The Effect of Dance on the Memory, Balance, and Proprioception of Elderly People

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Background

As people age, their memory and proprioceptive ability generally deteriorate, especially in their later years of life. According to the American Psychological Association (APA), after reaching maximum size in one's early twenties, human brains begin to decline in volume and receive less blood flow (APA Office on Aging and Committee on Aging, Vierck, n.d.). Despite this, the APA states that those who frequently get exercise and intellectual stimulation may be able to regrow their brain and continue learning and retaining information.

However, not all types of memory deteriorate with age. For example, according to the APA, semantic memory, or memory of general facts and concepts not associated with specific experiences, continues to develop as one ages. Procedural memory, or memory of how to do things, does not worsen with age. Yet, episodic memory, or memory of day to day events or experiences, as well as long term memory, generally decline over time, according to the APA. Additionally, balance deteriorates with age. According to USA Today, decrease in strength, flexibility, vision, touch, and mental functioning may all lead to less balance in later life. Tai chi and yoga are exercises proven to help balance.

Dance is a form of exercise, which can, on its own, enhance one's memory, however, by learning combinations (sequences of dance steps) and working the brain, dance can further improve memory and limit forgetfulness. Additionally, according to a study published in the National Library of Medicine, dance improves static balance (Stawicki, Wareńczak, & Lisiński, 2021).

Various studies have proven that dance improves memory. A study detailed in the New England Journal of Medicine by researchers at the Albert Einstein College of Medicine discovered that participants who danced had a 76 percent reduction in their risk of dementia

(Verghese et al., 2003). According to a study in the Frontiers in Aging Neuroscience, spatial memory is also improved by dance (Merom et al., 2016).

Studies have additionally found links between dance and bettered motor abilities, perception, and cognitive functions. In a study utilizing PET imaging in the Scientific American, researchers Steven Brown, director of the NeuroArts Lab at McMaster University, Lawrence M. Parsons, professor of psychology at the University of Sheffield, and Michael J. Martinez of the University of Texas Health Science Center at San Antonio, found that the motor cortex, somatosensory cortex, basal ganglia, and cerebellum are all parts of the brain that aid in learning dance and performing (2008). These regions displayed the functions of the brain needed to dance, and may explain why motor skills and coordination may improve by dancing. For example, the motor cortex creates signals that help plan, control, and execute movement, and the somatosensory cortex is related to motor control and hand-eye coordination. Furthermore, the study published in the Frontiers in Aging Neuroscience shows that motor, cognitive, and perceptual abilities are preserved when an active lifestyle is continued into old age.

My hypothesis is that due to the dance training, the people's scores on recall, limb control, and balance tests will improve. It is important to actively attempt to find solutions or ways to improve the memory and proprioceptive ability of elderly people, as these are problems they encounter frequently. Dance poses a cost-effective and potentially enjoyable solution to commonly experienced problems as people age.

Methods

The study I conducted tested the effect of 12, 20 minute dance classes on people of over 60 years' memory, balance, and proprioceptive ability. This study took place in a retirement

home, and participants took class at the home. I plan to disseminate the results of the study in an academic journal or use it to inform community members. In terms of testing, I tested before teaching any dance classes, their baseline level, then after the 12 classes were completed. I performed three tests to evaluate memory, balance, and proprioceptive ability.

For the first test, a memory test, I generated a list of 10 words using this website: https://www.randomlists.com/random-words?dup=false&qty=10. I gave each participant a list of these words. I will use a different list with different words for each of the two times I test. After looking at the words for 1 minute, I asked the participants to flip over the list so they could not read the words and record the words they remembered on a piece of paper in 1 minute. Similar to memorizing a string of movements in dance, this test evaluated the memorization of a string of words, testing the short-term memory of the participant.

In the next test, the 4-stage balance test (https://www.cdc.gov/steadi/pdf/4-Stage_Balance_Test-print.pdf), I asked the participant to move their feet in 4 different positions, recording the length of time the participant can hold their feet in this position each time. A chair was set up in front of the participant for them to grab if needed to ensure their safety. After 10 seconds, I stopped the timer, even if the participant could hold the position longer. If the participant moved their feet out of the position or grabbed the chair, this marked the end of the time as well. This tested the balance of the participant in different footing positions, which I predicted would improve with the movements in dance training.

For a distal proprioception test, the participant sat in a chair. I moved their right foot on the ground six inches to the right with them watching. I then asked the participant to close their eyes and complete the same action. I recorded the participant's distance from the six inch mark.

Next, I moved the participant's left leg to a 45 degree angle, which I will determined by taping a piece of rope to the participant's knee and measuring 45 degrees with a protractor. They then attempted to complete this action with their eyes closed, and I recorded if they did successfully, once again measuring using the rope and protractor. This was recorded as a pass-fail — whether they completed the movement correctly or not. In dance, many movements require correcting the placement of various body parts without looking at them, making this test applicable to dance training. These results over the months were compared to the participants' baseline in order to study the effects of dance.

The dance class I taught was similar to a dance warm up. The class took place in the auditorium at the retirement home, and the participants held onto chairs to stabilize themselves. Fourteen residents attended the classes, however, only four came consistently enough to test. The participants did the same set of combinations for each class, adding one new combination at the end of every other class or when time allowed. The first combination was prances facing the chair. Then, the participants performed tondues, mini ronde jambes, pliés, and degages. At the end of each class, the participants did all of the combinations in a row without stopping. During each combination, the participants had the option to take one hand or both hands off of the chair and test their balance.

I tested the participants using three methods before and after the 12 classes. To analyze my results, I used the t-test and a frequency evaluation. The t-test determines the probability of the data being a result of my intervention versus by chance, and the frequency evaluation was used for the pass-fail proprioception test.

Results

In Table 1, the t-test results showed that my intervention did not render statistically significant effects on the memory, balance, or proprioception of my participants. However, the changes in balance test #3 and proprioception test #1 had respective p-values of 0.0673 and 0.0691, with 0.05 being the highest result deeming an intervention statistically significant. For the second proprioception test, there was a 25 percent pass rate in the pre-test, and a 100 percent pass rate in the post-test.

Table of Results (Table 1):

T-test Results	T-Score	P-Value	SD - pre	SD - post
Memory	1.5667	0.2152	0.82	0.5
Balance #1	0	1	0	0
Balance #2	1	0.391	1	0
Balance #3	2.8098	0.0673	3.56	0
Balance #4	1.1326	0.3397	4.43	4.35
Proprioception #1	2.7775	0.0691	0.957	0.866
Proprioception #2	25% passed pre-test	100% passed post-test		

Discussion

The results of my intervention were not statistically significant in part due to my lack of participants. With four participants who came to at least 10 out of the 12 classes, I was only able to test these participants. In the t-test, the sample size is factored into the result, and since the data points for the third balance test and first proprioception test were within two percent from being statistically significant, it is possible that a higher number of participants would bring the t-test result down to 0.05 to deem the results statistically significant. In the future, I would modify this experiment to have more participants to render more accurate data. I would also

teach more dance classes over a longer period of time to identify true results. I would be able to perform the tests one time before any classes, once halfway through, and once at the end of all of the classes if I taught more and continued for a longer time.

Overall, the findings of my study testing the effect of dance on the memory, proprioception, and balance of elderly people did not provide any statistically significant results. However, the data points for the third balance test and first proprioception test were within two percent from being statistically significant, and, there was a 75 percent change in the pass rate of the proprioception #2 test.

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Appendix

Memory Test

Website: https://www.randomlists.com/random-words?dup=false&qty=10.

List #1:

1. reach
2. year
3. instruct
4. flood

5. panoramic
6. thing
7. company
8. lonely
9. pear
10. bushes

List #2:

1. cracker
2. tense
3. bite
4. ancient
5. badge
6. understood
7. awesome
8. winter
9. longing
10. dream

Balance Test

4-Stage Balance Test: https://www.cdc.gov/steadi/pdf/4-Stage_Balance_Test-print.pdf