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Positive Effect of Zumba on Memory Recall in Middle-aged to Older Population that is Experienced in Zumba

by

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Abstract

BACKGROUND: Zumba is a popular dance fitness program that incorporates Latin dance moves and traditional aerobic exercise. Zumba is an effective workout, and research has proven its many benefits. Aerobic exercise has been known to improve memory recall (MR) and Zumba is a type of aerobic exercise that may improve MR, but little research exists on this topic.

PURPOSE: To determine the effect of Zumba on MR. We believe that participation in a Zumba session will improve MR. **METHODS:** Fifteen middle to older aged (49.00 ± 6.47) females who were experienced in doing Zumba participated in the study. The digit span test was used to examine MR. The participants completed the digit span test upon arrival, participated in the 45-minute Zumba class, and then took the digit span test immediately following class. For the control session, the same group of participants came in on a different day, took the MR test before and after a 45-minute quiet period between, and participated in non-cognitive-stimulating activities. Session order was randomized for all participants and differences pre/post were compared using paired samples t-tests with significance set at $p < .05$. **RESULTS:** Zumba participation elicited significant improvements in MR ($p = .026$) and a medium effect size of ($d = .671$) when comparing pre/post values. **CONCLUSION:** Our study and its results revealed that Zumba can acutely improve MR in experienced Zumba participants. For the control session, the participants' MR stayed about the same. While further research could expand on our findings, Zumba participation has cognitive benefits as well as physical benefits which can encourage participation in Zumba.

Positive Effect of Zumba on Memory Recall in Middle-aged to Older Population that is Experienced in Zumba

Zumba is a fitness program that originated in Colombia and combines aerobic exercise with Latin dance moves. Zumba has become the most popular dance fitness program because it feels less like working out than traditional workouts (Blackler et al., 2019). It is known that Zumba is a beneficial form of aerobic exercise, burning more calories and increasing heart rates more than walking for the same length of time (Krause et al., 2022). However, there is little knowledge on the impact it has on short term memory.

In many previous studies aerobic exercise interventions show improvements in short term memory, but there is limited data on the impact of Zumba specifically. In one study both aerobic exercise and yoga showed statistical improvements in cognitive functioning and state trait anxiety. This study used middle school-aged students with poor academic performance and split them into yoga or aerobic exercise intervention groups. They tested the student's cognitive function using the stroop color and word test, corsi block tapping test, Raven's progressive matrices, (Parajuli et al., 2022). Zumba is considered aerobic exercise but it is more challenging and rhythmic than simply running on the treadmill or walking on the stairclimber and it also has a higher energy expenditure than walking for the same amount of time (Krause et al., 2022). Since it is more challenging than typical aerobic exercise it is likely that it can improve memory recall.

Short term memory is the ability to keep a small amount of information easily available for less than 30 seconds typically. Short term memory can be tested several different ways; the most straightforward verbal way to test short term memory is the digit span test which can be done forward or backward (Richardson, 2007). After hearing the digits appear in order one must

put them in the same order or in backwards order to complete the test. Several different studies test digit span recall after participation in an exercise intervention and see improvement in cognitive function. One of these studies by Alloway et al. (2015) tests digit span after an adult population participates in a proprioceptive group exercise, which is similar to yoga.

Proprioceptively demanding training showed an improvement in working memory. Working memory is the process of storing and manipulating the information stored for a short term.

Having a good working memory is important for paying attention and having strong focus and concentration. The purpose of our study was to figure out if Zumba would acutely improve MR in a middle aged to older population that is experienced in doing Zumba classes. We hypothesized that Zumba would indeed result in a better MR using a pre and post exercise test.

Methods

Participants

The participants recruited for this study were physically active adults who regularly participate in Zumba. They ranged in ages from 40 to 65, and they were all females. We recruited a total of 15 healthy participants. The main exclusion criteria were age and gender. We are only testing middle to older aged female adults, so we are excluding those that are younger than forty. For our control session, we tested the same participants on a different day and had them sit out during Zumba.

We protected the participants by adhering to confidentiality. We did not use any identifying factors in recording the data. They were assigned a number, and that is what they were referred to for testing instead of their name or another factor. The participants also

completed the Physical Activity Readiness Questionnaire (PAR-Q) as a screening tool. Before anyone participated in the study, The University of Alabama in Huntsville Institutional Review Board reviewed our study to ensure safety for the participants. The participants also signed an informed consent document.

Instrumentation

The test that was used in the study was the Digit Span test since it is utilized for assessing both working memory and attention and has very high reliability and validity (Romano Morris, 2020). For the Digit Span test, all that was needed was a piece of paper or a spreadsheet that had a randomized list of numbers. The numbers began as five-digit numbers and as each participant successfully recalled them a different set of numbers with an extra digit added each time the participant successfully recalled the numbers. The average person can recall 7 digits \pm 2 (Crook et al., 1980). We used score sheets for the participants to keep track of which sets of numbers they recalled, and during which trials.

Procedures

The data collection for this study took place at Dalton's Fitness-Fayetteville in the aerobics room. The Zumba classes last 45 minutes, and each test only takes a minute or two, the entire process should not exceed an hour for the participants. This is important when considering participant burden. Because these participants are regular members of the Zumba class, they only added at most 15 extra minutes if they chose to participate in the study. The instructor is a certified Zumba instructor and will be the same for each participant. The Zumba classes take

place on Monday and Thursday evenings from 6:15-7:00 p.m., which includes the warm-up and cool-down.

Prior to completing the Digit Span Test and engaging in Zumba, a PAR-Q was filled out by all participants. This ensured that all participants were safe to engage in the exercise and partake in the tests. The PAR-Q asked the participants questions about their general health, and, if necessary, participants may have had to answer follow-up questions regarding any medical conditions that could prevent them from engaging in Zumba and would have prevented them from being eligible to participate in the study.

Once enrolled, participants began by performing the initial MR test. We administered tests before and after the Zumba class to assess pre- and post-test evaluations to examine the effect Zumba had on MR. The class was split up into random groups with roughly five class members' memory recall being tested one after another. This was done for both the pre- and post-test. So, for each group, their MR were tested and they would perform the alternate condition at the subsequent testing session.

For our control session, we used the same participants on a different day that they normally would have come in for Zumba. We tested this group on memory recall, and then let them sit for 45 minutes (the same amount of time as a Zumba class). They were told not to engage in cognitively-stimulating activities here. The activities they did consisted of relaxing, reading emails, watching tv, etc. After these 45 minutes were up, the post-test was administered for memory recall. Using this control session allowed us to see the true effect Zumba had on memory recall in middle to older adult females.

To conduct the digit span test, we gave each participant a randomized list of numbers and read them out to them saying each single digit number at a rate of one number per second with

equal separation in a monotone voice. After hearing the digits appear in order one must put them in the same order to complete the test. If they pass the first test with 8 digits a second set of numbers will be read out containing more digits and so on (Erickson et al., 2010). The digit span test ended when a participant was unable to recall the digits in the correct order and their score will be recorded and the next participant was called into the quiet room to avoid external distractions messing up the validity of the tests.

Statistical Analysis

The statistical measure is done using SPSS version 28. We ran multiple paired samples t-tests, analyzing the difference between the pre- and post-test results and between the control and the Zumba session. We used paired samples t-tests due to the fact that we tested the same participants multiple times and also measured multiple variables. The significance level is set at $p < .05$. This allowed us to compare the differences between memory recall between both the pre- and post-tests, as well as between the experimental session and the control session.

Results

A total of 14 female participants completed both parts of the study. 15 started but one participant was unable to recall 5 digits on the first pre-test and had to be excluded from the study. The mean age was 49.00 ± 6.47 . Table 1 shows there was a statistically significant difference in Memory Recall between the Zumba Pre-test and the Zumba Post-test. Cohen's d shows there was a medium effect size for MR pre and post Zumba. There was no statistically

significant difference between the MR control Pre-test and the MR control Post-test. Table 2 shows the descriptive statistics for each set of tests.

Table 1

Average scores for memory recall (MR) and the statistical results of the two sessions

Variable	Time	Mean		SD	Significance	Effect size
Zumba Memory Recall	Pre	5.93	±	.829	<i>p</i> = .026	<i>d</i> = .671
	Post	6.86	±	1.099		
Control Memory Recall	Pre	6.50	±	1.225	<i>p</i> = .856	<i>d</i> = .050
	Post	6.43	±	.938		

The main findings were that participation in memory recall was higher following Zumba sessions by almost one whole digit using the forward digit span test. The average recall for the

pre-test was 5.93 digits and the average recall for the post-test is 6.86. One participant was unable to recall 5 digits on the first pre-test and had to be excluded from the study.

Discussion

The goal of this study was to see if there was a difference in memory recall for experienced middle to older-aged participants after they participated in Zumba versus after they sat down for 45 minutes and scrolled through their phones. There was little research on the effect Zumba has on short term memory, so our purpose was to fill in this gap in the literature to determine the impact that Zumba has. Our results showed that Zumba did have a significant effect on memory recall.

To analyze our data, we ran various paired samples t-tests. These paired samples t-tests included comparisons of MR before and after Zumba, MR before and after a control session, and the differences between changes in MR following the sessions. We did these 3 paired samples t-tests for memory recall along with the control for each. We used paired samples t-tests due to the fact that we tested the same participants multiple times and also measured multiple variables.

The main findings show that participation in Zumba increased memory recall by almost one whole digit using the forward digit span test. The average recall for the pre-test was 5.93 digits and the average recall for the post-test is 6.86. These results are similar to the results found in O'Brien et al.(2017) which tested whether digit span improvements would occur after a single bout of exercise, either closed skill or open skill. The open skill exercises in this study were tennis and badminton, the closed skill exercises were running and swimming. This shows that

aerobic activities similar to Zumba, which require a great deal of cognitive flexibility, can improve immediate memory following just one hour of participation.

Similarly, Norouzi et al. (2020), tested working memory before and after a Zumba or aerobic exercise intervention using the n-back task test on patients with fibromyalgia. The n-back task test is a different method of testing working memory. The person conducting the test reads out a list of letters and the subject alerts when the letter read was also read n letters earlier. The findings showed significant improvement in MR following both aerobic and Zumba interventions, but the improvements in MR were greater for the Zumba group. While we used different methods to test the working memory and had different populations, the Zumba intervention improved participant's in both studies.

A large-scale test was conducted by Hill et al. (2010) in elementary schools across the UK with over 1200 kids involved and they tested them using multiple cognitive tests, one of them being the digit symbol encoding and another being the digit span backwards test. Due to the number of participants in each group and wanting to be able to test all of the kids as quickly after exercise as possible it was best to slightly modify the tests. The digits were given over a recording and the students used pencil and paper to complete the tests. The digit symbol encoding tests working memory and visual scanning, participants are given a list of common keyboard symbols that correspond with numbers and they are given a time limit to see how many they can decode. The digit span backwards test has the same protocol as the digit span forward test, but the students had to repeat the numbers in reverse order. The participants were randomly split into two separate groups and each group had to take both tests. Group A was tested following a classroom exercise program which included 10-15 minutes of moderate intensity stretches, aerobic exercises, and hopping on beat with music, while group B took the tests

without the exercises. The groups switched their exercise condition. The exercise intervention improved performance in the cognitive assessments and showed that physical activity enhances cognitive performances. This study showed that even a 15-minute movement break can lead to an increase in cognitive performance including better working memory based on the results of the digit span backwards test.

While there is a wealth of data that shows exercise has a positive effect on working memory, we did review one study that showed contrary findings. A study by Monteiro-Junior et al., (2016) separated elderly participants into two separate groups, one was a control group and one was given an exercise intervention of playing Wii games. The results showed the digit span forward test following Wii gaming to be an entire digit worse than their control counterparts, however, executive function and semantic memory did show improvements over time during the study. Moneiro's study was unique in that not only did it not show improvements after each bout of exergames, but it actually showed a negative effect on memory temporarily. These effects appeared to get better over time showing improvements, this is interesting because our participants were all familiar with Zumba and regularly participated in it for years, which could account for them experiencing improvements after one session. Another reason for these results could be that they are using video game style workout videos which may lower participant's executive functioning, especially if it is something new to the participants.

Although our study did show significance, it was not without limitations. We had a relatively small sample size of 14 participants, but we showed a medium effect size ($d = .671$) for comparing memory recall before and after Zumba. The digits were randomized and read out to each participant, but some of the sets of numbers were recalled more successfully than others just based on chance; they seemed "easier" and some participants were more inconsistent than

anticipated. This occurred due to chance because we used computer generated random digit sequences, avoiding repeated digits in the same sequence. Another limitation is that the participants were too friendly with each other and while testing the women would “compete” with each other to see who could get the highest score. In the future I will definitely make sure to tell them not to talk about their scores until testing had been done for the day because the extrinsic motivation of the competition could skew our results.

We also thought of several ideas for future research. We focused our population on middle to older-aged females who are experienced in doing Zumba. Future research could examine a younger population or one that wasn’t experienced in Zumba. Another idea could be to look at longer-term effects, whereas we looked at the acute response.

In conclusion, Zumba has a positive acute effect on memory recall after one session in middle to older age adults who actively participate in Zumba. These findings will help us in further research on Zumba and may help encourage more people to participate in Zumba if they are made aware of the benefits. Memory recall is used in everyday life when we remember recipes, grocery lists, and phone numbers. As we age our memory worsens, having a good memory recall can make daily tasks easier.

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