THE RELATIONSHIP BETWEEN DANCE EXPERIENCE, ANXIETY, AND VISUAL WORKING MEMORY

By

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A capstone project submitted for Graduation with University Honors

May 7, 2026

University Honors

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Abstract

Dance offers benefits beyond physical movement, requiring the integration of visual input, auditory cues, mind–body coordination, and long-term memory recall. However, its influence on cognitive processes, particularly visual working memory (VWM), remains underexplored. VWM is essential for processing and retaining visual information, playing a key role in learning and decision-making. Additionally, dance also supports emotional states by providing an outlet for stress, a major disruptor of VWM. Thus, this study examines VWM performance through dancers and nondancers. Additionally, exploratory analyses considered whether anxiety's negative effects on VWM were dampened in dancers. Participants completed a dance history questionnaire, the Generalized Anxiety Disorder-7 item scale (GAD-7), and a Dot Matrix Task for VWM. Preliminary analyses showed no significant difference in memory performance between dancers and nondancers; however, there are hints of a potential correlation. When examining years of dance, a moderate significance was found. Participants with 4 years or more of experience had better VWM compared to those with less experience. Exploratory results showed that being a dancer significantly moderated anxiety's impact on recall error; higher levels of anxiety did not predict higher recall error in the dancer group as they did in the nondancer group. Data collection is ongoing, and a larger sample size is being pursued to more accurately determine whether observed patterns reflect a meaningful relationship or confirm null effects. By examining both cognitive outcomes and stress-related measures, this study aims to clarify how embodied movement and emotional state may jointly contribute to individual differences in memory ability.

Keywords: Visual Working Memory, Generalized Anxiety Disorder, Dot Matrix Task

Acknowledgements

I would like to thank Dr. Weiwei Zhang for his tremendous support and instruction, as well as Jessica Golding for her exceptional aid and training throughout the study. Additionally, I would like to thank Carissa Johnson and Yessella Moreno for their many superb contributions throughout the conduction of this study.

Introduction

Dance offers benefits that extend beyond physical movement by integrating visual input, auditory cues, mind-body coordination, fine motor skills, and short- and long-term memory. However, its specific impact on visual working memory (VWM) remains underexplored. VWM is responsible for processing and temporarily storing visual information, playing a crucial role in learning and decision-making. While the effects of physical activity on cognitive functions have been widely studied, including research focused on dance, many findings remain inconclusive, highlighting a notable gap in the literature.

Although physical activity is generally associated with enhanced cognitive function, studies focusing specifically on dance yield mixed results. For instance, Angela Park's 2024 study compared dancers and non-dancers across cognitive tasks such as phonemic and semantic word fluency, working memory, and visual-motor integration, finding that dancers outperformed non-dancers in some areas while the reverse was true in others (Park, 2024). This underscores the need for further investigation. In a similar vein, Mason Low's 2024 research found that dancers tended to exhibit stronger visuospatial memory, as assessed by the Dance History Questionnaire and subtests of the Test of Learning and Memory II (Low, 2024), though results varied across tasks. The significant findings and methodology of this study informed my own.

Additionally, while the emotional effects of dance on visual working memory (VWM) have been noted, they remain not fully understood. In particular, the mediating role of mood in the relationship between dance and cognition is still largely unexplored. Research suggests that a positive mood can enhance cognitive performance, implying that emotional states influenced by dance may significantly affect cognitive outcomes (Sarsaba, 2023). Dance can also support emotional well-being by providing an outlet for stress, which is known to disrupt VWM.

Regarding anxiety, prior studies have shown that individuals experiencing both depression and anxiety suffer increased severity and chronicity of symptoms, greater functional impairment, higher suicidal ideation, and worse treatment outcomes (Penninx, 2015). Some research has indicated that dance may help alleviate anxiety. For example, in a 1990 study by Lesté and Rust, the anxiety-reducing effects of dance were found to be greater than those of other forms of physical exercise, though recent studies specifically linking these benefits to cognitive outcomes are lacking.

Building on these findings, my research will investigate two main questions: 1) whether dancers outperform non-dancers in VWM tasks; and 2) whether the negative effects of anxiety on VWM are less pronounced in dancers. I hypothesize that individuals with two or more years of dance experience will perform better on visual memory tasks than those with little to no experience. Additionally, I expect that dance experience may at least partially mediate the negative effects of anxiety. The gap in the current literature underscores the need for this exploration into dance's impact on higher-level cognitive processes.

Methodology

Participants

This study involved human participants and therefore appropriately received approval from the Institutional Review Board (IRB). Researchers also completed the CITI program for human subjects training to ensure full compliance with ethical research standards.

A total of 126 undergraduate participants were recruited from the University of California, Riverside (UCR) through purposive and snowball sampling, as well as through SONA (UCR's undergraduate research participation system). Participants ranged in age from 18

to 23, included both male and female students, and represented a diverse mix of ethnic backgrounds, academic statuses, and majors, though the majority were psychology or STEM students.

Participants were divided into two groups. The first group, “Dancers,” included individuals with at least two years of experience in any dance style. While the study prioritized participants trained in Indian Classical Dance forms, such as Kathak, Bharatanatyam, Kuchipudi, and Odissi, individuals from all dance backgrounds were welcome. The second group, “Non-Dancers,” consisted of participants with two years or less of dance experience. In sum, there were 20 dancers and 106 non-dancers studied.

Measures

Demographic Survey. 14-unit demographic questionnaire on Qualtrics to ensure participant eligibility and gather relevant background information. (i.e., “What is your biological sex?”).

Mood Survey. 6-item scale survey on participants’ mood, administered pre- and post-memory task to gauge the influence of dance-related brain function on mood and mediating effects. (i.e., “How are you feeling at the moment of writing?” (Sarsaba, 2023).

Dot Matrix Task. 30-trial visual working memory task. Begins with a sequential presentation of 3 red dots on a 5 x 5 grid. Followed by a disruptive distractor task: “Find the F’s”, where participants are instructed to find the letter “F” amongst the “E” letters. Finally, followed by the recall on a given 5 x 5 graph.

Dance History Questionnaire. 13-unit assessment of participants' dance background to understand influences of dance and thus, identify factors for potential findings (i.e., “On average, how many years have you been practicing dance?”) (Low, 2024).

Generalized Anxiety Disorder (GAD-7). 7-item self-report questionnaire addressing participants' anxiety over the past two weeks. Statements include emotional states (i.e., "Feeling anxious, nervous or on edge") with a Likert scale ranging from "Not at all" to "Nearly Every Day" (Spitzer et al., 2006).

Procedures

To address this gap, the study employed a between-subjects design with pretest and posttest measures. Each participant required 20–60 minutes to complete the procedure, making the study feasible given available time and resources. This design allowed for a clear comparison between dancers and non-dancers, even though participants were tested individually at different times. Data were analyzed by group membership to ensure meaningful distinctions between the two cohorts.

At the beginning, all participants completed the IRB consent form and were thoroughly briefed on the study procedures. They were informed that the surveys included sensitive questions and assured that participation was voluntary, so if they felt uncomfortable, they could skip questions or withdraw from the study at any point while still receiving SONA credit or their incentive. Participants then completed a Demographic Questionnaire to determine eligibility and gather relevant background information, followed by the Mood Survey (Sarsaba, 2023) to assess baseline mood and examine its potential mediating effects on cognitive performance; both were administered via Qualtrics.

After these initial surveys, participants performed the Dot Matrix Task, which measured Visual Working Memory (VWM) and enabled direct comparison for analysis between dancers and non-dancers. Following this, they completed a second Qualtrics survey consisting of the

Dance History Questionnaire (Low, 2024) and the GAD-7 (Spitzer et al., 2006) to further explore the role of anxiety. Finally, a post-mood survey was administered to determine whether mood changes, particularly positive ones, mediated the relationship between dance and memory performance.

Upon completing all study components, participants received a debriefing that explained the purpose of each measure and the study's overall aims. Given the sensitive nature of some questions, all participants were provided with a mental health pamphlet and respectfully escorted from the premises.

Results

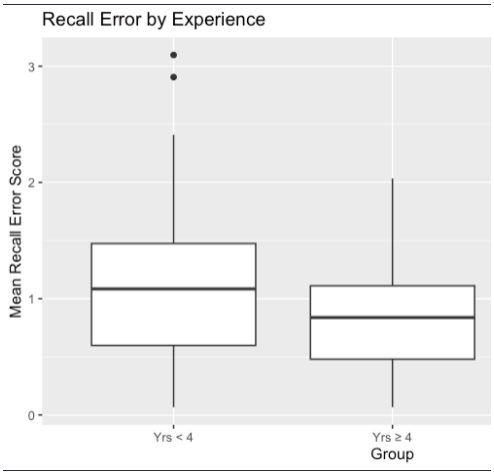

Figure 1. A two-samples t-test found that Dancers with over 4 years of experience (M = 1.10) scored significantly higher than those with less than 4 years of experience (M = 0.83) on the Dot Matrix Task, $t(81.68) = 2.62$, $p = .010$.

Data were analyzed using R software. To evaluate the first hypothesis, an independent-samples t-test was used to compare memory task performance between Dancers and Non-Dancers. Note: Recall error was measured by averaging the distance between the chosen

and correct answers. Initially, no significant difference was found between Dancer participants with 2 or more years of dance experience and Non-Dancers with 2 or fewer years of experience. However, when the threshold for dance experience was adjusted, a significant correlation emerged between the number of years of dance experience and memory performance. Specifically, participants with over four years of dance experience scored significantly higher on the Dot Matrix Task than those with less experience (p = .010).

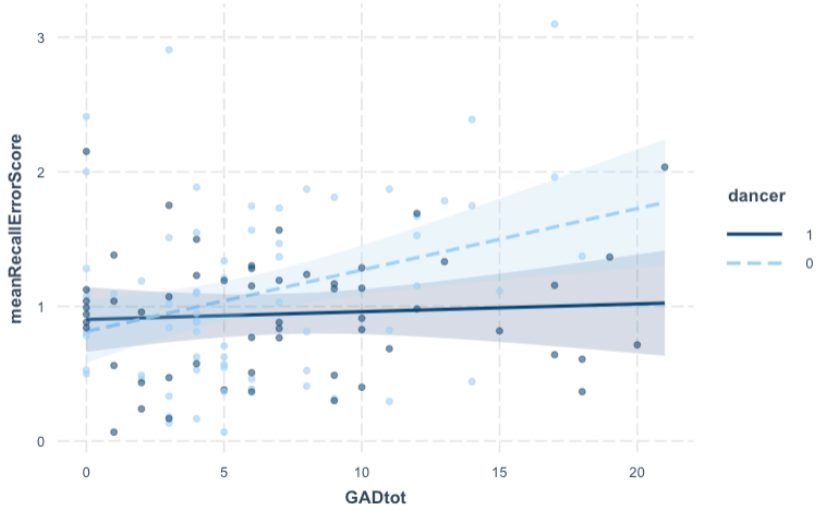

Figure 2. A multiple regression analysis revealed that dancing significantly moderates the effect of anxiety on recall error, $b = -0.04$, $t(118) = -1.99$, $p = .049$, $R^2 = 0.065$.

A multiple regression analysis was then conducted to examine the second hypothesis, the effects of anxiety on visual working memory (VWM) performance. Results indicated that dance experience significantly moderated the impact of anxiety on recall errors ($p = .049$, $R^2 = 0.065$). Individuals with higher anxiety exhibited poorer working memory, as indicated by higher error scores, but this effect was present only among non-dancers. Dancers did not show the same negative association between anxiety and working memory, rejecting the null. No significant effects were found for the Mood Survey.

Discussion

This project investigated the effects of both short-term and long-term dance experience on cognitive performance, with a primary focus on visual working memory. It also considered mood and anxiety as potential mediators of these effects. By comparing trained dancers to non-dancers, the study aimed to determine whether dance confers unique cognitive advantages beyond those gained through general physical activity. Accordingly, it fills a critical gap in existing research by linking kinesthetic movement to higher-order cognitive and emotional states.

A future extension of this research is under consideration to assess the immediate effects of a dance session followed by a memory task. This would provide insight into acute changes in brain function and fluid intelligence associated with dance. Nonetheless, to strengthen the validity of these findings, future studies should involve a larger and more diverse sample of dancers, encompassing a range of ages, genders, economic statuses, dance styles, and years of experience.

The implications of this work are far-reaching. By bridging psychology, physical health, and the arts, this study highlights dance as an accessible and powerful tool for cognitive and emotional development. The data may inform teaching strategies for individuals with atypical learning styles and support interventions for older adults experiencing memory loss. Dance could also be incorporated into therapeutic approaches for aging populations or those with cognitive impairments, such as dementia. Additionally, these findings support the integration of dance into educational and wellness programs, promoting a holistic view of intelligence that values both emotional and physical expression. By examining cognitive outcomes alongside stress-related measures, this research helps clarify how embodied movement and emotional states collectively

shape memory abilities. Ultimately, it deepens our understanding of the ways movement, brain function, and learning are interconnected.

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