Développés and Creativity: Developing a Movement Test of Creativity

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Creativity is a complex construct, containing a collection of affective, cognitive, and motivational processes. It does not yet have an accepted standard operationalized definition and most research focuses on creative products rather than processes. Intelligence and creativity are believed to be related, but the relationship is still unknown and research on the relationship varies. Variances in intelligence are expected to appear in creativity, which is tentatively supported at this time. Instrumentation of creativity is not well studied and there are demographic groups that have not been examined. Divergent thinking, fluency, originality, and flexibility are the most used concepts for measuring creativity. Few tests of kinesthetic creativity exist as most research focuses on verbal and visual abilities. Of the two tests reviewed here, one was found to have low test-retest reliability and the other is resource intensive. A kinesthetic creativity test is proposed that is simple to implement and has few equipment requirements.

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CHAPTER I. INTRODUCTION

I have always been interested in moving. As a child, I was enrolled in ballet classes off and on. Eventually, I reached the proficiency required to dance *en pointe* or, in informal terms, in those shoes ballerinas wear that allows them to dance on their toes, sometimes referred to as "toe shoes". As an undergraduate, I took social dance and some mixed martial arts classes. While I would not say that I am an expert in either, these classes further instilled in me a love of different kinds of movements.

I also enjoy various artistic pursuits including needlework, crochet, and doodling. As such, another area of great interest to me is creativity. In fact, my research project in college was on how movement effects creativity (Ewing, 2013). Unfortunately, as it was not a truly rigorous study, I was unable to make meaningful conclusions at the time. Of course, the generalizability of the results would have been minimal as my participant pool was the Psychology 101 students at a competitive, private liberal arts college in Minnesota.

In the interest of full disclosure, I was also in Gifted and Talented (G/T) classes for the majority of my primary school experience. As such, I am aware of the G/T testing process and that creativity is one of the necessary traits frequently considered. It would be remiss of me to dismiss the specialized nurturing of my curiosity and creativity received through my Gifted and Talented classes.

Creativity is a desirable and difficult to define construct (Amabile, Conti, Coon, Lazenby, & Herron, 1996; Runco, 1993). Creativity has been found to have benefits in a variety of areas such as workplace leadership, psychological functioning, coping, emotional growth, therapeutic interventions and treatments, maintaining relationships, conflict resolution, and problem solving (Plucker, Beghetto, & Dow, 2004) as well as alleviating frustration (Isaacs, 1974).

While there are currently a variety of tests used to investigate and measure creativity, the vast majority are not concerned with motor or kinesthetic movement (Brennan, 1982; Friedman et al., 2003; Leung, et al. 2012; Slepian & Ambady, 2012; Taft & Rossiter, 1966). This is problematic as kinesthetic abilities are possibly separate factors in intellectual functioning that are distinct from verbal and visual and figural abilities (Morgan, 1996). Thus, this dissertation seeks to create a kinesthetic test of creativity building off of the extant research.

Creativity as a concept is still relatively young, with research on it starting slowly in the 19th century (Runco & Jaeger, 2012). As such, has a relatively small body of research devoted to it. It is believed to be universal, cutting across cultures, domains, and disciplines (Han & Marvin, 2002; Rekdal, 1979), and complex, involving multiple processes (Rekdal, 1979).

The universality of creativity and the lack of research have led to rise of numerous myths surrounding the concept and people deemed to be creative (Plucker, Beghetto, & Dow, 2004; Treffinger, 1986). This has potentially contributed to the apparent reluctance to study creativity as it is often considered to be too "soft" or "fluffy" to study (Plucker, Beghetto, & Dow, 2004; Treffinger, 1986). Another of these myths has led to the frequent conflation of intelligence and creativity, most often when genius is discussed (Cropley, 1966; Fuchs-Beauchamp, Karnes, & Johnson, 1993; Krippner, 1963).

Creativity research is gaining more traction, but little has been done examining bodily-kinesthetic creativity (Brennan, 1982; Cleland, 1994; Cleland & Gallahue, 1993; Zachopoulou & Makri, 2005).

Rationale

Intelligence is highly valued in schools and there are a plethora of extensive measures

used to assess it. Creativity is theoretically desirable in the school setting, but is typically valued lower than intelligence and may even be outright disliked as a trait in students (Kaufman & Plucker, 2011). Furthermore, there are significantly fewer tests of creativity extant and only one is used with great regularity despite numerous critiques, though seldom used alone as the basis for admissions into gifted programs: The Torrance Tests of Creative Thinking (Amabile, 1982; Kaufman & Plucker, 2011; Kim, 2006). The TTCT subtests are mostly verbal while some involve drawing. Typically, the examinee is administered one or several of the subtests. Most other creativity tests are similar to the TTCT in content, administration, and scoring (Amabile, 1982). Furthermore, assessing creativity in higher education is difficult because most creativity assessment tools on the market are geared toward young children, tend to have insufficient reliability and validity, and/or assess only trivial aspects of creativity (Baer & McKool, 2009).

Most tests of creativity focus on verbal and visual creativity (Brennan, 1982; Friedman et al., 2003; Leung, et al. 2012; Slepian & Ambady, 2012; Taft & Rossiter, 1966). This manifests in the measures used. There are tests that use verbal fluency, drawing fluency, problem solving, idea generation, and visual closure ability to measure creativity. However, these are not necessarily generalizable to all forms of creativity (Gardner, 1995). As such a nonverbal, motor or kinesthetic test is needed to assess kinesthetic creativity. Currently, there is a paucity of such tests in the extant literature.

The question of what is the relationship between creativity and intelligence is significant due to the seemingly higher value placed on intelligence than on creativity in schools and tests. However, in daily life, creativity is equally, if not more, important since creativity helps with adapting to strange and different situations (Kaufman & Plucker, 2011). The answer to what the

relationship between these two constructs is exactly may very well affect numerous children's and adults' lives (Kaufman & Plucker, 2011).

Creativity is related to, but different from, giftedness (Karowe, 1963) and is important in various theories of giftedness. However, schools have difficulty developing reliable and consistent ways to identify gifted students, particularly gifted students with above-average creative skills (Kaufman & Plucker, 2011). Psychological testing detects intellectually gifted children, but does not easily detect those that are creatively gifted (Rekdal, 1979). Most assessments for identifying gifted students rely on verbal and quantitative content and focus on assessing achievement and aptitude in these domains (Kim, 2006).

While there are a variety of tests screening for and assessing giftedness, these tests are not synonymous with creativity tests. Furthermore, tests of giftedness assess for more than just creativity (Karowe, 1963; Rekdal, 1979). Mass testing, emphasis on academic achievement, as well as achievement and aptitude scores overlook many potentially creative individuals (Rekdal, 1979).

Researchers, psychologists, and educators typically focus on creativity or intelligence and seldom pay attention to the two's interrelatedness or accept the idea that the two are negatively correlated (Kaufman & Plucker, 2011). This likely explains the oft found result in research that teachers prefer smart students over creative ones, ignoring the possibility that students could be high, or low, in both traits. Finding out more about creativity's relationship with intelligence could help reveal aspects of both that are ignored in the traditional classroom (Kaufman & Plucker, 2011).

Purpose of the Dissertation

The purpose of this dissertation is to provide a nonverbal test of creativity to assess low and high kinesthetic creativity that can be used in research investigating kinesthetic creativity. For the purposes of this dissertation, a basic outline of what the test looks like will be provided as well as suggestions for variations researchers may be interested in pursuing. Furthermore, suggested scoring practices will also be provided.

Research Questions

The questions driving this dissertation are:

- What is creativity?
- How does it connect to intelligence?
- How is it measured?
- What kinesthetic creativity tests currently exist?
- What would a movement test of creativity look like?

Significance of the Study

The key stakeholders for this proposal are researchers and gifted and talented program testers, which by extension means gifted and talented students are stakeholders as well. Researchers will be able to use the creativity test to assess how different variables affect kinesthetic creativity. This may be particularly helpful in the field of Industrial/Organizational Psychology as interventions could be tested to see how creativity can be boosted in employees. Furthermore, reliance on written tests of creativity may be missing a number of children who would otherwise qualify for G/T classes (Stroup & Pielstick, 1965).

In policy and theory, creativity and giftedness are associated (Kettler & Bower, 2017;

Runco & Jaeger, 2012). In point of fact, creativity is one of the requirements for acceptance into Gifted and Talented Programs in many states and school districts since it is an important aspect of giftedness (Kettler & Bower, 2017; Runco, 1993).

To help identify gifted children, the United States Federal Government defines such children as follows:

> Gifted and talented children are those identified by professionally qualified persons, who by virtue of outstanding abilities are capable of high performance. These are children who require differentiated educational programs and/or services beyond those normally provided by the regular school program in order to realize their contribution to self and society.
>
> Children capable of high performance include those with demonstrated achievement and/or potential ability in any of the following areas, singly or in combination:
>
> 1. General intellectual ability,
> 2. Specific academic aptitude,
> 3. Creative or productive thinking,
> 4. Leadership ability,
> 5. Visual and performing arts.
> 6. Psychomotor ability. (Marland, 1971, p.8).

The abilities of these children may be general, affecting multiple areas of their lives, or very specific talents that are only apparent in certain circumstances (Pierangelo & Giuliani, 2001). It is estimated that approximately 3 to 5 percent of the school population is gifted and/or

talented (Pierangelo & Giuliani, 2001). Basing identification of gifted students solely on IQ scores risks missing students who are disadvantaged, poor test-takers, or with borderline scores. Furthermore, children identified solely by IQ are not always the most creative (Kim, 2006).

As there are different kinds of creativity as there are multiple intelligences, it may be beneficial for applicants to be able to have their kinesthetic creativity assessed. Furthermore, Gardner's (1995) multiple intelligences are sometimes used to assess giftedness (Reid & Romanoff, 1997), but bodily-kinesthetic intelligence is often overlooked (Stroup & Pielstick, 1965). This may allow some students who would qualify for gifted and talented programs to miss out as their area of giftedness is not assessed, especially since verbal creativity skills do not predict motor abilities (Stroup & Pielstick, 1965).

In general, motor creativity has been overlooked in the research (Brennan, 1982; Cleland, 1994; Cleland & Gallahue, 1993; Stroup & Pielstick, 1965; Zachopoulou & Makri, 2005). Few tests have been generated specifically examining kinesthetic creativity. There is a need for tests measuring this kind of creativity.

Group-administered inventories have historically been an ideal way to screen students for creatively gifted programs in schools. These instruments evaluate psychological, personality, motivational, and biographical traits that typically characterize the highly creative (Rimm, Davis, & Bien, 1982). Self-, parent-, and teacher-report screeners often involve items that detect traits like independence, perseverance, wide-ranging interests, and curiosity. Of course, the so-called characteristics approach to detecting creative students works best when paired with another method of assessment (Rimm, Davis, & Bien, 1982).

In practice, teacher nominations are the most common method for identifying gifted

students. However, teachers have been found to prefer gifted students with low creativity levels and are more likely to identify high achievers and "teacher pleasers" as gifted rather than unconventional creative students (Kim, 2006). Additionally, teacher recommendations and nominations focus more on classroom performance than on potential and they may mislabel energetic, "unconventional" students as having Attention-Deficit/Hyperactivity Disorder (ADHD) or a conduct disorder (Kim, 2006). When asked, teachers cite immature social and emotional behavior, lack of ambition, lower productivity, and low achievement as reasons for not expecting certain children to not be gifted (Kim, 2006). Unfortunately, bored gifted children may very well engage in all of these behaviors!

It is important to note that simply relying on ratings from peers and faculty is not enough in identifying creativity and giftedness as both groups of adults rely on different criteria for determining intelligence and creativity in individuals, thus suggesting important cues for rating both traits are being missed (Rossman, 1976). This is borne out by the fact that neither peers or faculty attend to fluency cues when asked to rate students on creativity. This failure to consider or detect cues of creativity can be addressed by assuring that judges have access to a wide range of ability, personality, and production data concerning the individual being assessed (Rossman, 1976).

CHAPTER II. LITERATURE REVIEW

How does one decide who is a creative person? Is it the one thought creative by peers or instructors? Or the one who produces creative works? Must a person meet all these criteria? Furthermore, is it possible to find indicators of creativity "independent-of-intelligence"? These are just a few of the questions that have plagued creativity research (Rossman, 1976).

What Is Creativity?

Creativity is often a greatly sought-after skill. There are a variety of situations in which priming or maximizing creativity is desired. For example, a business may wish to increase innovation, an artist needs a new idea for their next project, or a graduate student needs a novel way to expand on previous research. However, creativity is a complex concept consisting of many factors and, as such, is difficult to define and operationalize (Amabile, Conti, Coon, Lazenby, & Herron, 1996; Runco, 1993).

There are many ways to look at and define creativity. The standard way of defining it involves uniqueness and utility, but not all researchers use this definition (Amabile et al., 1996; Rekdal, 1979; Runco & Jaeger, 2012). Given that there are multiple ways to define creativity, it should not be surprising that there are multiple approaches to operationalizing creativity. Should it be considered to simply be broad-minded thinking (Friedman, Fishbach, Förster, & Werth, 2003)? Or perhaps fluidity in reasoning (Slepian & Ambady, 2012)? Simply originality in responding? Or maybe even how many different ideas generated (Leung et al., 2012)? It is important to know how creativity is defined since that dictates how it is measured and assessed, but first, a look at some myths surrounding creativity.

The Crazy Loner and Other Creative Myths

The first, and perhaps most persistent, myth that has been identified is that people are

born with a set capacity for creativity that is unchanging, similar to how we tend to view intelligence as fixed (Plucker, Beghetto, & Dow, 2004). However, this idea has been repeatedly refuted in research on training and fostering creativity (Plucker, Beghetto, & Dow, 2004; Treffinger, 1986).

This myth is most likely due to the mystification of creativity and the focus on eminent creators, referred to as “Big C” creativity (Plucker, Beghetto, & Dow, 2004; Treffinger, 1986). Big C creativity research focuses on individuals who are societally considered to be creative, which often ends up conflating creativity with genius. This perpetuates the stereotype of Big C versus little c creativity, which is a distinction that has not been formally studied or established (Plucker, Beghetto, & Dow, 2004).

A second myth is that creativity is inextricably linked with negative aspects of human psychology and society ("lone nut" stereotype- creative loner with a dark side). Many studies have been published examining the link between creativity, drug use, mental illness, and criminality that presuppose a strong link between these negative behaviors and conditions and creativity (Plucker, Beghetto, & Dow, 2004). This leads to situations like teachers viewing creative students as potential troublemakers despite the teachers having positive connotations of creativity and view it as important (Plucker, Beghetto, & Dow, 2004). However, these negative stereotypes are not born out in the research. In point of fact, drug usage has been found to enhance creative thought while creating an overall deficit in creative productivity (Plucker, Beghetto, & Dow, 2004). The focus on Big C creativity encourages the myth of the deviant creative and discourages focus on what leads some creative people to engage in illicit activities (Plucker, Beghetto, & Dow, 2004).

Arising partially from the stereotype of creative individuals as a "barefooted hippie running around a commune while rubbing crystals on his head" is the idea that creativity research is a soft science (Plucker, Beghetto, & Dow, 2004). Commercialized programs that promise to provide training and increase creativity in participants based on weak theoretical and empirical foundations contribute to this myth. Character traits such as "uninhibited", "risk-seeking", and "open to the irrational" support the 'beatnik creative' stereotype and enforce the myth that creativity is a soft, fuzzy subject. This is rather amusing since these traits have been identified as shared by creative college students and successful professionals (Plucker, Beghetto, & Dow, 2004). The extant research indicates creativity is as valid and "hard" a topic as any other in psychology research (Plucker, Beghetto, & Dow, 2004; Treffinger, 1986; Treffinger, 2009).

Another popular myth is that being in a group enhances creativity (Plucker, Beghetto, & Dow, 2004). However, this has not been born out in the literature. Brainstorming research consistently indicates that idea generation is more effective, and more creative, when individuals conduct their brainstorming on their own and then the group reconvenes to pool the ideas (Plucker, Beghetto, & Dow, 2004). This myth is problematic because it can encourage overlooking the influence and role of the individual within the group or a larger organization. The narrative of the more creative group is a new one and grew out of perceptions that the individual's role was overemphasized in earlier creativity research (Plucker, Beghetto, & Dow, 2004).

The final myth going to be touched on here is the idea that creativity is too difficult to measure (Plucker, Beghetto, & Dow, 2004; Treffinger, 1986; Treffinger, 2009). This myth finds

its roots in the previous myths and stereotypes about creativity. Fortunately, research does not support this myth either. A variety of operational definitions have been put forth to study creativity and numerous tests have been generated that have been utilized to research it (Plucker, Beghetto, & Dow, 2004; Treffinger, 1986; Treffinger, 2009; Zachopoulou & Makri, 2005).

The generation and pervasiveness of these myths both in popular opinion and in research have much to do with cultural and historical perspectives.

A Historical Perspective

The field of creativity studies stretches as far back as the 1930s, but the conflation of genius and creativity began centuries ago (Runco & Jaeger, 2012). Much of creativity research has focused on the concept as universally applicable across domains and disciplines (Han & Marvin, 2002; Rekdal, 1979). This leads to the hypothesis that all humans are, to varying degrees, potentially creative. The difference being in terms of how frequently creative and what level of creativity (Rekdal, 1979). The paradigm shift toward domain-specific, or various types, of creativity is still in its relative infancy, having started sometime around the 1980s (Han & Marvin, 2002).

Creativity as an idea, is in fact, universal and found both in Eastern and Western thought and culture (Krippner & Arons, 1973). However, Western creativity can be considered to be "product-centered", while Eastern creativity is more "process-centered." What makes for process-centered creativity is difficult to define and therefore assess, leaving product-centered creativity the one with a larger body of research (Krippner & Arons, 1973). If one looks closer at the different cultures within the East and West, one will find differences in what is considered to be a creative product or even a creative person. As such, it is difficult to define creativity in a

universally accepted way (Krippner & Arons, 1973).

Creativity is a complex set of cognitive, motivational, and affective processes (Rekdal, 1979). Historically, it has been examined and assessed from four perspectives: product, process, person, and place/environment (Hunsaker & Callahan, 1995; Kettler & Bower, 2017; Rekdal, 1979; Trevlas, Matsuoka, & Zachopoulou, 2003), but creativity can be viewed in a myriad of ways and only person and product are consistently studied (Hunsaker & Callahan, 1995). The creator's cognitive style and personal qualities, the product's properties, standards for judging, and the aesthetics of the responses are a few different lenses that can be used (Rekdal, 1979).

Given the universality of creativity, it is likely not particularly surprising that a number of myths have sprung up around it. Some of these myths have contributed to the lack of a clear definition of creativity in research (Plucker, Beghetto, & Dow, 2004).

Generally speaking, creativity and intelligence have been viewed as separate, unrelated abilities. As such, they have attracted the attention of different scholarly communities with different audiences. (Silvia, 2015). The idea that these two concepts are alike is a recent development and influenced heavily by Guilford's Structure of Intellect (SI) model (Guilford & Hoepfner, 1966; Kaufman & Plucker, 2011; Silvia, 2015). J. P. Guildford was the first to publicly recognize the need to independently study creativity (Kaufman & Plucker, 2011). The SI model is seen now more as a source of historical interest than an accurate model of intelligence and creativity while still providing influence to today's research (Silvia, 2015).

This influence takes the primary form of the idea that some mental processes are *convergent* and others *divergent*. Convergent processes are those that narrow or focus thoughts to find the correct answer while divergent processes widen or broaden thought to find multiple

answers or responses (Silvia, 2015). Due to Guilford's SI model, convergent processes are viewed as archetypal indicators of intelligence and divergent processes are indicators of creativity (Silvia, 2015). While Guilford considered divergent thinking as part of creative thinking, he noted that the two are not the same thing as creativity requires restructuring, transformation, and reinterpreting abilities as well (Gardner, 2006; Kim, 2006).

Guilford's Structure of Intellect Framework

J. P. Guilford, a psychologist generally credited with initiating the consideration creativity in psychology, also contended with the idea that intelligence is based upon one construct and creativity naturally flows from intelligence measured by IQ (Barlow, 2000; Kaufman & Plucker, 2011). As such, he created the *Structure of Intellect* (SI) model, which organizes the factors involved in thinking along three separate dimensions: content, product, and operations (Barlow, 2000; Brennan, 1982; Guilford & Hoepfner, 1966; Kaufman & Plucker, 2011).

The *content dimension* arose from his observations that different individuals attend to and process information from different sources more effectively (Barlow, 2000; Brennan, 1982; Guilford & Hoepfner, 1966 ; Kaufman & Plucker, 2011). The different sources of information in the SI model are: visual, auditory, symbolic, semantic, and behavioral. Visual and auditory information are information gained from the visual and auditory systems respectively. Semantic information is that derived from language and ideas while symbolic information is derived from symbols that convey meaning by standing for something else such as letters and numbers (Barlow, 2000). Behavioral information arises from observations of others' behavior and has been popularized as "social intelligence" (Barlow, 2000).

The *products dimension* is related to the content types and is concerned with how information is applied (Barlow, 2000; Brennan, 1982; Guilford & Hoepfner, 1966; Kaufman & Plucker, 2011). Guilford identifies units, classes, relations, systems, transformations, and implications as the components in this dimension (Barlow, 2000; Guilford & Hoepfner, 1966). *Units* are single, basic items of knowledge. These may be shapes, words, facial expressions, and so forth (Barlow, 2000). *Classes* are sets of units that share meaning or common attributes. *Relations* are the links between pairs of units and *systems* are the resulting linkage of relationships between more than two units (Barlow, 2000). *Implications* refer to expectations, be they predictions, inferences, consequences, or anticipations, that arise from given information sets (Barlow, 2000).

The final dimension of *operations* describes what the brain does with information (Barlow, 2000; Brennan, 1982; Guilford & Hoepfner, 1966; Kaufman & Plucker, 2011). In other words, the SI model believes there are five general intellectual processes: cognition, memory, divergent production, convergent production, and evaluation. *Cognition* is the ability to perceive information (Barlow, 2000). *Memory* here has two components, recording and retrieval of various kinds of information. Individual differences result in the various kinds of information being stored better or worse than other kinds (Barlow, 2000). *Divergent production* again refers to the ability to generate multiple solutions to a problem with no obvious, singular answer and is commonly seen as an important component in creativity (Barlow, 2000; Leung et al., 2012; Kaufman & Plucker, 2011). *Convergent production* is also similar to convergent thinking as defined above: the ability to find a single solution to a problem (Barlow, 2000; Leung et al., 2012). Guilford adds that convergent production includes most areas of logical problem-

solving (Barlow, 2000). Finally, *evaluation* refers to the ability to make judgements concerning information such as whether relationships exist between units, if some are better than others, or if units belong in a system (Barlow, 2000).

The five operations, four contents, and six products in Guilford's original model meant there were 120 different possible mental abilities, which he later expanded to 180, though the smaller model is the one best researched (Kaufman & Plucker, 2011). This model was exceptionally influential in education and a creativity curriculum was based on the divergent thinking aspects of SI (Kaufman & Plucker, 2011).

The SI model is generally considered defunct nowadays (Silvia, 2015). That said, Guilford effectively pioneered the approach of placing creativity within an intellectual framework, which has lead to some other theories of intelligence including creativity as a subcomponent (Kaufman & Plucker, 2011). Additionally, as previously mentioned, the SI model has lead to the reliance on convergent and divergent thinking tasks and measures in creativity research (Kaufman & Plucker, 2011; Silvia, 2015). However, most tests at this time are concerned with verbal abilities, embodied cognition, visual abilities, and problem solving (Brennan, 1982; Friedman et al., 2003; Leung, et al. 2012; Slepian & Ambady, 2012; Taft & Rossiter, 1966).

How Does Creativity Connect with Intelligence?

The question of what is the connection and interaction of divergent and convergent thinking rose naturally from the SI model and serves as the basis for modern research for the relationship between intelligence and creativity (Silvia, 2015). As a small, but consistent, correlation between intelligence and divergent thinking were found, the more a link between

creativity and intelligence was suspected. However, due to statistical and assessment advances, newer meta-analyses suggest the literature surrounding this link have underestimated the relationship (Silvia, 2015).

Ratings of creativity have been found to correlate with ratings of intelligence (Runco, 1993). This suggests raters might not discriminate between children who are intelligent versus those who are creative, which is part of the long history of the problem of discriminant validity (Runco, 1993). This problem may be avoided if raters are asked to base ratings on a more easily defined and related concept such as originality.

Convergent and divergent thinking have been found to be related and, at least on a factor-level, appear to be inter-related. Furthermore, divergent thinking has been found to correlate with intelligence (Cropley, 1966; Silvia, 2015). These findings strongly suggest that these modes of thinking are correlated with intelligence, thus linking creativity with intelligence as well. It then follows that an investigation into intelligence and how it is studied could provide some insights and directions for studying creativity.

Studies asking people to process aloud during divergent thinking tasks suggest executive processes are heavily involved in completing these tasks (Silvia, 2015). In particular, fluid intelligence, which encapsulates mental processes having to do with reasoning and executive functioning, strongly predicts creative responses, creativity of metaphors, and creativity strategy usage (Silvia, 2015). When combined with crystallized intelligence and broad retrieval ability, roughly half of the difference in metaphor creativity is accounted for (Silvia, 2015).

Creativity's relationship with intelligence in older children and adults has been studied extensively since the late 19th century (Fuchs-Beauchamp, Karnes, & Johnson, 1993; Krippner,

1963), with the predominate focus being on how divergent thinking relates to intelligence. Several factors are involved in divergent thinking abilities in addition to intelligence, but it is not clear what these factors might be (Fuchs-Beauchamp, Karnes, & Johnson, 1993).

Gardner's Theory of Multiple Intelligences

Gardner believed that human intelligence is not truly one construct. Instead, he proposed that there are multiple intelligences (Gardner, 1995; Gardner, 2006; Morgan, 1996; Visser, Ashton, & Vernon, 2006a). In essence, the theory of multiple intelligences (MI) posits that human intellect is better described as a collection of partially self-governed mental processes that handle specific types of information in specific ways. These processes, the multiple intelligences, can be further subdivided into sub-intelligences that may or may not correlate with each other (Gardner, 1995; Gardner, 2006; Morgan, 1996). Despite the initial rejection of *g*, Gardner has since modified his theory to include *g* and has stated that MI's intelligences are not entirely independent (Visser, Ashton, & Vernon, 2006a). Gardner's MI theory does not specifically address creativity, but does seem applicable to creativity (Kaufman & Plucker, 2011).

His original proposed seven intelligences are: Logical-Mathematical, Linguistic, Musical, Spatial, Bodily-Kinesthetic, Interpersonal, and Intrapersonal. Only Bodily-Kinesthetic intelligence will be explored and defined here.

In MI, Bodily-Kinesthetic intelligence refers to the abilities to control gross and fine motor movements and handle objects with skill in order to solve problems or create products (Gardner, 2006; Morgan, 1996). Gardner (2006) does note that it is possible that fine and gross motor movement intelligences may be separate abilities. However, there is not yet a strong body

of research such that a strong opinion can be made, and Gardner has not proposed any explanation for why fine and gross motor movement abilities can be expected to be highly associated with each other (Visser, Ashton, & Vernon, 2006a). It is therefore possible that an assessment of bodily-kinesthetic creativity needs to assess both types of motor movements (Visser, Ashton, & Vernon, 2006a).

It is important to note that one does not need to be a fully able-bodied person to have and exhibit this type of intelligence. Instead, bodily-kinesthetic intelligence represents the ability to process information in the process of solving motor or kinesthetic problems or producing bodily-kinesthetic products (Gardner, 2006). If it is true that this truly is a type of intelligence, it is quite likely this is a kind of creativity as well since the two concepts are closely related (Silvia, 2015). It is therefore important to provide a test that looks directly at this kind of creativity rather than rely on verbal or written tests of creativity (Gardner, 2006).

There is debate over whether or not Gardner's intelligences represent learning, cognitive, or working styles or domains (Gardner, 1995; Morgan, 1996). However, Gardner (1995) points out that a style assumes an individual will approach various types of content in a similar fashion, which is a different concept from that of intelligence. This raises interesting questions about the idea of a cognitive style as it could be the case that an individual does not use the same style with all kinds of content (Gardner, 1995). An intelligence, according to Gardner (1995), is a "biological and psychological potential; that potential is capable of being realized to a greater or lesser extent as a consequence of the experiential, cultural, and motivational factors that affect a person" (p. 202).

Another point of contention is over whether MI is correct in assuming multiple

intelligences and that *g*, general intelligence, as a representation of human intellect is incorrect. Only the Bodily-Kinesthetic and Intrapersonal intelligences have not been found to be similar to the second tier of the Cattell-Horn-Carroll (CHC) model of intelligence (Visser, Ashton, & Vernon, 2006a). This is not surprising as psychomotor abilities are not generally considered to be an aspect of cognitive ability and thus not included in most models of intelligence.

Gardner himself has admitted that it is possible some of his proposed intelligences may overlap (Gardner, 2006; Visser, Ashton, & Vernon, 2006a). Visser, Ashton, and Vernon (2006a) found that many of MI's intelligences do in fact correlate with *g* as well as non-*g* cognitive abilities, non-cognitive abilities, and personality characteristics (Gardner, 2006; Visser, Ashton, & Vernon, 2006a; Visser, Ashton, & Vernon, 2006b). However, they did find a lower loading of *g* in bodily-kinesthetic abilities and tasks involving motor abilities overall (Visser, Ashton, & Vernon, 2006a). In fact, they found no statistically significant positive correlation with the cognitive measure they chose.

Visser, Ashton, & Vernon (2006a) are possibly amongst the first to explicitly assess the Bodily-Kinesthetic Intelligence. They used two tests, one to assess gross motor movements and another for fine.

For assessing gross motor movements, Visser, Ashton, & Vernon (2006a) had participants conduct a balancing task. Participants were timed to see how long they could stand one the ball of one foot with hands on hips and the other leg bent such that that foot was on the inside of the other knee. Scores were obtained by averaging the two longest times in seconds out of the three trials between the heel being raised and the participant losing their balance. This test was chosen due to the belief that it would be less susceptible to training effects (Visser, Ashton,

& Vernon, 2006a).

The fine motor task was the Mark Making test from the General Aptitude Test Battery, which is a measure of manual dexterity (Visser, Ashton, & Vernon, 2006a). Participants made marks consisting of three parallel lines in as many squares on a printed grid as possible within one minute.

They found that the variance in performance on these tests had non-significant *g*-loadings, suggesting general intelligence has little-to-nothing to do with performance. Furthermore, the two tests had a weak intercorrelation, which they concluded means that the Bodily-Kinesthetic intelligence is poorly spelled out and not a coherent ability domain (Visser, Ashton, & Vernon, 2006a). That said, there are a few problems with their results.

The participants in their study were found to be above average intelligence college students, so results have poor generalizability (Visser, Ashton, & Vernon, 2006a). Additionally, the two tests they used were very different. The fine motor task is arguably vastly simpler than the gross motor task. Balancing on one foot in a position one presumably does not use often, if at all, is a much harder and more novel than simply drawing three short lines repeatedly. Much less thought and effort is needed for tasks like the fine motor task.

Furthermore, Gardner has stated that he has always maintained that fine motor intelligence could be quite different from bodily-kinesthetic intelligence (Gardner, 2006). If this is true, then Visser, Ashton, and Vernon (2006a) have taken tentative first steps toward proving this assertion to be true.

A Few More Theories

The Cattell-Horn-Carroll (CHC) theory is the most frequently applied to intelligence tests

(Kaufman & Plucker, 2011). The initial Cattell-Horn theory proposed there were two types of intelligence: crystallized and fluid. Crystallized intelligence (G_c) refers to knowledge a person already knows and fluid intelligence (G_f) has to do with problem solving and how new and different situations are handled (Kaufman & Plucker, 2011). Horn then expanded the theory to include more dimensions and organized them all into a proposed hierarchy. General ability is at the top, various broad abilities are in the middle, and narrow abilities are at the bottom (Kaufman & Plucker, 2011). The combined CHC model then includes a concept of general intelligence, *g*, and many other aspects.

Creativity was initially hypothesized to be strongly linked to fluid intelligence in the early stages of the Cattell-Horn theory. (Kaufman & Plucker, 2011). Based on factor analysis studies, the current CHC views creativity as a component of long-term storage and retrieval (G_{lr}). Fluid intelligence's relationship with problem-solving and handling novel problems is often the focus when discussing Gf, but the emphasis as far as creativity is concerned is on G_{lr} (Kaufman & Plucker, 2011).

There are arguments that placing creativity and originality solely under G_{lr} is too narrow and minimizing of the relationship between G_f and creativity (Kaufman & Plucker, 2011). A recent theory resulting from this perspective is Sternberg's (2005) theory of successful intelligence (Kaufman & Plucker, 2011). The ability to achieve success in life within the context of an individual's own personal standards and sociocultural context is the definition of successful intelligence in a nutshell. Success is obtained through the balance of analytical, practical, and creative skills (Sternberg & the Rainbow Project Collaborators [RPC], 2006).

Successful intelligence is composed of three "subtheories": the *componential subtheory*,

relating intelligence to the individual's internal world; the *experiential subtheory*, which focuses on the connection between intelligence and the individual's external and internal worlds; and the *contextual subtheory*, which deals with relating intelligence to the individual's external world (Kaufman & Plucker, 2011; Sternberg, 2005). Creativity is "directly related" to the experiential subtheory (Kaufman & Plucker, 2011). Application of creativity assessments to college admissions data increased the predictive power of college success and significantly reduced ethnic group differences (Kaufman & Plucker, 2011; Sternberg & the RPC, 2006).

The three main aspects of successful intelligence are analytical intelligence, practical intelligence, and creative intelligence (Sternberg, 2005). *Analytical intelligence* is the ability to analyze, evaluate, compare, and contrast. *Practical intelligence* comprises skills used to experience, adapt, shape, and select environments. *Creative intelligence* has to do with creating, inventing, discovering, imagining, theorizing, and hypothesizing (Sternberg & the RPC, 2006). Assessing abilities beyond those assessed by conventional intelligence tests is necessary to access sources of individual differences that are not measured by these tests. As such, Sternberg and the RCP (2006) stress the importance of including novel problems that may call for convergent or divergent thinking.

The Threshold Hypothesis

While between 5-24% of the variability in creativity is theorized to be due to intelligence (Fuchs-Beauchamp, Karnes, & Johnson, 1993), some claim the investigation of creativity has been hindered by being conflated with intelligence (Krippner, 1963).

The *threshold hypothesis* posits that intelligence is a prerequisite for creativity, but creativity and intelligence are independent of each other at the upper levels of intelligence

(Fuchs-Beauchamp, Karnes, & Johnson, 1993; Kettler & Bower, 2017). In other words, this hypothesis predicts a high correlation between creativity and intelligence when IQ is below 120 and much lower as IQ increases above 120. There is limited and varying support for the threshold hypothesis (Fuchs-Beauchamp, Karnes, & Johnson, 1993; Kaufman & Plucker, 2011; Kettler & Bower, 2017).

Research supporting the threshold hypothesis is lacking and mixed at best (Kaufman & Plucker, 2011; Kettler & Bower, 2017). Ultimately, it is not yet clear how exactly giftedness, intelligence, and creativity are related or if gifted and talented individuals show higher levels of creativity than their general education peers (Kettler & Bower, 2017).

Jauk, Benedek, Dunst, and Nenbauer (2013) hypothesized the threshold for creativity is much lower than 120. When using a more liberal criterion of originality, meaning at least two original ideas, the threshold they found was found to be around 100 IQ points. With more demanding criterion, the 120 IQ point threshold was upheld. In addition, a lower limit of approximately 85 IQ points was found as a necessity for purely quantitative measures of creative potential such as idea fluency (Jauk, Benedek, Dunst, & Nenbauer, 2013). It is possible that intelligence stops helping creativity after a certain point, but recent studies throw the threshold hypothesis into question (Kaufman & Plucker, 2011).

The different thresholds they found could explain some of the variance and discrepancies in previous research (Jauk, Benedek, Dunst, & Nenbauer, 2013). They also found that personality factors are more predictive of creativity after the IQ thresholds are met. However, Jauk, Benedek, Dunst, and Nenbauer (2013) did not find a threshold for creative achievement, suggesting higher intelligence is a benefit for creative achievement. This benefit exists at high

levels of intellectual ability as well (Jauk, Benedek, Dunst, & Nenbauer, 2013).

Creative Traits and Intelligence

Rossman (1976) identified several factors that correlate with creative ability that are commonly believed to be indicators of intellectual functioning: fluid intelligence (G_f), crystallized intelligence (G_c), and memory abilities. Crystallized intelligence mirrors the influence of acculturation and formal training. Fluid intelligence represents the influence of physiological, non-acculturation influences like genetics or aging (Rossman, 1976). The memory factor identified by Rossman (1976) is simply the ability to perform different kinds of recall tasks. Also identified was fluency abilities; predominately those that require divergent thinking.

Rossman (1976) further found some personality factors that were correlated with creativity. These factors include a "motivational flavor" or need for achievement, perceptual openness, originality, an independent temperament, willingness to take risks, and a playfulness that involves deriving pleasure from manipulating ideas and contemplating of the unusual or bizarre (Rossman, 1976). On the flip-side, anxiety, closed-mindedness, and rule-oriented thinking were found to be negatively correlated with creativity. A high achievement drive, originality, openness, willingness to take risks, and an independent temperament were found to correlate highly with peer and faculty evaluations of creativity (Rossman, 1976). These factors were also found to play a major role in predicting the variability in creative production and a contributing role in predicting other productivity measures. The fluency factor was found to be the most important in terms of total and artistic productivity (Rossman, 1976). The personality factors and fluency factors found by Rossman (1976) suggest that a creative person is one who

enjoys manipulating ideas and objects, interacting with unusual ideas, can perform well on divergent thinking and perceptual tasks, and is a producer of various kinds of works.

Ultimately, it does seem to be the case that creative people are fairly smart and smart people are fairly creative and even that is debated. Some studies have found that the nature of the relationship between creativity and intelligence differs based on the population studied and the assessments used (Kaufman & Plucker, 2011). Research on how creativity and intelligence relate is murky at best due to conflicting results. The threshold hypothesis names intelligence as a necessary-but-not-sufficient condition of creativity, but the interference hypothesis suggest high levels of intelligence interfere with creativity (Kaufman & Plucker, 2011).

In fairness to the researchers, they have been trying to hit two different moving targets. Creativity is notoriously poorly defined (Plucker, Beghetto, & Dow, 2004; Kaufman & Plucker, 2011) and intelligence has undergone rapid theoretical and psychometric development (Kaufman & Plucker, 2011). Until such conflicts are resolved or explained, meaningful conclusions about this relationship cannot be made. Thus, the relationship between creativity and intelligence remains an open question.

Creativity Defined

Explicit definitions of creativity in research are few and far between, at least partially due to the lack of a generally accepted and agreed upon definition of creativity (Plucker, Beghetto, & Dow, 2004). Many articles on creativity cite books and other articles from the 1980s and 90s (Runco & Jaeger, 2012). In their content analysis of 90 selected articles on creativity, Plucker, Beghetto, and Dow (2004) found that only 38% of the articles had an explicit definition, 41% used an implicit definition, and 21% offered no definition at all of creativity as a construct.

Common characteristics of explicit definitions of creativity are uniqueness and usefulness (Plucker, Beghetto, & Dow, 2004).

Creativity as a concept is recognized in many fields as complex and there is debate and misgivings surrounding measuring correlates of creativity (Kettler & Bower, 2017; Khatena, 1976). Furthermore, there is lack in agreement over just the definition of creativity, which is compounded by varying descriptions of what the energy source is for creativity (Kettler & Bower, 2017; Khatena, 1976). There are also questions concerning how many criteria should be included in a definition of creativity (Runco & Jaeger, 2012). These differing opinions are largely due to the fact that creativity is a continuum. Anyone who becomes interested in creativity tends to be naturally interested, and invested, in a specific point of the creativity continuum based on their own interests, needs, and experiences (Khatena, 1976).

Gowan (1972) attempted to classify the creative continuum and came up with a range from rational to psychedelic. His five levels of creativity are: cognitive, rational, and semantic; personality; high degree of mental health; Freudian; and psychedelic. The Freudian view here refers to the idea of creativity as the sublimation of the sexual urge and arising from the main source of cultural energy, the collective unconscious. This then implies the way creativity is drawn upon is through opening up the preconscious and moving material there to consciousness (Gowan, 1972; Khatena, 1976). Gowan (1972) viewed the psychedelic part of creativity to be connected to hypnotism, extrasensory perception, precognition, and other paranormal phenomena (Khatena, 1976).

Creativity is classically defined as the production of useful and innovative or novel ideas (Amabile et al., 1996). It is also traditionally believed to involve both *convergent* and *divergent*

thinking. Convergent thinking is the process of finding the single best answer or the one most creative solution to a problem, whereas divergent thinking involves generating many different, alternative solutions or ideas (Leung et al., 2012). As it is much more difficult to quantify the creativity of a single solution, most studies utilize divergent over convergent thinking measures. When convergent thinking is operationalized, responses are typically rated by a panel of judges to give each a score on its creativity (Leung et al., 2012; Slepian & Ambady, 2012).

The most common and generally agreed upon definition of creativity involves divergent thinking and the production of useful products that are novel or innovative (Amabile et al., 1996; Rekdal, 1979). This then leads to the two general categories of creativity tests: divergent thinking and biographical/personality tests.

A Formal Definition

The two main definitions of creativity that have been consistently used in research and instrument development are Guilford's divergent thinking and his Structure of Intellect Model, which was touched on above, and Torrance's definition, which views creativity as a process involving sensing gaps and missing elements, forming hypotheses, communicating results, and modifying and retesting hypotheses (Barlow, 2000; Guilford & Hoepfner, 1966; Khatena, 1976). Other definitions that frequently appear are the ability to generate ideas, products, or solutions within some criterion and the ability to break free from perceptual sets to form novel and meaningful associative bonds (Khatena, 1976).

The historical standard definition of creativity is that it requires originality and effectiveness (Runco & Jaeger, 2012). Originality makes sense in this definition for, if something is not original, unique, novel, etc., it is conventional, mundane, not creative.

However, originality is not sufficient because ideas and products can be original, but useless (Runco & Jaeger, 2012). A random word generator can create a book that is indeed novel, but it would be useless. Effectiveness sometimes appears in definitions of creativity as usefulness, utility, appropriateness, fit, or value (Runco & Jaeger, 2012).

The two-criterion definition of creativity has been in standard use since at least the 1960s. In fact, the first unambiguous use of such a definition may very well be from 1953 (Runco & Jaeger, 2012). Other ideas that are still in use and ahead of their time include that there is an aspect of social judgement as creative works tend to be useful to at least one group, creative insight arises from reintegration of pre-existing materials and knowledge into new elements, and there is a need to separate personal and historical creativity (Runco & Jaeger, 2012).

Plucker, Beghetto, and Dow (2004) proposed a definition of creativity: "Creativity is the interaction among *aptitude*, *process*, and *environment* by which an individual or group produces a *perceptible product* that is both *novel* and *useful* as defined within a *social context*."

Aptitude here refers to ability and affective influences such as attitude and motivation. They chose aptitude as they view these characteristics as dynamic and influenced by experience, learning, and training (Plucker, Beghetto, & Dow, 2004). In a similar vein, process was chosen over trait as traits are static and fixed. Environmental aspects are positively related to the existence of creativity (Amabile, Conti, Coon, Lazenby, & Herron, 1996; Plucker, Beghetto, & Dow, 2004). These three aspects were chosen to guard against the myth of innate, set creativity that cannot be changed (Plucker, Beghetto, & Dow, 2004).

A perceptible product is needed for study. Musing over whether someone is creative before producing a creative act or product is compelling and interesting, but not conducive to

research (Plucker, Beghetto, & Dow, 2004). Creativity is essentially preverbal and subconscious in origin (Krippner, 1965). Several creative artists have made claims that their moods and feelings, before they are expressed verbally or symbolically, are the beginning of their creative efforts (Krippner, 1965). There are latent, unobservable aspects and processes involved in creativity, but tangible evidence is needed to infer, determine, and evaluate the presence of creativity (Plucker, Beghetto, & Dow, 2004).

Novel and useful because novelty, utility, appropriateness, and value of responses frequently appear throughout extant research (Plucker, Beghetto, & Dow, 2004).

The social context is required to determine if and how a person, action, or product will be viewed as creative. This also helps bridge the gap between Big C- and everyday-creativity (Plucker, Beghetto, & Dow, 2004).

Assessing Creativity

Literature examining creativity instrumentation is widely scattered and there are gaps (Khatena, 1976). One such gap is the creative mental functioning in individuals with sight- and hearing-impairments or other physical disabilities, disadvantaged populations, and those with developmental delays and disorders (Khatena, 1976). This is important to note as extant research indicates there is a difference in performance on verbal imagery tests in the hearing and hearing-impaired children, amongst other differences in various groups (1976).

Most research on creativity and intelligence utilizes divergent-thinking tests or paper-and-pencil tests scored for fluency or other divergent thinking-related traits (Kaufman & Plucker, 2011). Furthermore, studies have found that creativity is significantly associated with intelligence measures, particularly those that are verbally-oriented no matter the type of

creativity examined. However, this relationship is not strong, possibly due to the tests not being a "true" measure of the constructs (Kaufman & Plucker, 2011). The overreliance solely on divergent thinking measures and the use of non-traditional measures of intelligence may explain some of the conflicts in the research.

Creative Concepts

The three components of divergent thinking consistently utilized in measuring creativity are fluency, flexibility, and originality. These components are loosely correlated, but complementary (Taft & Rossiter, 1966). The goal of a study determines how many and which of these components may be used to decide how to measure creativity.

Fluency, generating numerous ideas for a specified problem, is the first component. Fluency is a vital precursor to creativity since generating more ideas increases the likelihood of producing or coming across a unique or novel solution (Leung et al., 2012). Fluency tasks are usually limited to a few minutes and ask participants to produce as many creative uses for a specific object or solutions to a problem as they can within the time limit. Scores are based on the total number of responses (Leung et al., 2012; Kaufman & Plucker, 2011; Slepian & Ambady, 2012). Criticisms of fluency measures typically center around how the more ideas one generates, the more likely a unique and unusual idea will be found. The argument is then that fluency is a weaker measure of creativity due to its propensity for increasing the odds of a creative response being produced (Renzulli & Callahan, 1975).

Flexibility, the degree to which ideas vary, is the second component of divergent thinking. This variance can be measured by how much ideas differ from each other or across various categories (Leung et al., 2012). If the generated ideas span multiple concepts, divergent

thinking is shown. The ideas need to differ more than slightly to demonstrate high flexibility. When measuring flexibility, relying more on how much a participant's ideas differ from each other is more subjective. *Originality* is just that; how novel an idea is when compared to those previously known (Leung et al., 2012; Kaufman & Plucker, 2011). Creativity has been most often found to be conceptually linked with novelty (Amabile, 1982). Originality measures can be objective or subjective and can be used for measuring convergent thinking as well. Using a panel of judges to rate the originality/creativity of ideas and looking at the statistical infrequency of individual responses are two common methods to assess originality (Leung et al., 2012; Slepian & Ambady, 2012).

There are three more concepts used to define and assess creativity: the ability to break context-induced mental sets, restructuring, and unconscious mental search (Friedman & Förster, 2000). *Breaking context-induced mental sets* is the act of disregarding red herrings, unrelated interpretations, wrong strategies, and unnecessary assumptions, all of which are easily accessible because of the nature or context of a problem. *Restructuring* is fairly straightforward and refers to global shifts in perspective or new interpretations of stimuli leading to a new way of seeing the problem (Friedman & Förster, 2000). An example of this is the classic "faces or vases" or Rubin vase illusion where the faces or vase are visible based on whether the center is the figure or the background. *Unconscious mental search* is just that; looking for new solutions, combinations of ideas, or strategies unconsciously. This is believed to require spreading of activation, or broadened thinking (Friedman & Förster, 2000).

Creative Measures

Controlled associations tests, figure analogy completion and identification tasks, code

solving, remote associations and similarities tests, word association tests, a variety of tests have been used to research creativity. Participants have been asked to suggest improvements to implements, generate punchlines to caption-less comics from the *Saturday Evening Post* or *New York Times,* categorize statements taken from "letters to the editor", create short stories based on given titles, and figure out what can be made from two given object names (Kettner, Guilford, & Christensen, 1959; Sternberg & the RPC, 2006). Some studies have asked participants to generate as many different uses for an object, such as a brick or scissors, (Friedman et al., 2003; Slepian & Ambady, 2012). Others have had them solve *droodles*, which are ambiguous riddle doodles (Leung et al., 2012). Still others use the Remote Associates Test (Leung et al., 2012; Taft & Rossiter, 1966), or the Category Inclusiveness Task (Slepian & Ambady, 2012).

Divergent thinking tests can have *lenient* or *stringent* solution standards (Runco, 1993). Lenient solution standards are those in which any stimulus can be a problem and any response is viewed as a potential solution. Stringent solution standards have solutions and problems with are clearly defined (Runco, 1993). Most divergent thinking tests from the 1960s and '70s have lenient solution standards. The two categories of solution standards are both unrelated to IQ, indicating idea generation tests are not merely tapping general intellectual ability, but performance on these two kinds of tests appears to be relatively independent (Runco, 1993). The skills required to solve lenient vs. stringent fluency tasks are possibly different.

There are four qualities responses are scored by to measure their creativity: originality or unusualness, fit, transformation to overcome the constraints of reality, and *condensation*, which refers to the degree the product unifies and coheres relationships between the simple and complex (Rekdal, 1979). There may even be different levels of creativity, with five of them

being expressive, productive, inventive, innovative, and emergent (Rekdal, 1979). Scoring of divergent thinking tasks can rely on whether a response is given by a large proportion of the sample, *popular*, or given by a small proportion of the sample, *original* (Runco, 1993). This way of scoring can be ideal as it avoids systems of scoring that rely on overlapping originality and fluency scores.

Simplifying scoring to focus on a single score is another innovation in scoring divergent thinking tests. Using one score the participant's whole output makes scoring easier and tends to make scoring more accurate as well (Runco, 1993). Building off the method of comparing each response to other ideas to get scores for other domains, e.g., flexibility, the single-score method typically generates a score from the sum of each response's score in the separate domains (Runco, 1993). Another way of generating a single score is to have judges award a single score to the entirety of the participant's *ideational pool*, their complete set of responses. Decisions are then made based upon the entire response set (Runco, 1993).

Some divergent thinking tasks are derived from problems in reality and not artificially created ones. Real-world-based tasks have some of the highest predictive validity coefficients in divergent thinking literature (Runco, 1993). In addition, multiple regression analyses indicate these tests have predictive ability for creativity beyond typical divergent thinking. Thus, it is important to distinguish between artificial and realistic problem studies and results (Runco, 1993).

Problem Generation Test.

Problem generation tests ask participants to produce solutions to a self-selected problem in response to a prompt. The rationale behind these tests is that being able to choose the problem

leads to intrinsic motivation, an assumed maximizer of creativity (Rossman, 1976; Runco, 1993). After all, is it not easier and more fun to do something chosen by oneself?

Fluency Test.

Fluency tests focus on generating numerous ideas. The simplest method of measuring creativity is asking participants to come up with as many different uses for an object as possible within one minute (Friedman et al., 2003; Slepian & Ambady, 2012). How many different responses the participant produces are counted and used as the creativity score. Some researchers have a panel of judges rate each item's creativity as well in order to add some objectivity to this primarily a subjective task (Slepian & Ambady, 2012).

The biggest criticism levelled against fluency tests is that generating numerous ideas more or less guarantees that eventually a creative solution will be hit upon (Renzulli & Callahan, 1975). This suggests that fluency alone is insufficient for measuring creative potential despite being generally assumed to be a good measure of divergent thinking. This makes sense as simply looking at the quantity of ideas generated rather than the quality is not a good measure of creativity. Plus, simply looking at statistical infrequency of ideas is not enough. With a large enough sample size, it is possible for no more unique, valid responses to exist (Silvia, 2015).

Remote Associates Test.

The Remote Associates Test (RAT) asks individuals to come up with a fourth word that is associated with three other words that are presented to them (Leung et al., 2012; Taft & Rossiter, 1966). The RAT has been found to be more correlated with convergent rather than divergent thinking in that it requires the ability to analyze relationships between distant ideas and come up with one right solution (Leung et al., 2012; Taft & Rossiter, 1966). It has been found to

relate to the divergent thinking components of originality and fluency (Taft & Rossiter, 1966). Unconscious mental search is also considered to be a component necessary for successful RAT completion (Friedman & Förster, 2000). However, the RAT has also been found to correlate highly with academic achievement and verbal IQ, indicating it may not be a good measure of creativity (Cropley, 1966).

Category Inclusiveness Task.

The *Category Inclusiveness Task* (CIT) comprises rating the goodness of fit different items exhibit via a ten-point scale from 0 to 9, with ratings of zero meaning the item is a very poor example or "definitely does not belong" in the category and nine meaning the item is a very good example or "definitely does belong" in the category (Isen & Daubman, 1984; Rosch, 1975; Friedman & Förster, 2000; Slepian & Ambady, 2012).

The ten categories typically used, and chosen based on norms by Rosch (1975), are: birds, clothing, furniture, fruit, sports, tools, toys, vegetables, vehicles, and weapons. There is debate over the use of 'fruits' and 'vegetables' as categories since they are social constructs and not biology, especially concerning the weak exemplars such as 'tomato'. As such, these categories are no longer commonly used (Friedman & Förster, 2000; Slepian & Ambady, 2012). Otherwise, however, Rosch's (1975) original exemplars and categories are used as they were initially developed with some modernizations for some of the exemplars in the clothing category (Slepian & Ambady, 2012).

While the CIT has stayed mostly the same since its inception, one major change has been made that is now generally used. Three strong, three weak, and three moderate exemplars, for a total of nine items, are presented for one category at a time. Norms for the goodness of fit of

each exemplar allow for consistent and reliable use of the items (Friedman & Förster, 2000; Isen & Daubman, 1984; Slepian & Ambady, 2012).

While the exemplars presentation is randomized, the first item presented is usually a strong one (Friedman & Förster, 2000; Isen & Daubman, 1984; Slepian & Ambady, 2012). For instance, if the category is 'vehicles', 'car' would be the first item presented and then followed by the other strong, the moderate, and weak exemplars in random order (Friedman & Förster, 2000; Isen & Daubman, 1984; Rosch, 1975). As 'car' has always been strongly rated as an example of a category, it goes first.

The ratings of the weak exemplars by participants are what is examined in the CIT. Higher ratings of the weaker examples in each category are assumed to be the result of more fluid or creative thinking (Friedman & Förster, 2000; Friedman et al., 2003; Isen & Daubman, 1984; Slepian & Ambady, 2012). On the face of it, this makes sense as the imagination has to work harder to view a camel as a vehicle and then giving it a high belongingness rating. This could also be a form of breaking context-induced sets since rating weak exemplars highly requires stepping away from schemas or traditional understandings of the category (Friedman & Förster, 2000; Friedman et al., 2003).

Embedded Figures Task.

The *Embedded Figures Task* (EFT) is widely used to measure creativity and measures the ability to break mental sets induced by context (Friedman & Förster, 2000). Simple figures are hidden within complex images or intricate visual patterns and examinees are asked to identify the simple figures. Being able to break the target figures loose from the context of the whole image is believed to require creativity (Friedman & Förster, 2000).

Snowy Pictures Test.

Similar to the EFT is the *Snowy Pictures Test* (SPT). The SPT asks examinees to identify images of familiar objects buried inside complex visual patterns or "snow", hence the name (Friedman & Förster, 2000). The SPT follows the same rationale as the EFT as the hidden object can only be found once the context of the snow is broken.

Gestalt Completion Task.

The *Gestalt Completion Task* (GCT) is a measure of the ability to cognitively restructure. Participants are shown fragmented and jumbled images of familiar objects and have to change their perspective and reinterpret the fragments to achieve gestalt closure and identify the object (Friedman & Förster, 2000).

Verbal Analogies Test.

The last way of measuring creativity that will be explored here is using verbal analogies. Solving these verbal puzzles are believed to involve unconscious mental search through spreading activation to discover more possible related attributes and relationships (Friedman & Förster, 2000).

Consensual Assessment Technique

The subjective nature inherent in most methods of scoring creativity is problematic due to reliance on the test creator's or scorer's intuition on what is creative. Most studies rely on conceptual definitions that are not tied to the assessment procedures and fail to differentiate between the responses' creativity and other constructs, such as aesthetic appeal (Amabile, 1982). Scoring should focus on the creative product rather than the process. It is, so far, still impossible to clearly articulate what the creative process is and looks like (Amabile, 1982). To overcome

the inherent subjectivity in this kind of scoring, Amabile (1982) developed the Consensual Assessment Technique.

The Consensual Assessment Technique (CAT) was developed by Teresa Amabile (1982) and is well-validated to the degree that it has been called the "gold standard" for creativity assessment, but its usage is mostly limited to research purposes due to the amount of resources it uses (Baer & McKool, 2009). The CAT is based on the idea that the best measure of creativity is combined assessment of experts in the domain of the final products, which is what most prize committees do to award prizes (Baer & McKool, 2009).

On the face of it, the CAT has a few requirements and the basic process is simple: examinees make something and experts independently evaluate the somethings. Experts rate the products on a 5-point scale and are allowed to use fractions if they wish. While they are not instructed to or asked to defend or explain their answers in any way, judges are asked to use the full scale (Baer & McKool, 2009).

Judges must be familiar with and have some experience in the domain being examined, though they do not need to have the same level of experience and do not need to have generated highly creative works in the domain themselves. The assessments must be made independently to avoid influencing each other's ratings and the examinee's products should be rated relative to each other rather than absolute standards (Amabile, 1982; Baer & McKool, 2009). Other dimensions besides creativity should also be rated. As a minimum, Amabile (1982) suggests that technical aspects of the product and aesthetic appeal, if relevant, should be rated. The final recommendation for judging creative tasks, Amabile (1982) made is to present the products in a random order to avoid method artifacts. It is then recommended that interjudge reliability is

analyzed and a factor analysis of the different dimensions be conducted. If a straightforward identification of specific objective features are found, these features can be assessed and correlated with creativity ratings (Amabile, 1982; Baer & McKool, 2009).

Ratings on the CAT are largely stable over time. Experts do not always agree and expert opinion does change with time, but a large number of studies consistently show that experts do agree, typically in the .70 to .90 range (Baer & McKool, 2009). However, motivation does impact ratings. Extrinsic motivation, such as a reward or expected evaluation, has been found to lead to lower creative performance, particularly for girls (Baer & McKool, 2009).

While the CAT has good discriminant validity and has consistently been found to be a good assessment of creativity, there are some criticisms levelled against it. The CAT does not provide evidence of more general creativity-relevant abilities, which may not exist (Baer & McKool, 2009). Tests of domain generality using the CAT revealed that correlations of ratings of subjects' creativity in different domains is near zero. However, there is disagreement on how much domain generality there is for creativity and, ultimately, there is probably a hierarchical model of some kind with some abilities contributing modestly to creativity across domains, others specific to a domain or on specific tasks within a domain (Baer & McKool, 2009).

The other major complaint with the CAT is how resource intensive administration can be (Amabile, 1982; Baer & McKool, 2009). While the only real requirement to be an expert judge has been found to simply be a familiarity with “the domain of endeavor in which the product was made”, it can still be difficult to gather judges when the complexity of the subject requires specialized knowledge to have familiarity. Furthermore, the amount of correlations and factor analyses Amabile (1982) recommends can be quite taxing and mean that studies need to be

repeated. Judge fatigue and difficulty keeping criteria consistent throughout judging is also a real concern (Amabile, 1982; Baer & McKool, 2009).

Amabile (1982) also points out that the CAT is likely not useful for identifying a wide range of stable individual differences in creativity and that ratings will be bounded to time and place since the shared subjectivity of creativity criteria change over time and differ across cultures.

The Torrance Tests of Creative Thinking.

E. Paul Torrance is best known for his development of the Torrance Tests of Creative Thinking (TTCT) in 1966, which can be administered individually or in groups to kindergarteners to graduate students and beyond. The TTCT manual has been revised to include a stream-lined scoring system, but the tests themselves have remained the same. It has since been re-normed four times, the most recent of which was in 1998 (Kim, 2006).

The definition of creativity Torrance used is concerned mostly with the detection of problems or missing information, identifying difficulties, looking for solutions, forming and testing possible solutions, and then communicating the results. However, the TTCT does not fully operationalize this definition and Torrance never meant for the TTCT to be used alone to make decisions (Kim, 2006). He believed that creative motivation as well as skills and abilities are necessary for creative achievement. The TTCT was developed to enhance as well as measure creativity, individualize and evaluate instruction, assist with interventions, and raise awareness of latent potentialities (Kim, 2006). Today, the TTCT has been used predominately for the identification of gifted children despite the Torrance's intended purpose of individualizing instruction (Kim, 2006).

The TTCT has two versions: the TTCT-Verbal and TTCT-Figural. Both of these versions have an A and B form. The TTCT-Verbal has five tasks: ask-and-guess, product improvement, unusual uses, unusual questions, and just suppose. Each task has a stimulus picture that examinees respond to in writing (Amabile, 1982; Kim, 2006). The TTCT-Figural has three tasks: picture construction, picture completion, and repeated figures of lines or circles. Picture construction has examinees make a picture on a page with a pear or jellybean shape on it (Kim, 2006). Picture completion presents the examinee with ten incomplete figures to make an object or picture. The final task asks them to make pictures incorporating lines or circles on three pages (Kim, 2006). Each task in the TTCT-Figural takes about ten minutes. Responses are scored based on the number and variety of ideas, idea elaboration, and statistical infrequency (Amabile, 1982).

The TTCT-Figural has five subscales: fluency, originality, elaboration, abstractness of titles, and resistance to premature closure (Kim, 2006). Fluency scores, as is typical, are simply the number of relevant ideas. Originality is based on statistical infrequency. Common scores are awarded a score of zero and other legitimate scores get one point. Lists of common responses are provided for scorers based on normative data from 1998 (Kim, 2006). Elaboration scores are based on the number of added ideas. Abstractness of titles measures the degree beyond concrete labeling of the stimuli. The final subscale scores are based on the degree of psychological openness (Kim, 2006).

There are also thirteen criterion-referenced "creative strengths" that were added after the initial iteration of the TTCT. These strengths are: "emotional expressiveness", "storytelling articulateness", "movement or action", "expressiveness of titles", "synthesis of incomplete

figures", "synthesis of lines or circles", "unusual visualization", "internal visualization", "extending or breaking boundaries", "humor", "richness of imagery", "colorfulness of imagery", and "fantasy" (Kim, 2006). The additional scoring measures were added based on new information obtained through continued research to expand the TTCT (Kim, 2006).

Norms for the 1998 TTCT manual were generated in the summer of 1997 from 55,600 primary school students from kindergarten through 12th-grade predominately in the western United States (57.6%) (Kim, 2006; Plucker, 1999). The TTCT has been used in over 35 countries for research, but there are few versions with norms developed for other countries. In the countries that do have country norms, these were developed by the local author (Kim, 2006).

The test-retest reliability of the TTCT ranges from .50 to .93, possibly due to motivational conditions (Kim, 2006; Plucker, 1999). However, validity and reliability for the latest edition of the TTCT have not been provided. This is problematic because the use of a new norm group may have changed the existing values and using a test without reliability and validity runs counter to the American Psychological Association standards of practice (American Psychological Association [APA], 2017).

The TTCT-Figural can be fair in terms of gender, ethnicity, socioeconomic status, language, and culture. In fact, the TTCT has, in some cases, been found to favor children from lower socioeconomic status (Kim, 2006). However, demographic characteristics were not outlined and need to be included despite belief that the TTCT is a fair test. It is presumptuous to assume that the originality of scores would persist from 1998 to the present. Originality has been found to be culture-dependent, so it would make sense for there to be cohort effects across time (Kim, 2006).

The fluency, originality, and flexibility subscales have been found to correlate significantly at the .01 level with the quantity and quality of creative achievements at a 7-year follow-up. Furthermore, the TTCT scores were a better predictor of creative achievement than IQ scores, high academic achievement, or peer nominations (Kim, 2006; Plucker, 1999). While criticisms have been leveled against the original longitudinal study outcomes, Plucker (1999), in a reanalysis, found tentative proof that the initial findings were correct.

Studies examining the TTCT's construct validity have conflicting results Kim, 2006). Some studies have found a high correlation between originality and fluency, suggesting the subscales are not independent constructs. Discriminant validity findings for the TTCT are low as well, with some studies suggesting it fails to meet even the loosest standards of validity (Baer & McKool, 2009; Kim, 2006).

Thinking Creatively

The definition of creativity used drives the measures and method used when studying creativity. Some designs work better with more than one measure or multiple variations on one measure. In others, the experimental condition limits the available methods to assess creativity. One example of this is avoiding written components when assessing how movement effects creativity (Friedman et al., 2003; Friedman & Förster, 2000).

There is not yet, and likely will never be, one true way of measuring creativity. It is probable that more than one method should be used to measure creativity to get at its different components since no one measure captures all of the components (Friedman et al., 2000; Leung et al., 2012). Any given method of stimulating creativity may only touch one or two creativity components.

So, What About Kinesthetic Creativity?

Paper-and-pencil tests are commonly used to measure creativity (Brennan, 1982). However, how can one measure kinesthetic creativity through such a test? Unfortunately, at this time, there are few kinesthetic tests of creativity existent.

Brennan (1982) utilized the SI model as framework for the generation of a measure of creativity in dance. Participants took three movement tests requiring them to use divergent production designed to match elements from Guilford's SI model (Brennan, 1982). Brennan (1982) defined movement as a change of position and body positions as a basic unit of kinesthetic information. Systems were represented by movement patterns or sequences (Brennan, 1982).

The three components of divergent thinking most commonly utilized in measuring creativity were assessed here: originality, fluency, and flexibility (Brennan, 1982; Taft & Rossiter, 1966; Treffinger, 1986). Originality was rated for use of space, meaning range, direction, and level of actions as well as the "interrelationship of body parts and design", and dynamics, movement speed and energy use, on a seven-point scale for uniqueness (Brennan, 1982). Flexibility was defined as the degree to which responses to a stimulus differed and was measured using a similar scale as for originality (Brennan, 1982). Fluency was measured by counting the number of appropriate responses within the time limit (Brennan, 1982).

The tests created by Brennan (1982) are all variations on the fluency test described previously (Friedman et al., 2003; Slepian & Ambady, 2012). The *positions test* asked participants to take as many imaginative body positions as possible within ninety seconds (Brennan, 1982). The *composition test* had the participants use four body positions demonstrated

for them in an imaginative sequence. No time limit was imposed, but the four positions had to be used in the order presented at least one time (Brennan, 1982). They were videotaped to make judging easier later and asked to compose a second imaginative sequence. The third test, the *improvisation test*, asked participants to improvise movements while keeping one foot in constant contact with a spot on the floor (Brennan, 1982).

All three tests were repeated, two with alternate versions, by twenty randomly chosen participants two and eight weeks later to check for reliability (Brennan, 1982). For the composition test, participants were given four new positions. The alternate form of the improvisation test, had them pick a spot on the wall to keep their hand (Brennan, 1982). Comparison of the results indicated low to moderate reliability on all three tests. Brennan (1982) hypothesized the low reliability in the improvisation test was due to the inherent limitations in movement by having to keep a hand high on the wall versus the mobility options available while keeping a foot on the ground and proposed requiring participants to keep their hands at mid-height as a possible alternative. As the only requirement for participation in the study was at least one semester of dance training, it is possible the level of ability impacted scores on the composition test retest (Brennan, 1982). Low reliability in the positions test may have been due to participants favoring quantity over originality or novelty while generating new positions (Brennan, 1982).

To test for a relationship between creative motor ability and variables generally assessed by traditional creativity tests, participants were also given two verbal creativity and two visual-figural creativity tests proposed by Guilford (Brennan, 1982). All four tests had time limits. The verbal tests were variations on the fluency task while the visual-figural tasks had participants use

geometric figures to draw named items or recognizable figures (Brennan, 1982). Participants were also given a questionnaire and an inventory to assess personal traits and information that identify creative individuals in the arts and sciences (Brennan, 1982).

Brennan (1982) found no relationship between dance creativity and attributes of creative individuals or among the types of variables tested. This supports the idea that originality and flexibility in movement are distinct factors and represent distinct divergent production abilities in the SI model (Brennan, 1982). It also raises doubts over the suitability of a 'one size fits all' approach to testing creativity similar to those raised by Gardner's model of intelligence (Gardner, 1995; Morgan, 1996).

Zachopoulou and Makri (2005) used the Divergent Movement Ability Test (DMAT) by Cleland and Gallahue (1993). The DMAT consists of three movement tasks: a type of obstacle course, ball-handling and -manipulation, and a balancing task on a bench (Cleland, 1994). Children administered the DMAT receive verbal directions and are encouraged to move in as many different ways they can using all the equipment for each task (Cleland, 1994; Cleland & Gallahue, 1993; Zachopoulou & Makri, 2005).

For the first task, children were asked to interact with equipment at four stations. One station had four cones arranged in a diagonal line, another had a 4-foot-by-6-foot mat, the third a 3-foot jump rope tied to two chairs, and the last a hula hoop suspended a foot above the floor on top of three foam cubes (Cleland & Gallahue, 1993; Zachopoulou & Makri, 2005). Scores were generated based on the number of different movement patterns the children generated and how much flexibility, difference in the patterns, they demonstrated (Cleland, 1994; Cleland & Gallahue, 1993; Zachopoulou & Makri, 2005).

The second part of the DMAT assess the examinee's ability to make shapes on, next to, below, or at the end of an 18"-high padded bench or balance beam (Cleland, 1994; Cleland & Gallahue, 1993; Zachopoulou & Makri, 2005). This shape task measures how many body parts the children used to perform a variety of movements and where in space.

The third part had the children manipulate a 9-inch-diameter ball. The children were relegated to a 10-foot-by-15-foot area marked by a wall at one side and cones. They were also told they could use the wall if they wanted during the task (Cleland, 1994; Cleland & Gallahue, 1993; Zachopoulou & Makri, 2005).

The results consistently found by the DMAT indicate that older children tend to have higher scores than younger children (Cleland, 1994; Cleland & Gallahue, 1993; Zachopoulou & Makri, 2005). Furthermore, preschoolers produced similar numbers of divergent movement responses and had similar patterns, suggesting they have similar divergent movement ability (Zachopoulou & Makri, 2005). Zachopoulou and Makri (2005) proposed that older children have a greater range in responses due to cognitive maturation, differing levels of development, different motivational factors, and more experience with moving as well as detecting and evaluating motivational and environmental cues. Gender consistently has been found to not be correlated with performance on the DMAT (Cleland, 1994; Cleland & Gallahue, 1993; Zachopoulou & Makri, 2005). In fact, no clear pattern of gender differences in creativity is a consistent finding in the literature. Results are mixed for different tests, creative tests, and creativity in general (Kettler & Bower, 2017).

CHAPTER III. BODILY-KINESTHETIC CREATIVITY TEST

So now we have a working definition of creativity, an idea of where the research stands, and a brief look at the existing tests of motor creativity. We have also taken a look at the relationship between creativity and intelligence and how creativity is measured. Now it is time to take a look at a new test of kinesthetic creativity, the Bodily-Kinesthetic Creativity Test (B-KCT).

Rationale

There are several reasons for developing a new test of kinesthetic creativity. Most of the existing research and tests focus on verbal and visual creativity (Brennan, 1982; Friedman et al., 2003; Leung, et al. 2012; Slepian & Ambady, 2012; Taft & Rossiter, 1966). Given that an individual's intellectual abilities can vary and that creativity appears to be linked in some way to intelligence, it is very likely the case that creativity shares the same capability for variance (Gardner, 1995). It then follows that there should be different types of creativity tests to allow for fair testing and to investigate if there are variances in creative performance based on task.

Furthermore, a motor test of creativity would be expected to not have high verbal loading, meaning that it could address some of the biases inherent in many verbal tests toward higher socioeconomic status and certain ethnic groups (Gardner, 1995; Visser, Ashton, & Vernon, 2006a). Adding creativity measures has been found to erase some of these biases when projecting outcomes for college students, so a nonverbal test could potentially remove some more of this bias.

Bodily abilities are largely overlooked in the research (Brennan, 1982; Cleland, 1994; Cleland & Gallahue, 1993; Friedman et al., 2003; Leung, et al. 2012; Slepian & Ambady, 2012; Taft & Rossiter, 1966; Zachopoulou & Makri, 2005). This is a problem because it means there

are few tests and measures to choose from in assessing these abilities and traits. It is recommended that, at a minimum, two measures be used to assess potential for creativity and there simply are not enough tests to choose from reliably such that the minimum is frequently met (Kim, 2006). Even worse is the low amount of studies examining the validity and utility of the few tests that do exist. More tests need to be created and all of them need to be further investigated for reliability and validity.

The sheer number and variety of intelligence tests that are extant speaks volumes to the need for a greater variety of creativity tests. For future research, it is important to use multiple measures of creativity and test models with different demographic, environmental, and social variables (Plucker, 1999).

Gifted and Talented (G/T) testing can be high stakes for students and their parents. However, schools have a difficult time determining what tests to use to assess creativity in particular and giftedness in general (Kaufman & Plucker, 2011). The paucity of choices available limits them to tests that are lacking in support, outdated norms, and/or concerning criticisms leveled against them (Kim, 2006). The development of new tests can help further research and advances in G/T testing.

Theoretical Foundations

Product-centered creativity is, by far, much easier to assess than process-centered creativity (Krippner & Arons, 1973). As such, process-centered bodily creativity was not considered in the development of the B-KCT and the following definition was chosen: creativity "is the interaction among aptitude, process, and environment by which an individual or group produces a perceptible product that is both novel and useful as defined within a social context"

(Plucker, Beghetto, & Dow, 2012). The test then needed to ensure that examinees generate some kind of tangible, evaluable product. This will be accomplished through the use of video recording.

In determining how to go about selecting what type of tasks to use to assess bodily-kinesthetic creativity, the relationship between intelligence and creativity was examined. Creativity has been suspected to be related to and associated with intelligence, though they are generally viewed as separate, unrelated abilities (Silvia, 2015). Guilford's work on creativity is credited with being the first to publicly acknowledge the need to study the construct on its own, which ignited the examination into the links between creativity and intelligence (Kaufman & Plucker, 2011; Silvia, 2015).

The relationship between the two is unclear, but they do appear to share some factors and processes (Cropley, 1966; Fuchs-Beauchamp, Karnes, & Johnson, 1993). Divergent and convergent thinking are two of these processes. Fluid and crystallized intelligence, fluency, and memory abilities have been found to correlate with creativity as well (Rossman, 1976). It is therefore likely that theories covering variances in intelligence cover those in creativity as well. In particular, Gardner's theory of multiple intelligences applies to creativity as well (Gardner, 1995; Han & Marvin, 2002; Morgan, 1966). The fact that verbal creativity skills have not been found to predict motor creativity supports this assumption (Stroup & Pielstick, 1965). Guilford's structure of intellect framework (SI model) further suggests creativity and intelligence are related and similar in makeup, though the SI model is now considered to be primarily of historical significance (Barlow, 2000; Brennan, 1982; Silvia, 2015). The SI model's legacy is that convergent processes are now considered standard indicators of intelligence, while divergent

ones are the same for creativity, though it is important to note that the processes themselves are not the same as the construct (Kim, 2006; Plucker, Beghetto, & Dow, 2004; Runco, 1993; Silvia, 2015). Additionally, divergent thinking tests may only be estimating the potential for creative thought, which is still useful to know (Runco, 1993). Given these findings, the B-KCT must have tasks that elicit divergent thinking. Lenient standards will be used, meaning all responses will be viewed as potential solutions (Runco, 1993).

There are three parts of divergent thinking that are used frequently when operationalizing creativity: fluency, flexibility, and originality (Leung et al., 2012; Slepian & Ambady, 2012). Fluency measures focus on generating ideas in response to a problem within a limited amount of time and flexibility ones look at how much responses differ and how many concepts they span. There are subjective and objective ways to measure originality. A panel of judges rating responses is the most reliable subjective method for assessing originality and examining statistical infrequency of responses is the most common objective method (Leung et al., 2012; Slepian & Ambady, 2012).

Pure fluency tests are seen as weak measures of creativity as the more ideas that are generated, the greater the likelihood that an original idea will be found (Renzulli & Callahan, 1975). This was a problem with Brennan's (1982) test and the subtests had low test-retest reliability. As such, it is better to use more than just fluency measures in a test of creativity. For the B-KCT, this means there will be more than one part and a fluency measure will go first to serve as a warm-up and possibly ease test anxiety.

It would be interesting to examine the statistical frequency of responses in the B-KCT, especially as there would likely be regional and cultural differences in response, but it would be

difficult to code those in to words or pictures for use in a manual. As such, that leaves subjective measures for originality and the need to trust that raters are good judges of creativity as found by the Consensual Assessment Technique (Amabile, 1982; Baer & McKool, 2009).

Brennan (1982) had raters examine responses for use of space, range, direction, level, dynamics, movement speed, energy use, and "interrelationship of body parts and design". These appear to be good coding of different movement concepts and similar ratings will be used in the B-KCT for rating originality and flexibility.

Breaking context-induced mental sets, restructuring, and unconscious mental search are three other concepts commonly used to investigate creativity (Friedman & Förster, 2000). It appears, at least thus far, that there are no tests of kinesthetic creativity that utilize these. This makes intuitive sense as it is difficult to conceive of how one can reliably induce these concepts in bodily tasks.

Existing kinesthetic creativity tests have focused on fluency, flexibility, and originality. Brennan (1982) had participants make imaginative body positions within ninety seconds, use four given poses to generate imaginative sequences, and improvise movements while keeping one body part in constant contact with a specific spot on the floor or wall. She found low reliability when retesting participants with an alternate form, possibly due to the level of dance training the participants received than creative ability and the use of only fluency measures (Brennan, 1982; Renzulli & Callahan, 1975).

The Divergent Movement Ability Test (DMAT) also has three movement tasks: an obstacle-course-type task, manipulating and handling balls, and balancing on and around a padded bench (Cleland, 1994; Cleland & Gallahue, 1993; Zachopoulou & Makri, 2005). The

amount of materials required in the DMAT make it inconvenient for simple testing and use. One of the goals of the B-KCT is to be accessible for as many different types of users as possible and simple for schools to utilize in giftedness testing. While the DMAT appears to be a good test of motor creativity, it is ultimately biased against differently abled individuals and schools with limited resources.

Core Assumptions

Perhaps the most important assumption underpinning this test is that there are varying degrees of creativity. The assumption of creativity existing on a continuum is commonplace (Amabile, 1982). Whether or not creativity does have continuous underlying processes is an unresolved point of contention in the literature (Baer & McKool, 2009).

Another unknown is whether or not creativity is domain-specific. Some research tentatively suggests that it is as skill-based training in creative endeavors has been found to be narrowly domain-specific (Baer & McKool, 2009). In addition, fine motor intelligence is indeed separate from Bodily-Kinesthetic intelligence. Therefore, the same difference likely exists within creativity (Gardner, 1995; Gardner, 2006; Visser, Ashton, & Vernon, 2006a). As such, the focus of the tasks in the test are on gross motor movements and products produced from them are more aligned with the initial motivations for this dissertation.

A third assumption is that creativity has the same underlying processes despite the modality such that tests in one mode can be translated to fit another mode, e.g. verbal creativity tests can be modified into kinesthetic ones. This is important as kinesthetic creativity has been mostly overlooked in the research (Brennan, 1982; Cleland, 1994; Cleland & Gallahue, 1993; Stroup & Pielstick, 1965; Zachopoulou & Makri, 2005). However, there are various verbal and

visual tests of creativity that are well supported and appear to be reliable and valid assessments of creativity. These serve as a jumping off point for the generation of this test.

The last major assumption is based on the repeated findings that expert ratings on the Consensual Assessment Technique (CAT) are highly consistent (Amabile, 1982; Baer & McKool, 2009), it should be accurate and valid to trust any one judge who is an expert on the domain of the test. As the B-KCT tasks are similar to everyday movements, any person should be able to score the subtests.

The Bodily-Kinesthetic Creativity Test

A good task for creativity testing needs to avoid being too reliant on highly specialized skills and needs to be open-ended to allow for flexibility and novelty in the products and responses made (Amabile, 1982). This means the B-KCT should be easily understood and executed by any layperson in the field of body movement.

The proposed test consists of three parts: a free condition as a warm up, creating four poses to use in multiple sequences, and silly walks. Scoring creativity for all parts would be done using a rating from 1 to 5, with five being the most creative or whatever is the dimension being assessed, and fluency is based on the number of responses made. The same dimensions or concepts will be used for rating creativity, similar to those used in the test created by Brennan (1982).

A clear, clean space would be needed to perform the test with enough open area to mark off a twenty-foot square for participants to move around in. A camera, preferably on a tripod, will also be needed to record participants' responses so the responses can be reviewed later for scoring. Finally, a stop watch or timer will be used to keep track of time.

Part One: Free Condition

Creativity research has consistently shown that generating more ideas leads to increased likelihood in coming up with new and unusual ideas (Renzulli & Callahan, 1975). By definition, creative ideas are unusual or infrequent solutions to problems and asking individuals to come up with additional answers after an initial bout of answers or ideas can lead to unusual and unique responses (Renzulli & Callahan, 1975). Brennan (1982) found that a pure fluency condition did not cluster with other measures of creativity, which complements other findings that fluency tests are weak predictors of creative ability (Renzulli & Callahan, 1975).

Performing this kind of task can serve as a warm-up exercise for more complicated activities through providing access to more creative processes. Furthermore, as there are no right or wrong answers to open-ended fluency tasks, it can help create a psychologically safe atmosphere and potentially lower anxiety through avoiding rigorous external evaluation by doing these tasks first (Renzulli & Callahan, 1975). To further this end, it is equally important for the examiner to maintain a pleasant and engaging attitude throughout the administration.

Participants would be asked to make different poses and hold them for a count of three within a time limit of three minutes. The pausing would allow for counting the number of poses generated later upon viewing the video. The performance would need to be videotaped so perseverative poses could be discounted. Additionally, video recordings helps ensure accuracy of transcription and inter-observer reliability (Trevlas, Matsouka, & Zachopoulou, 2003) and provides the scorer with the examinee's entire ideational pool. Scoring ideational pools retains the associative pattern use by examinees and provides the rater with more information than one idea at a time and produces highly reliable scores, with inter-rater coefficients higher than .90

(Runco, 1993). Scorers can determine how many answers were generated, how many unusual ideas were found, and what patterns or strategies were used, to name a few benefits (Runco, 1993). Less subjective discrimination is needed to award a score and increases the likelihood of creating scores indicative of creativity rather than originality, especially when other dimensions are scored simultaneously (Amabile, 1982; Baer & McKool, 2009).

Part Two: Four Poses

Inspired by Brennan's (1982) compositions test, the Design Fluency four lines condition, and problem generation tests, the second part of the kinesthetic creativity test has participants come up with four poses and use those to generate imaginative sequences within ten minutes. Producing the poses to be used themselves mimics choreography projects dance students are sometimes tasked with and hopefully represents a real-world problem. This should then increase intrinsic motivation and predictive ability of this subtest (Runco, 1993).

Since the poses will not be given to the participants, they will need time to generate the poses before formulating sequences. Anxiety is a creativity killer (Renzulli & Callahan, 1975; Rossman, 1976; Kim, 2006). As such, being forced to come up with poses within a time limit could be stressful to the point of negatively impacting performance. Participants would not be timed for the pose generation format, only the unique sequences portion. Some participants may choose poses they just did in the free condition. They should be encouraged to pick four of the most creative poses of which they can think.

Once they decide on their four poses, participants would be asked to demonstrate the poses for photographing and the sequences portion videotaped and timed. Participants would be scored separately on their poses and sequences, with scoring focused on number of sequences

made, creativity of the poses and the sequences, and the uniqueness of the sequences and poses.

Brennan (1982) noted that part of the problem with reliability on her compositions test was that the raters did not use the full scale. This phenomenon was observed by Amabile (1982), who was able to overcome this difficulty by encouraging raters to use the full 5-point scale, making sure they were aware of the time constraints of the task, and having judges rate products for other dimensions like aesthetic appeal. Therefore, the four poses test will be scored for creativity, aesthetic appeal, and technical difficulty.

Part Three: Silly Walks

As mentioned previously, tests based on abstract and artificial situations do not have a strong relationship with real-world performance and may not adequately predict creative capacity (Runco, 1993). So, the final part of the test has examinees walk across a ten-foot square in different ways. This will hopefully prove to be a useful measure of bodily-kinesthetic creativity as walking is a daily part of life and the situation allows for examinees to create novel ways of walking, thus satisfying the real-world aspect as well as the definition of creativity (Plucker, Beghetto, & Dow, 2004).

Examinees would tasked with coming up with one, creative way of getting from one side of the space to another. They will be allowed to start and end at any two points on opposite ends and take as long of a route as they like. The task will be repeated three times and each trial will last a maximum of 15 minutes. The time limit encompasses the amount of time the participants spend thinking about and planning their walk; they will not be given separate time to plan.

Strengths and Limitations

The B-KCT has been designed to be as resource light and as inclusive as possible. Few

materials are needed aside from a large enough space, a camera, and a way to view photos and videos. Some way to mark off the boundaries of the space is needed. Either chalk lines or blue tape is recommended. Overall, it should be very simple to implement the B-KCT for assessment and research.

Furthermore, it is expected to be free of demographic biases and help lower ethnic group differences when utilized for admission into specialized programs (Kaufman & Plucker, 2011; Sternberg & the RPC, 2006).

Blind judging of participants is more effective because it eliminates many demographic factors that may bias the rater or raters (Baer & McKool, 2009). This implies that having a test that relies heavily on watching participants directly has the opposite effect. It is possible that needing to review recordings for a participant with only minimal masking of their demographic factors will bias the raters. As there will only be one rater, this is potentially a problem.

Using divergent thinking methods may lower the predictive validity of the test as the connection between creative performance and creative production in the natural environment is unknown (Runco, 1993). Additionally, the initial fluency task may serve to only prime creativity and serve as a rapport builder and anxiety reducer (Renzulli & Callahan, 1975). Its utility as a predictor of creative potential is anticipated to be low to moderate, similar to other tests (Brennan, 1982).

Ethical Considerations

There are several ethical considerations concerning the B-KCT. The extant literature examining the instrumentation of creativity is spotty. As such, it is difficult to predict what biases may be inherent in the test structure. What little research that does exist suggests that

creative functioning is different for individuals with physical disabilities, developmental delays and disorders, and from disadvantaged backgrounds (Khatena, 1976). In addition, there are no consistent findings regarding gender in the literature (Kettler & Bower, 2017). This means it is necessary to examine what, if any, differences exist for seeing- and hearing-impaired individuals, individuals with other physical or mental disabilities, and different socioeconomic status individuals. Gender differences are not expected, but need to also be explored. There are some studies that indicate there are differences in motor creativity levels dependent on age, so this is another dimension that needs to be examined (Zachopoulou & Makri, 2005).

There are also concerns regarding video recording participants. The recordings need to be kept secure and destroyed following typical procedures for testing protocols. Extra care should be taken since the participants' likenesses will be recorded. Furthermore, it needs to be made explicit to participants that they will be recorded and what the procedures will be to keep the recordings confidential.

It is also important to consider the natural range of motion of the participants and to encourage them to listen to their bodies and not strain themselves. The space used for testing should be well-maintained and free of potential tripping or slipping hazards. Additionally, a modified version of the test may be needed for individuals with limited mobility. The test as it appears to require a moderate range of motion that may mean it is not suitable for individuals with certain physical disabilities.

And finally, the B-KCT should not be used to make any high-stakes decisions until there is a large body of research available that is able to speak to its reliability and validity as a measure of kinesthetic creativity. This is especially true as the test proposed here has in no way

been tested and is at this time only theoretical. Pilot studies are needed to assess its utility and to determine what revisions may need to be made. Moreover, one test alone should not be used to make determinations concerning an individual or admissions.

Summary

A greater effort has been made on studying verbal and visual creativity and related concepts, such as problem solving and embodied cognition, than motor creativity (Brennan, 1982; Friedman et al., 2003; Leung, et al. 2012; Slepian & Ambady, 2012; Taft & Rossiter, 1966). This is problematic as motor or kinesthetic creativity is very likely separate from verbal, visual, and figural abilities and few tests specifically assess kinesthetic creativity (Guilford, 2006; Morgan, 1996; Visser, Ashton, & Vernon, 2006a).

The B-KCT proposed here consists of three parts: a pure fluency task, a mixed real-world and divergent thinking task, and a real-world problem solving task. The test will need to be piloted and likely undergo revisions before it reaches its final form. As is, the B-KCT is a guide for future researchers.

CHAPTER IV. DISCUSSION

Creativity is a fascinating and multifaceted concept that is still being defined and investigated (Amabile, Conti, Coon, Lazenby, & Herron, 1996; Runco, 1993). The benefits of creativity have been found in numerous psychological, therapeutic, and workplace domains (Isaacs, 1974; Plucker, Beghetto, & Dow, 2004). While research into creativity is increasing and diversifying, there is still a dearth of literature examining bodily-kinesthetic creativity (Brennan, 1982; Cleland, 1994; Cleland & Gallahue, 1993; Zachopoulou & Makri, 2005). A new method for examining motor creativity was proposed in this dissertation.

What is Creativity?

Creativity is best described as an intricate collection of affective, cognitive, and motivational processes (Rekdal, 1979). Culturally, creativity is seen as being process- or product-centered, with product-centered creativity being the most well studied as it is much easier to conduct research that results in a tangible item (Krippner & Arons, 1973). There are three other perspectives to examine and assess creativity from besides product: process, person, and place or environment (Hunsaker & Callahan, 1995; Kettler & Bower, 2017; Rekdal, 1979; Trevlas, Matsuoka, & Zachopoulou, 2003). Person is the only other consistently studied perspective (Hunsaker & Callahan, 1995).

The relationship between intelligence and creativity is unclear, but the two concepts seem to share some factors and underlying processes (Cropley, 1966; Fuchs-Beauchamp, Karnes, & Johnson, 1993). Divergent and convergent thinking are related on a factor-level and inter-related. Both of these processes are believed to be components of creativity and divergent thinking has been found to correlate with intelligence (Cropley, 1966; Fuchs-Beauchamp, Karnes, & Johnson, 1993). Furthermore, fluid and crystallized intelligence as well as fluency

and memory abilities have been found to correlate with creativity (Rossman, 1976).

Given that intelligence and creativity are related and have some overlap, it is highly likely that Gardner's theory of multiple intelligences applies to creativity as well (Gardner, 1995; Han & Marvin, 2002; Morgan, 1966). Verbal creativity skills have not been found to predict motor creativity, which supports this assumption (Stroup & Pielstick, 1965). Guilford's structure of intellect framework (SI model) further suggests creativity and intelligence are related and similar in makeup (Barlow, 2000; Brennan, 1982).

There are also personality factors that correlate with creativity that have overlap with traits correlated with intelligence and genius (Rossman, 1976). These factors include a need for achievement, independent temperament, willingness to take risks, and openness to different ideas that may be unusual or bizarre. The creative person enjoys manipulating ideas and objects, engaging with atypical ideas, produces a variety of different kinds of works, and is a strong divergent and perceptual thinker (Rossman, 1976).

A variety of definitions for creativity have been proposed and there is yet to be a widely agreed upon definition (Plucker, Beghetto, & Dow, 2004). In fact, a large number of articles elect to provide no or only an implicit definition of creativity as a construct. When proposed definitions are explicit, uniqueness and usefulness are common characteristics that occur across definitions (Plucker, Beghetto, & Dow, 2004). Plucker, Beghetto, and Dow (2004) proposed to define creativity as "the interaction among aptitude, process, and environment by which an individual or group produces a perceptible product that is both novel and useful as defined within a social context." They envisioned creativity as a dynamic process that is influenced by experience, learning, and training that produces a tangible product that can then be studied. The

social context is needed to attest to the novelty and utility of the product produced (Plucker, Beghetto, & Dow, 2004).

How is Creativity Measured?

There are gaps in the literature examining creativity instrumentation, partially due to the scattering of research (Khatena, 1976). These gaps include those the creative functioning in individuals with physical disabilities, developmental delays and disorders, and in disadvantaged populations. What little research there is surrounding creativity in these various groups suggests there are differences in creative functioning (Khatena, 1976). However, there has not been examination in how the different kinds of creativity manifest in these populations.

Divergent thinking is commonly used to operationalize creativity and at least three components are consistently utilized in assessing creativity: fluency, flexibility, and originality. These are loosely correlated and complementary and can be used for convergent thinking as well (Taft & Rossiter, 1966; Treffinger, 1986). Any number of these components can be used as a basis for measuring creativity.

Fluency measures have examinees generate as many ideas in response to a problem as they can within a short amount of time (Leung et al., 2012; Slepian & Ambady, 2012). Flexibility measures tend to be more subjective as they produce scores based on how much a participant's ideas differ. Originality tests are the most straightforward. Originality can be measured subjectively through the use of a panel of judges to rate responses or objectively through the use of the statistical infrequency of individual responses (Leung et al., 2012; Slepian & Ambady, 2012).

Three more concepts frequently used to define creativity are breaking context-induced

mental sets, restructuring, and unconscious mental search (Friedman & Förster, 2000). Set breaking tests involve ignoring deceptive or irrelevant interpretations and assumptions as well as ignoring incorrect strategies, all of which are easily accessible because of the problem's context. Restructuring tests require global shifts of perspective or reinterpreting stimuli in order to see the problem in a new way (Friedman & Förster, 2000). A classic example of restructuring is figure-ground reversal tasks. Unconscious mental search tasks involve looking for new answers, strategies, and idea combinations through extensive spreading of activation or broadened thinking (Friedman & Förster, 2000).

The pervasiveness of the idea that creativity involves divergent thinking and producing original and useful products (Rekdal, 1979) has led to divergent thinking and biographical or personality tests being the two general categories of creativity tests. Divergent thinking tests are frequently used to assess creativity, but may be truly only estimating the potential for creative thought, which is still useful (Runco, 1993), as divergent thinking and creativity are not synonymous (Plucker, Beghetto, & Dow, 2004; Runco, 1993). Criticisms of divergent thinking focus primarily on the moderate predictive validity of measures testing divergent thinking as well as the unclear connection to creative performance and production in the natural environment (Runco, 1993).

What Kinesthetic Creativity Tests Currently Exist?

The majority of measures of creativity focus on verbal and visual abilities, embodied cognition, and problem solving (Brennan, 1982; Friedman et al., 2003; Leung, et al. 2012; Slepian & Ambady, 2012; Taft & Rossiter, 1966). As kinesthetic abilities are likely separate factors in intellectual functioning and distinct from verbal, visual, and figural abilities (Morgan,

1996), this is a problem, especially since few tests specifically assessing kinesthetic or motor creativity exist (Brennan 1982).

Brennan (1982) used the SI model to generate a measure of creativity in dance. Movement was defined as position change and body positions as a basic unit of kinesthetic information. Originality, fluency, and flexibility were assessed in the three parts of the test (Brennan, 1982). Participants' originality was rated on a seven-point scale for uniqueness according to use of space, range, direction, level of actions, dynamics, movement speed, and energy use. Flexibility was measured using a similar scale while fluency was measured by counting how many appropriate responses were generated within the time-limit (Brennan, 1982).

The positions test had participants generate as many imaginative body positions as they could within ninety seconds. The composition test videotaped participants using four body positions that were demonstrated to them to form imaginative sequences without a time limit. The improvisation test had participants improvise movements while keeping one foot in constant contact with a specific spot on the floor (Brennan, 1982). The three tests were then repeated, but with different positions for the composition test and a new condition for the improvisation test. Instead of their foot, participants had to keep one hand high on a wall, which ended up limiting their range of movements (Brennan, 1982).

Brennan (1982) had low reliability in the positions test, which may have been due to participants favoring quantity over originality while generating new positions. Furthermore, all her participants had at least one semester of dance training. Her results may have better reflected level of training versus creative facility (Brennan, 1982). Brennan (1982) found no relationship between kinesthetic creativity and attributes of creative individuals.

The Divergent Movement Ability Test (DMAT) was created by Cleland and Gallahue (1993), which has also been used by Zachopoulou and Makri (2005). Like Brennan's (1982) dance test, the DMAT has three movement tasks: an obstacle-course-type task, ball-handling and -manipulation, and balancing on a bench (Cleland, 1994; Cleland & Gallahue, 1993; Zachopoulou & Makri, 2005). The obstacle course task had children interact with four different stations with different equipment chosen to elicit different movement patterns. Scores were based on how many patterns the children generated and how much flexibility they demonstrated (Cleland, 1994; Cleland & Gallahue, 1993; Zachopoulou & Makri, 2005). The balance beam task had the children use their bodies to make shapes on, next to, below, or at the end of an 18"-high padded bench. The number of body parts the children used to perform the different movements as well as where in space the movements were made was what the scores were based on (Cleland, 1994; Cleland & Gallahue, 1993; Zachopoulou & Makri, 2005). The ball-manipulation and -handling task had the children interact with a 9"-diameter ball within a 10' by 15' area denoted by a wall at one side and cones (Cleland, 1994; Cleland & Gallahue, 1993; Zachopoulou & Makri, 2005).

What Would A Movement Test Of Creativity Look Like?

The test proposed here consists of three parts like the DMAT and the dance test: a free condition to warm up, coming up with four poses to use to generate multiple sequences, and silly walks.

The free condition is an open-ended fluency task, which serves to increase the likelihood that participants will be able to come up with novel and original ideas (Renzulli & Callahan, 1975). This makes the free condition a warm-up exercise and a perfect opportunity to build

rapport and familiarize examinees with the test (Renzulli & Callahan, 1975).

Real-world, discovered problem tests have better predictability beyond typical tests of creativity (Runco, 1993). Additionally, problem generation tests can lead to increased intrinsic motivation, which likely maximizes creativity (Rossman, 1976; Runco, 1993). Going off of these conclusions, Brennan's (1982) compositions test, and the four lines condition from the design fluency test, the four poses subtest has examinees create four poses to then use to generate imaginative sequences within a few minutes.

Tests based on abstract and artificial situations have weak relationships with real-world performance and likely are not adequately predictive of creative capacity (Runco, 1993). Therefore, the last subtest has examinees walk across a space, which is a fairly commonplace problem most of us face in daily life.

Clinical Implications

The B-KCT is a new take on Brennan's (1982) dance test of creativity and the Consensual Assessment Technique (CAT). The modifications should allow for increased reliability and validity and simpler implementation than the CAT.

Administering the B-KCT will not require as many resources as the Divergent Movement Ability Task (DMAT). This makes it easier to use for research and assessment. The B-KCT is also more accessible to individuals with physical disabilities, though modifications are needed to ensure that it is truly capable of being administered to anyone.

The B-KCT could also potentially serve as a screener of kinesthetic creative ability and be incorporated into a test battery. As not much is yet known about this type of creativity, it is unclear if the B-KCT can be used for more in-depth analysis of creative functioning.

Recommendations for Future Research

Pilot studies on the B-KCT should be conducted. It is recommended to investigate the efficacy of instructions, how overall administration plays out, and conduct statistical analyses of the scoring results. Demographic information including experience with moving, e.g., dance training, sports training, etc., should be recorded as well to verify the test is assessing creativity and not just level of experience with moving. The time limits provided are expected to need adjustments. It may also be interesting to examine if there is a correlation between time spent on tasks and creativity scores.

Something that future researchers will want to consider is variations for individuals with physical disabilities, particularly those that limit movement. That said, early studies using the B-KCT would likely benefit from using able-bodied individuals first so that it is easier to work out what issues there are with the test and make it simpler to further develop it.

Figuring out how to translate more existing tests into kinesthetic versions could help with discovering whether or not the same processes are involved in creativity in different domains. Presumably, changing the domain assessed, but not the underlying method of assessment, would result in tests that utilize the same cognitive processes. Doing so would have to be done with great caution and much thought to assure that the tasks are still tapping into the same concept and fundamentally the same (Brennan, 1982). It would also be interesting to see how changing the domain of a task impacts a person's performance, which would speak to the domain-generalizability of creativity and related skills.

Conclusion

Creativity is a fun and fascinating concept to study. It is neither easy to or consistently

identified by the various different types of tests attempting to assess it (Brennan, 1982). There is no one perfect method to study any type of creativity. More tests of bodily-kinesthetic creativity are needed to further the research and add to the diversity of tests available to consumers.

The B-KCT is a simple, easy to administer test of bodily-kinesthetic creativity. Piloting is needed to guide it to its final form and the version here serves as a roadmap to do so.

References

Almeida, L. S., Prieto, M. D., Ferreira, A. I., Bermejo, M. R., Ferrando, M., & Ferrándiz, C. (2010). Intelligence assessment: Gardner multiple intelligence theory as an alternative. *Learning and Individual Differences*, *20*(3), 225-230.

Amabile, T. M. (1982). Social psychology of creativity: A Consensual Assessment Technique. *Journal of personality and social psychology*, *43*(5), 997.

Amabile, T. M., Conti, R., Coon, H., Lazenby, J., & Herron, M. (1996). Assessing the work environment for creativity. *Academy of management journal, 39(*5), 1154-1184.

American Psychological Association. (2017). *Ethical Principles of Psychologists and Code of Conduct*. Washington, DC: American Psychological Association.

Baer, J., & McKool, S. S. (2009). Assessing creativity using the Consensual Assessment Technique. In *Handbook of research on assessment technologies, methods, and applications in higher education* (pp. 65-77). IGI Global.

Barlow, C. M. (2000). Guilford's Structure of the Intellect. *The Co-Creativity Institute*. Retrieved October 14, 2017 from http://www.cocreativity.com/handouts/guilford.pdf.

Brennan, M. A. (1982). Relationship between creative ability in dance and selected creative attributes. *Perceptual and motor skills*, *55*(1), 47-56.

Cleland, F. E. (1994). Young children's divergent movement ability: Study II. *Journal of teaching in Physical Education*, *13*(3), 228-241.

Cleland, F. E., & Gallahue, D. L. (1993). Young children's divergent movement ability. *Perceptual and motor skills*, *77*(2), 535-544.

Cropley, A. J. (1966). Creativity and intelligence. *British Journal of Educational Psychology*,

36(3), 259-266.

Ewing, X. (2013). *Movement Direction, Movement Type, and Category Inclusiveness.* Unpublished manuscript, Department of Psychology, Macalester College.

Fuchs-Beauchamp, K. D., Karnes, M. B., & Johnson, L. J. (1993). Creativity and intelligence in preschoolers. *Gifted Child Quarterly, 3*7(3), 113-117.

Friedman, R. S., Fishbach, A., Förster, J., & Werth, L. (2003). Attentional priming effects on creativity. *Creativity Research Journal, 15*, 277-286. doi:10.1207/S15326934CRJ152&3_18.

Friedman, R. S., & Förster, J. (2000). The effects of approach and avoidance motor actions on the elements of creative insight. *Journal of Personality and Social Psychology, 79*, 477-492. doi:10.1037//0022-3514.79.4.477.

Friedman, R. S., & Förster, J. (2010). Implicit affective cues and attentional tuning: An integrative review. *Psychological Bulletin, 136*, 875-893. doi:10.1037/a0020495

Gardner, H. (1995). Reflections on multiple intelligences: Myths and messages. *Phi Delta Kappan*, *77*(3), 200.

Gardner, H. (2006). On failing to grasp the core of MI theory: A response to Visser et al. *Intelligence*, *34*(5), 503-505. doi:10.1016/j.intell.2006.04.002

Gowan, J. C. (1972). *Development of the creative individual*. RR Knapp.

Guilford, J. P. (1962). Potentiality for creativity. *Gifted Child Quarterly, 6*(3), 87-90.

Guilford, J. P., & Hoepfner, R. (1966). *Structure-of-intellect factors and their tests, 1966. Studies of aptitudes of high-level personnel* (No. 36). University Of Southern California Los Angeles Psychological Lab.

Han, K. S., & Marvin, C. (2002). Multiple creativities? Investigating domain-specificity of creativity in young children. *Gifted Child Quarterly, 46*(2), 98-109.

Hunsaker, S. L., & Callahan, C. M. (1995). Creativity and giftedness: Published instrument uses and abuses. *Gifted Child Quarterly, 39*(2), 110-114.

Isaacs, A. F. (1974). Creativity and Frustration. *Gifted Child Quarterly, 18*(3), 224-226.

Isen, A. M., & Daubman, K. A. (1984). The influence of affect on categorization. *Journal of personality and social psychology, 47*(6), 1206-1217.

Jauk, E., Benedek, M., Dunst, B., & Neubauer, A. C. (2013). The relationship between intelligence and creativity: New support for the threshold hypothesis by means of empirical breakpoint detection. *Intelligence*, *41*(4), 212-221.

Karowe, H. E. (1963). Giftedness and creativity. *Gifted Child Quarterly, 7*(4), 165-175.

Kaufman, J., & Plucker, J. (2011). Intelligence and Creativity. In R. Sternberg & S. Kaufman (Eds.), *The Cambridge Handbook of Intelligence* (Cambridge Handbooks in Psychology, pp. 771-783). Cambridge: Cambridge University Press. doi:10.1017/CBO9780511977244.039

Kettler, T., & Bower, J. (2017). Measuring creative capacity in gifted students: comparing teacher ratings and student products. *Gifted Child Quarterly, 61*(4), 290-299.

Kettner, N. W., Guilford, J. P., & Christensen, P. R. (1959). A factor-analytic study across the domains of reasoning, creativity, and evaluation. *Psychological Monographs: General and Applied, 73*(9), 1.

Khatena, J. (1976). Major directions in creativity research. *Gifted Child Quarterly, 20*(3), 336-349.

Kim, K. H. (2006). Can we trust creativity tests? A review of the Torrance Tests of Creative Thinking (TTCT). *Creativity research journal*, *18*(1), 3-14.

Klein, P. D. (1997). Multiplying the problems of intelligence by eight: A critique of Gardner's theory. *Canadian Journal of Education/Revue Canadienne de l'Education*, 377-394.

Krippner, S. (1963). Creativity and psychic phenomena. *Gifted Child Quarterly, 7*(2), 51-63.

Krippner, S. (1965). Hypnosis and creativity. *American Journal of Clinical Hypnosis*, *8*(2), 94-99.

Krippner, S., & Arons, M. (1973). Creativity: Person, product, or process?. *Gifted Child Quarterly, 17*(2), 116-123.

Leung, A. K. Y., Kim, S., Polman, E., Ong, L. S., Qiu, L., Goncalo, J. A., & Sanchez-Burks, J. (2012). Embodied metaphors and creative "acts". *Psychological science, 23*(5), 502-509.

Marland Jr, S. P. (1971). Education of the Gifted and Talented-Volume 1: Report to the Congress of the United States by the US Commissioner of Education.

McGrew, K. S. (2009). CHC theory and the human cognitive abilities project: Standing on the shoulders of the giants of psychometric intelligence research. *Intelligence, 37*(1), 1-10. doi:10.1016/j.intell.2008.08.004

Morgan, H. (1996). An analysis of Gardner's theory of multiple intelligence. *Roeper Review*, *18*(4), 263-269.

Pierangelo, R., & Giuliani, G. A. (2001). *What every teacher should know about students with special needs: Promoting success in the classroom*. Champaign, IL: Research Press.

Plucker, J. A. (1999). Is the proof in the pudding? Reanalyses of Torrance's (1958 to present) longitudinal data. *Creativity Research Journal*, *12*(2), 103-114.

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*(2), 83-96.

Reid, C., & Romanoff, B. (1997). Using multiple intelligence theory to identify gifted children. *Educational Leadership*, *55*, 71-75.

Rekdal, C. K. (1979). Genius creativity and eminence. *Gifted Child Quarterly, 23*(4), 837-854.

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

Rimm, S., Davis, G. A., & Bien, Y. (1982). Identifying creativity: A characteristics approach. *Gifted Child Quarterly, 26*(4), 165-171.

Rossman, B. B. (1976). Art, creativity and the elephant: Some clues to artistic creativity among the gifted. *Gifted Child Quarterly, 20*(4), 392-402.

Runco, M. A. (1993). Divergent thinking, creativity, and giftedness. *Gifted Child Quarterly, 37*(1), 16-22.

Runco, M. A., & Jaeger, G. J. (2012). The standard definition of creativity. *Creativity Research Journal*, *24*(1), 92-96.

Silvia, P. J. (2015). Intelligence and creativity are pretty similar after all. *Educational Psychology Review*, *27*(4), 599-606.

Slepian, M. L., & Ambady, N. (2012). Fluid movement and creativity. *Journal of Experimental Psychology: General, 141*, 625-629. doi:10.1037/a0027395.

Sternberg, R. J. (2005). The Theory of Successful Intelligence. *Revista Interamericana de Psicología*, *39*, 2.

Sternberg, R. J., & the Rainbow Project Collaborators (2006). The Rainbow Project: Enhancing the SAT through assessments of analytical, practical, and creative skills. *Intelligence*, *34*(4), 321-350.

Stroup, F., & Pielstick, N. L. (1965). Motor ability and creativity. *Perceptual and Motor Skills*, *20*(1), 76-78.

Taft, R., & Rossiter, J. R. (1966). The Remote Associates Test: divergent or convergent thinking?. *Psychological Reports, 19*(3f), 1313-1314.

Treffinger, D. J. (1986). Research on creativity. *Gifted Child Quarterly*, *30*(1), 15-19.

Treffinger, D. J. (2009). Myth 5: Creativity is too difficult to measure. *Gifted Child Quarterly, 53*(4), 245-247.

Trevlas, E., Matsouka, O., & Zachopoulou, E. (2003). Relationship between playfulness and motor creativity in preschool children. *Early Child Development and Care*, *173*(5), 535-543. doi:10.1080/0300443032000070482.

Visser, B. A., Ashton, M. C., & Vernon, P. A. (2006a). Beyond g: Putting multiple intelligences theory to the test. *Intelligence*, *34*, 487-502.

Visser, B. A., Ashton, M. C., & Vernon, P. A. (2006b). g and the measurement of Multiple Intelligences: A response to Gardner. *Intelligence*, *34*(5), 507-510. doi:10.1016/j.intell.2006.04.006

Zachopoulou, E., & Makri, A. (2005). A developmental perspective of divergent movement ability in early young children. *Early Child Development and Care*, *175*(1), 85-95. doi:10.1080/0300443042000230401

Appendix A

Chaminade University

Institutional Review Board.
Chair: Helen Turner, Ph.D.
Vice-Chair: Claire Wright, Ph.D.
Vice Chair: Darren Iwamoto, Ph.D.
irb@chaminade.edu

May 16, 2019

Ms. Xenia Ewing
PsyD Program
Chaminade University

Dear Ms. Ewing:

This letter is to confirm receipt of your Institutional Review Board (IRB) request for Determination for the study entitled " Developing a motor test of creativity". The CUH protocol number for your study is CUH 099-2019.

The Chair of the CUH IRB IRB00007927 reviewed the above request for Determination.

Since this study involves no data collection or human subjects, and is a literature and research review, it does not constitute human subjects research and is not regulated by the CUH IRB.

Should this status change you will be required to submit an application for approval of human subjects research to the CUH IRB.

Please feel free to contact the IRB above with any questions or concerns.

Kind Regards,

Helen Turner, PhD
Chair, Chaminade IRB Committee

Appendix B

Sample Instructions for Administration

Today I'm going to be asking you to do some silly things that involve moving your body around in creative ways.

Free Condition:

The first thing I'm going to ask you to do is to stand in the middle of this space and strike a pose. I'd like for you to hold it for three seconds and then make a new pose. You will have three minutes to make as many different imaginative poses as you can. Ready? Go.

Four Poses:

Now I am going to ask you to pick four of the most creative poses you can think of. You are going to use them to make imaginative sequences. I'm going to give you some time to think about which poses you would like to use and try them out. When you know which poses you are going to use, let me know so that you can show them to me and I'll take a picture of each one. Alright, now I am going to give you ten minutes to come up with as many imaginative sequences you can think of with your poses. Ready? Go.

Silly Walks:

The last thing I'm going to ask you to do is to walk across the space here. But I want you to do it in as silly a way as you can. You can start at any point on this side [point to stage left] and end at any point on this side [point to stage right]. The path you can take can be as long or short as you like. Let me know when you're ready and I'll record your walk. Ready? Go.

Good job! We're going to do this again two more times. You can start your walk on that side from any point and walk to any point on the other side. Ready? Go. [Repeat for final walk.]

Appendix C

Scoring Instructions

For each subtest, score each of the participant's poses, sequences, and walks using a 5-point scale to rate each item. Please try to use the full scale. Rate each item for creativity, aesthetic appeal, and technical difficulty. Use your own, subjective definitions for each scale.

Sample Scoring Sheet:

Creativity:	1	2	3	4	5
	Low		Medium		High
Aesthetic Appeal:	1	2	3	4	5
	Low		Medium		High
Technical Difficulty:	1	2	3	4	5
	Low		Medium		High