Scale presented a new way to look at the scale. In particular, the two new subscales, the Divergent Thinking Subscale and the Scatterbrained Subscale, reflect the factor structure present in these two large samples, and provide a new theoretical insight into the scale. This factor structure should be replicated in future research.

The confirmatory factor analysis of the Grit Scale provided further evidence of a correlated two-factor structure. Previous research on the Grit Scale indicated clear loadings on the two factors of interest and effort, and this research confirmed that structure overall. Because of the replication of this structure, the scale appears to be an adequate overall measure of grit and can be used with confidence.

Finally, this research detected some underlying ethnic and gender differences in the scales. Men had higher scores on creativity, and African Americans had higher scores on grit than all other groups. Although a MANOVA can point out underlying differences in means, it can be somewhat problematic to interpret the importance of these

differences. The surprising indication that men had higher creativity should be examined in future research on the RIBS Scale. Future research on grit should narrow the focus of the research to fewer ethnic groups in order to detect clear differences in how these constructs operate among diverse populations. In addition, research regarding interventions to promote grit should be explored.

There were limitations to this research. Although the sample size was strong enough for robust analyses, it was a convenience sample of students in social science courses who were predominantly female. Additional research could include a confirmation of this factor structure among working adults in order to see if the structure is replicated outside of an undergraduate sample. In addition, these adults could be sampled from diverse workplaces including creative and non-creative fields in order to see if these contexts uncover any differences in how these constructs operate.

Table 1

Factor Loadings and Communalities Based on Principal Axis Factoring with Oblimin Rotation for 23 Items from the Runco Ideational Behavior Scale (RIBS)

Scale Item	RU Sample (N = 817)			MC Sample (N = 187)			
	F1	F2	E	F1	F2	F3	E
9-I have always been an active thinker--I have lots of ideas.	.75		.62	.70			.61
8-I would rate myself highly in being able to come up with ideas.	.74		.62	.67			.52
6-I like to play around with ideas for the fun of it.	.71		.55	.71			.54
15-I am good at combining ideas in ways that others have not tried.	.69		.56	.68			.57
17-I have ideas about new inventions or about how to improve things.	.66		.46	.69			.52
2-I think about ideas more often than most people.	.66		.47	.67			.54
1-I have many wild ideas.	.65		.52	.61			.47
22-I often find that one of my ideas has led me to other ideas, and I end up with an idea and do not know where it came from.	.64	.39*	.57	.60	.48		.60
5-I come up with an idea or solution other people have never thought of.	.64		.48	.66			.54
18-My ideas are often considered "impractical" or even "wild."	.64		.51	.63			.57
14-I am able to think up answers to problems that haven't already been figured out.	.64		.54	.67			.68
7-It is important to be able to think of bizarre and wild possibilities.	.63		.45	.63			.58
3-I often get excited by my own new ideas.	.63		.45	.61			.49
19-Sometimes I get so interested in a new idea that I forget about other things that I should be doing.	.62	.40	.54	.64	.42		.60
4-I come up with a lot of ideas or solutions to problems.	.61		.49	.62			.51
12-I am able to think about things intensely for many hours.	.59		.45	.59			.38
11-I would take a college course which was based on original ideas.	.58		.34	.55			.37
16-Friends ask me to help them think of ideas and solutions.	.56		.36	.50			.38
13-I try to exercise my mind by thinking things through.	.55		.44	.55		.49	.69
20-I often have trouble sleeping at night, because so many ideas keep popping into my head.	.52		.44	.58			.41
10-I enjoy having flexibility in the things I do and room to make up my own mind.	.55		.35	.46			.36
21-When writing papers or talking to people, I often have trouble staying with one topic because I think of so many things to write or say.	.54	.46	.51	.50	.47		.53
23-Some people might think me scatterbrained or absentminded because I think about a variety of things at once.	.54	.55	.60	.50	.63		.65

Note. . F1 = Factor 1; F2 = Factor 2; F3 = Factor 3; E = Extraction. Factor loadings < .40 not included.

* Indicates factor included because it was nearing .40 Eigen values were: (RU sample) F1 = 9.54 and F2 = 2.05; (MC sample) F1 = 9.14, F2 = 2.30, and F3 = 1.27.

Table 2

Cronbach's Alphas, Means, and Correlations for RIBS Subscales by Sample

	α	Means (SD)	Subscale correlation
MC Sample (<i>N</i> = 187)			
RIBS full scale	.93	3.28 (.63)	
1. Divergent Thinking Subscale	.92	3.33 (.63)	
2. Scatterbrained Subscale	.85	3.00 (.97)	.57**
RU Sample (<i>N</i> = 817)			
RIBS full scale	.94	3.27 (.64)	
1. Divergent Thinking Subscale	.93	3.31 (.64)	
2. Scatterbrained Subscale	.84	3.03 (.95)	.62**

Note. ** $p < .01$.

Table 3

Chi-Square and Goodness of Fit Indices for Final Models of the Grit Scale

Factor model	χ^2	df	CFI	RMSEA	GFI	RMR	TLI
Two-factor correlated 12-item scale (MC Sample)	50.548	47	.996	.020	.958	.051	.994
Two-factor correlated 10-item scale (RU Sample)	23.443*	23	1.0	.052	.994	.020	1.0

Note. The criteria of good fit used for these analyses included a non-significant chi-square value, CFI >.9, RMSEA <.05, GFI >.9, RMR >.05, and TLI >.95. * significant chi-square value.

Table 4

Variances, Covariance Matrix, and Correlation Matrix for the Grit Scale in Both Samples

MC	Interest Subscale						Effort Subscale					
	1	2	3	4	5	6	7	8	9	10	11	12
1	.90	.48	.54	.43	.43	.31	.27	.18	.12	.13	.08	.14
2	.52	.93	.61	.49	.46	.45	.28	.17	.09	.10	.12	.13
3	.52	.57	1.23	.79	.46	.44	.43	.34	.19	.21	.25	.26
4	.43	.48	.68	1.10	.43	.48	.31	.20	.11	.15	.07	.13
5	.44	.46	.40	.40	1.07	.78	.27	.13	.10	.12	.17	.14
6	.32	.44	.37	.43	.71	1.11	.24	.09	.12	.09	.18	.09
7	.30	.31	.41	.32	.27	.24	.90	.44	.40	.25	.39	.39
8	.19	.18	.31	.19	.13	.08	.46	.98	.44	.18	.40	.41
9	.14	.11	.19	.11	.11	.13	.47	.49	.82	.30	.39	.43
10	.19	.14	.26	.20	.16	.12	.37	.25	.45	.52	.30	.34
11	.09	.12	.22	.07	.16	.16	.41	.40	.42	.41	1.05	.54
12	.17	.15	.26	.14	.15	.10	.45	.46	.53	.52	.59	.81
RU												
1	.94	.59	.54	.50	.48	.41	.22	.13	.15	.14	.21	.19
2	.59	1.08	.68	.55	.51	.45	.24	.15	.17	.16	.23	.21
3	.50	.57	1.26	.69	.55	.45	.27	.17	.19	.18	.26	.24
4	.51	.54	.62	.99	.49	.39	.22	.14	.15	.14	.21	.19
5	.46	.48	.47	.47	1.12	.70	.21	.13	.15	.14	.21	.19
6	.43	.45	.41	.39	.66	.99	.18	.11	.13	.12	.17	.16
7	.36	.35	.38	.29	.26	.20	.81	.33	.38	.36	.37	.32
8	.15	.16	.24	.16	.11	.08	.35	1.12	.34	.23	.32	.29
9	.19	.17	.28	.15	.14	.10	.48	.38	.71	.40	.38	.32
10	.16	.17	.22	.12	.12	.10	.46	.29	.62	.60	.36	.31
11	.13	.15	.25	.14	.13	.05	.41	.32	.46	.49	1.00	.53
12	.16	.17	.23	.11	.12	.05	.43	.32	.49	.55	.65	.66

Note. Variances are in the diagonal, covariances are above the diagonal, and correlations are in the diagonal.

Table 5

Pattern and Structure Coefficients for Confirmatory Factor Analysis Results of the Grit Scale Models

	MC Sample				RU Sample			
	Interest		Effort		Interest		Effort	
	Pattern	Structure	Pattern	Structure	Pattern	Structure	Pattern	Structure
1	.70	.71	.03	.23	.75	.76	.04	.25
2	.78	.77	-.02	.21	.78	.79	.04	.26
3	.73	.78	.16	.38	.72	.77	.17	.37
4	.76	.76	.00	.22	.77	.77	.00	.21
5	.77	.75	-.04	.19	.79	.77	-.05	.16
6	.74	.72	-.07	.15	.76	.73	-.12	.09
7	.26	.44	.62	.69	.26	.43	.62	.69
8	.04	.24	.68	.69	.05	.20	.55	.56
9	-.08	.15	.80	.77	.00	.21	.78	.78
10	.03	.23	.66	.67	-.05	.17	.80	.79
11	-.06	.16	.75	.74	-.06	.16	.79	.77
12	-.05	.19	.84	.82	-.07	.15	.82	.80

Table 6

Cronbach's Alphas, Means, and Correlations for the Grit Subscales by Sample

	α	Means (SD)	Subscale correlation
MC Sample ($N = 187$)			
Grit full scale	.84	3.51 (.59)	
1. Interest Subscale	.85	3.07 (.77)	
2. Effort Subscale	.83	3.94 (.67)	.33**
RU Sample ($N = 815$)			
Grit full scale	.84	3.41 (.59)	
1. Interest Subscale	.86	2.94 (.79)	
2. Effort Subscale	.82	3.88 (.66)	.32**

Note. ** $p < .01$.

Table 7

Significant Multivariate Effects

Effect	Pillai's Trace	F statistic	Sig.	df	Error df	Partial Eta Squared	Power
Gender	.01	6.068	<.01	2	963.000	.012	.89
Ethnicity	.02	1.658	<.001	12	1928.99	.010	.87

Note. RU and MC samples were combined to examine differences by sample, gender, and ethnicity. There were no significant differences by sample.

Table 8

Grit Means by Ethnicity

Ethnicity	Means (SD)
White	3.43 (.61)
Hispanic	3.46 (.51)
Black	3.56 (.58)
Other	3.34 (.53)

Note. Combined sample, $N = 991$.

Figure 1

Correlated Two-Factor Model of the Grit Scale

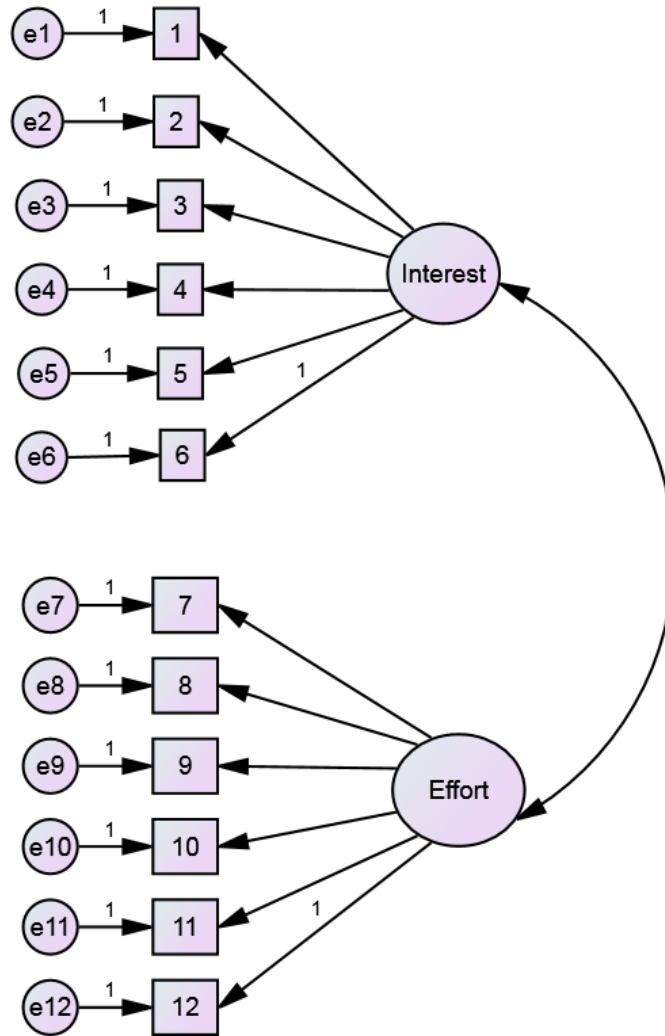


Figure 2

Correlated Two-Factor Model of the Grit Scale in the MC Sample

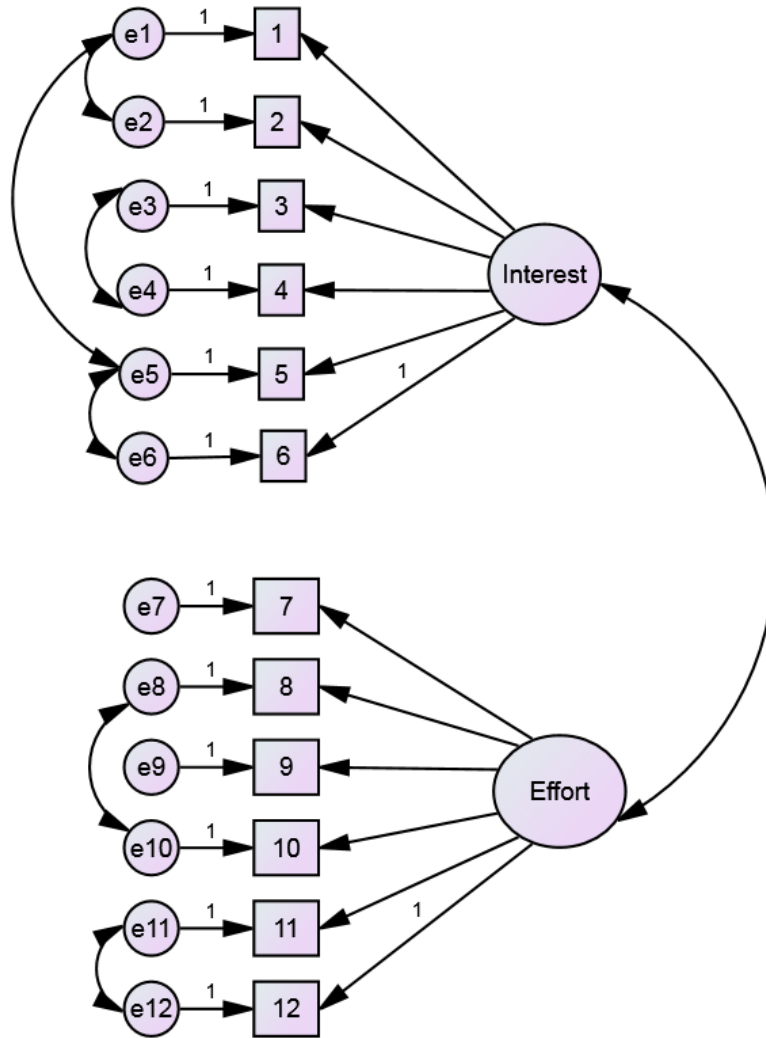
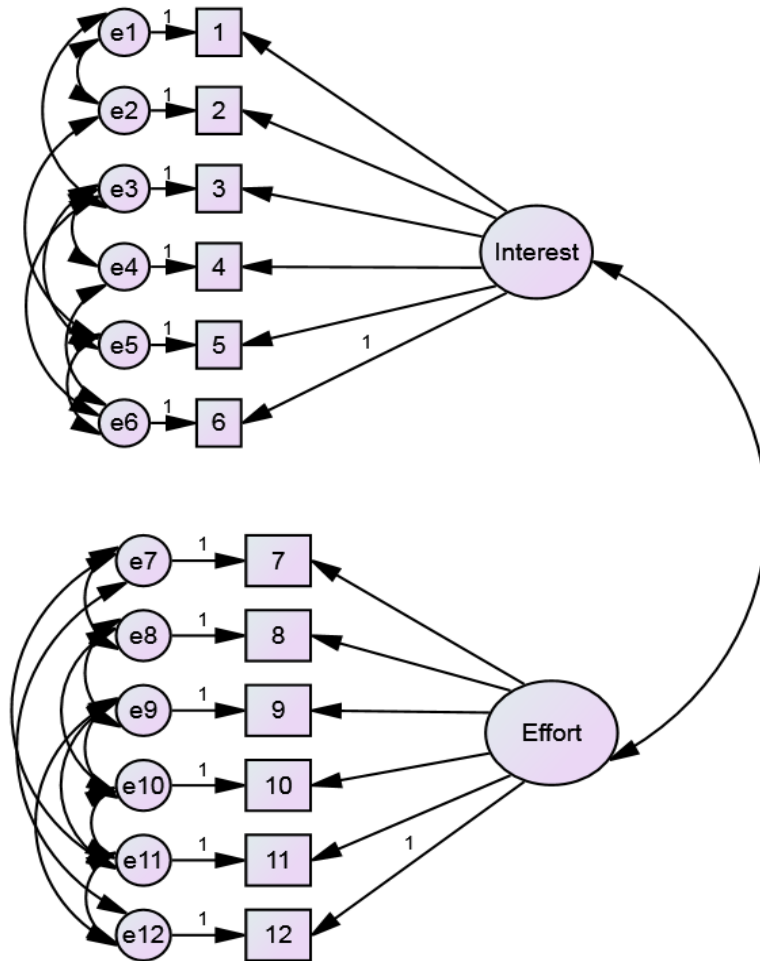


Figure 3

Model 3: Correlated Two-Factor Structure of the Grit Scale in the RU Sample



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Chapter 4: Study 2

Who Will Succeed? Creativity and Motivation in College Students

Joanne P. Rojas

University of Kentucky

Abstract

Creativity is an important individual difference among college students that is not typically measured in educational research. In this study, the relationships among measures of creativity, perseverance (grit), two measures of academic motivation (academic self-efficacy and avoidance of novelty), and self-reported grades were examined among two samples of college students ($N = 817$; $N = 187$). Correlations were examined and hierarchical multiple regressions controlling for gender, age, and ethnicity were conducted to determine which of these variables significantly predicted participants' self-reported grades. In addition, grit was tested as a potential mediator between the three other independent variables (academic self-efficacy, avoiding novelty, and creative ideation) and students' self-reported grades. In the larger sample, grit only mediated the relationship between academic self-efficacy and grades. No relationship emerged between creative ideation and grades, although traditional academic motivation measures robustly predicted grades. Limitations and implications of these findings and future research directions are discussed.

Keywords: creative ideation, grit, noncognitive constructs, motivation

Who Will Succeed? An Examination of Creative Ideation, Grit, and Academic Motivation as Predictors of Grades

Educational researchers tend to neglect creativity as an individual difference among college students. Creativity is an important part of higher-level thinking and, as such, its presence in students is worthy of study alongside other individual differences such as motivation. Typically, creativity is operationalized as the production of novel ideas and may be measured as creative ideation (Runco, Plucker, & Lim, 2001).

However, creativity is a much more complex construct than creative ideation alone. In this research, creativity is operationalized as a combination of creative ideation and grit, defined as the passion and perseverance to pursue long-term goals (Duckworth, Peterson, Matthews, & Kelly, 2007). This study is guided by the overarching question: What are the relationships among creative ideation, grit, academic motivation, and grades among college students? The exploration of these relationships is based upon the investment theory of creativity (Sternberg & Lubart, 1996).

Investment Theory

The investment theory defines creativity with an economic metaphor. Creative investors "buy low" and "sell high" within the marketplace of ideas. Unusual ideas that are undervalued are "bought" by the creative investor when others are not interested. These ideas are later "sold" when this individual persuades the marketplace of the value of these ideas. This creative investor must persevere in order to sell these ideas to a resistant market and must consistently seek new ideas to pursue. At the heart of this theory is a pairing of creativity with long-term perseverance.

Creativity

Identifying the individual differences that will determine which students will be successful in college is a common pursuit of educational research. In addition to cognitive skills, such as the intellectual abilities to learn content, write, or solve mathematical problems, other influential variables may influence student success. One such important individual difference to be considered is creativity.

Creativity can be viewed as a developing skill that should be nurtured as an integral part of intelligence (Sternberg, 2008) and as a higher-level process that works in conjunction with critical and higher-order thinking (Krathwohl, 2002; Perkins, 1990; Ross, 1976; Wu & Chiou, 2008; Yang, Wan, & Chiou, 2010). Although some educational psychologists have bemoaned the neglect of this topic in the field of educational research (Plucker, Beghetto, & Dow, 2004; Sternberg & Lubart, 1996), there is some experimental research which has indicated that even among those who explicitly state an endorsement for creativity may hold implicit bias against it (Mueller, Melwani, & Goncalo, 2012).

In academic settings, there are many examples of how creativity is actively discouraged. For example, although schoolteachers often claim to value creativity in the classroom, their actual teaching behaviors and attitudes often do not favor creative students (Beghetto, 2007; Sawyer, 2006; Scott, 1999; Torrance, 1963; Westby & Dawson, 1995). The way that students are taught can inhibit creativity by overemphasizing selection of correct responses rather than engaging in the learning process itself. Runco (2004) pointed to the overemphasis on convergent thinking in classrooms, which requires students to arrive at the one pre-determined, correct answer,

versus an emphasis on divergent thinking, which requires that students engage in creative ideation, and produce many ideas as possible solutions. Although teachers themselves can support creativity in the classroom with strategies such as providing choice and opportunity for imaginative assignments and encouraging students' intrinsic motivation (Beghetto & Kaufman, 2014), such is often an exception rather than a rule.

In addition to this bias against creativity in the classroom, the creative students themselves frequently have a tendency toward nonconformity; going against the crowd is not always welcome in the classroom (Sternberg & Lubart, 1996). For example, gifted underachievers, highly intelligent students who do not achieve at high levels within school, are often creative students who are prone to dropping out of school because they feel they do not belong, they are bored, or they feel the work is irrelevant (Kim, 2008). In a comprehensive literature review, several characteristics of these creative underachievers were found across studies including sensitivity to rigid teaching styles, negative social feedback, and a push towards conformity in schools that make them more prone to underachievement (Kim, 2008). The very nature of traditional classroom constraints such as the presence of external rewards, competition, lack of autonomy, and the expectation of being evaluated can all have a negative impact on the intrinsic motivation necessary for creativity (Amabile, 1996; Hennesey & Amabile, 1998).

There are concerns that some creative college students may not make the transition to college as smoothly as less creative students. Standardized testing is often held up as a barrier to creativity because creative thinking does not fit neatly into multiple-choice format. There have been some efforts to expand college admissions criteria to include creativity. For example, there has been a reworking of the admissions

criteria at Tufts University to include creative thinking assessments as one of the important admissions factors (Sternberg & the Rainbow Project Collaborators, 2006). In sharp contrast to this ongoing concern about standardized testing screening for creative students, Dollinger (2011) found that ACT scores, a strong predictor of college grades, also predicted variance on three separate creativity measures (self-reported creative accomplishments, two creative products assessed by multiple raters: a creative drawing exercise and a photo essay, as well as a measure of self-reported creative accomplishments) among 492 undergraduate students. This was a somewhat surprising finding considering the ongoing debate about whether standardized tests may penalize creative thinking and creative students whose skills and abilities are not explicitly measured (Duckworth, 2009; Kaufman & Agars, 2009; Sackett, Borneman, & Connelly, 2009). Clearly, at least some creative students manage to make it to college.

In fact, some college environments may be amenable to the development of creative students. A recent study of data taken from the 2010 National Survey of Student Engagement found that both freshman and senior college students used creative cognitive processes on a daily basis in their college careers (Miller & Dumford, 2014). Many campuses include creativity classes as part of a core curriculum of electives designed to produce well-rounded thinkers (Bull, Montgomery, & Baloche, 1995). Some colleges such as Buffalo State University, the University of Georgia, and Eastern Kentucky University, even offer majors and degrees in creative studies (Pappano, 2014).

Traditionally, creative disciplines such as the arts often emphasize creativity, as do other disciplines interested in creative problem solving such as engineering (e.g., Cropley &

Cropley, 2000), science (e.g., Simonton, 2009), and business entrepreneurship (e.g., Ward, 2003).

Creativity is one of the many so-called "noncognitive factors" that should be considered in research among college students (Farrington et al., 2012). The term noncognitive can be misleading since every psychological process studied is related to the cognitive functioning of the brain; noncognitive is simply a shorthand means of referring to those factors other than cognitive ability and knowledge that may affect how students perform in school (Duckworth, 2009). Noncognitive factors include such things as preferred thinking styles, motivation, self-beliefs, temperament, interests, and goals. Noncognitive factors have been examined as predictors of a variety of academic outcomes such as grades and college attendance (Farrington et al., 2012; Jacob, 2002). For example, perseverance, self-perceptions of academic ability, and attitudes towards learning new material all affect student outcomes (Farrington et al., 2012).

One popular noncognitive construct measuring a form of perseverance is grit, or the passionate pursuit of long-term goals (Duckworth, Peterson, Matthews, & Kelly, 2007). Grit has been measured primarily among young adults, and it has shown the potential to account for additional variance in academic success over and above traditional cognitive measures. For example, grit predicts grades among college students and retention of West Point Cadets after controlling for other strong predictors such as IQ measures and conscientiousness (Duckworth et al., 2007; Duckworth & Quinn, 2009). It has also been used as a predictor in such other diverse areas as novice teacher effectiveness (Robertson-Kraft & Duckworth, 2014), staying married (Eskreis-Winkler,

Shulman, Beal, & Duckworth, 2014), and psychological well-being (Salles, Cohen, & Mueller, 2014).

In addition to grit, longer-established academic motivation constructs such as student self-perceptions, beliefs, and strategies are powerful predictors of student behavior (Midgley et al., 2000). For example, self-efficacy beliefs predict a tendency to persevere in spite of challenges (Bandura, 1997). However, self-efficacy is a domain-specific construct regarding task-specific beliefs; grit is a domain-general construct regarding perseverance in general. The two academic motivation constructs selected for this research were academic self-efficacy (students' beliefs in their ability to complete academic tasks) and avoidance of novelty (students' preference for avoiding new or unfamiliar academic work (Midgley et al., 2000). Academic self-efficacy tends to lead to positive academic outcomes, while higher levels of avoidance of novelty tend to lead to negative academic outcomes. For example, academic self-efficacy is positively related to successful academic strategies such as help-seeking behaviors (Ryan, Gheen, & Midgley, 1998) and number of hours spent studying (Torres & Solberg, 2001). Academic self-efficacy also predicts higher grades (Bong, 2001; Brent, Lent, & Larkin, 1989). Avoidance of novelty is related to other unsuccessful academic strategies such as self-handicapping and is predictive of lower grades (Midgley, Arunkumar, & Urdan, 1996; Turner et al., 2002).

The purpose of this research was to examine the associations among creativity, grit, academic self-efficacy, and avoidance of novelty among undergraduate students. A creative thinking measure: the Runco Ideational Behavior Scale (RIBS, Runco et al., 2001); a measure of perseverance: the Grit Scale (Duckworth et al., 2007); and two

academic self-perception measures: Academic Self-Efficacy and Avoiding Novelty, taken from the Patterns for Adaptive Learning Scales (PALS, Midgley et al., 2000), were examined as potential predictors of academic success as measured by self-reported grades. Grit was also examined as a potential mediator between the other variables and grades. The exploration of grit as a mediator occurred for several reasons. In particular, applying the constructs of creative ideation and grit to the investment theory of creativity, grit could theoretically mediate the relationship between creativity and perseverance--that is, grit could explain the mechanism of the creative process that exists between creative ideation and grades. In addition, since this process is exploratory, the relationship between grit was also examined as a mediator between the motivation variables (academic self-efficacy and avoidance of novelty) and grades. The exploratory hypothesis behind this was that grit, a steady perseverance to accomplish goals, could possibly be the process by which creative thinking, academic self-efficacy, and avoidance of novelty might actually lead to academic outcomes.

Methods

Participants

Two samples of undergraduate research participants ($N = 817$; $N = 187$) participated in this research in the Fall of 2014. In the research university (RU) sample, undergraduate student participants were recruited from one Southeastern US university ($N = 817$). These students were offered extra credit by their instructors or participated in the survey in order to fulfill a research requirement for their class. A second multi-campus (MC) sample ($N = 187$) was recruited from several different undergraduate campuses from California, Oklahoma, Massachusetts, Tennessee, Washington, Idaho,

Illinois, South Carolina, Ohio, and Louisiana. These students were either offered extra credit from their instructors in sociology and education courses or the incentive of being entered into a random drawing for one of three \$25 Amazon gift cards. The survey was administered electronically through Qualtrics, and students participated by following an electronic link to the online survey. The student survey included demographic information such as gender, age, and ethnicity, as well as the 23-item RIBS Scale (Runco et al., 2001), the 12-item Grit Scale (Duckworth et al., 2007), and two 5-item PALS measures (Midgley et al., 2000).

Demographic information regarding both samples is presented in Table 1. Roughly three-fourths of all students were female in both samples, and the majority of students were of traditional college age. The RU sample was 76% White, 9% Black/African American and less than 5% of any other ethnicity. The MC sample was more diverse: 42% Hispanic, 27% White, 10% Black/African American, 7% multiple ethnicities, 6% Asian, and 8% other.

Instrumentation and Measures

Runco Ideational Behavior Scale

Creativity is an underdeveloped area of research within educational psychology (Plucker et al., 2004), even though there are connections in the creativity literature between creative ideation and cognition (Runco & Chand, 1995) and conceptualizations of creativity as a form of intelligence (Sternberg, 2008). The Runco Ideational Behavior Scale (RIBS; Runco et al., 2001) was developed as a survey instrument to measure creative ideational behavior. The 23 items of this scale describe the individual's skill level with, use, and appreciation of ideas. Researchers have used the RIBS Scale as a

measure of creative thinking among high school dropouts (Kim & Hull, 2012), elementary and high school students (Kim & VanTassel-Baska, 2010), college students (Plucker, Runco, & Lim, 2006), entrepreneurs (Ames & Runco, 2005), and young and middle age adults (Doyle & Furnham, 2012). The initial psychometric analysis of the scale was based on two samples of undergraduate students from different U.S. universities ($N = 97$; $N = 224$). The scale demonstrated strong internal consistency on both samples (.92 & .91), and was judged to be unidimensional (Runco et al., 2001).

Additionally, the RIBS has been examined as an indicator of creative potential and has proven to be statistically associated with other creativity measures. Plucker et al. (2006) administered divergent thinking tests and the RIBS to one sample of American undergraduate students ($N = 95$) and one sample of Korean undergraduate students ($N = 117$). Particularly of interest were the findings that scores on a measure of originality significantly predicted scores on the RIBS, and that there were no significant cultural differences between samples (Plucker et al., 2006). This provided evidence that the RIBS is an indicator of individual creativity that is useful cross-culturally. In a separate study examining creativity as a factor affecting dropping out of high school among a sample of 87 low-income high school students (43% Hispanic and 57% Black/African American), Kim and Hull (2012) found that the RIBS correlated significantly with other creativity tests such as the standardized Torrance Tests of Creative Thinking (TTCT, Scholastic Testing Service, 2009; Torrance, 1974) and the teacher-reported Scales for Rating the Behavioral Characteristics of Superior Students (SRBCSS, Renzulli, Siegle, Reis, Gavin, & Sytsma Reed, 2009). Similarly, Kim and Hull (2012) found significant correlations

between the RIBS and SRBCSS and TTCT among Korean elementary school students ($N = 40$) and Korean high school students ($N = 89$).

Sample items from the scale include the following: "I am good at combining ideas in ways that others have not tried." and "I like to play around with ideas for the fun of it." The RIBS is measured on a Likert scale of 1 (*never*) to 5 (*very often*). Higher scores indicate higher levels of creative ideation. Mean scores were calculated across the 23 items of the scale.

Grit Scale

Grit was measured using the Grit Scale developed by Duckworth, Peterson, Matthews, and Kelly (2007). Grit is a relatively new motivation construct that is theorized to combine perseverance and passion to accomplish long-term goals. The Grit Scale (Duckworth et al., 2007) was developed and validated through multiple administrations of the scale among several different populations: adults older than 25 collected via website ($N = 1,545$ and $N = 706$), undergraduates at an elite university ($N = 139$), two incoming classes of West Point Cadets ($N = 1,218$ and $N = 1,308$) and upper elementary and middle school children who were Spelling Bee Champions ($N = 175$). This scale demonstrated evidence of internal consistency reliability (from .77 to .85) across six samples. Factor analysis indicated two factors: consistency of interests and perseverance of effort (Duckworth et al., 2007). Reliabilities for each subscale were as follows: consistency of interests ($\alpha = .84$) and perseverance of effort ($\alpha = .78$).

"I often set a goal but later choose to pursue a different one." is a typical item from the consistency of interests subscale, and "I have overcome setbacks to conquer an important challenge" is a typical item from the perseverance of effort subscale. Grit is

measured with a 5-point Likert scale (1 = not at all like me; 5 = very much like me).

After transforming reverse-scored items, mean scores were calculated from all 12 items with higher scores indicating higher levels of grit.

PALS

The PALS (Midgley et al., 2000) is a collection of self-report motivation scales based on goal orientation theory (Dweck & Leggett, 1988; Pintrich, 2000). Goal orientation theory posits that the types of goals and students' self-beliefs affect their ability to accomplish schoolwork (Anderman & Wolters, 2006; Elliott & Dweck, 1988). The PALS five-point Likert-type scales are frequently used by researchers to assess student and teacher motivation, affect, and behavior (e.g., Ryan et al., 1998).

Academic Self-Efficacy. This scale asks students to report on their self-efficacy to complete academic work successfully. The PALS Manual reports that the Academic Self-Efficacy Scale exhibits acceptable levels of internal consistency ($\alpha = .78$) and has been shown to be unidimensional (Midgley et al., 2000). Kaplan and Midgley (1997) used the measure to assess academic self-efficacy in math and English among 229 seventh grade students and found that it was predictive of the use of adaptive learning strategies. Ryan et al. (1998) found that academic self-efficacy was a negative predictor of academic help-seeking behaviors among 516 sixth grade students.

A sample item is: "Even if the work is hard, I can learn it." Academic self-efficacy is measured on a 5-point Likert scale (1 = strongly disagree; 5 = strongly agree). Means are calculated across the five items of the scale. Higher levels of academic self-efficacy indicate greater confidence in one's ability to accomplish academic work.

Avoiding Novelty. This scale asks students to report on their preference for

avoiding academic work that is novel or unfamiliar. Turner et al. (2002) found that among sixth-grade elementary school students ($N = 1,092$), avoiding novelty was correlated significantly with academic self-handicapping and the avoidance of help seeking. Similarly, among Taiwanese 8th graders ($N = 461$), Avoidance strategies including avoiding novelty scores were exhibited at higher levels among students in classrooms that were not supportive of autonomy (Shih, 2009). Finally, among Spanish undergraduate students, avoiding novelty was found to be a negative correlate of personal development and academic interest (Doménech-Betoret, Gómez-Artiga, & Lloret-Segura, 2014). The original authors of the Avoiding Novelty Scale have reported acceptable levels of internal consistency, $\alpha = .78$ (Midgley et al., 2000). A Chinese translation of the scale yielded similar results with a confirmatory factor analysis indicating unidimensionality and acceptable internal consistency estimate, $\alpha = .80$ (Shih, 2009).

A sample item is "I prefer to do work as I have always done it, rather than trying something new." Avoiding Novelty includes five items on a 5-point Likert scale (1 = strongly disagree; 5 = strongly agree). Mean scores are calculated across the five items. Higher levels of avoidance of novelty indicate a greater tendency to avoid learning new things. This scale is the only scale in this research in which higher levels of the trait are considered negative in relation to academic outcomes.

Self-Reported Grades

Self-reported grades are often used as a measure of academic achievement, although there is some debate about the accuracy of such self-reports (Cassady, 2001; Frucot & Cook, 1994; Goldman, Flake, & Matheson, 1990; Zimmerman, Caldwell, & Bernat, 2006). There are some indications that lower-achieving students and minority

students may tend to overestimate their grades (Zimmerman et al., 2006). As with other self-report scales, there is also concern about social desirability bias, or the tendency to inflate those traits or behaviors that are generally approved by society (Nederhof, 1985). Some researchers think this concern regarding social desirability is overstated in survey research in general (Krosnick, 1999).

In spite of the concerns about error in self-reported grades, these self-reports of grades are significantly correlated to actual school-record grades (Caskie, Sutton, & Eckhardt, 2014; Goldman et al., 1990; Gray & Watson, 2002; Nofle & Robins, 2007). In a critical meta-analysis of over 60,000 high school and undergraduate students, self-reported grades were strongly moderated by actual levels of achievement and cognitive ability (Kuncel, Crede & Thomas, 2005). Kuncel et al. (2005) found that students of higher ability were more likely to report their grades accurately, and students of lower ability were more likely to report inaccurate grades. They also found, however, that college students ($N = 12,089$) were found to be the most accurate reporters of their own grades with 90% credibility intervals ranging from .82 to .98. In addition, self-reported standardized ability tests were comparable to self-reported grades. Kuncel et al. (2005) recommend that self-reported grades among high-achieving college students are most likely to be accurate.

In this research, students were asked to select the category into which their grades fall; these categories were taken from previous educational research that used self-reported grades as a measure (Dornbusch, Ritter, Leiderman, Roberts, & Fraleigh, 1987; Steinberg, Lamborn, Darling, Mounts, & Dornbusch, 1994). In response to the question, "What kind of grades do you typically receive?" students selected one of the following

categories: *mostly As, about half As and Bs, mostly Bs, about half Bs and Cs, mostly Cs, about half Cs and Ds, mostly Ds, and mostly below D*. Students surveyed came from a variety of majors and their creativity, perseverance, and academic motivation were being measured in a domain-general way rather than specific to their major or to a particular class. Therefore, a self-reported measure generalizing grades overall seemed appropriate as a means to quantify academic achievement. It may have been advantageous to have access to students' school records, but this was not possible. In addition, research has indicated that self-reported grades have adequate correlations with student grades taken from school records and are a useful summation of how well students are responding to the curriculum (Dornbusch et al., 1987; Steinberg et al., 1994).

Statistical Analyses

Means, standard deviations, and internal consistency reliability estimates were calculated for all four scales (RIBS, Grit, Academic Self-Efficacy, and Avoiding Novelty). Zero-order correlations were calculated among all mean scores for these four scales. A hierarchical linear regression was run using the demographic variables in Step 1 and the four measures (RIBS, Grit, Academic Self-Efficacy, and Avoiding Novelty) in Step 2.

Finally, three different mediation models were tested at each campus for the three different independent variables. In order to test a simple mediation model, there are three steps presented by Baron and Kenny (1986): Step 1, regress the mediator on the independent variable; Step 2, regress the dependent variable on the independent variable, and Step 3, regress the dependent variable on the independent variable and the mediator while controlling for the independent variable. For example, for the first mediation

model tested, grit was regressed on academic self-efficacy. Then, self-reported grades were regressed on grit. Finally, self-reported grades were regressed on both academic self-efficacy and grit while controlling for academic self-efficacy. In mediation testing, progress to the next step only occurs when the regression is significant. If a step is not significant, then there is no evidence of mediation (see Figures 1-3 for the three possible mediation models that were explored). If evidence of mediation is found, then a Sobel Test is calculated as recommended by Baron and Kenny (1986). The online Sobel calculator used in this research (Preacher, 2015) determines a z-value that finds the mediation model significant at $p < .05$.

Research Questions and Hypotheses

The following questions guided this research:

R1: What are the relationships between the independent variables (RIBS, Grit, Academic Self-Efficacy, and Avoiding Novelty) and the dependent variable (self-reported grades) in each sample?

H1: All variables (RIBS, Grit, Academic Self-Efficacy, Avoiding Novelty, and self-reported grades) will be significantly correlated for each sample. All correlations should be positive except for those involving Avoiding Novelty. A tendency to avoid novelty should correlate negatively with RIBS (because those who engage in creative ideation seek novelty), with Grit (which pursues long-term goals and should include new learning), and with grades.

R2: Do creative ideation, grit, academic self-efficacy, and avoidance novelty statistically predict self-reported grades while controlling for demographic measures?

H2: Creative ideation, grit, academic self-efficacy, and avoidance of novelty will predict

self-reported grades while controlling for demographic variables.

R3: Does grit mediate the relationships between the other independent variables and self-reported grades?

(A) Does grit mediate the relationship between creative ideation and self-reported grades in each sample?

(B) Does grit mediate the relationship between academic self-efficacy and self-reported grades in each sample?

(C) Does grit mediate the relationship between avoidance of novelty and self-reported grades in each sample?

H3: Although grit has not been previously explored as a mediator in educational research, this exploratory question is being asked because of grit's predictive power in others studies. Also, the dual nature of the construct (both consistency of interest and perseverance of effort) suggests that it might be a powerful process through which other predictive variables are mediated. Grit will be tested as a mediator in three separate models between the three other variables (creative ideation, academic self-efficacy, and avoidance of novelty) and self-reported grades.

Results

Cronbach's alphas, scale means, grades, and correlation matrices were calculated in both samples as reported in Table 2. Cronbach's alphas for all scores were strong in both samples, with values ranging from .84 to .97. Students in both samples reported relatively high mean scores in Academic Self-Efficacy and Grit. RIBS Scale scores indicated that, on average, students engaged in creative ideation, but not at a high level. Avoiding Novelty scores were 2.90 for the MC sample and 3.31 for the RU sample

indicating that in both samples, there may be a tendency to engage in avoidance of novelty as a negative coping strategy.

Hypothesis 1 stated that all variables (RIBS, Grit, Academic Self-Efficacy, and Avoiding Novelty) would be significantly correlated with each other and with self-reported grades for each sample. There was partial evidence for this hypothesis. First, it was expected that RIBS, Grit, Academic Self-Efficacy, and grades would be positively correlated. However, RIBS did not correlate with grades in either sample. In addition, Grit did not correlate with grades in the MC sample. The relationship between RIBS and Grit was also different than hypothesized. In the MC sample, they were not significantly correlated, and in the RU sample, there was a small but significant negative correlation ($r = -.11, p < .05$). Avoiding Novelty was expected to correlate negatively with all other scales and with grades. This part of the hypothesis was fully supported in both samples.

Hypothesis 2 stated that the creative ideation, grit, academic self-efficacy, and avoidance of novelty would predict self-reported grades while controlling for demographic measures. This hypothesis was only partly supported. See Table 3 for information regarding the complete results of the two-step hierarchical regression conducted.

The demographic variables (gender, age, and ethnicity) were entered in the first block as covariates. This model accounted for between 2% and 4% of the variance in grades in both samples, respectively. Age and ethnicity were significant in the first block of the regression model for the RU sample, but demographic variables were not significant in the first block of the regression model for the MC sample. The primary variables of interest were the four scales: RIBS, Grit, Academic Self-Efficacy, and

Avoiding Novelty; these were included in the second block. The full model for the RU sample, $F(4, 752) = 29.990$, $p < .001$, $R^2 = .16$, accounted for 16% of the variance in grades in the RU sample. The full model for the MC sample, $F(4, 157) = 4.108$, $p < .01$, $R^2 = .13$, accounted for 13% of the variance in grades in the MC sample. The RIBS Scale did not predict grades in either sample. Grit only predicted grades in the RU sample. However, both Academic Self-Efficacy and Avoidance of Novelty were both significant predictors of self-reported grades in both samples.

The third hypothesis was that Grit would mediate the relationships between the other independent variables (RIBS, Academic Self-Efficacy, and Avoiding Novelty) and self-reported grades. All three possible mediation models were considered in each sample; see Figures 1 through 3 for each model.

The first step to test each of the possible models was to regress the potential mediator (grit) on the independent variable (grades). Grit did not predict self-reported grades in the MC sample. Therefore, grit could not be tested as a mediator in any of the models for the MC sample at all. All other testing of mediation models could only be conducted in the RU sample.

In the RU sample, grit did predict self-reported grades, $B = .23$, $p < .001$. The second step was to regress the dependent variable (grades) on the independent variable (creative ideation). Creative ideation did not predict grades; therefore, there was no relationship to be mediated. There was no evidence that grit mediated the relationship between creative ideation and grades in either sample.

The second model to be tested in the RU sample (see Figure 2) was grit as a potential mediator between academic self-efficacy and grades. Since it was already clear

that Grit was predictive of self-reported grades, the next step was to regress the dependent variable (grades) on the independent variable (academic self-efficacy). Academic self-efficacy, $B = .32, p < .001$, significantly predicted grades. Finally, in the third step, grades were regressed on academic self-efficacy and grit while controlling for academic self-efficacy, academic self-efficacy, $B = .28, p < .001$, and grit, $B = .14, p < .001$, final $F(2, 811) = 52.83, R^2 = .34$, predicted grades while controlling for grit. The Aroian test statistic, popularized by Baron and Kenny as the Sobel test and considered significant at $p < .05$, was calculated with the following values: $a = .276; b = .245; sa = .028; sb = .062$. The Aroian test statistic was $z = 3.75, p < .001$. Within the RU sample, grit did mediate the relationship between academic self-efficacy and grades.

The final model to be examined in the RU sample was grit as a potential mediator between avoiding novelty and grades. It was already determined that grit significantly predicted grades in Step 1. Step 2 was to regress the dependent variable (grades) on the independent variable (avoiding novelty). Avoiding novelty ($B = -.09, p < .01$) did significantly predict grades. The third and final step was to regress grades on avoiding novelty and grit while controlling for grit. Avoiding novelty ($B = -.05, p = .14$) did not predict grades at this point in the analysis. Therefore, there was no evidence that grit mediated the relationship between avoiding novelty and grades.

Discussion

The purpose of this research was to examine creativity in an academic context. Since creativity is a complex construct with multiple definitions, how it is operationalized affects the clarity of research findings. Within this research, the RIBS Scale was used as a measure of creative ideation and measured alongside Grit as an operationalization of

the investment theory of creativity (Sternberg & Lubart, 1996). In addition, two academic motivation variables were included, Academic Self-Efficacy and Avoiding Novelty, in order to examine creativity within a comprehensive academic context. All four of these scales were examined as potential predictors of grades. These correlations were an exploration of the validity of the RIBS Scale and the Grit Scale within this research. According to Messick (1995), validity should be a comprehensive and unified concept that includes such "types" of validity as content, construct, predictive, etc. All of these analyses are an exploration of the validity of these measures within this research.

In order to answer the first research question, the correlations among the scale variables and grades were examined. All of these correlations were expected to be significant. RIBS, Grit, Academic Self-Efficacy, and grades were all expected to correlate positively. Avoiding Novelty was expected to be the only negative correlate among all variables. The RIBS Scale and the Grit Scale were proposed as a means to operationalize the two-part process of the investment theory with a measure of creative ideation and perseverance, but these two scales did not correlate as expected. In the RU sample, they correlated significantly but negatively ($-.11, p < .05$) and did not correlate significantly in the MC sample ($.03, n.s.$). This was surprising because they were expected to correlate positively and significantly. Although these two processes are related in the investment theory of creativity, this finding suggests that they may be orthogonal to one another in practice. The first step of buying low while engaging in creative ideation appears to be independent of the second step of selling high while persevering. It may also be that these average college students, some of whom may become creative contributors to society later in life, have not yet developed to the point

that these two processes are working in tandem. Data did show that mean RIBS scores increased from year to year of age, so it may be that creative ideation increases with experience. Perhaps as their environment changes, their exercise of creativity and grit together will continue to change. For example, if these students go on to graduate level education, they may be expected to generate more original work requiring higher-level thinking and perseverance. Alternatively, in the workplace, these students might find themselves in challenging jobs that nurture and expect creative effort. A change in context may be the impetus for new growth in both of these areas. In addition, these students were not chosen because of their levels of creativity, so an examination of these variables in highly creative students might yield different results.

The RIBS Scale correlated as expected with the academic motivation scales. RIBS positively correlated with Academic Self-Efficacy in the RU sample ($r = .22, p < .001$) and in the MC sample ($r = .17, p < .01$). The sizes of the correlations between creative ideation and academic self-efficacy was small though significant, providing evidence of discriminant validity. Those who enjoy engaging with ideas would likely also have confidence to engage in academic tasks. The RIBS Scale negatively correlated with Avoiding Novelty in the RU sample ($r = .33, p < .01$) and in the MC sample ($r = .36, p < .01$). This also makes sense because those who are at high levels of engaging in new ideas would be at low levels of the avoidance of novelty. The size of these correlations was slightly higher mostly because both constructs explicitly address novelty again providing evidence of validity for the RIBS Scale.

All other correlations among Grit, Academic Self-Efficacy, and Avoiding Novelty in both samples were as expected. Grit and Academic Self-Efficacy were positively

correlated in the RU sample ($r = .33, p < .01$) and in the MC sample ($r = .36, p < .01$). Those high in grit would likely also be high in confidence to accomplish academic tasks. Avoiding Novelty negatively and significantly correlated with all other scales with values ranging from $-.10$ to $-.31$. The negative coping strategy of avoiding new learning is opposite to these other positive coping strategies of persevering with grit and approaching learning with confidence with academic self-efficacy. The significant correlations between grit and these longer-established academic motivation constructs provided evidence of concurrent validity, and the moderate size of these correlations provided evidence of discriminant validity. This research provides more evidence of grit as a valid academic measure.

When looking at correlations with grades, there were also a few surprises. RIBS did not correlate significantly with grades in either sample. The fact that creative ideation is not related to grades may be an indication that creative ideation is orthogonal to academic achievement at least as measured by grades. This may be because of the focus on basic knowledge acquisition in grading, which is easily measurable, as opposed to creative thinking, which is more challenging to measure. In addition, grit, a powerful predictor of academic achievement in other research, was only significantly related to grades in the RU sample ($r = -.22, p < .01$). One important finding of this research is that the longer-established academic motivation measures, Academic Self-Efficacy and Avoiding Novelty, were significantly correlated with grades and were consistent correlates across samples. As levels of Academic Self-Efficacy increase, so do grades. Inversely, as levels of Avoiding Novelty increase, grades decrease.

In order to answer the second research question, a two-step hierarchical regression was conducted in each sample to find out how RIBS, Grit, Academic Self-Efficacy, and Avoiding Novelty statistically predicted self-reported grades while controlling for demographic measures. The regression models for both samples revealed different predictors. In the RU model, the statistically significant predictors for grades were gender, age, ethnicity, Grit, Academic Self-Efficacy, and Avoiding Novelty. In the MC model, the only significant predictors were Academic Self-Efficacy and Avoiding Novelty. The RIBS Scale did not predict grades in either sample. The fact that creative ideation had no significant relationship with grades in either sample suggests that creativity, at least among undergraduate students, may be orthogonal to academic achievement. It may indicate that typical college settings are not nurturing of creativity (Beghetto & Kaufman, 2014; Mueller, Melwani, & Goncalo, 2012). Across both samples, mean scores did increase on RIBS with each year of age, but there were no statistically significant differences from year to year. Although creativity might be a goal in individual classes or assignments, overall, the grades are not likely measuring creativity. Generating new ideas is a helpful skill at the beginning of most assignments, but the final product may not be assessed for novelty as much as it is for exhibiting the expected answers. If an assignment were to be graded on creativity, it would be assessed on both novelty and usefulness as a measure of how a student has mastered particular content.

Although the primary focus of the research was on the predictive power of creative ideation, grit, academic self-efficacy, and avoiding novelty, there were some notable points in the RU sample. First, female students were more likely to have higher grades than male students had. In addition, older students had lower grades than younger

students had. Finally, being a White student in the RU sample statistically predicted higher grades than identifying with any other ethnicities. As mentioned, none of these demographic predictors was significant in the ethnically diverse MC sample. The advantage of women over men in the RU sample regarding grades is not surprising because over the past few decades women have continued to outpace men in attendance and completion of college as well as earning higher grades (Buchmann & DiPrete, 2006). In addition, the higher grades earned by Whites in the RU sample may be explained in part by the fact that how students formulate their academic expectations and, consequently, their academic performance, varies by ethnic groups (Museus, Harper, & Nichols, 2010). It may also be that in the larger sample taken from a predominantly White institution, being a majority student provided an advantage in grades. The multi-campus sample had more ethnic diversity, and included, for example, one institution that was Hispanic-serving, and it may be that the more diverse environments are more supportive of diverse student achievement. This is speculative based on these data, but it is a question that should be explored further in future research.

Regarding the predictive validity of the scales, only three of them were significant in the RU sample, and only two of them in the MC sample. Students higher in Grit in the RU sample had higher grades, while Grit did not predict grades in the MC sample. Across both samples Academic Self-Efficacy and Avoiding Novelty significantly predicted grades. Those higher in Academic Self-Efficacy had higher grades, and those higher in Avoiding Novelty had lower grades. Within academic settings, the traditional motivation scales seem to be a strong choice to predict grades, and their short, 5-item length gives them both elegance and usefulness.

Finally, the third research question explored Grit as a possible mediator between the other independent variables and grades. There was limited evidence for the mediating power of Grit. It only mediated the relationship between Academic Self-Efficacy and grades in the RU sample. The MC sample was more diverse than the largely homogeneous RU sample, and the way that grit is expressed may be different in diverse populations. Most grit research has not examined ethnic differences, so this is an area meriting further examination.

Limitations and Future Research

Limitations to this research include the use of self-reported information. Surveys are a useful tool to gather information from a large number of participants in a reasonable amount of time, but with this type of design, there is no way to triangulate the data to ensure accuracy and reduce possible social desirability throughout the findings. Future research might also include other types of measures reported by peers or instructors that could provide more evidence of the presence of creativity in students. In addition, ideational behavior is only one slice of creativity. Another measure of creative accomplishment might provide a more nuanced view of creativity. Many creativity researchers advocate multiple measures (e.g., Silvia, Wigert, Reiter-Palmon, & Kaufman, 2012). In addition, because there is partial evidence for grit as a mediator, future research looking at grit as part of the operationalization of creativity should examine grit as a mediator between creative ideation and an outcome variable that explicitly measures creative accomplishment rather than grades.

Another limitation of this research is the usage of a cross-sectional survey taken at one point in time. Repeated measures across the same students would allow an exploration of the development of creativity and motivation over time in college. In

addition, a longitudinal study could allow for more robust predictors of academic success than self-reported grades. Retention, graduation rates, and securing a professional job upon graduation are other measures of academic success that could be measured over time.

This research could be continued with a graduate student sample in order to determine if creativity is related to the higher-level thinking required by graduate school programs. Perhaps the orthogonal relationship between creative ideation and grades was due to the demands of a typical undergraduate education. In the presumably more rigorous demands of a graduate program, perhaps creativity is more relevant and rewarded by grades.

Additional future directions to be considered include finding additional measures of perseverance within the creative process. Grit is conceptualized as a passionate pursuit of long-term goals, but the factors are meant to represent interest and effort. Another measure that more explicitly measures passion might be more relevant to the creative process. Interest and effort alone do not necessarily indicate passion, although they do seem to measure perseverance.

Table 1

Demographic Information Regarding Samples

Category	RU Sample	MC Sample
Gender		
Female	76%	71%
Male	24%	29%
Age		
Mean (SD)	19.64 (3.13)	21.48 (5.48)
Mode	18	19
Ethnicity		
White	76%	27%
Hispanic	3%	42%
Black/African American	9%	10%
Asian	4%	6%
Native American	<1%	<1%
Multiple Ethnicities	3%	7%
Other	4%	8%

Note. Percentages are rounded.

Table 2

Means/Frequencies, Correlation Matrices, and Cronbach's Alphas for Study Variables by Sample

	Cronbach's α	Means (SD) / Frequency	1	2	3	4
MC Sample						
<i>(N = 187)</i>						
1. Creative Ideation	.93	3.28 (.63)	--			
2. Grit	.84	3.51 (.59)	.03	--		
3. Academic Self- Efficacy	.87	3.99 (.69)	.17*	.36**	--	
4. Avoidance Novelty	.84	2.90 (.81)	-.20**	-.31**	-.17*	--
5. Grades			.08	.11	.20**	-.25*
Mostly As		18.6%				
About half As & Bs		39.4%				
Mostly Bs		23.4%				
About half Bs & Cs		16.5%				
Mostly Cs		1.1%				
About half Cs & Ds		1.1%				
Mostly below D		0%				
RU Sample						
<i>(N = 817)</i>						
1. Creative Ideation	.94	3.27 (.64)				
2. Grit	.84	3.41 (.59)	-.11*			
3. Academic Self- Efficacy	.89	3.94 (.70)	.22**	.33**		
4. Avoidance Novelty	.87	3.31 (.79)	-.15**	-.17**	-.10**	
5. Grades			-.02	.22**	.32**	-.09*
Mostly As		35.0%				
About half As & Bs		36.7%				
Mostly Bs		16.6%				
About half Bs & Cs		16.6%				
Mostly Cs		1.3%				
About half Cs & Ds		.1%				
Mostly below D		.1%				

Note. * $p < .05$ ** $p < .01$ (2-tailed).

Table 3

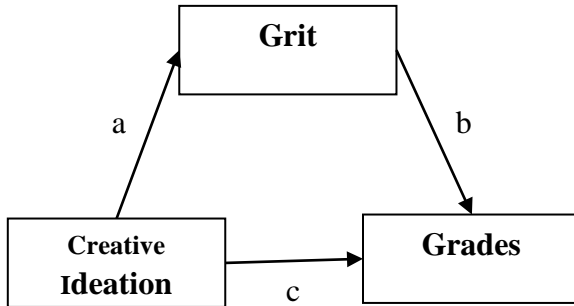
Hierarchical Regressions Predicting Self-Reported grades

MC Sample	Block	R^2	ΔR^2	Model	B	95% CI	β			
	1	.04	.04	Constant***	5.98	[5.22,6.75]				
				Gender	.30	[-.06,.65]	.13			
				Age	.02	[-.01,.05]	.09			
				Ethnicity	-.08	[-.17,.01]	-.13			
	2	.13	.13**	Constant***	.09	[4.68,8.14]				
				Gender	.34	[-.02,.69]	.14			
				Age	.01	[-.02,.03]	.02			
				Ethnicity	-.01	[-.10,.08]	-.02			
				Creative	-.14	[-.40,.11]	-.09			
				Grit	-.11	[-.41,.18]	-.07			
				Ac SE***	.36	[.11,.61]	.24			
				Avoid ***	-.31	[-.51,-.10]	-.25			
RU Sample	Block	R^2	ΔR^2	Model	B	95% CI	β			
	1	.02	.02***	Constant***	7.68	[7.15, 8.20]				
				Gender	-.12	[-.30, .06]	-.05			
				Age*	-.03	[-.05, -.00]	-.08			
				Ethnicity**	-.07	[-.12,-.02]	-.11			
	2	.15	.14***	Constant***	6.15	[5.25,7.05]				
				Gender*	-.20	[-.36,-.03]	-.08			
				Age***	-.04	[-.07, -.02]	-.13			
				Ethnicity*	-.05	[-.10,-.01]	-.08			
				Creative	-.10	[-.22,.02]	-.06			
				Grit***	.23	[.10,.36]	.13			
				Ac SE***	.45	[.34,.56]	.29			
				Avoid*	-.10	[-.20,-.01]	-.07			

Note. * $p < .05$ ** $p < .01$ *** $p < .001$ Creative = creative ideation Ac SE = academic self-efficacy. Avoid = avoiding novelty. Age = age in years; Gender (female [coded as 0] or male [coded as 1]).

Figure 1

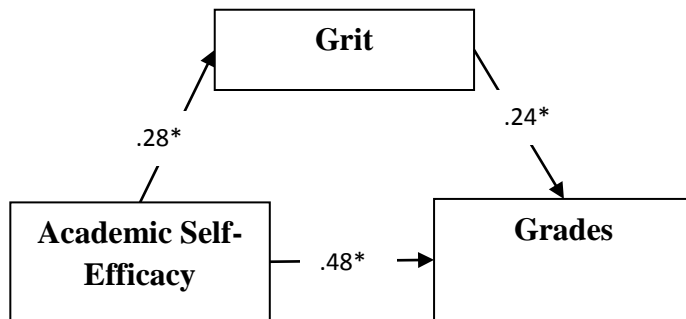
Mediation Model 1



Note. This model was not significant in either sample.

Figure 2

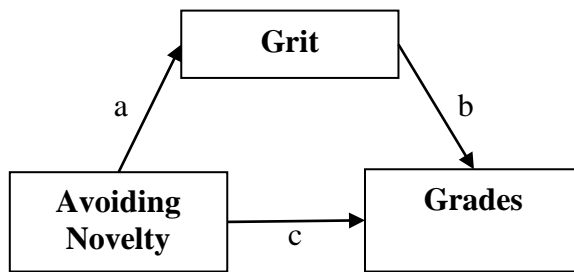
Mediation Model 2



Note. Structural model with standardized path coefficients. **t* value significant. Values reflect the RU sample, ($z = 3.75, p < .001$). No evidence of mediation in MC sample.

Figure 3

Mediation Model 4



Note. This model was not significant in either sample.

Chapter 5: General Discussion

Creativity research belongs in educational psychology because creativity itself is an important area of individual differences among students. Creativity is a broad construct, and there are many ways to explore it. The theoretical framework for the two studies conducted in this multiple manuscript dissertation was the investment theory of creativity (Sternberg & Lubart, 1996). This dissertation research was an exploration of the role of creativity among two samples of undergraduate students ($N = 187$; $N = 817$). Creativity was measured with the Runco Ideational Behavior Scale (RIBS, Runco et al., 2001). This scale was selected because of its focus on a thinking behavior that might have an influence in academic settings. In addition, a measure of perseverance was selected, the Grit Scale (Duckworth et al., 2007). Perseverance is inherent in the investment theory, as it is in many conceptualizations of creativity, although it is not typically measured in the research. In addition, two academic motivation variables were selected from the PALS Inventory (Midgley et al., 2000): Academic Self-Efficacy and Avoiding Novelty. These two scales provided additional academic context for creative ideation. Study 1 examined the psychometric properties and factor structure of the RIBS Scale and the Grit Scale and also explored group differences across gender and ethnicity. Study 2 explored the relationships between the four scales: RIBS, Grit, Academic Self-Efficacy, and Avoiding Novelty and their ability to predict self-reported grades in both student samples. Grit was also explored as a potential mediator among variables.

The first important finding of this research was regarding the psychometrics and factor structure of the RIBS Scale. Previous research regarding the RIBS factor structure has been contradictory. Factor analyses in the initial validation study (Runco et al., 2001)

reported eigenvalues greater than .9, but a visual inspection of the scree plot seemed to indicate a unidimensional solution. Follow up analyses led to conflicting findings indicated from one to four factors in the scale. The final determination was to treat these additional factors as error and to treat the RIBS Scale as a unidimensional scale. The scale has continued to be used by researchers in both English and translated versions across the world. A recent factor analysis (von Stumm et al., 2011) of the RIBS Scale first cut out all of the items with loadings below .25, and then ran an exploratory factor analysis on a reduced 16-item scale. However, the deletion of the items did not make the scale unidimensional. Instead, they found three factors that they named quantity of ideas, absorption, and originality. These differing findings leave open the question of what the factor structure for the 23-item RIBS Scale is.

This research attempted to answer that question by analyzing scores with an exploratory factor analysis on the RIBS taken from two large samples of students. This allowed sufficient power to detect the factor structure, and also allowed for confirmation of the results within the same research. This factor analysis of the full 23-item scale indicated a clear loading on two factors which were called "divergent thinking" and "scatterbrained." The first factor represents the generative aspects of creative ideation. These aspects include the fluency and flexibility of generating novel ideas. The second factor represents the distracted aspects of creative ideation. These aspects include getting lost in one's thoughts or one's writing and appearing absentminded to others. This factor structure was consistent across both samples. Since both factors also significantly correlated, the recommendation to creativity researchers is to treat the scale as a unidimensional scale loading on two correlated factors. Subscales would only be

recommended if these two factors were not correlated. Creativity is a complex construct and the use of the RIBS Scales as a unidimensional measure makes theoretical and statistical sense.

The second factor analysis was conducted on the Grit Scale. This analysis was conducted as a confirmatory factor analysis because the research has consistently shown a two-factor structure of six items each. Surprisingly, this scale had some important differences from other research findings. There were several items with loadings on the opposite factor expected. Interestingly, this occurred in both samples, so it is not an anomaly due solely to sample error. The problematic items had wording that could be argued to represent either factor, and this likely accounted for the problematic loadings. However, overall, the scale still did represent two factors and can be used as a representation of the larger construct of grit. However, it is not recommended to use the subscales because they do not load consistently on the original subscale factors.

Finally, group differences were examined. There were gender differences on the RIBS Scale and ethnic differences on Grit, Academic Self-Efficacy, and Avoiding Novelty. Male students reported higher levels of creative ideation than female students across samples. A recent literature review of the creativity research reported that although some studies point to gender differences, these differences are not consistent across studies (Baer & Kaufman, 2008). The differences in this study were statistically significant, but not necessarily practically significant. Male students' creative ideation, $M = 3.48 (.62)$, was only .27 points (less than half a standard deviation) higher than female students' creative ideation, $M = 3.21 (.63)$, with a negligible effect sizes ($d = .006$).

The fact that there were some ethnic differences on the other scales pointed to the fact that research on ethnically diverse samples is important. One notable fact was that Black students reported the highest level of grit. It might be that being a minority student on a campus requires more passion and perseverance than being a majority student on campus. This echoes a recent study among Black students at predominantly White institution that found that grit predicted success among Black students at these institutions (Strayhorn, 2014).

All ethnic groups reported strong levels of Academic Self-Efficacy, although White and Black students reported the highest levels. The companion scale for Academic Self-Efficacy was Avoiding Novelty. This scale was the only negative coping skill measured in this research; higher levels are predictive of less academic success vis-à-vis self-reported grades. No ethnic groups reported high levels of this tendency, although White students reported the lowest means with scores below 3.0. This examination of the scales indicated that they could be used with confidence to measure creative ideation, grit, academic self-efficacy, and avoidance of novelty among college students.

The second study further examined the relationships among these scales to examine their predictive validity of grades. Study 2 examined the correlations among all scales with grades. In addition, hierarchical multiple regressions controlling for gender, age, and ethnicity were conducted in order to determine the predictive validity of the demographic and the scales to predict self-predicted grades.

The RIBS Scale and the Grit Scale were proposed to measure two important aspects of the investment theory of creativity. The RIBS Scale measures the tendency to generate ideas, and the Grit Scale measures the tendency to purposefully persevere.

These two scales were expected to correlate positively. Surprisingly, these two scales either did not correlate significantly, or they negatively correlated at a low level. These two processes may be orthogonal to one another perhaps because they take place at different points in time. It may also be that the domain generality of both of these traits is too broad to detect the specific creative tendencies of individuals who are at a high level of creativity within the framework of the investment theory. Perhaps domain-specific measures of creative ideation and grit regarding a particular type of creative activity might demonstrate a correlation between creative ideation and grit.

The RIBS measure correlated positively with Academic Self-Efficacy. This provides evidence that creative ideation may be a positive trait within an academic context. In addition, the RIBS Scale correlated negatively with Avoiding Novelty. This, again, provides evidence for the positive aspect of creative ideation within academic work.

However, creative ideation did not correlate with grades, and in the hierarchical regressions, it did not predict grades. This may be an indication that grades do not measure the contribution of creative ideation to learning. This, however, does not indicate that creativity is not important in educational settings. This research focused on domain-general creative ideation and self-reported grades across domains. A more domain-specific examination of creativity with a grade on a capstone project, for example, might show a strong relationship between creative thinking and grades. Future educational research with creativity should also look at outcomes that are broader than grades. Grades are only one indicator of learning, and there are many other outcomes that should be examined. Long-term outcomes that could be considered include

employment, creative achievements, and work satisfaction. Creativity remains a critical higher-level thinking skill for students (Plucker et al.,2004), a relevant student learning outcome for undergraduate students (AACU, 2007), and a vital skill for 21st century workers (Amabile & Khaire, 2008; Florida. 2004). Other interesting findings for educational research are that the most robust predictors of grades across both samples were the longer-established academic motivation measures of Academic Self-Efficacy and Avoiding Novelty. Grit, although very popular over the last decade, was only a significant predictor of grades in one sample. In addition, it was considered as a possible mediator between the motivation variables (Academic Self-Efficacy and Avoiding Novelty) and grades. There was limited evidence that Grit mediated the relationship between Academic Self-Efficacy and grades in the larger sample only. The recommendation to educational researchers interested in motivation is that the more parsimonious 5-item PALS scales may be the best predictor of grades.

The limitations of this research are that it was a cross-sectional survey design. This research does not measure students longitudinally, and it is based solely on self-reported data. However, much of educational research is necessarily produced by examining surveys because of their ability to collect large amounts of data from large samples of students. This research sought to carefully examine the psychometrics as well as the predictive validity of measures. Future research building on these findings might be able to expand the understanding for creative ideation, grit, and academic motivation by including professor-report scales. In addition, open-ended questions could be added to ask students to provide examples of their creative ideation, grit, or motivation. These

questions could be coded for qualitative analysis and could shed light on the nuances of creativity and perseverance in academic contexts.

The results of these two studies would be of primary interest to creativity researchers and education researchers. However, the implications of the studies have a broader audience to include educators, administrators, and policy makers who determine what learning outcomes are important for undergraduate students. Although there are efforts to focus on creative thinking, grit, motivation, and other noncognitive factors as an important aspect of higher education (Farrington et al., 2012) and as constructs that affect how students perform in school (Duckworth, 2009), more work needs to be done in this area.

Appendix A: Survey Questions

RIBS Scale

Please rate yourself on the following statements on a scale of 1 to 5 (1 = *never*; 5 = *very often*.)

1. I have many wild ideas.
2. I think about ideas more often than most people.
3. I often get excited by my own new ideas.
4. I come up with a lot of ideas or solutions to problems.
5. I come up with an idea or solution other people have never thought of.
6. I like to play around with ideas for the fun of it.
7. It is important to be able to think of bizarre and wild possibilities.
8. I would rate myself highly in being able to come up with ideas.
9. I have always been an active thinker--I have lots of ideas
10. I enjoy having flexibility in the things I do and room to make up my own mind.
11. I would take a college course which was based on original ideas.
12. I am able to think about things intensely for many hours.
13. I try to exercise my mind by thinking things through.
14. I am able to think up answers to problems that haven't already been figured out.
15. I am good at combining ideas in ways that others have not tried.
16. Friends ask me to help them think of ideas and solutions.
17. I have ideas about new inventions or about how to improve things.
18. My ideas are often considered "impractical" or even "wild."
19. Sometimes I get so interested in a new idea that I forget about other things that I should be doing.
20. I often have trouble sleeping at night, because so many ideas keep popping into my head.
21. When writing papers or talking to people, I often have trouble staying with one topic because I think of so many things to write or say.
22. I often find that one of my ideas has led me to other ideas, and I end up with an idea and do not know where it came from.
23. Some people might think me scatterbrained or absentminded because I think about a variety of things at once.

Grit Scale

Please rate yourself on the following statements on a scale of 1 to 5 (1 = *not at all like me*; 5 = *very much like me*).

1. I often set a goal but later choose to pursue a different one.
2. I have been obsessed with a certain idea or project for a short time but later lost interest.
3. I have difficulty maintaining my focus on projects that take more than a few months to complete.
4. New ideas and projects sometimes distract me from previous ones.
5. My interests change from year to year.

6. I become interested in new pursuits every few months.
7. I finish whatever I begin.
8. Setbacks don't discourage me.
9. I am diligent.
10. I am a hard worker.
11. I have achieved a goal that took years of work.
12. I have overcome setbacks to conquer an important challenge.

Academic Self-Efficacy Scale

Please rate how much you personally agree or disagree with these statements and how much they reflect how you feel or think personally. On a scale of 1 to 5 (1 = *strongly disagree*; 5 = *strongly agree*)

1. I'm certain I can figure out how to do the most difficult class work.
2. I can do almost all the work in my classes if I don't give up.
3. Even if the work is hard, I can learn it.
4. I can do even the hardest work in my classes if I try.
5. I'm certain I can master the skills taught in my classes this year

Avoiding Novelty Scale

Please rate how much you personally agree or disagree with these statements and how much they reflect how you feel or think personally. On a scale of 1 to 5 (1 = *strongly disagree*; 5 = *strongly agree*)

1. I would prefer to do class work that is familiar to me, rather than work I would have to learn how to do.
2. I don't like to learn a lot of new concepts in class.
3. I prefer to do work as I have always done it, rather than trying something new.
4. I like academic concepts that are familiar to me, rather than those I haven't thought about before.
5. I would choose class work I knew I could do, rather than work I haven't done before.

Self-Reported Grades

What kind of grades do you typically receive?

- Mostly As
- About half As and Bs
- Mostly Bs
- About half Bs and Cs
- Mostly C
- About half Cs and Ds
- Mostly Ds
- Mostly below D

Appendix B: IRB Paperwork



Office of Research Integrity
IRB, IACUC, RDRC
315 Kinkead Hall
Lexington, KY 40506-0057
859 257-9428
fax 859 257-8995
www.research.uky.edu/ori/

EXEMPTION CERTIFICATION

MEMO: Joanne Patricia Rojas
Education Psych & Counseling
3145 Cottontail Lane
Lexington, KY 40503
PI phone #: (859)699-3094

FROM: Institutional Review Board
c/o Office of Research Integrity

SUBJECT: Exemption Certification for Protocol No. 14-0366-X4B

DATE: May 7, 2014

On May 7, 2014, it was determined that your project entitled, *An Examination of the Relationships Between Ethnic Identity, Creativity, Grit, and Motivation in Academic Success*, meets federal criteria to qualify as an exempt study.

Because the study has been certified as exempt, you will not be required to complete continuation or final review reports. However, it is your responsibility to notify the IRB prior to making any changes to the study. Please note that changes made to an exempt protocol may disqualify it from exempt status and may require an expedited or full review.

The Office of Research Integrity will hold your exemption application for six years. Before the end of the sixth year, you will be notified that your file will be closed and the application destroyed. If your project is still ongoing, you will need to contact the Office of Research Integrity upon receipt of that letter and follow the instructions for completing a new exemption application. It is, therefore, important that you keep your address current with the Office of Research Integrity.

For information describing investigator responsibilities after obtaining IRB approval, download and read the document "PI Guidance to Responsibilities, Qualifications, Records and Documentation of Human Subjects Research" from the Office of Research Integrity's IRB Survival Handbook web page [<http://www.research.uky.edu/ori/IRB-Survival-Handbook.html#PIresponsibilities>]. Additional information regarding IRB review, federal regulations, and institutional policies may be found through ORI's web site [<http://www.research.uky.edu/ori/>]. If you have questions, need additional information, or would like a paper copy of the above mentioned document, contact the Office of Research Integrity at (859) 257-9428.

Dear Student:

For this project, we are interested in the relationship between personal factors and academic outcomes. The person in charge of this study is Joanne Rojas (Principal Investigator, PI) of University of Kentucky, Department of Educational Psychology. Candice Davis is the Co-PI for this study. We are doctoral students being guided in this research by Professor Kenneth Tyler, PhD (Advisor).

We would be most appreciative if you could take the time to complete this online survey. Your honest response will help assure that the data in this project is representative of the largest possible population.

Although you will not get personal benefit from taking part in this research study, your responses may help us understand more about how individual differences influence academic outcomes. We hope to receive completed questionnaires from about 400 people, so your answers are important to us. Of course, you have a choice about whether or not to complete the survey/questionnaire, but if you do participate, you are free to skip any questions or discontinue at any time. The completion of this survey indicates your willingness to participate in the study.

The online survey will take 20-30 minutes to complete. There are no known risks to participating in this study. Your response to the survey is anonymous which means no names will appear or be used on research documents, or be used in presentations or publications. The research team will not know that any information you provided came from you, nor even whether you participated in the study. Please be aware, while we make every effort to safeguard your data once received on our servers, given the nature of online surveys, as with anything involving the Internet, we can never guarantee the confidentiality of the data while still en route to us.

Here is the link to the survey: https://uky.az1.qualtrics.com/SE/?SID=SV_6hajXgFc44riotL

If you have questions about the study, please feel free to ask; my contact information is given below. If you have complaints, suggestions, or questions about your rights as a research volunteer, contact the staff in the University of Kentucky Office of Research Integrity at 859-257-9428 or toll-free at 1-866-400-9428.

Thank you in advance for your assistance with this important project. To ensure that your responses will be included, please complete this questionnaire within ten (10) days.

Sincerely,

Joanne P. Rojas
Doctoral Student, Department of Educational Psychology
University of Kentucky
E-MAIL: joanne.rojas@uky.edu

References

- Ai, X. (1999). Creativity and academic achievement: An investigation of gender differences. *Creativity Research Journal*, 4, 329-337.
http://dx.doi.org/10.1207/s15326934crj1204_11
- Amabile, T. M. (1996). *Creativity in context*. Boulder, CO: Westview Press.
- Amabile, T. M. (1998). How to kill creativity. *Harvard Business Review*, 76, 76-87.
<http://dx.doi.org/10.4135/9781446213704.n2>
- Amabile, T. M., & Khaire M. (2008). Creativity and the role of the leader. *Harvard Business Review*, 86, 101-109.
- Ames, M., & Runco, M. A. (2005). Predicting entrepreneurship from ideation and divergent thinking. *Creativity and Innovation Management*, 14, 311-315.
<http://dx.doi.org/10.1111/j.1467-8691.2004.00349.x>
- Anderman, E., & Wolters, C. (2006). Goals, values, and affect: Influences on student motivation. In P. Alexander & P. Winne (Eds.), *Handbook of educational psychology* (pp. 369–389). Mahwah, NJ: Erlbaum.
- Argulewicz, E. N., & Kush, J. C. (1984). Concurrent validity of the SRBCSS Creativity Scale for Anglo-American and Mexican-American gifted students. *Educational and Psychological Research*, 4, 81-89. <http://dx.doi.org/10.1177/073428298300100207>
- Association of American Colleges and Universities (2007). *College learning for the new global century*. Washington, DC: Association of American Colleges and Universities.

- Baer, J. (1997). Gender differences in the effects of anticipated evaluation on creativity. *Creativity Research Journal, 10*, 25-31.
http://dx.doi.org/10.1207/s15326934crj1001_3
- Baer, J. (2012). Domain specificity and the limits of creativity theory. *Journal of Creative Behavior, 46*, 16-29. <http://dx.doi.org/10.1002/jocb.002>
- Baer, J., & Kaufman, J. C. (2008). Gender differences in creativity. *Journal of Creative Behavior, 42*, 75-105. <http://dx.doi.org/10.1002/j.2162-6057.2008.tb01289.x>
- Bandura, A. (1997). *Self-efficacy: The exercise of control*. New York: W. H. Freeman and Company.
- Baron, R. M., & Kenny, D. A. (1986). The moderator-mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology, 51*, 1173-1182.
<http://dx.doi.org/10.1037/0022-3514.51.6.1173>
- Barron, F. (1955). The disposition towards originality. *Journal of Abnormal and Social Psychology, 51*, 478-485. <http://dx.doi.org/10.1037/h0048073>
- Beghetto, R. A. (2007). Does creativity have a place in classroom discussions? Prospective teachers' response preferences. *Thinking Skills and Creativity, 2*, 1-9.
<http://dx.doi.org/10.1016/j.tsc.2006.09.002>
- Beghetto, R. A., & Kaufman, J. C. (2014). Classroom contexts for creativity. *High Ability Studies, 25*, 53-79. <http://dx.doi.org/10.1080/13598139.2014.905247>
- Benedek, M., Könen, T., Neubauer, A. C. (2012). Associative abilities underlying creativity. *Psychology of Aesthetics, Creativity, and the Arts, 3*, 273-281.
<http://dx.doi.org/10.1037/a0027059>

- Berrett, D. (2013, April 1). Creativity: A cure for the common curriculum. *Chronicle of Higher Education*. Retrieved from <http://chronicle.com>
- Bong, M. (2001). Role of self-efficacy and task-value in predicting college students' course performance and future enrollment intentions. *Contemporary Educational Psychology, 26*, 553-570. <http://dx.doi.org/10.1006/ceps.2000.1048>
- Brent, S. D., Lent, R. W., & Larkin, K. C. (1989). Self-efficacy as a moderator of scholastic aptitude--Academic performance relationships. *Journal of Vocational Behavior, 35*, 64-75. [http://dx.doi.org/10.1016/0001-8791\(89\)90048-1](http://dx.doi.org/10.1016/0001-8791(89)90048-1)
- Brophy, D. R. (1998). Understanding, measuring, and enhancing individual creative problem-solving efforts. *Creativity Research Journal, 11*, 123-150. http://dx.doi.org/10.1207/s15326934crj1102_4
- Buchmann, C., & DiPrete, T. A. (2006). The growing female advantage in college completion: The role of family background and academic achievement. *American Sociological Review, 71*, 515-541. <http://dx.doi.org/10.1177/000312240607100401>
- Bull, K. S., Montgomery, D., & Baloché, L. (1995). Teaching creativity at the college level: A synthesis of curricular components perceived important by instructors. *Creativity Research Journal, 8*, 83-89. http://dx.doi.org/10.1207/s15326934crj0801_7
- Byrne, B. B. (2001). *Structural equation modeling with AMOS*. Mahwah, NJ: Lawrence Erlbaum Associates, Publishers.
- Carson, S. H., Peterson, J. B., Higgins, D. M. (2005). Reliability, validity, and factor structure of the creative achievement questionnaire. *Creativity Research Journal, 17*, 37-50. http://dx.doi.org/10.1207/s15326934crj1701_4

- Caskie, G. I. L., Sutton, M. C., Eckhardt, A. G. (2014). Accuracy of self-reported college grades: Gender moderated differences by achievement level and academic self-efficacy. *Journal of College Student Development, 55*, 385-390.
<http://dx.doi.org/10.1353/csd.2014.0038>
- Cassady, J. C. (2001). Self-reported grades and SAT: A methodological note. *Practical Assessment, Research & Evaluation, 7*(12). Retrieved January 8, 2014 from
<http://PAREonline.net/getvn.asp?v=7&n=12>.
- Cohen, J. R., & Ferrari, J. R. (2010). Take some time to think this over: The relation between rumination, indecision, and creativity. *Creativity Research Journal, 22*, 68-73. <http://dx.doi.org/10.1080/10400410903579601>
- Costello, A. B., & Osborne, J. W. (2005). Best practices in exploratory factor analysis: Four recommendations for getting the most from your analysis. *Practical Assessment, Research & Evaluation, 10*, 1-9. Retrieved from
<http://pareonline.net/pdf/v10n7.pdf>
- Cropley, D. H., & Cropley, A. J. (2000). Fostering creativity in engineering undergraduates. *High Ability Studies, 11*, 207-219.
<http://dx.doi.org/10.1080/13598130020001223>
- Csíkszentmihályi, M. (1996). *Creativity: Flow and the psychology of discovery and invention*. New York, NY: Harper Collins Publishers.
- Csíkszentmihályi, M., & Wolfe, R. (2000). New conceptions and research approaches to creativity: Implications of a systems perspective for creativity in education. In K. A. Heller, F. J. Monks, R. Subotnik, & R. J. Sternberg, (Eds.), *The international*

- handbook of giftedness and talent* (pp. 81-93). Oxford, England: Elsevier Science Ltd.
- DeGraaf, L. (2013). *Edison and the rise of innovation*. New York: Sterling Signature.
- DeMoss, K., Milich, R., & DeMers, S. (1993). Gender, creativity, depression, and attributional style in adolescents with high academic ability. *Journal of Abnormal Child Psychology*, *21*, 455–467. <http://dx.doi.org/10.1007/bf01261604>
- Dollinger, S. J. (2011). "Standardized minds" or individuality? Admissions tests and creativity revisited. *Psychology of Aesthetics, Creativity, and the Arts*, *5*, 329-341. <http://dx.doi.org/10.1037/a0023659>
- Dollinger, S. J., Urban, K. K., & James, T. A. (2004). Creativity and openness: Further validation of two creative product measures. *Creativity Research Journal*, *16*, 35-47. http://dx.doi.org/10.1207/s15326934crj1601_4
- Doménech-Betoret, F., Gómez-Artiga, A., & Lloret-Segura, S. (2014). Personal variables, motivation, and avoidance learning strategies in undergraduate students. *Learning and Individual Differences*, *35*, 122-129. <http://dx.doi.org/10.1016/j.lindif.2014.06.007>
- Dornbusch, S. M., Ritter, P. L., Leiderman, P. H., Roberts, D. F., & Fraleigh, M. J. (1987). The relation of parenting style to adolescent school performance. *Child Development*, *58*, 1244-1257. <http://dx.doi.org/10.2307/1130618>
- Doyle, M., & Furnham, A. (2012). The distracting effects of music on the cognitive test performance of creative and non-creative individuals. *Thinking Skills and Creativity*, *7*, 1-7. <http://dx.doi.org/10.1016/j.tsc.2011.09.002>

- Duckworth, A. L. (2009). (Over and) beyond high-stakes testing. *American Psychologist*, 63, 279-280. <http://dx.doi.org/10.1037/a0014923>
- Duckworth, A. J., & Quinn, P. D. (2009). Development and validation of the Short Grit Scale (Grit-S). *Journal of Personality Assessment*, 91, 166-174. <http://dx.doi.org/10.1080/00223890802634290>
- Duckworth, A. L., Peterson, C., Matthews, M. D., & Kelly, D. R. (2007). Grit: Perseverance and passion for long-term goals. *Journal of Personality and Social Psychology*, 92, 1087-1101. <http://dx.doi.org/10.1037/0022-3514.92.6.1087>
- Duckworth, A. L., & Quinn, P. D. (2009). Development and validation of the Short Grit Scale (Grit-S). *Journal of Personality Assessment*, 91, 166-174. <http://dx.doi.org/10.1080/00223890802634290>
- Dweck, C. S., & Leggett, E. L. (1988). A social-cognitive approach to motivation and personality. *Psychological Review*, 95, 256-273. <http://dx.doi.org/10.1037/0033-295X.95.2.256>
- Eilam, B., Zeidner, M., & Aharon, I. (2009). Student conscientiousness, self-regulated learning, and science achievement: An explorative field study. *Psychology in the Schools*, 46, 420-432. <http://dx.doi.org/10.1002/pits.20387>
- Elliott, E. S., & Dweck, C. S. (1988). Goals: An approach to motivation and achievement. *Attitudes and Social Cognition*, 54, 5-12. <http://dx.doi.org/10.1037//0022-3514.54.1.5>
- Ericsson, K. A., & Charness, N. (1994). Expert performance: Its structure and acquisition. *American Psychologist*, 49, 725-747. <http://dx.doi.org/10.1037/0003-066X.49.8.725>

- Eskreis-Winkler, L., Shulman, E. P., Beal, S. A., & Duckworth, A. L. (2014). The grit effect: predicting retention in the military, the workplace, school, and marriage. *Frontiers in Psychology, 5*, 1-12. <http://dx.doi.org/10.3389/fpsyg.2014.00036>
- Everitt, B. S. (1975). Multivariate analysis: The need for data, and other problems. *British Journal of Psychiatry, 126*, 273-240. <http://dx.doi.org/10.1192/bjp.126.3.237>
- Farrington, C.A., Roderick, M., Allensworth, E., Nagaoka, J., Keyes, T.S., Johnson, D.W., & Beechum, N.O. (2012). *Teaching adolescents to become learners. The role of noncognitive factors in shaping school performance: A critical literature review*. Chicago: University of Chicago Consortium on Chicago School Research.
- Feingold, A. (1994). Gender differences in personality: A meta-analysis. *Psychological Bulletin, 116*, 429-456. <http://dx.doi.org/10.1037/0033-2909.116.3.429>
- Feist, G. J. (1998). A meta-analysis of personality in scientific and artistic creativity. *Personality and Social Psychology Review, 2*, 290-309. http://dx.doi.org/10.1207/s15327957pspr0204_5
- Feldman, D. H. (1982). A developmental framework for research with gifted children. In D. H. Feldman (Ed.), *Developmental approaches to giftedness and creativity* (pp. 31-45). San Francisco, CA: Jossey-Bass. <http://dx.doi.org/10.1002/cd.23219821705>
- Florida, R. (2004). America's looming creativity crisis. *Harvard Business Review, 82*, 122-136. <http://dx.doi.org/10.1109/emr.2005.25181>
- Florida, R., & Goodnight, J. (2005). Managing for creativity. *Harvard Business Review, 82*, 122-131.

- Frucot, V. G., & Cook, G. L. (1994). Further research on the accuracy of students' self-reported grade point averages, SAT scores, and course grades. *Perceptual and Motor Skills, 79*, 743-746. <http://dx.doi.org/10.2466/pms.1994.79.2.743>
- Goldman, B. A., Flake, W. L., & Matheson, M. B. (1990). Accuracy of college students' perceptions of their SAT scores, high school and college grade point averages relative to their ability. *Perceptual and Motor Skills, 70*, 514-515. <http://dx.doi.org/10.2466/pms.1990.70.2.514>
- Gorsuch, R.L. (1983). *Factor analysis*. 2nd edition. Hillsdale, N.J.: Lawrence Erlbaum.
- Gough, H. G. (1979). A creative personality scale for the Adjective Check List. *Journal of Personality and Social Psychology, 37*, 1398-1405. <http://dx.doi.org/10.1037/0022-3514.37.8.1398>
- Gray, E., & Watson, D. (2002). General and specific traits of personality and their relation to sleep and academic performance. *Journal of Personality, 70*, 177-205. <http://dx.doi.org/10.1111/1467-6494.05002>
- Grice, J. W. (2001). Computing and evaluating factor scores. *Psychological Methods, 6*, 430-450. <http://dx.doi.org/10.1037/0003-066x.50.9.741>
- Grice, J. W., & Iwasaki, M. (2007). A truly multivariate approach to MANOVA. *Applied Multivariate Research, 12*, 199-226.
- Griffin, M., & McDermott, M. R. (1998). Exploring a tripartite relationship between rebelliousness, openness to experience, and creativity. *Social Behavior and Personality, 26*, 347-356. <http://dx.doi.org/10.2224/sbp.1998.26.4.347>
- Guilford, J.P. (1950). Creativity. *American Psychologist, 5*, 444-454. <http://dx.doi.org/10.1037/h0063487>

- Guilford, J. P. (1967). *The nature of human intelligence*. New York, NY: McGraw-Hill.
- Hennessey, B. A., & Amabile, T. A. (1998). Reward, intrinsic motivation, and creativity. *American Psychologist*, *53*, 674-675. <http://dx.doi.org/10.1037/0003-066X.53.6.674>
- Hennessey, B. A., & Amabile, T. A. (2010). Creativity. *Annual Review of Psychology*, *61*, 569-598. <http://dx.doi.org/10.1146/annurev.psych.093008.100416>
- Hocevar, D. (1979). Ideational fluency as a confounding factor in the measurement of originality. *Journal of Educational Psychology*, *71*, 191-196. <http://dx.doi.org/10.1037/0022-0663.71.2.191>
- Hocevar, D. (1981). Measurement of creativity: Review and critique. *Journal of Personality Assessment*, *45*, 450-464. http://dx.doi.org/10.1207/s15327752jpa4505_1
- Hocevar, D., & Bachelor, P. (1989). A taxonomy and critique of measurements used in the study of creativity. In J. A. Glover, R. R. Ronning, & C. R. Reynolds (Eds.), *Handbook of creativity* (pp. 53-75). New York: Plenum Press. http://dx.doi.org/10.1007/978-1-4757-5356-1_3
- Hunt, E. (2008). Applying the theory of successful intelligence to education--The good, the bad, and the ogre: Commentary on Sternberg et al. (2008). *Perspectives on Psychological Science*, *3*, 509-515. <http://dx.doi.org/10.1111/j.1745-6924.2008.00094.x>
- Jacob, B. A. (2002). Where the boys aren't: non-cognitive skills, returns to school and the gender gap in higher education. *Economics of Education Review*, *21*, 589-598. [http://dx.doi.org/10.1016/S0272-7757\(01\)00051-6](http://dx.doi.org/10.1016/S0272-7757(01)00051-6)

- Jeon, K., Moon, S. M., & French, B. (2011). Differential effects of divergent thinking, domain knowledge, and interest on creative performance in art and math. *Creativity Research Journal*, 23, 60-71. <http://dx.doi.org/10.1080/10400419.2011.545750>
- Johnson, S. (2014). *How we got to now: Six innovations that made the modern world*. New York: Riverhead Books.
- Johnson-Laird, P. N. (1988). Freedom and constraint in creativity. In R. J. Sternberg (Ed.), *The nature of creativity* (pp. 202-219). New York, NY: Cambridge University Press.
- Kaplan, A., & Midgley, C. (1997). The effect of achievement goals: Does level of perceived academic competence make a difference? *Contemporary Educational Psychology*, 22, 415-435. <http://dx.doi.org/10.1006/ceps.1997.0943>
- Kaufman, J. C. (2006). Self-reported differences in creativity by ethnicity and gender. *Applied Cognitive Psychology*, 20, 1065-1082. <http://dx.doi.org/10.1002/acp.1255>
- Kaufman, J. C., & Agars, M. D. (2009). Being creative with the predictors *and* criteria for success. *American Psychologist*, 63, 280-281.
<http://dx.doi.org/10.1037/a0014926>
- Kaufman, J. C., & Beghetto, R. A. (2009). Beyond big and little: The Four C Model of Creativity. *Review of General Psychology*, 13, 1-12.
<http://dx.doi.org/10.1037/a0013688>
- Kessler, C., & Quinn, M. E. (1987). Language minority children's linguistic and cognitive creativity. *Journal of Multilingual and Multicultural Development*, 8, 173-186.
<http://dx.doi.org/10.1080/01434632.1987.9994284>

- Khatena, J., & Torrance, E. P. (1976). *Manual for Khatena-Torrance Creative Perception Inventory*. Chicago, IL: Stoelting.
- Kim, K. H. (2006). Can we trust creativity tests? A review of the Torrance Tests of Creative Thinking (TTCT). *Creativity Research Journal, 18*, 3-14.
http://dx.doi.org/10.1207/s15326934crj1801_2
- Kim, K. H., & Hull, M. F. (2012). Creative personality and anticreative environment for high school dropouts. *Creativity Research Journal, 24*, 169-176.
<http://dx.doi.org/10.1080/10400419.2012.677318>
- Kim, K. H., & VanTassel-Baska, J. (2010). The relationship between creativity and behavior problems among underachieving elementary and high school students. *Creativity Research Journal, 22*, 185-193.
<http://dx.doi.org/10.1080/10400419.2010.481518>
- Krathwohl, D. R. (2002). A revision of Bloom's Taxonomy: An overview. *Theory Into Practice, 41*, 212-218. http://dx.doi.org/10.1207/s15430421tip4104_2
- Krosnick, J. A. (1999). Survey research. *Annual Review of Psychology, 50*, 537-67.
<http://dx.doi.org/10.1146/annurev.psych.50.1.537>
- Kunce, J. T., Cook, D. W., & Miller, D. E. (1975). Random variables and correlational overkill. *Educational and Psychological Measurement, 35*, 529-534.
<http://dx.doi.org/10.1177/001316447503500301>
- Kuncel, N. R., Crede, M., & Thomas, L. L. (2005). The validity of self-reported grade point averages, class ranks, and test scores: A meta-analysis and review of the literature. *Review of Educational Research, 75*, 63-82.

- Lowry, P. B., & Gaskin, J. (2014). Partial least squares (PLS) structural equation modeling (SEM) for building and testing behavioral causal theory: When to choose it and how to use it. *IEEE Transactions on Professional Communication*, *57*, 123-146. <http://dx.doi.org/10.1109/tpc.2014.2312452>
- Lubart, T. I., & Sternberg, R. J. (1995). An investment approach to creativity: Theory and data. In S. M. Smith, T. B. Ward, & R. A. Finke (Eds.), *The creative cognition approach* (pp. 269-302). Cambridge, MA: MIT Press.
- MacKinnon, D. W. (1965). Personality and the realization of creative potential. *American Psychologist*, *20*, 273-281. <http://dx.doi.org/10.1037/h0022403>
- Marsh, H. W., & Hocevar, D. (1985). Application of confirmatory factor analysis to the study of self-concept: First- and higher order factor models and their invariance across groups. *Psychological Bulletin*, *97*, 562-582. <http://dx.doi.org/10.1037/0033-2909.97.3.562>
- Mayer, R. E. (1999). Fifty years of creativity research. In R. J. Sternberg (Ed.), *Handbook of creativity* (pp. 449-460). Cambridge, England: Cambridge University Press.
- Mayer, R. E. (2008). Incorporating individual differences into the science of learning: Commentary on Sternberg et al. (2008). *Perspectives on Psychological Science*, *3*, 507-508. <http://dx.doi.org/10.1111/j.1745-6924.2008.00093.x>
- McCrae, R. R. (1987). Creativity, divergent thinking, and openness to experience. *Journal of Personality and Social Psychology*, *52*, 1258-1265. <http://dx.doi.org/10.1037/0022-3514.52.6.1258>

- McWilliam, E., & Dawson, S. (2008). Teaching for creativity: Towards sustainable and replicable pedagogical practice. *Higher Education, 56*, 633-643.
<http://dx.doi.org/10.1007/s10734-008-9115-7>
- Messick, S. (1995). Validity of psychological assessment: Validation of inferences from persons' responses and performances as scientific inquiry into score meaning. *American Psychologist, 50*, 741-749. <http://dx.doi.org/10.1037/0003-066x.50.9.741>
- Mednick, S. A. (1962). The associative basis of the creative process. *Psychological Review, 69*, 220-232. <http://dx.doi.org/10.1037/h0048850>
- Midgley, C., Arunkumar, R., & Urdan, T. C. (1996). "If I don't do well tomorrow, there's a reason": Predictors of adolescents' use of academic self-handicapping strategies. *Journal of Educational Psychology, 88*, 423-434. <http://dx.doi.org/10.1037/0022-0663.88.3.423>
- Midgley, C., Maehr, M. L., Huda, L. Z., Anderman, E., Anderman, L., Freeman, K. E., ... Urdan, T. (2000). *Manual for the Patterns of Adaptive Learning Scales (PALS)*. Ann Arbor, MI: University of Michigan. <http://dx.doi.org/10.1037/0022-0663.88.3.423>
- Miller, A. L., & Dumford, A. D. (2014). Creative cognitive processes in higher education. *The Journal of Creative Behavior, 0*, 1-17.
<http://dx.doi.org/10.1002/jocb.77>
- Moran, S. (2010). The roles of creativity in society. In J. C. Kaufman, & R. J. Sternberg (Eds.), *The Cambridge Handbook of Creativity* (pp. 74-90). Cambridge, England: Cambridge University Press. <http://dx.doi.org/10.1017/cbo9780511763205.006>

- Mueller, J. S., Melwani, S., & Goncalo, J. A. (2012). The bias against creativity: Why people desire but reject creative ideas. *Psychological Science, 23*, 13-17.
<http://dx.doi.org/10.1177/0956797611421018>
- Museus, S. D., Harper, S. R., & Nichols, A. N. (2010). Racial differences in the formation of postsecondary educational expectations: A structural model. *Teachers College Record, 112*, 811-842. Retrieved from www.tcrecord.org/
- Nederhof, A. J. (1985). Methods of coping with social desirability. *European Journal of Social Psychology, 15*, 263-280. <http://dx.doi.org/10.1002/ejsp.2420150303>
- Nijstad, B. A., De Dreu, C. K. W., Rietzschel, E. F., & Baas, M. (2010). The dual pathway to creativity model: Creative ideation as a function of flexibility and persistence. *European Review of Social Psychology, 21*, 34-77.
<http://dx.doi.org/10.1080/10463281003765323>
- Noffle, E. E., & Robins, R. W. (2007). Personality predictors of academic outcomes: Big five correlates of grades and SAT scores. *Journal of Personality and Social Psychology, 93*, 116-130. <http://dx.doi.org/10.1037/0022-3514.93.1.116>
- Okuda, S. M., Runco, M. A., & Berger, D. E. (1991). Creativity and the finding and solving of real-world problems. *Journal of Psychoeducational Assessment, 9*, 45-53.
<http://dx.doi.org/10.1177/073428299100900104>
- Osborne, J. W., & Costello, A. B. (2004). Sample size and subject to item ratio in principal components analysis. *Practical Assessment, Research, & Evaluation, 9*(11). Retrieved December 13, 2013 from <http://PAREonline.net/getvn.asp?=9&n=11>.

- Osborne, J. W., Costello, A. B., & Kellow, J. T. (2008). Best practices in exploratory factor analysis. In J. Osborne (Ed.), *Best practices in quantitative methods* (pp. 86-124). Thousand Oaks, CA: Sage. <http://dx.doi.org/10.4135/9781412995627.d8>
- Pappano, L. (2014, February 5). Learning to think outside the box. Creativity becomes an academic discipline. *The New York Times*. Retrieved from <http://www.nytimes.com>
- Pashler, H., McDaniel, M., Rohrer, D., & Bjork, R. (2009). Learning styles: Concepts and evidence. *Psychological Science in the Public Interest*, 9, 105-119. <http://dx.doi.org/10.1111/j.1539-6053.2009.01038.x>
- Patrick, H., Ryan, A. M., & Kaplan, A. (2007). Early adolescents' perceptions of the classroom social environment, motivational beliefs, and engagement. *Journal of Educational Psychology*, 99,83-98. <http://dx.doi.org/10.1037/0022-0663.99.1.83>
- Perkins, D. N. (1990). The nature and nurture of creativity. In B. F. Jones & L. Idol (Eds.), *Dimensions of thinking and cognitive instruction*, (pp. 415-443). Hillsdale, NJ: Erlbaum.
- Peterson, C., & Seligman, M. E. P, (2001). VIA Strengths Survey for Children. Retrieved from <http://www.authentichappiness.sas.upenn.edu/>
- Peterson, C., & Seligman, M. E. P, (2004). *Character strengths and virtues: A handbook and classification*. New York, NY: Oxford University Press.
- Piaget, J. (1950). *The psychology of intelligence*. New York: International Universities Press.
- Piaget, J. (1971). Comment on Beilin's paper. In D. R. Green, M. P. Ford, & G. B. Flamer (Eds.), *Measurement and Piaget* (pp. 192–194). New York: McGraw-Hill.

- Pintrich, P. R. (2000). The role of goal orientation in learning and achievement. *Journal of Educational Psychology, 95*,544-555. <http://dx.doi.org/10.1037/0022-0663.92.3.544>
- Plucker, J. A., Beghetto, R. A., & Dow, G. T. (2004). Why isn't creativity more important to educational psychologists? Potentials, pitfalls, and future directions in creativity research. *Educational Psychologist, 39*, 83-96. http://dx.doi.org/10.1207/s15326985ep3902_1
- Plucker, J. A., & Makel, M. C. (2010). Assessment of creativity. In J. C. Kaufman & R. J. Sternberg (Eds.), *Cambridge handbook of creativity* (pp.48-73). New York: Cambridge University Press. <http://dx.doi.org/10.1017/CBO9780511763205.005>
- Plucker, J. A., Runco, M. A., & Lim, W. (2006). Predicting ideational behavior from divergent thinking and discretionary time on task. *Creativity Research Journal, 18*, 55-63. http://dx.doi.org/10.1207/s15326934crj1801_7
- Preacher, K. J. (2015). Calculation for the Sobel Test: An interactive calculation tool for Mediation tests. Retrieved from <http://quantpsy.org/sobel/sobel.htm>
- Renzulli, J. S. (1976). The Enrichment Triad Model: A guide for developing defensible programs for the gifted and talented. *Gifted Child Quarterly, 20*, 303-326.
- Renzulli, J. S. (1994). *Schools for talent development: A practical plan for total school improvement*. Mansfield Center, CT: Creative Learning Press.
- Renzulli, J. S. (2012). Reexamining the role of gifted education and talent development for the 21st century: A four-part theoretical approach. *Gifted Child Quarterly, 56*, 150-159. <http://dx.doi.org/10.1177/0016986212444901>

- Renzulli, J. S., Siegle, D., Reis, S. M., Gavin, M. K., & Sytsma Reed, R. E. (2009). An investigation of the reliability and factor structure of four new Scales for Rating the Behavioral Characteristics of Superior Students. *Journal of Advanced Academics, 21*, 84-108. <http://dx.doi.org/10.1177/1932202X0902100105>
- Rhodes, M. (1961). An analysis of creativity. *The Phi Delta Kappan, 42*, 305-310.
- Robertson-Kraft, C., & Duckworth, A. L. (2014). True grit: Trait-level perseverance and passion for long-term goals predicts effectiveness and retention among novice teachers. *Teachers College Record, 116*, 1-28. Retrieved from www.tcrecord.org/
- Roskes, M., De Dreu, C. K., & Nijstad, B. A. (2012). Necessity is the mother of invention: Avoidance motivation stimulates creativity through cognitive effort. *Journal of Personality and Social Psychology, 2*, 242-256. <http://dx.doi.org/10.1037/a0028442>
- Ross, R. J. (1976). The development of formal thinking and creativity in adolescence. *Adolescence, 11*, 609-617. doi.apa.org
- Rubenson, D. L., & Runco, M. A. (1992). The psychoeconomic approach to creativity. *New Ideas in Psychology, 10*, 131-147. [http://dx.doi.org/10.1016/0732-118X\(92\)90021-Q](http://dx.doi.org/10.1016/0732-118X(92)90021-Q)
- Runco, M. A. (1985). Reliability and convergent validity of ideational flexibility as a function of academic achievement. *Perceptual and Motor Skills, 61*, 1075-1081 <http://dx.doi.org/10.2466/pms.1985.61.3f.1075v>
- Runco, M. A. (1996). Personal creativity. *New Directions for Child Development, 72*, 3-30. <http://dx.doi.org/10.1002/cd.23219967203>

- Runco, M. A. (2004). Creativity. *Annual Review of Psychology*, *55*, 657-687.
<http://dx.doi.org/10.1146/annurev.psych.55.090902.141502>
- Runco, M. A., & Chand, I. (1995). Cognition and creativity. *Educational Psychology Review*, *7*, 243-267. <http://dx.doi.org/10.1007/BF02213373>
- Runco, M. A., Plucker, J. A., & Lim, W. (2001). Development and psychometric integrity of a measure of ideational behavior. *Creativity Research Journal*, *13*, 393-400. http://dx.doi.org/10.1207/S15326934CRJ1334_16
- Ruscio, J., Whitney, D. M., & Amabile, T. M. (1998). Looking inside the fishbowl of creativity: Verbal and behavioral predictors of creative performance. *Creativity Research Journal*, *11*, 243-263. http://dx.doi.org/10.1207/s15326934crj1103_4
- Ryan, A. M., Gheen, M. H., & Midgley, C. (1998). Why do some students avoid asking for help? An examination of the interplay among students' academic efficacy, teachers' social-emotional role, and the classroom goal structure. *Journal of Educational Psychology*, *90*, 528-535. <http://dx.doi.org/10.1037/0022-0663.90.3.528>
- Ryan, A. M., Patrick, H., & Shim, S. (2005). Differential profiles of students identified by their teacher as having avoidant, appropriate, or dependent help-seeking tendencies in the classroom. *Journal of Educational Psychology*, *97*, 275-85.
- Ryan, A. M., & Shin, H. (2011). Help-seeking tendencies during early adolescence: An examination of motivational correlates and consequences for achievement. *Learning and Instruction*, *21*, 247-256.
- Sackett, P. R., Borneman, M. J., & Connelly, B. S. (2009). High stakes testing in higher education and employment: Appraising the evidence for validity and fairness. *American Psychologist*, *63*, 215-227. <http://dx.doi.org/10.1037/0003-066X.63.4.215>

- Salles, A., Cohen, G. L., Mueller, C. M. (2014). The relationship between grit and resident well-being. *The American Journal of Surgery*, 207, 251-254.
<http://dx.doi.org/10.1016/j.amjsurg.2013.09.006>
- Sawyer, R. K. (2003). *Creativity and development*. Oxford, England: Oxford University Press.
- Sawyer, R. K. (2006). Education for innovation. *Thinking Skills and Creativity*, 1, 41-48.
<http://dx.doi.org/10.1016/j.tsc.2005.08.001>
- Scholastic Testing Service (2009). Gifted education: Torrance Tests of Creative Thinking. Retrieved from <http://www.ststesting.com/2005giftttct.html>.
- Scott, C. L. (1999). Teachers' biases toward creative children. *Creativity Research Journal*, 12, 321-328. http://dx.doi.org/10.1207/s15326934crj1204_10
- Shalley, C. E., & Perry-Smith, J. E. (2001). Effects of social-psychological factors on creative performance: The role of informational and controlling expected evaluation and modeling experience. *Organizational Behavior and Human Decision Processes*, 84, 1-22. <http://dx.doi.org/10.1006/obhd.2000.2918>
- Shih, S. (2009). An examination of factors related to Taiwanese adolescents' reports of avoidance strategies. *Journal of Educational Research*, 105, 377-388.
<http://dx.doi.org/10.3200/JOER.102.5.377-388>
- Silverman, I. W. (2003). Gender differences in delay of gratification: A meta-analysis. *Sex Roles*, 49, 451-463. <http://dx.doi.org/10.1023/A:1025872421115>
- Silvia, P. J., Winterstein, B. P., Willse, J. T., Barona, C. M., Cram, J. T., Hess, K. I., Martinez, J. L., & Richard, C. A. (2008). Assessing creativity with divergent thinking tasks: Exploring the reliability and validity of new subjective scoring

methods. *Psychology of Aesthetics, Creativity, and the Arts*, 2, 68-85.

<http://dx.doi.org/10.1037/1931-3896.2.2.68>

Silvia, P. J., Nusbaum, E. C., Berg, C. Martin, C., & O'Connor, A. (2009). Openness to experience, plasticity, and creativity: Exploring lower-order, high-order, and interactive effects. *Journal of Research in Personality*, 43, 1089-1090.

<http://dx.doi.org/10.1016/j.jrp.2009.04.015>

Silvia, P. J., Wigert, B., Reiter-Palmon, R., & Kaufman, J. C. (2012). Assessing creativity with self-report scales: A review and empirical evaluation. *Psychology of Aesthetics, Creativity, and the Arts*, 6, 19-34. <http://dx.doi.org/10.1037/a0024071>

Simonton, D. K. (1986). Presidential personality: Biographical use of the Gough Adjective Check List. *Journal of Personality and Social Psychology*, 51, 149-160.

<http://dx.doi.org/10.1037/0022-3514.51.1.149>

Simonton, D. K. (1991). Emergence and realization of genius: The lives and works of 120 classical composers. *Journal of Personality and Social Psychology*, 61, 829-840. <http://dx.doi.org/10.1037/0022-3514.61.5.829>

Simonton, D. K. (1992). The social context of career success and course for 2,026 scientists and inventors. *Personality and Social Psychology Bulletin*, 18, 452-463.

<http://dx.doi.org/10.1177/0146167292184009>

Simonton, D. K. (1999). Significant samples: The psychological study of eminent individuals. *Psychological Methods*, 4, 425-451. <http://dx.doi.org/10.1037/1082-989X.4.4.425>

- Simonton, D. K. (2007). The creative process in Picasso's *Guernica* sketches: Monotonic improvements versus nonmonotonic variants. *Creativity Research Journal*, 19, 329-344. <http://dx.doi.org/10.1080/10400410701753291>
- Simonton, D. K. (2009). Varieties of (scientific) creativity: A hierarchical model of domain-specific disposition, development, and achievement. *Perspectives on Psychological Science*, 4: 441-452. <http://dx.doi.org/10.1111/j.1745-6924.2009.01152.x>
- Steinberg, L., Lamborn, S. D., Darling, N., Mounts, N. S., & Dornbusch, S. M. (1994). Over-time changes in adjustment and competence among adolescents from authoritative, authoritarian, indulgent, and neglectful families. *Child Development*, 65, 754-770. <http://dx.doi.org/10.2307/1131416>
- Sternberg, R. J. (1997a). *Successful intelligence*. New York: Plume.
<http://dx.doi.org/10.1017/CBO9780511584152>
- Sternberg, R. J. (1997b). *Thinking styles*. New York: Cambridge University Press.
- Sternberg, R. J. (1998). Applying the triarchic theory of human intelligence in the classroom. In R. J. Sternberg & W. W. Williams (Eds.), *Intelligence, Instruction, and Assessment*. Mahwah, NJ: Lawrence Erlbaum
- Sternberg, R. J. (1999). The theory of successful intelligence. *Review of General Psychology*, 3, 292-316. <http://dx.doi.org/10.1037/1089-2680.3.4.292>
- Sternberg, R. J. (2000). Identifying and developing creative giftedness. *Roeper Review*, 23, 60-64. <http://dx.doi.org/10.1080/02783190009554067>
- Sternberg, R. J. (2002). Creativity as a decision. *American Psychologist*, 57, 376.

- Sternberg, R. J. (2006). The nature of creativity. *Creativity Research Journal*, 18, 87-98.
http://dx.doi.org/10.1207/s15326934crj1801_10
- Sternberg, R. J. (2012). The assessment of creativity: An investment-based approach. *Creativity Research Journal*, 24, 3-12.
<http://dx.doi.org/10.1080/10400419.2012.652925>
- Sternberg, R. J., & Grigorenko, E. L. (2004). Successful intelligence in the classroom. *Theory into Practice*, 43, 274-280.
- Sternberg, R. J., & Lubart, T. I. (1995). *Defying the crowd: Cultivating creativity in a culture of conformity*. New York: The Free Press.
- Sternberg, R. J., & Lubart, T. I. (1996). Investing in creativity. *American Psychologist*, 51, 677-688. <http://dx.doi.org/10.1037/0003-066X.51.7.677>
- Sternberg, R. J., & the Rainbow Project Collaborators. (2006). The Rainbow Project: Enhancing the SAT through assessments of analytical, practical, and creative skills. *Intelligence*, 34, 321-350. <http://dx.doi.org/10.1016/j.intell.2006.01.002>
- Sternberg, R. J. (2008). Applying psychological theories to educational practice. *American Educational Research Journal*, 45, 150-165.
<http://dx.doi.org/10.3102/0002831207312910>
- Stevens, J. P. (2002). *Applied multivariate statistics for the social sciences* (4th Ed.). Mahwah, NJ: Lawrence Erlbaum.
- Strayhorn, T. L. (2014). What role does grit play in the academic success of Black male collegians as predominantly White institutions? *Journal of African American Studies*, 18, 1-10. <http://dx.doi.org/10.1007/s12111-012-9243-0>

- Tabachnick, B. G., & Fidell L. S. (2006). *Using multivariate statistics* (5th Ed.). Boston, MA: Allyn and Bacon.
- Torrance, E. P. (1962). *Guiding creative talent*. Englewood Cliffs, NJ: Prentice Hall.
<http://dx.doi.org/10.1037/13134-000>
- Torrance, E. P. (1963). The creative personality and the ideal pupil. *Teachers College Record*, 65, 220-226. Retrieved from www.tcrecord.org/
- Torrance, E. P. (1971). Are the Torrance Tests of Creative Thinking biased against or in favour of the disadvantaged groups? *Gifted Child Quarterly*, 15, 75-80.
- Torrance, E. P. (1972). Predictive validity of Torrance Tests of Creative Thinking. *Journal of Creative Behavior*, 6, 236-252. <http://dx.doi.org/10.1002/j.2162-6057.1972.tb00936.x>
- Torrance, E. P. (1973). Non-test indicators of creative talent among disadvantaged children. *Gifted Child Quarterly*, 17, 3-9.
<http://dx.doi.org/10.1177/001698627301700101>
- Torrance, E. P. (1974). *The Torrance Tests of Creative Thinking-Norms-Technical Manual Research Edition-Verbal Tests, Forms A and B-Figural Tests, Forms A and B*. Princeton, NJ: Personnel Press
- Torres, J. B., & Solberg, V. S. (2001). Role of self-efficacy, stress, social integration, and family support in Latino college student persistence and health. *Journal of Vocational Behavior*, 59, 53-63. <http://dx.doi.org/10.1006/jvbe.2000.1785>
- Treffinger, D. J. (1995). Creative Problem Solving: Overview and educational implications. *Educational Psychology Review*, 7, 301-312.
<http://dx.doi.org/10.1007/BF02213375>

- Treffinger, D. J., & Isaksen, S. G. (2005). Creative problem solving: The history, development, and implications for gifted education and talent development. *Gifted Child Quarterly*, 49, 342-353. <http://dx.doi.org/10.1177/001698620504900407>
- Turner, J. C., Midgley, C., Meyer, D. K., Gheen, M., Anderman, E. M., Kang, Y., & Patrick, H. (2002). The classroom environment and students reports of avoidance strategies in mathematics: A multimethod study. *Journal of Educational Psychology*, 94, 88-106. <http://dx.doi.org/10.1037/0022-0663.94.1.88>
- van Geert, P. (1998). A dynamic systems model of basic developmental mechanisms: Piaget, Vygotsky, and beyond. *Psychological Review*, 105, 645-677. <http://dx.doi.org/10.1037//0033-295x.105.4.634-677>
- von Stumm, S., Chung, A., & Furnham, A. (2011). Creative ability, creative ideation, and latent classes of creative achievement: What is the role of personality? *Psychology of Aesthetics, Creativity, and the Arts*, 5, 107-114.
- Ward, T. B. (2007). Creative cognition as a window on creativity. *Methods*, 42, 28-37. <http://dx.doi.org/10.1016/j.ymeth.2006.12.002>
- Westby, E. L., & Dawson, V. L. (1995). Creativity: Asset or burden in the classroom? *Creativity Research Journal*, 8, 1-10. http://dx.doi.org/10.1207/s15326934crj0801_1
- Wu, P. L., & Chiou, W. B. (2008). Postformal thinking and creativity among late adolescents: A post-Piagetian approach. *Adolescence*, 43, 237-251.
- Yang, C. C., Wan, C. S., & Chiou, W. B. (2010). Dialectical thinking and creativity among young adults: A postformal operations perspective. *Psychological Reports*, 106, 79-92. <http://dx.doi.org/10.2466/PRO.106.1.79-92>

- Yeager, D. S., & Walton, G. M. (2011). Social-psychological interventions in education: They're not magic. *Review of Educational Research, 81*, 267-301
<http://dx.doi.org/10.3102/0034654311405999>
- Zhang, L. F., & Huang, J. (2001). Thinking styles and the Five-Factor Model of Personality. *European Journal of Personality, 15*, 465-476.
<http://dx.doi.org/10.1002/per.429>
- Zhang, L. F., & Sternberg, R. J. (2005). A threefold model of intellectual styles. *Educational Psychology Review, 17*, 1-52. <http://dx.doi.org/10.1007/s10648-005-1635-4>
- Zhang, L. F., & Sternberg, R. J. (2011). Revisiting the investment theory of creativity. *Creativity Research Journal, 23*, 229-238.
<http://dx.doi.org/10.1080/10400419.2011.595974>
- Zhou, J. (1998). Feedback valence, feedback style, task autonomy, and achievement orientation: Interactive effects on creative performance. *Journal of Applied Psychology, 83*, 261-276. <http://dx.doi.org/10.1037/0021-9010.83.2.261>
- Zimmerman, M. A., Caldwell, C. H., & Bernat, D. H. (2006). Discrepancy between self-report and school-record grade point average: Correlates with psychosocial outcomes among African American adolescents. *Journal of Applied Social Psychology, 32*, 86-109. <http://dx.doi.org/10.1111/j.1559-1816.2002.tb01421.x>

Vita
Joanne Patricia Rojas

Education

- 1999 Gordon-Conwell Theological Seminary, Hamilton, Massachusetts.
Master of Arts in Christian Education
- 1989 New York University, Tisch School of the Arts, New York, New York.
Bachelor of Fine Arts in Drama.

Professional Positions

- 2015 Postdoctoral Researcher & Research Project Manager, Human
Development Institute, Kentucky Partnership for Early Childhood
Services, University of Kentucky, Lexington,
Kentucky.
- 2013 - 2015 Doctoral Research Associate in Assessment, Division of Student Affairs,
University of Kentucky, Lexington, KY
- 2009 – 2012 University Instructor, University of Kentucky, Lexington, KY
- 2008 - 2009 Science Educator, Living Arts and Science Center, Lexington, KY.
- 1997-2007 Coordinator and Teacher, Worcester Collegiate Christian Network
- 1995-1997 Job Placement Specialist, Easter Seal Society of RI

Scholastic and Professional Honors

- 2012-2013 Graduate School Academic Year Fellowship, University of Kentucky
- 2012 Mixson Outstanding Graduate Student Research Award, Second Annual
Interdisciplinary Graduate Student Conference for Research on Children
at Risk.

Professional Publications

- 2014 Rojas, J. P., & Springer, D. G. (2014). An exploratory study of musicians'
self-efficacy to maintain practice schedules. *The Bulletin of the
Council for Research in Music Education*, 199, 39-52.
doi: 10.5406/bulcouresmusedu.199.0039