2022

Put on Your Dancing Shoes: Boosting Divergent Thinking in Older Adults

Megan Itagaki

PUT ON YOUR DANCING SHOES: BOOSTING DIVERGENT THINKING IN OLDER ADULTS

by

MEGAN C. ITAGAKI

SUBMITTED TO SCRIPPS COLLEGE IN PARTIAL FULFILLMENT OF THE DEGREE OF BACHELOR OF ARTS

PROFESSOR MA

PROFESSOR MESINAS

DECEMBER 10, 2021

Abstract

This thesis will explore the influence of two dance modalities (dance improvisation and Zumba dance) on divergent thinking (i.e., an aspect of creativity) in older adults using a quasi-experimental design. Given the existing research on dance as a creativity intervention in the younger half of the population, this study may address a gap in the literature by extending these findings to older adults. Once prescreened to ensure cognitive competence and adequate physical mobility, participants will complete a divergent thinking task before their designated 20-minute dance intervention. After the intervention, participants will complete a divergent thinking task. It is hypothesized that engagement in either dance intervention will increase divergent thinking abilities, although participants in the improvisation dance condition will exhibit significantly higher post-test divergent thinking scores than those in the Zumba dance condition. The personality trait, openness to new experiences, is expected to moderate the relationship between dance modality and divergent thinking post-scores; there will not be a significant difference in divergent thinking scores between the two dance conditions among those high in openness to new experiences, whereas there will be a significant difference in scores among those low in openness. Since dance is an inexpensive, easily accessible intervention with multiple benefits, it is useful to establish which dance modality may be the most effective in boosting creativity, as this information can inform the development of future interventions aimed at promoting healthy aging.

Key words: divergent thinking, creativity, aging, older adults, dance, improvisation

Put on your dancing shoes: Boosting divergent thinking in older adults

The concept of creativity is often a trending topic of discussion, from popular media to academic conferences, and from elementary schools to corporate workplaces. The internet is full of webpages boasting the benefits of creativity, such as stress relief, improved problem-solving skills, feelings of accomplishment, and increased confidence and self-expression (Be Kind Magazine, 2019; TeachThought Staff, 2019). Past research highlights multiple interventions aimed at boosting creativity, including walking (Oppezzo & Schwartz, 2014), mindfulness programs (Bellosta-Batalla et al., 2021), writing (Sierpina & Cole, 2004), and dance (Gondola, 1987; Lewis, 2012; Richard et al., 2021; Sowden et al., 2015; Steinberg et al., 1997). However, older adults are often left out of these conversations. Given the lack of research on creativity interventions for older adults, this thesis will examine the influence of dance improvisation and Zumba dance on divergent thinking abilities in this previously neglected population, addressing a current gap in the literature.

Defining Creativity

Despite the ubiquity of discussions on creativity, there is still no single, unanimous definition (Baer & Kaufman, 2005; Flood & Phillips, 2007; Lewis, 2012; Runco, 2011; Sierpina & Cole, 2004; Sternberg & Lubart, 1999), which leads to difficulties when studying this construct. Conceptual theories can inform our understanding of creativity, which can be broken down into multiple abilities or components (Guilford, 1956; 1967a & b; Sternberg & Lubart, 1999). Sternberg & Lubart's (1999) investment theory of creativity posits that creativity consists of six interconnected components, which are intellectual abilities, knowledge, styles of thinking, personality, intrinsic motivation, and a supportive environment. Of these six components, some are domain-general, meaning they are important for creativity across all domains, while others

are domain-specific, signifying their value in specific tasks (Baer & Kaufman, 2005). For example, self-efficacy and risk-taking may be domain-general attributes of creativity, while knowledge in a specific domain may only apply to creativity in that one area (Sternberg & Lubart, 1999). Thus, these researchers (Baer & Kaufman, 2005; Sternberg & Lubart, 1999) argue that both domain-general and domain-specific abilities are necessary for creativity to occur.

Definitions of creativity can vary from study to study, as they may differ based on whether the researchers are more focused on the creative *process* or *product*, thus shifting their interpretation of creativity to fit their specific research interest (Lewis, 2012). Nevertheless, there seems to be some consensus surrounding certain critical components of creativity, such as novelty, originality, appropriateness, and relevance (Baer & Kaufman, 2005; Karakelle, 2009; Lewis, 2012; Richard et al., 2021; Sierpina & Cole, 2004; Sowden et al., 2015; Sternberg & Lubart, 1999). Problem-solving is also described as integral to creative processes (Flood & Phillips, 2007), although this alone is not sufficient to produce creativity (Runco, 2011). Given these criteria (Baer & Kaufman, 2005; Flood & Phillips, 2007; Guilford, 1967a; Karakelle, 2009; Lewis, 2012; Richard et al., 2021; Sowden et al., 2015; Sternberg & Lubart, 1999), while it is hard to construct a single, all-encompassing definition of creativity, for the purpose of this thesis, creativity will be defined as a multidimensional trait that involves the production of novel and relevant ideas, solutions, or products, oftentimes generated through open-minded and flexible thinking.

Creativity and Divergent Thinking

Guilford's structure of intellect model (1956; 1967a & b) describes creativity as a facet of intelligence. Like intelligence, creativity significantly varies between individuals, as some may be more creatively inclined than others (Baer & Kaufman, 2005; Guilford, 1967a & b; Runco,

2011). Guilford (1956) suggests multiple components of creative thinking processes, which are categorized into three distinct groups: discovery/cognition, production, and evaluation factors. These factors encapsulate an individual's thought process, since initial discovery (discovery/cognition) leads to the generation of a product (production), which is often followed by evaluation of said product (evaluation).

Production factors are split into two opposing categories: divergent and convergent thinking (Guilford, 1956). Convergent thinking processes are typically employed when there is a single solution, as cognitive resources are directed toward obtaining a specific answer (Guilford, 1956; Lewis, 2012). For example, convergent thinking is typically employed while taking a standardized intelligence test (Razumnikova, 2013). This process may lack or inhibit creative thought processes, as one ceases their cognitive search upon arriving at a particular answer (Razumnikova, 2013). On the other hand, divergent thinking involves various mental search processes and is associated with open-ended tasks in which there are multiple, alternative solutions (Guilford, 1956; Lewis, 2012; Lewis & Lovatt, 2013; Razumnikova, 2013; Richard et al., 2021). During this process, the individual generates a multitude of ideas, often by relying on associations between various concepts in one's memory (Acar & Runco, 2019; Lewis & Lovatt, 2013; Razumnikova, 2013). Given the unrestricted, flexible nature of this process, divergent thinking is considered central to creative thinking, highlighting the cognitive aspects of creativity (Karakelle, 2009; Razumnikova, 2013; Sowden et al., 2015).

While researching all aspects of creativity would be ideal, this thesis will focus on divergent thinking because of its importance in facilitating creativity (Razumnikova, 2013; Sowden et al., 2015), the ease with which it can be operationalized (Acar & Runco, 2019; Guilford, 1967b; Torrance, 1966), and its prevalence in past research exploring dance as an

intervention for creativity (Gondola, 1987; Lewis, 2012; Richard et al., 2021; Sowden et al., 2015; Steinberg et al., 1997). Divergent thinking consists of various components, which are fluency, flexibility, and originality (Alpaugh & Birren, 1977; Guilford, 1956; 1967a & b; Karakelle, 2009; Lewis & Lovatt, 2013; Razumnikova, 2013; Richard et al., 2021; Runco, 2011). Fluency represents the quantity of ideas generated, flexibility refers to the number of unique themes or categories that classifies one's ideas, and originality indicates the rarity or novelty of an idea (Alpaugh & Birren, 1977; Karakelle, 2009; Lewis & Lovatt, 2013; Razumnikova, 2013). While there are other proposed components of divergent thinking, like redefinition (Alpaugh & Birren, 1997) and elaboration (Guilford, 1956; 1967a & b), fluency, flexibility and originality are the most frequently discussed both theoretically (Guilford, 1956; 1967b) and when scoring divergent thinking tasks (Runco, 2011). Thus, for the purposes of this thesis, discussion will focus primarily on these three main components.

The Benefits of Creativity

Creativity is not only relevant today, but also dates back to prehistoric times when these skills held evolutionary and adaptive value (Bonetto et al., 2021; Puccio, 2017). Although we no longer encounter the survival problems of our ancestors, the evolutionary benefits of creativity are still valued today, although they take on different, more nuanced forms. As demonstrated in the media (Be Kind Magazine, 2019; TeachThought Staff, 2019), creativity boasts a wide range of benefits such as greater confidence, reduced stress, increased feelings of accomplishment, and enhanced problem-solving abilities. These benefits are also cited in the empirical psychological literature, which demonstrates the psychological and emotional benefits of creativity across the lifespan (Buskirk-Cohen, 2015; Fisher & Specht, 1999; Flood & Phillips, 2007; Sierpina & Cole,

2004). For instance, Buskirk-Cohen (2015) found that creative summer arts programs increased social wellness and behavior in children with social, emotional, or learning differences.

At the other end of the lifespan, creativity has been shown to lead to increased self-esteem, better coping strategies, decreased anxiety and depression, improved health outcomes, and greater life satisfaction (Flood & Phillips, 2007; Sierpina & Cole, 2004). Interventions for creativity can also increase one's sense of control (Flood & Phillips, 2007), which may be important for older adults given the lack of control they experience in multiple aspects of their lives. In addition, boosting creativity in late adulthood increases feelings of competency, a sense of purpose, personal growth, and motivation (Fisher & Specht, 1999). These positive aspects of creativity may be particularly vital for older adults coping with a variety of changes associated with aging, which may include interpersonal loss, declines in physical mobility, and modified living arrangements. Thus, while boosting creativity is beneficial throughout the lifespan, it may be especially advantageous in late adulthood, mitigating the negative impact of certain events specific to this stage of life.

Individual Differences in Creativity

Creativity significantly varies between individuals, as some may be more creatively inclined than others (Baer & Kaufman, 2005; Guilford, 1967; Runco, 2011). This may partially be attributed to an individual's personality and other unique characteristics since certain traits are associated with higher levels of creativity. For example, one's work style, which is a creativity-relevant skill, can be influenced by one's specific personality traits, including self-discipline and perseverance (Amabile, 1983). These personality traits indirectly affect one's ability to be creative. Other personality traits, like confidence, self-acceptance, impulsivity, and hostility can

also influence the extent of one's creativity (Feist, 1998). Artists, who are perceived as more creative, score higher on all of these characteristics compared to non-artists (Feist, 1998).

Openness to New Experiences

Perhaps the most widely studied trait in relation to creativity is openness to new experiences, which is part of the five-factor model of personality (Digman, 1990), more commonly referred to as the Big Five. This personality characteristic refers to one's willingness to try and experience new things (Digman, 1990; McCrae, 1987) and can be categorized into six dimensions: openness to fantasy, aesthetics, feelings, actions, ideas, and values (McCrae et al., 2005; Hogrefe Ltd, 2016). Those who score high on openness to new experiences tend to exhibit high levels of general creativity (Feist, 1998) and more specifically, divergent thinking (McCrae, 1987). This relationship may be due to one's increased willingness to explore unconventional concepts and situations, which may encourage one to think "outside the box," increasing creativity and divergent thinking abilities.

Influence of Age on Creativity and Divergent Thinking

While creativity boasts a wide range of psychological and physiological benefits for older adults, it has been shown to decline with age, as exhibited in the decreasing number of creative outputs produced in late adulthood (Alpaugh & Birren, 1977; Palmiero, 2015). More specifically, psychological literature supports the idea that divergent thinking decreases with age (Alpaugh & Birren, 1977; McCrae et al., 1987), although the literature is mixed (Palmiero et al., 2014; Palmiero, 2015). Alpaugh and Birren (1977) observed that younger adult participants scored better on divergent thinking tasks than older adults, particularly in originality, adaptive flexibility, and fluency. Moreover, McCrae and others (1987) observed that divergent thinking begins to significantly decrease after age 40 and continues to decrease from middle to late

adulthood, although the latter finding may be modest at best. Conversely, Palmiero and others (2014) suggest no age-related differences in divergent thinking abilities. In this study, older and younger adult participants performed similarly on both verbal and visual divergent thinking tasks. The only significant difference they observed was in visual fluency, as older adults generated fewer visual ideas than younger adults.

However, Palmiero (2015) conducted a later study sampling from the same populations and observed that divergent thinking abilities decrease with age, although this decline is not linear and eventually plateaus before reaching zero. Palmiero attempted to reconcile these contradictory results, claiming that these new findings were consistent with those in his prior study, as he argued that the plateau in divergent thinking abilities demonstrates older adults' potential to think divergently. However, his argument was unsatisfactory and unconvincing given the conflicting data. Nevertheless, even though the literature presents inconsistent results, the consensus seems to suggest that divergent thinking abilities decrease with age.

Boosting Creativity and Divergent Thinking Abilities

Given these findings (Fisher & Specht, 1999; Flood & Phillips, 2007), interventions must be developed to boost creative processes in late adulthood, especially when considering the extent to which creativity and divergent thinking benefit older adults (Fisher & Specht, 1999; Flood & Phillips, 2007). These interventions may be particularly important given the pervasiveness of stereotypes regarding a perceived lack of creativity in older adulthood (Galenson, 2017). Recent research demonstrates that walking (Oppezzo & Schwartz, 2014), participating in mindfulness interventions (Bellosta-Batalla et al., 2021), and writing about one's life story (Sierpina & Cole, 2004) can lead to increases in creativity as assessed via one's divergent thinking abilities. Moreover, sports and creativity research suggest aerobic exercise

programs as promising interventions for fostering such creative skills (Blanchette et al., 2005; Curnow & Turner, 1992; Steinberg et al., 1997). For example, when younger adults participate in aerobic exercise (e.g., swimming, jogging, stair climbing, biking), they exhibit higher levels of creativity relative to when they do not exercise (Blanchette et al., 2005). Furthermore, creativity scores taken immediately after exercise were not significantly different from scores taken after a delay, indicating both immediate and residual benefits of exercise on creativity.

Curnow and Turner (1992) observed changes in fluency on divergent thinking tasks, as students who cycled on a stationary bike (exercise condition) yielded higher fluency scores than those who did not (control condition). On the other hand, Steinberg and others (1997) observed higher flexibility scores on divergent thinking tasks in those who participated in an aerobic workout compared to those who did not exercise. Although there are differing results regarding the specific divergent thinking component influenced by exercise, it is clear that exercise boosts creativity and divergent thinking abilities. However, these creative benefits are not solely confined to more traditional forms of aerobic exercise, but also extend to dance (Campion & Levita, 2014; Goff, 1992; Gondola, 1987; Lewis, 2012; Richard et al., 2021; Sowden et al., 2015; Steinberg et al., 1997).

Dance as a Potential Intervention for Creativity

Dance can be categorized as both exercise and performance art, since many associate dance with both physical fitness and artistry. Given this unique combination, dance seems to be a natural fit for a creativity intervention. Past research has described dance as a universal form of communication (Kattenstroth et al., 2013; Teixeira-Machado et al., 2019; Thomson, 2017), “a fundamental human behavior” (Lovatt, 2018, p. vii), or simply the freedom of movement (Campion & Levita, 2014; Lovatt, 2018). How one defines dance may depend on what the

activity represents for the individual, as some people dance recreationally or socially while others dance professionally. These multiple, sometimes unrelated, definitions may also stem from the variety of dance styles and modalities. Dance styles such as ballet, ballroom, hip-hop, and musical theater all involve vastly dissimilar ways of moving one's body, although they are all grouped under the broad category of "dance." Moreover, within any dance style, multiple dance modalities, or ways of generating movement, may be involved, thus leading to even greater variation in definitions of dance.

When studying different dance modalities, dance improvisation is often compared to emulated dance formats because of the differential emphasis on creating one's own movement. Given that the freedom to dictate one's movement may be associated with creativity, some dance modalities may be inherently more likely to encourage divergent thinking than others. Broadly, improvisation is "the process of creating ideas spontaneously—on the spot—without the allowance of planning or refinement of the creative idea" (Sowden et al., 2015, p. 129). In dance, improvisation involves the unrehearsed production of movement, as opposed to learning a set combination of moves. For example, dancing to your favorite song in the comfort of your bedroom would be considered improvisation. While dancing, you are not anticipating what movement will come next, but simply enjoying the moment. This process allows for no preemptive planning, which is why improvisation has been proposed as both the "process and product of creativity" (Lewis, 2012, p. 1), providing insight into one's creative thought processes (Sowden et al. 2015). Dance improvisation focuses on free, spontaneous movement that is unique, since it cannot be exactly replicated upon request thereafter (Coubard et al., 2011; Lewis, 2012; Lewis & Lovatt, 2013; Lovatt, 2018; Richard et al., 2021). This dance modality

emphasizes freedom of expression, grounding oneself in the present moment (Richard et al., 2021).

On the other hand, emulated dance occurs when participants do not create their own movement, but rather, copy the codified motions demonstrated by the instructor (Lovatt, 2018; Richard et al., 2021). Emulated dance can occur in a variety of settings, including a fitness-oriented Zumba class or traditional dance class focused on learning set choreography. Zumba classes typically involve replicating the instructor's movements in real time, allowing participants to engage in the instantaneous mimicry of motions to the rhythm of the music. Participants are not taught the choreography beforehand but are instead expected to follow along by copying the instructor. Conversely, when learning set choreography, participants are taught the movements step-by-step, practicing one section before gradually learning more choreography in small increments. Although the way in which one learns the set choreography differs, participants in both types of emulated dance formats act as passive recipients of movement, unable to create their own motions like those in improvisational dance sessions. Thus, both formats may be considered emulated dance.

Nevertheless, while variation in both style and modality exists, dance is fundamentally about movement (Lovatt, 2018). It combines sensorimotor skills, physical mobility, memory, emotions, balance, motor coordination, musicality and rhythm, spatial awareness, and more, drawing on several cognitive and physical skills (Kattenstroth et al., 2013; Müller et al., 2017; Predovan et al., 2019; Quiroga Murcia et al., 2010; Rehfeld et al., 2018; Teixeira-Machado et al., 2019; Thomson, 2017), which add richness and complexity to the craft. Dance enhances physical, psychological, and cognitive skills across all ages (Lindberg, 2019; Predovan et al., 2019; Quiroga Murcia et al., 2010; Ward, 2008). Some physical benefits of dance include

improved cardiovascular health, balance, flexibility, muscular strength, and endurance (Lindberg, 2019; Predovan et al., 2019; Ward, 2008). Psychological benefits include improved mood, increased well-being, greater self-esteem, and enhanced feelings of independence (Houston, 2005; Kattenstroth et al., 2013; Lindberg, 2019; Quiroga Murcia et al., 2010).

Many of the cognitive benefits of dance, including improved memory (Rehfeld et al., 2018; Teixeira-Machado et al., 2019), attentional control (Coubard et al., 2011), and executive function (Kimura & Hozumi, 2012), may be attributed to increased levels of brain-derived neurotrophic factor (BDNF) in the brain (Kattenstroth et al., 2013; Müller et al., 2017; Rehfeld et al., 2018; Teixeira-Machado et al., 2019). BDNF is a type of neurotrophin, which is a protein that aids in the development and maintenance of neurons (Miranda et al., 2019). It plays a crucial role in synaptic plasticity, consequently enhancing a variety of cognitive functions (Miranda et al., 2019). Given that BDNF naturally decreases with age (Miranda et al., 2019), these benefits of "dance-induced neuroplasticity" (Müller et al., 2017, p. 6) are particularly important for older adults.

Furthermore, dance can promote structural changes in the brain, leading to greater volume in the left precentral gyrus (Müller et al., 2017), cingulate cortex, insula, corpus callosum and sensorimotor cortex (Rehfeld et al., 2018), which are responsible for voluntary movement (Müller et al., 2017), working memory, executive function, attention, and communication between brain hemispheres (Rehfeld et al., 2018). These structural changes should theoretically precede related functional changes, thus boosting certain cognitive functions.

Dance can also be perceived as a form of embodied cognition, which emphasizes the bidirectional interaction between one's body and mind (Foglia & Wilson, 2013). Embodied cognition theory highlights the importance of sensory and motor functions to cognition (Foglia &

Wilson, 2013), all of which are involved in dance. Creativity is also considered a form of embodied cognition during which internal psychological processes interact with external behavioral outputs (Richard et al., 2021). The relationship between the mind and body may be similar when dancing and thinking creatively. Given this similarity, dance may lead to greater changes in divergent thinking abilities compared to a typical exercise regimen, since the latter does not involve embodied cognition. Thus, dance may be a better intervention for creative cognition than traditional aerobic exercise programs.

Moreover, dance may be perceived as more enjoyable and motivational than conventional forms of exercise (Alpert et al., 2009; Goff, 1992; Kattenstroth et al., 2013; Teixeira-Machado et al., 2019), leading to increased compliance and continuation of these programs. Dance may be motivational for many reasons, which likely vary between individuals. For some, they may dance to relieve stress and be in the present moment. For others, they may enjoy the social aspect (Maraz et al., 2015) of attending dance classes. Still, others may dance to boost their mood (Maraz et al., 2015), attempting to hold onto the positive feelings gained from this activity. Regardless of their specific reason, motivation is crucial to the creative process, as it is one of the "initial requirements" (Baer & Kaufman, 2005, p. 159) of creativity. In other words, creativity cannot occur without sufficient motivation (Baer & Kaufman, 2005; Sternberg & Lubart, 1999). Thus, a more motivational intervention, like dance, may consequently produce greater creative benefits than less motivational programs.

Dance may also be more beneficial than traditional aerobic exercise programs because of the variety of elements and skills involved in this activity. In addition to typical elements of physical activity (e.g., balance, motor coordination, flexibility, muscle strength), dance combines rhythm, musicality, kinesthesia, and multisensory enrichment (Kattenstroth et al., 2013; Müller

et al., 2017; Quiroga Murcia et al., 2010; Rehfeld et al., 2018; Teixeira-Machado et al., 2019; Thomson, 2017). The inclusion of these diverse components may promote divergent thinking, activating additional neural pathways and brain regions. Dance may be a particularly beneficial intervention for older adults, leading to improvements in abilities that typically decline with age. Nevertheless, given the diversity of dance styles and modalities (Lovatt, 2018; Thomson, 2017), some may produce greater creative benefits than others.

The Impact of Different Dance Modalities

Emulated Dance Formats

While emulated dance and dance improvisation represent distinct dance modalities, both have been shown to increase divergent thinking abilities. For example, female college students who participated in an aerobic dance class that lacked the opportunity for creative expression displayed higher scores on all divergent thinking tasks compared to those who did not dance (Gondola, 1987). Similarly, adults who engaged in aerobic dance exercise exhibited higher levels of creative thinking relative to those who simply watched a documentary (i.e., control condition; Steinberg et al., 1997). Although there is not much literature on the effect of emulated dance formats on divergent thinking, this limited research suggests that participation in this dance modality can improve divergent thinking abilities.

Dance Improvisation

Dance improvisation can also boost divergent thinking abilities. For example, undergraduates who improvised exhibited increases in scores on two out of the three divergent thinking tasks (Lewis, 2012). Moreover, when comparing dance improvisation and emulated dance activities, children in the improvisation group scored higher on the originality component of divergent thinking relative to those in the emulated dance group (Sowden et al., 2015). In

another study comparing these dance modalities, college students in an improvisation condition exhibited increased motor creativity in relation to those in the aerobic dance condition (Richard et al., 2021). However, these researchers did not find significant differences in divergent thinking abilities between the dance conditions, contradicting previous findings (Lewis, 2012; Sowden et al., 2015).

Thus, the literature seems to be inconsistent, as dance improvisation leads to improvements in divergent thinking in some cases (Lewis, 2012; Sowden et al., 2015) while there are no significant differences between improvisation and control conditions in others (Campion & Levita, 2014; Lewis, 2012). This may in part be attributed to the type of divergent thinking measures being implemented, given that Lewis (2012) found significant differences between the dance improvisation and emulated dance condition on the Divergent Maths task (Guilford, 1957) and Matchsticks task (Guilford, 1957), but not on the Alternative Uses Task (Guilford, 1967b). In the Divergent Maths task, also known as the Alternative Additions Task, participants are given one relatively large number and five smaller numbers (Lewis, 2012). Using the five smaller numbers, participants must produce a variety of combinations that equal the larger number by employing addition, subtraction, multiplication, and division (Lewis, 2012). In the Matchsticks task, participants are presented with a grid of matchsticks which form an array of squares (Lewis, 2012). Participants must create a certain number of squares in the grid by removing as many matchsticks as they would like (Lewis, 2012). Lastly, in the Alternative Uses Task, participants are given an everyday object and instructed to come up with different uses for the object (Karakelle, 2009; Lewis, 2012; Lewis & Lovatt, 2013; Palmiero, 2015).

The goal of these three tasks is to think of as many solutions as possible, which suggests that these tasks may share some similarities. However, the Divergent Maths task is mathematical,

the Matchsticks task is figural, and the Alternative Uses Task is verbal, emphasizing different domains in which divergent thinking can occur. These domains must be taken into consideration when selecting a divergent thinking task, as this may influence whether one's results are significant or not.

Previous inconsistent results may also be related to the duration of the dance intervention. For example, Campion and Levita's (2014) intervention only lasted five minutes, which may not have been enough time for the given manipulation to influence creativity. These findings may reflect methodological issues rather than the absence of a true effect. Given these contradictory findings and the scarcity of literature on the effects of dance improvisation on divergent thinking, one must turn to the literature on other forms of improvisation to inform our understanding of the influence of dance improvisation.

Past research demonstrates that verbal (Lewis, 2012; Lewis & Lovatt, 2013; Sowden et al., 2015), drama (Karakelle, 2009; Sowden et al., 2015), and music (Lewis & Lovatt, 2013) improvisation can lead to improved divergent thinking abilities. While there are differences between dance improvisation and other types of improvisation, research on these other forms may nevertheless aid our understanding of how dance improvisation may influence divergent thinking abilities. At the core, improvisation in any domain involves spontaneous production (Lewis, 2012; Lewis & Lovatt, 2013; Lovatt, 2018; Sowden et al., 2015), whether that is based in movement, music, or words. The freedom to explore and create opens the door to a multitude of possibilities, which in turn may foster creativity (Karakelle, 2009).

The influence of improvisation on creativity and divergent thinking abilities may be attributed to a differential activation of schemas, or general knowledge structures, that help us understand the world and the various situations we encounter (Lewis, 2012; Lewis & Lovatt,

2013). An overreliance on particular schemas leads to set, automatic patterns of thinking (Lewis, 2012; Lewis & Lovatt, 2013), which may prevent divergent thinking processes. However, participating in improvisation may encourage individuals to deviate from habitual thought patterns through the activation of under-used cognitive pathways (Lewis & Lovatt, 2013). The freedom and spontaneity of improvisation may inspire the exploration of novel movement phrases, encouraging individuals to simultaneously break routine thought and movement patterns. Implementing a domain-general approach like Sowden and others (2015), the benefits of dance improvisation may extend not only to motor creativity in the domain of dance, but also to general divergent thinking abilities. The act of improvising may stimulate infrequently activated pathways and promote more flexible thinking, either by activating unique schemas or using typical schemas in an original way (Sowden et al., 2015). Therefore, although the empirical literature yields mixed results regarding the influence of dance improvisation on divergent thinking abilities, the theoretical literature supports the creative benefits of dance improvisation.

While past research examined how dance improvisation influences divergent thinking abilities in younger and middle-aged adults (Campion & Levita, 2014; Gondola, 1987; Richard et al., 2021; Steinberg et al., 1997), there has only been one known study (Goff, 1992) that extends this research to older adults. However, Goff (1992) did not exclusively focus on dance, as she studied the effects of a Quality of Life Program on creativity, which combined multiple activities including dance, drama, fitness, and art. Although Goff provides evidence that dance may indeed increase divergent thinking abilities in older adults, we cannot solely attribute these observed changes to dance, since these changes may have been attributed to the other activities in the program. Thus, to date, there has not been a comprehensive study exploring the impact of

dance on divergent thinking skills in older adults. This may be due to the prevalence of ageism in the dance community (Seshadri, 2017), which likely creates barriers to accessing these interventions. Given this exclusivity, it is imperative to conduct this type of research, as the knowledge gained from this thesis will hopefully promote the inclusion of older adults in the dance community.

Based on the evidence (Alpaugh & Birren, 1977; Flood & Phillips, 2007; McCrae et al., 1987) that divergent thinking decreases with age, it is important to explore whether these positive effects of dance on divergent thinking abilities can be extended to older adults. By addressing this gap in the literature, this thesis aims to provide insight into possible dance interventions aimed at combatting normative age-related declines in divergent thinking. However, the extent to which different dance modalities influence divergent thinking abilities remains unclear. Nevertheless, given that improvisation may encourage individuals to break schema-related thought patterns (Lewis, 2012; Lewis & Lovatt, 2013; Sowden et al., 2015), dance improvisation may produce greater changes in divergent thinking relative to emulated dance formats.

Moreover, given the possible physical limitations of older adults, dance improvisation may be a safer movement alternative, since older adults can create movement within their range of mobility. This freedom is lost in emulated dance formats, as one's movement is dictated by the instructor. Furthermore, one's physical mobility may limit their ability to perform these designated movement patterns. This may result in frustration when they are unable to fully replicate the movements, which could impede potential cognitive benefits. Therefore, dance improvisation may be superior to emulated dance in boosting divergent thinking abilities in older adults.

Current Study

Using a quasi-experimental design, the current thesis will explore the effects of a short dance improvisation session and Zumba-style dance session (i.e., emulated dance format) on divergent thinking abilities in older adults. Divergent thinking will be measured both before and after participation in a dance intervention. This thesis aims to 1) clarify the effects of dance improvisation and emulated Zumba dance on divergent thinking abilities, 2) extend this work to older adults, 3) determine whether openness to new experiences may moderate the relationship between dance modality and divergent thinking abilities, 4) inform the development of possible creativity interventions for older adults, and 5) combat ageist stereotypes regarding creativity (Galenson, 2017) and dance (Seshadri, 2017).

While both dance modalities should increase divergent thinking based on past findings (Goff, 1992; Gondola, 1987; Lewis, 2012; Richard et al., 2021; Sowden et al., 2015; Steinberg et al., 1997), it is hypothesized that dance improvisation will lead to greater changes in divergent thinking abilities than Zumba, as improvisation may encourage individuals to think more freely and deviate from set patterns of thinking (Lewis, 2012; Lewis & Lovatt, 2013; Sowden et al., 2015). Nevertheless, past literature reports both significant (Lewis, 2012; Sowden et al., 2015) and nonsignificant (Lewis, 2012; Richard et al., 2021) differences in divergent thinking abilities between emulated and improvisational dance conditions, providing equivocal results. Thus, this thesis intends to reconcile this inconsistency and gain a better understanding of the effects of different dance modalities on divergent thinking abilities.

This study will also address a current gap in the literature by studying a previously neglected population, extending the benefits of dance in boosting creativity to older adults. In addition, this study aims to examine the effect of openness to new experiences on the

relationship between dance modality and divergent thinking, which will inform the extent to which dance interventions may be beneficial for certain individuals. These findings may inspire the development of future interventions aimed at boosting creativity in late adulthood. Overall, the research question this thesis aims to answer is, how do different dance modalities, specifically improvisation and emulated dance formats, influence divergent thinking abilities in older adults?

Proposed Method

Participants

A moderate effect size was estimated based on previous literature (Goff, 1992; Lewis, 2012; Sowden et al., 2015) on this topic with similar quasi-experimental designs. According to G*Power (Faul et al., 2007), 100 participants will be needed for this study assuming a medium effect size, desired power = 0.8, $\alpha = 0.05$, and a repeated measures multivariate analysis of covariance design with six predictors.

Individuals 60 years of age or older will be initially eligible to participate and there will be no exclusions based on gender or race. However, not all individuals who meet the age requirement will be able to participate, since they must pass a prescreening to ensure cognitive competence and good physical health. Anyone who has had a significant surgery or injury within the previous three months will not be able to participate.

Participants will be older adults living in the local and the surrounding areas. Some will be recruited through various older adult communities (e.g., age-restricted, independent living, and retirement communities) via flyers. Others will be recruited from a local professor's older adult participant database. Participants will be compensated with an exercise and dance resource guide. This guide will include free online exercise and dance videos, tips for exercising safely,

and information about local dance programs for older adults. Those who prefer a monetary form of compensation will receive $25.

Based on past research (Coubard et al., 2011; Kattenstroth et al., 2013; Kimura & Hozumi, 2012; Müller et al., 2017), the mean age of participants will likely be around 70 years of age. Past research (Campion & Levita, 2014; Coubard et al., 2011; Kattenstroth et al., 2013; Kimura & Hozumi, 2012; Lewis, 2012; Müller et al., 2017) indicated an unequal proportion of female and male participants, with the mean percentage of females around 72.8%. Therefore, the sample will likely include a greater percentage of females compared to males. Based on census data (United States Census Bureau, 2019), 63.9% of participants will be White, 5.3% will be Black, 1.0% will be American Indian/Alaska Native, 14.3% will be Asian, 0% will be Native Hawaiian/other Pacific Islander, 25.4% will be Hispanic/Latinx and 7.1% will be two or more races.[1]

Materials

Due to the COVID-19 pandemic, this study will be conducted solely online. While this may unintentionally exclude potential participants, it is important to prioritize older adults' health. Thus, an online Qualtrics survey will be used for the majority of this study. All materials other than the cognitive competence and physical mobility prescreening questions will be included in this survey.

Cognitive Competence

The Mini-Mental State Exam (MMSE, Folstein et al., 1975), which is a basic measure of cognitive functioning, will be included to ensure older adult participants are cognitively sound and have the legal ability to consent. This scale consists of 11 main questions, some of which

[1] While these percentages do not add up to 100%, this was the only up-to-date data available. The City of Claremont did not have their own demographic data, which is why the Census data is reported here.

include sub-questions, for a total of 19 open-ended items. It will be administered by the principal investigator in an informal interview in which participants will verbally or behaviorally answer questions about orientation, word registration, attention and calculation, recall, and language.

Orientation refers to one's understanding of time (e.g., temporal orientation) and place (e.g., place/spatial orientation; Huisingh et al., 2018). For example, Folstein and others (1975) suggest that to gauge one's temporal orientation, one should answer questions regarding the year, month, date, day, and season. For orientation to place, the participant will be asked to report the state, country, city, building, and floor they are on. To assess word registration, or the ability to process and verbalize presented words, the principal investigator will say three objects aloud then ask participants to repeat them. Attention and calculation are measured by asking participants to count backward by 7s from 100. For recall, participants are asked to name the three objects that were previously learned. Lastly, to assess language abilities, the principal investigator will ask participants questions which require both verbal and behavioral responses. Some behavioral responses include writing a sentence or copying a design on a piece of paper. For these questions, participants will be asked ahead of time to have a pen and a blank piece of paper available.

The MMSE has sufficient reliability, with a reported internal consistency ranging from 0.62-0.81 (Lopez et al., 2005; Tombaugh et al., 1996). This scale also has good convergent validity, as it is highly correlated with other neuropsychological measures, specifically those that measure verbal abilities (Mitrushina & Satz, 1991).

Divergent Thinking

Divergent thinking abilities will be measured using Guilford's Alternative Uses Task (AUT; Guilford, 1967b). This measure was selected based on its extensive use in previous

research (Gondola, 1987; Karakelle, 2009; Lewis, 2012; Lewis & Lovatt, 2013) on the influence of dance or improvisation on divergent thinking. In this task, participants will be asked to think of as many alternative uses for a common object as possible. The objects used will be a brick and a newspaper, both of which were included in the Palmiero (2015) study. Furthermore, the instructions will be similar to those developed by Lewis and Lovatt (2013), although participants will be given as much time as they would like to complete the task. For full instructions, see Appendix A.

Responses will be scored on the main components of divergent thinking (i.e., fluency, flexibility, and originality) using a strategy derived from Lewis and Lovatt's (2013) methodology. While these researchers relied on the Torrance Tests of Creative Thinking scoring manual (Torrance, 1966), the current study refrains from solely following this manual due to slight variations in scoring. For example, the Torrance Tests of Creative Thinking scoring manual includes explicit categories for scoring flexibility for certain objects, such as a cardboard box. However, since this study uses common objects that are not included in this scoring manual, flexibility scores will not be based on specificities of this guide. Thus, while this study will employ Torrance's (1966) general approach, it will not use the specific object details in the manual.

Fluency will be scored as the number of responses given by a participant. Flexibility will be scored as the number of different themes or categories one's responses fall into. For example, imagine that a participant's responses include using a brick as a paperweight and an anchor to prevent a picnic blanket from flying away. While these are two separate responses (i.e., fluency = 2), both responses fall within the same category of using the brick as a weight to hold an item in place. Therefore, this participant would receive a flexibility score of 1. However, if the

participant included a third response, such as propping a brick under the broken leg of a table to prevent the table from wobbling, they would now receive a flexibility score of 2, since the new response introduces a novel theme. Lastly, originality will be scored on a binary scale. Individual responses will be scored such that responses that are mentioned less than 5% of the time (i.e., rare) are given a score of 1. Responses that do not meet this criterion will be given a score of 0. These numbers will be summed up to obtain the participant's overall originality score. Thus, once the data are scored, each participant will have a fluency, flexibility, and originality score for both the pre-test and post-test AUT.

The AUT has adequate reliability and validity (Benedek et al., 2013). While psychometric properties of the AUT are difficult to assess given the multitude of scoring methods, internal consistency is generally sufficient, given that it is typically above 0.85 for fluency and above 0.8 for originality (Benedek et al., 2013). Moreover, both fluency and originality have good convergent validity, as exhibited in correlations with similar measures (Benedek et al., 2013).

Dance Modality Intervention

Two pre-recorded dance videos will act as the dance intervention in which the dance modality will vary. Pre-recorded videos will be used to minimize possible confounding variables. Each video will last 20 minutes and include the same warm-up and music. The song, "A Sky Full of Stars - Instrumental" by Coldplay (Calvo, 2016), will be used for warm-up and a playlist, Lounge - Soft House (Spotify, n.d.), will be used for the main dance session in both conditions. This playlist was specifically chosen because of its versatility, as it can be used in both dance improvisation and Zumba dance. Combining elements of certain music styles typically

associated with each dance modality, this playlist should not contradict or distract from one's movement in either dance condition.

Although a longitudinal study would be ideal for determining whether different dance modalities lead to specific changes in divergent thinking abilities, previous research (Blanchette et al., 2005; Curnow & Turner, 1992; Gondola, 1987; Lewis, 2012; Sowden et al., 2015; Steinberg et al., 1997) has demonstrated that single, brief (i.e., 10-30 minutes) dance or exercise sessions can still produce significant changes in creativity. Therefore, a single, 20-minute dance session will likely be long enough to assess whether dance improvisation and Zumba have different influences on divergent thinking abilities.

Dance Improvisation. Warm-up will consist of shoulder rolls, arm raises, torso rotations, and hip circles (Senior Exercises Online, n.d.; Smith, 2019). All warm-up exercises will be timed to the beat of the music and participants will be asked to mirror the principal investigator's movements in the video. Each exercise will be 30 seconds, and the entire warm-up routine will be completed twice. Therefore, warm-up will last a total of four minutes.

For the remaining 16 minutes of the dance session, participants will partake in three guided improvisation exercises. Before these exercises, the principal investigator, as seen in the pre-recorded video, will verbally explain each exercise, briefly demonstrating how one may move in response to each prompt. After the instructions are given, the music will turn on and the pre-recorded video screen will go blank. When it is time to switch prompts, a pre-recorded voice audio will inform participants that they will be moving onto the next exercise, reminding them of the specific prompt. This process will repeat for each guided improvisation exercise.

For the first improvisation exercise, participants will be asked to imagine themselves carving the space around them, like they are scooping ice cream. They will be told to focus on

one part of their body at a time, attending to that specific limb's relationship to three-dimensional space. They will focus on a single body part for as long as they would like before turning their attention to a different body part.

Next, participants will be asked to move as though they are "leaves floating on the wind" (Lovatt, 2018, p. 49). This open-ended prompt will give participants the opportunity to move in ways that feel most comfortable or natural for them, allowing them the freedom to explore their own movement. For the last exercise, participants will be asked to create movement that is inspired by the emotion, happiness. This could be interpreted as producing movements that bring one joy or using one's movements to express what happiness looks like, thus embodying the emotion.

Throughout the session, participants will be reminded that there is no right or wrong way to move their body and that all forms of movement are encouraged and accepted. To decrease performance anxiety or the fear of evaluation, the principal investigator will turn their Zoom camera off for the entirety of the dance intervention, only turning their camera on to answer questions.

Zumba. This dance intervention will include the same warm-up and music as the dance improvisation session. It will include three Zumba "dances" to correspond to the three dance improvisation exercises. In this condition, participants will follow the principal investigator via the video for the entirety of the session. Similar to the dance intervention described by Lovatt (2018), the principal investigator will move their entire body, using a range of motions that will be coordinated to the beat of the music. All choreography will be modified to accommodate older adults, excluding potentially risky movements like jumps, fast spins, and high kicks.

A manipulation check will be included to ensure that the intervention worked as intended.

It is important that those in the improvisation condition create their own movement rather than merely replicating previously learned choreography. In the Zumba condition, participants should follow the instructor, refraining from simply coming up with their own movements. To address these concerns, participants will be asked what they did during their dance session, specifically focusing on how their movement was generated. They will answer three questions: *Did you create your own movement? Were you following someone else's movement? Were you thinking of dances you learned in the past?* For each question, participants will be given the option to select *yes* or *no.* Those in the improvisation condition who answer yes to only the first question will pass this manipulation check, while those in the Zumba condition who answer yes to only the second question will pass.

Engagement during Dance

Since some participants may be more engaged during their dance session than others, it is important to measure engagement and later control for it during data analysis. To assess this, participants will be asked, *on a scale of 1-10, how engaged were you during the dance session? In other words, how much effort did you put into the task?* Participants will drag a slider to the number that best represents their level of engagement (1-*not engaged at all,* 10-*fully engaged*).

Exercise Intensity

Exercise intensity, which refers to how physically exerting the dance session was, will be measured by taking one's pulse. Participants will be asked to find their pulse by gently pressing two fingers into the side of their neck. The principal investigator will demonstrate how to take one's pulse if necessary. Once they find their pulse, they will be asked to count the number of beats per 15 seconds. Before data analysis, this number will be multiplied by four to determine beats per minute.

Although this is not an ideal measure of exercise intensity, it is the most feasible and practical. At the very least, this measure has adequate face validity. Furthermore, past researchers used pulse rate to operationalize exercise intensity or physical exertion, thus adding to the credibility of this measure (Blanchette et al., 2005; Campion & Levita, 2014; Gondola, 1987).

Openness to New Experiences

Openness to new experiences will be measured using select items from the self-report NEO-PI-3 (McCrae et al., 2005), which is a revised version of the NEO Personality Inventory. Within the NEO-PI-3, there are 48 items related to openness across six dimensions (i.e., eight items per dimension). For this thesis, a subset of 12 items (i.e., two items from each dimension) will be randomly selected (see Appendix B). Response options will be presented on a 5-point Likert scale, from *strongly disagree* to *strongly agree*. A composite score will be calculated, with a higher composite score representing greater openness to new experiences. Before the composite is created, relevant items will be reverse scored.

This measure has good internal consistency ($\alpha = 0.89$; McCrae et al., 2005). In addition, correlations with other similar and dissimilar measures demonstrate adequate convergent and discriminant validity, respectively (McCrae et al., 2005).

Demographics

Participants will be asked to report their age, gender, race, level of education, amount of weekly exercise, and previous dance experience. Age, amount of weekly exercise, and previous dance experience items will be open-ended. For weekly exercise, participants will be asked to report the number of days a week they partake in some form of exercise. Participants will also report on their previous dance experience. They will provide the number of years of experience

and will also be given the opportunity to describe the nature of their dance experience, especially as it pertains to emulated dance formats versus improvisation. Both of these dance modalities will be defined in the prompt.

Gender, race, and level of education items will be fixed-format. Participants will be given four response options for gender (*man, woman, non-binary, other*) and seven options for race (*White, Black/African American, American Indian/Alaskan Native, Asian, Native Hawaiian/Other Pacific Islander, Latinx/Hispanic, other*). Participants will be allowed to select more than one race option if applicable. For level of education, participants will be asked to report their highest level of education from six response options (*middle school, high school, associate, bachelor's, master's, doctorate*).

Procedure

Participants will complete the study individually via the online video call application, Zoom. To begin, participants will join a Zoom meeting using the link emailed to them prior to their appointment. Upon entering the Zoom meeting, the principal investigator will greet the participant and briefly explain what they will do during the study. Next, the principal investigator will send a Qualtrics survey link in the Zoom chat, which will include the consent form, study measures, and debriefing. Participants will read the informed consent and after consenting, will be directed back to the Zoom meeting.

Participants will then partake in the prescreening, which will begin with the MMSE (Folstein et al., 1975) to ensure older adults have the legal ability to consent. Next, participants will verbally respond to a few questions assessing their physical mobility. While physical mobility would ideally be measured via a physical examination conducted by a medical doctor, this is not possible due to the practical constraints of this study. Instead, to ensure adequate

physical mobility, potential participants will be asked to seriously consider their motor abilities. Those who report a significant surgery or injury within the previous three months will not be able to participate in this study. If they pass the MMSE and report no significant motor impairments, injuries, or recent surgeries, they will continue in the study.

After the prescreening, participants will be directed back to the Qualtrics survey, where they will complete the pre-test divergent thinking task. Next, they will measure their pulse rate for 15 seconds and record the number of heartbeats. After these tasks are completed, older adults will participate in their respective dance session, which will be on a pre-recorded video embedded in the Qualtrics survey. Half of the participants will be randomly assigned to the dance improvisation condition, while the other half will be assigned to the Zumba condition. Before beginning the dance session, older adults will be given the opportunity to prepare their space. When ready, they will click the dance video and complete this session. After dancing, they will sit back down and measure their pulse rate for 15 seconds, reporting the number of heartbeats. Then, they will complete the post-test divergent thinking task via Qualtrics. The objects used in the pre- and post-test will be counterbalanced, as some participants will think about a brick during the pre-test and a newspaper during the post-test, while others will be presented these objects in reverse. Next, participants will complete the engagement and openness to new experiences measures. Finally, participants will provide demographic information.

At the end of the study, participants will be debriefed, thanked, and informed that they should receive their compensation in the mail within the next week. While the debriefing form will be included in the Qualtrics survey, participants may also ask the principal investigator any lingering questions at this time. When ready, participants will exit the Zoom meeting.

Ethical Considerations

Generally, in society, older adults are often categorized as a vulnerable population due to age-related physical and cognitive declines. However, a prescreening will be conducted to ensure that those participating in the proposed study have the cognitive capacity to consent, thus avoiding the sampling of vulnerable older adults. Prescreening questions addressing physical mobility will also be included to confirm that those volunteering to participate are in good physical health. This should ideally reduce the risk of physical injury associated with participating in the dance intervention.

Along with concerns for potential injury, concerns related to participants' privacy will also be addressed. Data collection will be anonymous and the principal investigator will be the only one with access to participants' contact information, which will be stored separately on a password-protected laptop. Once participants are compensated, this contact information will be deleted. In order to decrease the possibility of emotional discomfort, participants will not be asked to provide sensitive information or consider sensitive topics that may make them uncomfortable. In addition, they will neither be deceived nor coerced. Participation in this study is truly voluntary, as those participating will have demonstrated the legal competence to consent. Participants will also have the right to withdraw from the study at any time without penalty.

This study also involves minimal risk since participants will encounter no more risk than they would experience in everyday life. The main potential risk is possible injury resulting from participation in a short dance session. However, this risk will be reduced by creating modified dance routines that are safe for older adults. Moreover, potential participants will be asked to seriously consider their physical mobility and motor qualifications before deciding to participate in this study. Anyone who has had knee surgery, hip replacement, or another significant surgery

or injury within the previous three months will not be able to participate. Taking these precautions should significantly reduce the risk of injury to participants.

Another potential risk is temporary embarrassment, as participants may feel uncomfortable or awkward if they are unaccustomed to dancing in front of others (Campion & Levita, 2014). To decrease social concerns and ideally minimize feelings of awkwardness, the principal investigator will turn off their Zoom camera while older adults complete the study, only turning their camera on to answer questions. However, participants will be required to have their camera on to ensure participation throughout the entire dance session.

Lastly, there is always a chance that participants may become frustrated, either during the dance session or during the divergent thinking task. However, this is unlikely since the dance sessions will be modified to accommodate older adults' physical abilities. Moreover, past research demonstrates the positive effect of dance on older adults' moods, emphasizing their enjoyment of this activity (Bungay et al., 2020). In addition, significant levels of frustration while completing the Alternative Uses Task have not been reported in previous literature. Although all of these risks were considered in the development of methodology, from initial recruitment to the procedure, they were not a cause of major concern as they do not exceed minimal risk.

Overall, while there are minimal risks to participating in this study, it could yield many potential benefits. First, this research could add to the growing literature in dance psychology by increasing the knowledge base in a very small and developing field. In addition, this thesis could demonstrate how different dance modalities may influence cognition, which has implications for professional dancers and social dancers alike. More specifically, this study could inform both scholars and the general public on how dance may improve older adults' creative cognition. In

terms of direct benefits to the older adults in this study, participation in a dance session could lead to improved mood (Campion & Levita, 2014; Sowden et al., 2015; Steinberg et al., 1997) and increased levels of BDNF in the brain (Kattenstroth et al., 2013; Müller et al., 2017; Rehfeld et al., 2018; Teixeira-Machado et al., 2019), both of which would positively impact participating individuals.

Furthermore, since divergent thinking declines with age (Alpaugh & Birren, 1977; McCrae et al., 1987; Palmiero, 2015), the results of this study could also highlight potential interventions aimed at boosting divergent thinking in older adults. Therefore, given the multitude of benefits that may result from this study, the knowledge to be gained and potential participant benefits outweigh the possibility of minimal risk to participants.

Predicted Results

Scoring the AUT

Participants' responses to the pre- and post-test AUT will be scored by two independent raters. Prior to data coding, coders will practice coding a small subset of data to explore inter-rater reliability. Once inter-rater reliability reaches 0.8, data coding will occur. Discrepancies between the two raters will be resolved by the principal investigator.

Analysis Strategy

First, preliminary analyses will be conducted on the divergent thinking scores to test for normality. If the data are skewed, they will be adjusted accordingly before conducting additional descriptive or inferential statistical analyses. Next, descriptive analyses of age, gender, race, education level, amount of weekly exercise, and previous dance experience will be conducted. After that, a series of dependent samples t-tests will be conducted to determine whether engaging in a dance intervention increases fluency, originality, and flexibility scores on the Alternative

Uses Task. Lastly, a repeated measures multivariate analysis of covariance (MANCOVA) with covariate interactions will be conducted on each of the divergent thinking variables to test the remaining hypotheses. Time of data collection (pre vs. post) will vary within participants and all other predictors will vary between participants.

Hypothesized Results

Engaging in any dance intervention should increase divergent thinking post-test scores relative to one's pre-test scores, ideally replicating past findings (Goff, 1992; Gondola, 1987; Lewis, 2012; Richard et al., 2021; Sowden et al., 2015; Steinberg et al., 1997) across all divergent thinking components. However, the type of dance modality may influence the extent to which divergent thinking abilities increase. While past research has found both significant (Lewis, 2012; Sowden et al., 2015) and nonsignificant (Lewis, 2012; Richard et al., 2021) differences in divergent thinking abilities between emulated and improvisational dance conditions, it is hypothesized that dance improvisation will lead to a greater increase in divergent thinking abilities than Zumba. Dance improvisation may encourage individuals to think more freely by breaking schema-based patterns of thinking (Lewis, 2012; Lewis & Lovatt, 2013; Sowden et al., 2015), which may stimulate infrequently activated cognitive pathways and promote more flexible and divergent thinking (Sowden et al., 2015). Thus, the two dance modalities will influence divergent thinking differently. Participants in the improvisation dance condition should exhibit significantly higher post-test divergent thinking scores than those in the Zumba dance condition when controlling for possible confounding variables (i.e., exercise intensity, engagement, openness to new experiences, amount of weekly exercise, previous dance experience) and pre-test scores.

However, when not controlling for openness to new experiences, it is hypothesized that this trait will moderate the relationship between dance and divergent thinking abilities. Given that divergent thinking abilities are highly correlated with openness to new experiences (McCrae, 1987), people who score high on this personality trait likely exhibit greater divergent thinking abilities. For participants low in openness, it is expected that those in the improvisation condition will have significantly higher post-test divergent thinking scores than those in the Zumba condition. For those high in openness, those in the improvisation condition will also score higher in the post-test divergent thinking task compared to those in the Zumba condition, although this difference will not be significant. Thus, the dance interventions, specifically dance improvisation, may not have the same impact for those higher on the openness scale compared to those who are lower on this scale.

Lastly, the type of divergent thinking by dance condition interaction will explore whether the hypothesized effects differ based on which component of divergent thinking is assessed. However, it is currently unclear which components may be more influenced by these dance interventions, as originality (Richard et al., 2021; Sowden et al., 2015) and flexibility (Steinberg et al., 1997) were shown to be particularly sensitive to dance manipulations on different occasions. Thus, the purpose of this exploratory hypothesis is to partially reconcile previously inconsistent findings (Richard et al., 2021; Sowden et al., 2015; Steinberg et al., 1997).

Scholarly Merit and Broader Impacts

This thesis combines past literature from multiple fields, integrating research on a variety of topics including creativity, divergent thinking, aging, dance, aerobic exercise, and improvisation. Through this process, this study attempts to address a gap in the literature, since no known study has examined the influence of dance on divergent thinking skills in the older

adult population. While past research explored these effects in children (Sowden et al., 2015), young adults (Campion & Levita, 2014; Gondola, 1987; Lewis, 2012; Richard et al., 2021; Steinberg et al., 1997), and middle-aged adults (Steinberg et al., 1997), older adults continue to be left out of most research samples, thus weakening the external validity of past results, and preventing the extension of these findings to the general population. By studying older adults, this thesis may mitigate ageist attitudes (Galenson, 2017) regarding the creative capacity of older adults, demonstrating that creativity is indeed present throughout the lifespan. Moreover, this study may combat ageism in the dance community (Seshadri, 2017), increasing older adults' sense of belongingness and accessibility to these resources.

As we witness increases in the aging population (National Institutes of Health, 2016), it is imperative we seek out novel interventions aimed at promoting healthy aging. Given that dance is an inexpensive, easily accessible intervention, it is important to establish which modality of dance may be the most effective to inform the development of future programs. It is also important to consider how personality characteristics, such as openness to new experiences, may influence the efficacy of dance interventions, as some older adults with certain traits may benefit from these interventions more than others.

While physical health interventions will most likely take priority, creativity interventions like dance should not be neglected, especially since they offer a multitude of physical and mental health benefits (Flood & Phillips, 2007; Sierpina & Cole, 2004). This thesis may highlight divergent thinking as a worthwhile benefit of such interventions, providing evidence in favor of allocating more resources to older adult programs.

Overall, this thesis will examine how dance improvisation and Zumba dance influence divergent thinking abilities during late adulthood. In doing so, this study will extend past

literature on this topic to a novel population, providing useful information to aid in the development of creativity interventions for older adults. Moreover, this research will hopefully combat ageist stereotypes related to both creativity (Galenson, 2017) and dance (Seshadri, 2017). Thus, this thesis will increase the overall acceptance of older adults, expand our knowledge of creativity interventions, and inform innovative approaches to healthy aging.

References

Acar, S., & Runco, M.A. (2019). Divergent thinking: New methods, recent research, and extended theory. *Psychology of Aesthetics, Creativity, and the Arts*, *13*(2), 153-158. https://doi.org/10.1037/aca0000231

Alpaugh, P. K., & Birren, J. E. (1977). Variables affecting creative contributions across the adult life span. *Human Development*, *20*(4), 240-248. https://doi.org/10.1159/000271559

Amabile, T. M. (1983). The social psychology of creativity: A componential conceptualization. *Journal of Personality and Social Psychology*, *45*(2), 357-376. https://doi.org/10.1037/0022-3514.45.2.357

Alpert, P. T., Miller, S. K., Wallmann, H., Havey, R., Cross, C., Chevalia, T., Gillis, C. B., & Kodandapari, K. (2009). The effect of modified jazz dance on balance, cognition, and mood in older adults. *Journal of the American Academy of Nurse Practitioners*, *21*(2), 108-115. https://doi.org/10.1111/j.1745-7599.2008.00392.x

Baer, J., & Kaufman, J. C. (2005). Bridging generality and specificity: The amusement park theoretical (APT) model of creativity. *Roeper Review: A Journal on Gifted Education*, *27*, 158-163. https://doi.org/10.1080/02783190509554310

Be Kind Magazine. (August 19, 2019). *7 benefits of being creative*. https://www.bekindmagazine.com/7-benefits-of-being-creative/

Bellosta-Batalla, M., Cebolla, A., Pérez-Blasco, J., & Moya-Albiol, L. (2021). Introducing mindfulness and compassion-based interventions to improve verbal creativity in students of clinical and health psychology. *Psychology and Psychotherapy*, *94*(3), 541-557. https://doi.org/10.1111/papt.12329

Benedek, M., Mühlmann, C., Jauk, E., & Neubauer, A. C. (2013). Assessment of divergent thinking by means of the subjective top-scoring method: Effects of the number of top-ideas and time-on-task on reliability and validity. *Psychology of Aesthetics, Creativity, and the Arts, 7*(4), 341-349. https://doi.org/10.1037/a0033644

Blanchette, D. M., Ramocki, S. P., O'del, J. N., & Casey, M. S. (2005). Aerobic exercise and creative potential: Immediate and residual effects. *Creativity Research Journal, 17*(2-3), 257-264. https://doi.org/10.1207/s15326934crj1702&3_10

Bonetto, E., Pichot, N., Pavani, J.-B., & Adam-Troïan, J. (2021). The paradox of creativity. *New Ideas in Psychology, 60,* Article 100820. https://doi.org/10.1016/j.newideapsych.2020.100820

Bungay, H., Hughes, S., Jacobs, C., & Zhang, J. (2020). Dance for health: The impact of creative dance sessions on older people in an acute hospital setting. *Arts & Health*, 1-13. Advance online publication. https://doi.org/10.1080/17533015.2020.1725072

Buskirk-Cohen, A. A. (2015). Effectiveness of a creative arts summer camp: Benefits of a short-term, intensive program on children's social behaviors and relationships. *Journal of Creativity in Mental Health*, *10*(1), 34-45. https://doi.org/10.1080/15401383.2014.946637

Calvo, J. A. (2016, December 13). *Coldplay - A sky full of stars (instrumental)* [Video]. YouTube. https://www.youtube.com/watch?v=Z5nFb4Qzo88

Campion, M., & Levita, L. (2014). Enhancing positive affect and divergent thinking abilities: Play some music and dance. *The Journal of Positive Psychology, 9*(2), 137-145. https://doi.org/10.1080/17439760.2013.848376

Coubard, O. A., Duretz, S., Lefebvre, V., Lapalus, P., & Ferrufino, L. (2011). Practice of contemporary dance improves cognitive flexibility in aging. *Frontiers in Aging Neuroscience*, *3*, 1-12. https://doi.org/10.3389/fnagi.2011.00013

Curnow, K. E., & Turner, E. T. (1992). The effect of exercise and music on the creativity of college students. *The Journal of Creative Behavior, 26*(1), 50-52. https://doi.org/10.1002/j.2162-6057.1992.tb01156.x

Digman, J. M. (1990). Personality structure: Emergence of the five-factor model. *Annual Review of Psychology, 41*, 417-440. https://doi.org/10.1146/annurev.ps.41.020190.002221

Faul, F., Erdfelder, E., Lang, A.-G., & Buchner, A. (2007). G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods, 39*(2), 175-191. https://doi.org/10.3758/BF03193146

Feist, G. J. (1998). A meta-analysis of personality in scientific and artistic creativity. *Personality and Social Psychology Review*, *2*(4), 290-309. https://doi.org/10.1207/s15327957pspr0204_5

Fisher, B. J., & Specht, D. K. (1999). Successful aging and creativity in later life. *Journal of Aging Studies, 13*(4), 457-472. https://doi.org/10.1016/S0890-4065(99)00021-3

Flood, M., & Phillips, K. D. (2007). Creativity in older adults: A plethora of possibilities. *Issues in Mental Health Nursing*, *28*(4), 389-411. https://doi.org/10.1080/01612840701252956

Foglia, L., & Wilson, R. A. (2013). Embodied cognition. *Wiley Interdisciplinary Reviews: Cognitive Science*, *4*(3), 319-325. https://doi.org/10.1002/wcs.1226

Folstein, M. F., Folstein, S. E., & McHugh, P. R. (1975). Mini-mental state: A practical method for grading the cognitive state of patients for the clinician. *Journal of Psychiatric Research, 12*(3), 189-198. https://doi.org/10.1016/0022-3956(75)90026-6

Galenson, D. (December 6, 2017). *Ageism and creativity.* HuffPost. https://www.huffpost.com/entry/ageism-and-creativity_b_9329156

Goff, K. (1992). Enhancing creativity in older adults. *The Journal of Creative Behavior, 26*(1), 40-49. https://doi.org/10.1002/j.2162-6057.1992.tb01155.x

Gondola, J. C. (1987). The effects of a single bout of aerobic dancing on selected tests of creativity. *Journal of Social Behavior & Personality, 2*, 275-278.

Guilford, J. P. (1956). The structure of intellect. *Psychological Bulletin, 53*(4), 267-293. https://doi.org/10.1037/h0040755

Guilford, J. P. (1957). *A revised structure of intellect*. Defense Technical Information Center.

Guilford, J. P. (1967a). Creativity: Yesterday, today, and tomorrow. *The Journal of Creative Behavior, 1*(1), 3-14. https://doi.org/10.1002/j.2162-6057.1967.tb00002.x

Guilford, J.P. (1967b). *The nature of human intelligence.* McGraw-Hill.

Hogrefe Ltd. (2016). *NEO-PI-3 technical report.* https://middleeast.psionline.com/assessment/personality-assessment

Houston, S. (2005). Dance for older people. *Primary Health Care, 15*, 18-19. https://doi.org/10.7748/phc.15.8.18.s22

Huisingh, C., Wadley, V. G., McGwin, G. J., & Owsley, C. (2018). Relationship between areas of cognitive functioning on the mini-mental state examination and crash risk. *Geriatrics, 3*(1), Article 10. https://doi.org/10.3390/geriatrics3010010

Karakelle, S. (2009). Enhancing fluent and flexible thinking through the creative drama process. *Thinking Skills and Creativity, 4*(2), 124-129. https://doi.org/10.1016/j.tsc.2009.05.002

Kattenstroth, J. C., Kalisch, T., Holt, S., Tegenthoff, M., & Dinse, H. R. (2013). Six months of dance intervention enhances postural, sensorimotor, and cognitive performance in elderly without affecting cardio-respiratory functions. *Frontiers in Aging Neuroscience, 5*, Article 5. https://doi.org/10.3389/fnagi.2013.00005

Kimura, K., & Hozumi, N. (2012). Investigating the acute effect of an aerobic dance exercise program on neuro-cognitive function in the elderly. *Psychology of Sport and Exercise, 13*(5), 623-629. https://doi.org/10.1016/j.psychsport.2012.04.001

Lewis, C. (2012). The relationship between improvisation and cognition. [Unpublished doctoral thesis]. University of Hertfordshire. https://uhra.herts.ac.uk/bitstream/handle/2299/8890/05107372%20Lewis%20Carine%20-%20final%20PhD%20submission.pdf?sequence=1

Lewis, C., & Lovatt, P. (2013). Breaking away from set patterns of thinking: Improvisation and divergent thinking. *Thinking Skills and Creativity, 9,* 46-58. https://doi.org/10.1016/j.tsc.2013.03.001

Lindberg, S. (2019, May 10). *8 benefits of dance.* Healthline. https://www.healthline.com/health/fitness-exercise/benefits-of-dance

Lopez, M. N., Charter, R. A., Mostafavi, B., Nibut, L. P., & Smith, W. E. (2005). Psychometric properties of the Folstein Mini-Mental State Examination. *Assessment, 12*(2), 137-144. https://doi.org/10.1177/1073191105275412

Lovatt, P. (2018). *Dance psychology*. Dr Dance Presents.

Maraz, A., Király, O., Urbán, R., Griffiths, M. D., & Demetrovics, Z. (2015). Why do you dance? Development of the dance motivation inventory (DMI). *PLOS One*, *10*(3). https://doi.org/10.1371/journal.pone.0122866

McCrae, R. R. (1987). Creativity, divergent thinking, and openness to experience. *Journal of Personality and Social Psychology, 52*(6), 1258-1265. https://doi.org/10.1037/0022-3514.52.6.1258

McCrae, R. R., Arenberg, D., & Costa, P. T. (1987). Declines in divergent thinking with age: Cross-sectional, longitudinal, and cross-sequential analyses. *Psychology and Aging, 2*(2), 130-137. https://doi.org/10.1037/0882-7974.2.2.130

McCrae, R. R., Costa, P. T., Jr., & Martin, T. A. (2005). The NEO-PI 3: A more readable Revised NEO Personality Inventory. *Journal of Personality Assessment, 84*(3), 261-270. https://doi.org/10.1207/s15327752jpa8403_05

Miranda, M., Morici, J. F., Zanoni, M. B., & Bekinschtein, P. (2019). Brain-derived neurotrophic factor: A key molecule for memory in the healthy and the pathological brain. *Frontiers in Cellular Neuroscience, 13,* 1-25. https://doi.org/10.3389/fncel.2019.00363

Mitrushina, M., & Satz, P. (1991). Reliability and validity of the Mini-Mental State Exam in neurologically intact elderly. *Journal of Clinical Psychology, 47*(4), 537-543. https://doi.org/10.1002/1097-4679(199107)47:4<537::AID-JCLP2270470411>3.0.CO;2-9

Müller, P., Rehfeld, K., Schmicker, M., Hökelmann, A., Dordevic, M., Lessmann, V., Brigadski, T., Kaufmann, J., & Müller, N. G. (2017). Evolution of neuroplasticity in response to physical activity in old age: The case for dancing. *Frontiers in Aging Neuroscience, 9,* Article 56. https://doi.org/10.3389/fnagi.2017.00056

National Institutes of Health. (2016, March 28). *World's older population grows dramatically.* https://www.nih.gov/news-events/news-releases/worlds-older-population-grows-dramatically

Oppezzo, M., & Schwartz, D. L. (2014). Give your ideas some legs: The positive effect of walking on creative thinking. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *40*(4), 1142-1152. https://doi.org/10.1037/a0036577

Palmiero, M. (2015). The effects of age on divergent thinking and creative objects production: A cross-sectional study. *High Ability Studies*, *26*(1), 93-104. https://doi.org/10.1080/13598139.2015.1029117

Palmiero, M., Di Giacomo, D., & Passafiume, D. (2014). Divergent thinking and age-related changes. *Creativity Research Journal*, *26*(4), 456-460. https://doi.org/10.1080/10400419.2014.961786

Predovan, D., Julien, A., Esmail, A., & Bherer, L. (2019). Effects of dancing on cognition in healthy older adults: A systematic review. *Journal of Cognitive Enhancement*, *3*(2), 161-167. https://doi.org/10.1007/s41465-018-0103-2

Puccio, G. J. (2017). From the dawn of humanity to the 21st century: Creativity as an enduring survival skill. *The Journal of Creative Behavior*, *51*(4), 330-334. https://doi.org/10.1002/jocb.203

Quiroga Murcia, C., Kreutz, G., Clift, S., & Bongard, S. (2010). Shall we dance? An exploration of the perceived benefits of dancing on well-being. *Arts & Health*, *2*(2), 149-163. https://doi.org/10.1080/17533010903488582

Razumnikova, O.M. (2013). Divergent versus convergent thinking. In E.G. Carayannis (Ed.) *Encyclopedia of creativity, invention, innovation and entrepreneurship.* Springer. https://doi.org/10.1007/978-1-4614-3858-8_362

Rehfeld, K., Lüders, A., Hökelmann. A., Lessmann, V., Kaufmann, J., Brigadski, T., Müller, P., & Müller, N.G. (2018). Dance training is superior to repetitive physical exercise in

inducing brain plasticity in the elderly. *PLOS One*, *13*(7), 1-15. https://doi.org/10.1371/journal.pone.0196636

Richard, V., Ben-Zaken, S., Siekańska M., & Tenenbaum, G. (2021). Effects of movement improvisation and aerobic dancing on motor creativity and divergent thinking. *The Journal of Creative Behavior*, *55*(1), 255-267. https://doi.org/10.1002/jocb.450

Runco, M.A. (2011). Divergent thinking. In S. Pritzker & M.A. Runco (Eds.), *Encyclopedia of creativity* (Vol. 2, pp. 400-403). Academic Press.

Senior Exercises Online. (n.d.) *How to warm up before exercising.* https://www.seniorexercisesonline.com/warm-up.html

Seshadri, N. (2017, April 18). Let's talk about ageism and dance. *Nirmala Seshadri Blog.* https://www.nirmalaseshadri.net/blog/2017/4/15/ageism-dance

Sierpina, M., & Cole, T. R. (2004). Stimulating creativity in all elders: A continuum of interventions. *Care Management Journals*, *5*(3), 175-182. https://doi.org/10.1891/cmaj.2004.5.3.175

Smith, V. (2019, May 28). The right way to warm up before exercise. *Silver Sneakers.* https://www.silversneakers.com/blog/warm-up-exercise/

Sowden, P. T., Clements, L., Redlich, C., & Lewis, C. (2015). Improvisation facilitates divergent thinking and creativity: Realizing a benefit of primary school arts education. *Psychology of Aesthetics, Creativity, and the Arts*, *9*(2), 128-138. https://doi.org/10.1037/aca0000018

Spotify. (n.d.). Lounge - soft house [Playlist]. https://open.spotify.com/playlist/37i9dQZF1DX82pCGH5USnM

Steinberg, H., Sykes, E. A., Moss, T., Lowery, S., LeBoutillier, N., & Dewey, A. (1997). Exercise enhances creativity independently of mood. *British Journal of Sports Medicine, 31*(3), 240-245. https://doi.org/10.1136/bjsm.31.3.240

Sternberg, R. J., & Lubart, T. I. (1999). The concept of creativity: Prospects and paradigms. In R. J. Sternberg (Ed.), *Handbook of creativity* (pp. 3-15). Cambridge University Press.

TeachThought Staff. (November 15, 2019). *The significant benefits of creativity in the classroom.* TeachThought. https://www.teachthought.com/learning/innovation-imagination-12-benefits-creativity/

Teixeira-Machado, L., Arida, R. M., & de Jesus Mari, J. (2019). Dance for neuroplasticity: A descriptive systematic review. *Neuroscience and Biobehavioral Reviews, 96,* 232-240. https://doi.org/10.1016/j.neubiorev.2018.12.010

Thomson, P. (2017). Dance: The challenges of measuring embodied creativity. In J. Kaufman, V. Glăveanu, & J. Baer (Eds.), *The Cambridge handbook of creativity across domains* (pp. 181-196). Cambridge University Press. https://doi.org/10.1017/9781316274385.011

Tombaugh, T. N., McDowell, I., Kristjansson, B., & Hubley, A. M. (1996). Mini-Mental State Examination (MMSE) and the Modified MMSE (3MS): A psychometric comparison and normative data. *Psychological Assessment, 8*(1), 48-59. https://doi.org/10.1037/1040-3590.8.1.48

Torrance, E. P. (1966). *Torrance tests of creative thinking*. Personnel Press.

United States Census Bureau. (2019). *QuickFacts Claremont City, California.* https://www.census.gov/quickfacts/claremontcitycalifornia

Ward, S. A. (2008). Health and the power of dance. *Journal of Physical Education, Recreation & Dance, 79*(4), 33-36. https://doi.org/10.1080/07303084.2008.10598161

Appendix A

Alternative Uses Task Instructions

"For this task, you will be asked to think of as many alternative uses for a *brick/newspaper* as possible. This should not include the intended use of the object, such as *to build a house/to read about current events*. In the textbox provided, please list as many uses for this object as you can. You should begin each response on a new row (i.e., press the enter/return key before listing a new response) and you may take as long as you'd like to complete this task. When you are finished, please press the arrow on the bottom right corner of your screen to move to the next activity. If you have any questions, you may ask the principal investigator now."

Appendix B

Openness to New Experiences Scale Items (McCrae et al., 2005)

O1: Openness to Fantasy

1. I rarely enjoyed games of make-believe as child. RS
2. I enjoy concentrating on a daydream, letting it grow and develop.

O2: Openness to Aesthetics

3. I'm not really interested in arts. RS
4. Watching ballet or modern dance bores me. RS

O3: Openness to Feelings

5. I pay little attention to my feelings. RS
6. Scents or talk of far places can evoke strong feelings in me.

O4: Openness to Actions

7. I like the old-fashioned methods I'm used to. RS
8. I spend time learning and developing new hobbies.

O5: Openness to Ideas

9. I often enjoy playing with theories and/or abstract ideas.
10. I have a wide range of intellectual interests.

O6: Openness to Values

11. Laws and social policies should change with the changing world.
12. If young people hear controversial views, it will confuse them. RS

RS = reverse scored