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Dance's Effect on Auditory and Visual Memory

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ABSTRACT

The benefits of aerobic exercise in enhancing memory are well known. However, dance in particular has the possibility of new or even stronger memory benefits due to its combination of physical and mental stimulation. The current data available on dance only assesses middle aged or elder populations, as science is continually looking for ways to combat diseases such as dementia. However, there are many potential benefits to memory enhancement beginning at a young age as well. Therefore, dancers ages 9-17 were used in this study to determine the effect dance has on auditory and sensory memory in dancers. A quantitative experiment using a test called the N-back was run prior to and following an hour long dance class. My hypothesis was that both auditory and visual memory would be enhanced by dance, but that visual memory would be enhanced more than auditory memory. In the final analysis, this was proven partially correct and partially incorrect. While both auditory and sensory memory ended up being enhanced by dance, auditory memory was enhanced more than visual memory. A statistical analysis on both tests determined that the difference between the pre-test and post-test for auditory memory was statistically significant while this difference was statistically insignificant for the visual group. In other words, the enhancement from the visual group was too small and likely due to chance, while the enhancement observed in the auditory group was large enough to conclude that in the presence of minimal confounding variables, the dance class must have generated this enhancement. This data adds to the current body of knowledge present on exercise's effect on memory. Most importantly, it can be incorporated into educational settings as a way to help students maximize their learning potential.

Introduction

In a fast-paced world where it is far too easy to get distracted or lose track of vital information, developing a strong memory can be essential to success. Consider how the ability to recall facts or events could create a multitude of future opportunities in work, education, or, perhaps most importantly, in personal relationships. Strengthening memory skills is crucial to just about every aspect of life.

In particular, aerobic exercise, or physical activity that increases intake of oxygen and blood flow, has been recognized to not only improve physical conditioning, but mental conditioning as well. Specifically, memory improved following aerobic exercise in every scholarly journal that was reviewed prior to the experiment.

Dance is a unique form of aerobic exercise with the potential to create the strongest cognitive benefits. Dancers must first learn the complex choreography they perform. Therefore, it integrates physical and cognitive exercise elements into a single class.

In addition to overall memory, some studies focused on specifically working memory such as the study produced by Lin Li, a professor in the Ministry of Education in the East China Normal University. Working memory is a type of short term memory that involves the temporary storage of information while other mental processes are going on (Li et al., 2014). Through MRI observation, it was found that aerobic exercise increases working memory capacity.

Working memory itself can be divided into further subsections, such as sensory types. The first in this type is visual memory. This is classified as the ability to remember things that were seen. The second is auditory

memory, which is defined as the ability to remember things that were heard. This analysis leads to the question: To what extent does dance enhance auditory and visual memory in females ages 9-17? The gap focused on in this experiment will compare these two types of memory both prior to and following a dance class. This age group was chosen because it has not been previously researched pertaining to this topic. My hypothesis was that both groups would achieve better scores following the dance class. However, I believed the visual group would have more improvement in scores than the auditory group.

Literature Review

To better understand the gap in research, it is crucial to first identify the established body of knowledge regarding dance and memory, as divided into three themes. The first is aerobic exercise influencing cognitive function in elders, the second is aerobic exercise influencing cognitive function in younger populations, and the third is how the cognitive benefits of dance differ from other forms of aerobic exercise.

Section 1: Dance's Effects on Declining Brain Health In Elders

The correlation between aerobic exercise and memory has been investigated largely in the elder population due to its potential to prolong brain health. There have been a plethora of studies that study the effects of group exercise classes and their role in preventing the development of brain diseases such as dementia or Alzheimer's. Analyzing prior research, the results have consistently shown that aerobic exercise has a positive effect on the brain and memory.

A group of researchers led by Yi Zhu, head of the first affiliated hospital department at Nanjing Medical University, were able to make conclusions about those who are more susceptible to dementia. Following three months of testing, the group of participants who learned dance choreography had much better cognitive skills than the control group that did not learn choreography (Zhu et al., 2018). Thus, it demonstrated that learning dance patterns lessened cognitive impairment. Moreover, the results found the most success in areas of the brain associated with episodic memory, which involves the recognition of specific information or events. This raised the question of whether dance enhanced particular memory types more than other forms. A group of scientists from the Proceedings of the National Academy of Sciences also conducted a study on an older population. They concluded that consistent aerobic exercise helps increase the size of the hippocampus, which is one part of the brain associated with memory (Napoli, 2011). A study measuring the difference between acute yoga and aerobic exercise on cognitive function is also significant in this field. Susannah M. Moore, a professor and researcher with a PhD in Psychology, and her colleagues at the University of Northern Colorado, discovered that yoga was better for mental flexibility while aerobic exercise was better for problem solving (Moore et al., 2019). These findings established that similar types of exercise could have different cognitive benefits, which is a concept that would be further explored in this study. Additionally, researchers from Chemnitz University of Technology were able to compare older participants' working memory after reading an audiobook and exercising. The results stayed consistent with other studies, finding that those who exercised had better performance both 15 and 45 minutes after the exercise was completed (Stute et al., 2020). Since my research focuses on two types of working memory, this article provided helpful insight into how this type of memory can be enhanced by exercise. The researchers also used a letter recognition test to evaluate the extent to which working memory was enhanced. They saw this test as the best way to make conclusions about the parts of the brain involved with working memory, so it was influential in developing the methods used in my own research.

Section 2: Dance's Effect On Memory Enhancement in Children and Teenagers

Exercise is not only a useful tool for helping the elderly with memory skills, but it could also be used to help children enhance their memory skills. It is important to note that the research group for the chosen topic will be ages 9-17, therefore the reactions of the participants in these articles was informative for my research.

In 2021, Giovanna Morini, who holds a PhD in Hearing & Speech Sciences, worked with a team of researchers at the University of Delaware to see if exercise would enhance word recall in children like it did adults. The trials concluded that those who did predetermined aerobic exercises were found to have better word recognition than those who did anaerobic activity and those who did not do any exercise (Pruitt et al., 2021). This establishes the fact that aerobic exercise does not only improve recognition of phrases/facts in children, but accomplishes it better than other types of activities. Another significant aspect of the 2021 study is that the children used in the study were from a swim team, and on many other sports teams as well. Most competitive dancers have little time for other activities. This makes it easier to find participants without having to consider the impact of other activities they would have potentially participated in. In addition, this article also used a method where participants memorized words, making me more inclined to use a word/letter method. Other studies have used neurological approaches to reach similar conclusions. One such study was run by researchers including Lin Li, who has a doctorate in exercise psychology. Using MRI technology following working memory tasks, the brain scans showed how aerobic exercise worked the prefrontal and occipital cortices of the brain (Li et al., 2014). These parts of the brain are associated with executive control, or the ability to execute goal directed behavior. This is similar to working memory. This can explain why those who participated in the aerobic exercise and activated these parts of the brain had better results than those in the control group who did not do the exercises. A 2021 study by the Turkish Education Association was the first to incorporate both auditory and visual memory. Yoga was found to be beneficial to both of these types of memory. It did not, however, discuss which factor it enhanced more (Ozgun et al., 2021). Moreover, yoga involves more complex body positioning similar to dance compared to other more straight forward forms of exercise. To further the idea that exercise has a positive impact on auditory memory, a 2021 study was led by Yusaku Amaya, member of the Department of Psychosomatic and General Internal Medicine for Kansai Medical University. An auditory test confirmed that exercise improved test scores, but not in a significant way (Amaya et al., 2021). This evidence, and those from other sources, helped direct my observations to the hypothesis that dance would better enhance visual memory.

Section 3: Dance and Cognitive Benefits

One might think that the results of dance are no more and no less important than those of more general types of aerobic exercise. However, the relationship of dance with the brain, and memory specifically, is different from any other type of aerobic exercise.

Zhiguang Ji, who holds a PhD in cognitive neuroscience, collaborated with other researchers to examine different variables of exercise on 20 participants. The results showed that combined exercise and cognitive groups had the best cognitive benefits (Ji et al., 2019) Dance has physical exercise and cognitive exercise elements since it combines aerobic activity, learning choreography, and memorizing steps to specific counts. Furthermore, combined exercise was found to be more effective than single exercise in producing these cognitive benefits (Ji et al., 2019). Dance could also be considered combined exercise as it strengthens cardiovascular endurance, strength, flexibility, and more. Thus, dance could produce greater memory results due to its combined mental and physical components. Studying the different effects of dance, Piotr Gronek, from the Facility of Sports Sciences at Poznan University of Physical Education, conducted a content analysis in 2021 on dance's benefits. As dancers must memorize choreography, patterns, basic moves, and at what point in the music choreography must be done,

memory is an important requirement in dance. Overall, dance greatly improves cognitive function involving the processes of remembering to do certain actions, form complex thoughts, and prevent diseases such as dementia (Gronek, 2021). A 6-month experiment accomplished by German scientists aimed to examine the difference between dance and conventional exercise on cognitive enhancement, including memory, attention, balance, and other neurological areas by using MRI technology between verbal learning and memory tasks. While both groups improved, the dance group was found to have more gray-matter areas in these MRIs (Rehfeld et al., 2018). The growth in these ´gray-matter areas' is associated with growth in cognitive abilities. While dance is a type of aerobic exercise, the idea that its memory benefits could be even better than most other forms of aerobic exercise demonstrate a need to explore this gap further.

Method

With the intention of exploring the gap between dance and memory, the method ultimately chosen for this study was an experimental design. Most of the cited peer reviewed journals used this method, as it is ideal for demonstrating exercises' direct effect on memory through letter recognition tests. Using these tests are essential as they have the ability to target specific types of memory, which is necessary for the comparison of sensory memory presented here. Quantitative data was collected in the form of test scores.

No other methodology would be applicable because, while there is data on sensory memory alone, there is not enough already published on auditory and visual memory in exercise. This is especially true in studies involving dance specifically. Consequently, a method that involves finding connections in previous studies, such as a content analysis, would not be applicable and would not achieve the goal of comparing the two types of memory in a dance class, due to the lack of available information. The choice to test memory through quantitative tests is much more accurate than asking people to attest to their own memory skills through a qualitative method. Consequently, a survey or questionnaire of this type could have inaccurate self-evaluations over auditory and sensory memory.

Participants

In total, the study encompassed 26 females, who were split into two groups of 13. Zhiguang Ji's study, which revolved around the idea of combining physical exercise and cognitive function, was used as a metric, as it used a total of 20 participants before dividing them. The participants' ages in my study varied from 9-17 (M = 13.5) , an age group that has not been previously studied for dance and memory. The group of females were taken from a suburban year-round competitive dance team on Long Island, New York. The dancers each take weekly classes of the same structure and they are taught choreography by the same teachers.

Focusing solely on this studio was necessary to keep their dance background consistent. The decision to have all participants from the same studio is ultimately what led me to study only females. While there are male dancers at studios, their numbers are very low in comparison, with a female-to-male dancer ratio of 13:1. Other studios that were considered had similar ratios. With so few males for examination, the needed demographic to properly evaluate their memory enhancement was not available. The females who did participate were asked to note their age on the consent form (see appendix A) to ensure they fit this category as well as to allow me to place an equal amount of ages in each of the two groups.

N-back Test

Reflecting upon the experiments that were studied beforehand, a few used MRI technology in order to make observations on exercise's effect on the brain. While these were good for scientific background, getting

access to MRI scans for a sufficient number of participants would not be feasible due to logistics and expense. Instead, since a majority of the studies used a word or letter recall test to assess memory enhancement, I incorporated one as well. Since my study was going deeper into working memory by examining the differences between sensory and auditory memory, I needed a test specifically designed for both audio and visual testing. The N-back test used in a paper by Madasamy Thirumalai, a PhD and professor and academic dean at Bethany College of Missions, met this requirement. (Thirumalai et. al). The findings themselves don't have significance to this study, yet the N-back test was the most efficient way found to test both auditory and sensory memory.

Science Direct, which gives open access to peer reviewed journal articles and book chapters, describes N-back test procedure by stating that participants will be presented a series of letters and have to determine if the presented stimulus matches the presented stimulus "n" items ago (Moustafa, 2021). Designed to challenge the working memory parts of the brain, participants must memorize the pattern and be able to recite certain letters. In this case, it would be a 2-back test, as dancers must determine if the current stimulus matches the one that had been presented two stimuli ago. This is one of the simpler versions of the N-back test, due to its increasing difficulty as the number increases. In total, 12 letters were presented to make it manageable to memorize. The visual test displayed the letters on a television screen through the software Google Slides. The auditory test played over a speaker. Each letter was placed 3 seconds apart in order to give dancers sufficient time to acknowledge the stimuli while still challenging their sensory memory.

Procedure

Dancers were handed the consent form the week prior to the study. The form included basic information about the study to address any ethical concerns. Parental and child signatures were required to secure permission for minors, and these names/signatures would only be seen by the researcher to create confidentiality. In addition, an incentive that would be used in the study was discussed in the consent form. Being a part of the experiment would give each child candy and enter each child into a raffle to win a gift card. This was devised with the purpose of thanking participants for their time without affecting results.

On the day of the study, all 26 females entered into the same room and were briefly described the task involved. In view of the fact that it was unlikely they had previous knowledge of the N-back test, the summary beforehand was necessary to prevent confusion that could impact results.

Following this, the participants were then sequestered into two separate rooms. The groups were made by random selection, with the intent of representing the age range in both groups, resulting in a mean age difference of .38 between the rooms. One room made up the auditory group (A-group), and the other made up the visual group (V-group). They each received a sheet (see appendix b) before the assessment that had slightly different wording depending on the group. Regardless, the format was the same in order to control unexpected variables, and the sheets were easy to follow to account for the unfamiliarity of the test and the younger population. In addition, names were collected to organize information, but would not be made public. Each of the two groups would run a N-back test with the same twelve letters. The A-group heard the letters through a speaker and the V-group saw the letters displayed on a google slide presentation.

Following the tests, sheets were collected while all the participants were entering a common room. There, they would take the same 1-hour dance class that involved warming up, going through old choreography, and learning new choreography.

At the end of the dance class, the A-group and V-group, consisting of the same dancers established prior to the session, would once again divide into two rooms. Once separated, they would take another N-back test with twelve letters. This set of letters was different but had the same pattern as the first set. They were then given a form of the same format they had previously received. After the test was concluded, the participants handed in their individual sheets and were free to leave.

Scoring

Since the test assessed participants' ability to remember if a letter was the same as the letter presented two positions prior in a sequence, the first or second letter would not count as a score. Throughout the duration of the exam, dancers would place a '✓' symbol if the letter matched the one shown 2 before. If the letter did not match the one they believed was "correct" in conjunction with the instructions, they would place an 'X' symbol in the box. I would then calculate their score --correct or incorrect-- in the last column with the highest score being 10. Considering that the point of the study was to determine which type of memory dance best enhanced, how well they scored on a single test alone was not the point. Each participants' pre-test and post-test scores would be compared to analyze the difference in scores after the dance class.

Results

Participants

In total, 26 females completed the experiment: 13 in the A-group (50%) and 13 in the V-group (50%). Ultimately, the A-group had an average age of 13.31 and the V-group had an average age of 13.69.

Experiment

Each group took two tests, one before the dance class and one following the dance class.

In the tables below, each participant was represented by a different letter. A row for their age, first test score, and second test score can be seen.

Table 1

Auditory Group Scores and Ages

Participant	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**	**M**
Age	9	13	13	14	13	13	13	11	11	14	16	16	17
Pre Test A	2	3	10	10	10	6	5	3	4	2	4	6	8
Post Test A	9	9	9	9	10	9	9	3	9	9	9	9	10

Table 2

Visual group Scores and Ages

Participant	**N**	**O**	**P**	**Q**	**R**	**S**	**T**	**U**	**V**	**W**	**X**	**Y**	**Z**
Age	14	13	14	13	13	9	12	12	10	17	17	17	17
Pre Test V	9	9	10	10	10	7	10	10	9	3	1	2	10
Post Test V	10	7	9	10	9	4	10	10	10	8	8	8	8

With a maximum score of 10, on the first test, the A-group had an average score of 5.62 and the V-group had an average score of 7.62. In regard to the second test, the A-group had an average score of 8.62 and the V-group had an average score of 8.54. In essence, this means that both the A and V groups' average score increased following the dance class. On top of this, the standard deviation was calculated from the test data to determine on average how far away each participant's score deviated from the mean score. The first A-group test had a standard deviation of 3.015, and the second A-group test had a standard deviation of 1.750. Likewise, the first V-group test had a standard deviation of 3.376, and the second V-group test had a standard deviation of 1.173. In short, the A and V groups had similar standard deviation for their initial and final tests. In further observation, the two groups both had a smaller standard deviation on their second round of testing.

Table 3

Mean Scores and Standard Deviation (SD) *for Auditory and Visual Groups*

	Auditory	**Visual**
Pre-test Mean	5.62	7.62
Pre-Test SD	3.015	3.376
Post-Test Mean	8.62	8.54
Post-Test SD	1.750	1.713

The next step was to determine if this difference in test scores was statistically significant enough to conclude that the score increase must have been due to the dance class.

Statistical Analysis

Given these points, the data collected was analyzed using two hypothesis tests: one for the A-group and one for the V-group. In this case, the null hypothesis (H_o) was that any difference between the pre-dance test and post-dance test was simply due to chance. On the contrary, the alternative hypothesis (H_a) was that the difference between the pre- test and post- test was so large that an outside factor must have influenced it. The outside factor for this experiment would be the dance class between the two tests. Failing to reject the null hypothesis for the two groups would ultimately prove my initial hypothesis. Both the null and alternative hypotheses were represented by proportions that can be seen in the table below.

$H_o: P_1 = P_2$	$H_a: P_1 < P_2$

Figure 1. *Proportions for null and alternative hypothesis used in statistical analysis.*

With this in mind, a 2 sample hypothesis test was run on the data. This compiled the test score means, standard deviation, and other factors to determine if the difference between first test P-value and second test P-value was statistically significant. A statistically significant difference would bring value to the study, since it would show that the difference in test scores could not have simply been due to chance. Instead, there is a greater probability that the difference was caused by an outside factor. Being that an hour long dance class took place between the two tests, the outside factor would most likely be the class itself. All in all, running this test was neces-

sary as it would provide mathematical evidence that the dance class was able to improve memory test scores. Moreover, I would be able to compare the A-group and V-group hypothesis tests to one another to discover which sensory memory score increase was more statistically significant.

A 2-sample hypothesis test was the most suitable statistical analysis for this experiment. While both chi square tests and hypothesis tests use quantitative data, a chi square test is used to evaluate the numerical value of something qualitative occurring. In conclusion, a chi square test would not be the top choice for this experiment's sole quantitative data. Moreover, the 2-sample aspect of the hypothesis test would allow it to evaluate the difference between the pre-test and post-test. Accordingly, it would answer my research question on the enhancement of memory.

Table 4
P-Values of the difference of test scores

Auditory Group	Visual Group
0.00246	0.21445

Following this, it had to be determined whether or not these p-values were statistically significant. To do so, a sigma value of $\sigma = 0.05$ was used.

If $P > \sigma$, results are not statistically significant $\rightarrow$fail to reject null hypothesis
If $P < \sigma$, results are statistically significant $\rightarrow$reject null hypothesis

Figure 2. *Using Sigma to Determine if P-Value is statistically significant*

In final analysis, the V-group memory enhancement p-value is above sigma, meaning the difference in test scores is not statistically significant. Hence, visual data would fail to reject the null hypothesis, and any difference in scores was likely due to chance. On the other hand, the A-group memory enhancement falls below sigma, meaning that the difference in test scores is statistically significant. Therefore, auditory data would reject the null hypothesis, and the difference in test scores must have been due to the outside factor.

Discussion

The study was created to answer my research question: to what extent does dance enhance auditory and visual memory in female dancers ages 9-17? The hypothesis covered two points. First, it was predicted that dance would enhance both auditory and visual memory. In measurable terms, this meant that the test scores would improve following the dance class. Second, it was predicted that visual memory would be enhanced more than auditory memory. In the end, one of these predictions would be correct while the other would be disproven.

The first point of my hypothesis was proven correct by taking the means from the data, meaning that the A and V groups' scores did both in fact increase following the study. However, the statistical analysis found that the V-group's increase in scores was too small to be deemed statistically significant. There was too much probability that this increase was due to chance, such as a natural increase in comfort with the test on the second round. In other words, while the pre-test and post-test were compiled with a different set of letters, the increase in testing ability for the V-group could have simply been caused by better understanding the second round. The A-group had a much larger p-value than the V-group, and was found to be statistically significant. Therefore, this increase must have been due to a factor other than chance. Connecting back to the literature review, aerobic exercise strengthens working memory. This experiment concluded that dance certainly activates auditory memory. It could

possibly activate visual memory, but it was too small of an increase in scores to be certain.

The second point of my hypothesis did not match my results. It became evident that dance had a larger effect on auditory memory compared to visual memory. For one thing, the p-values were not close as the A-group was $p = 0.00246$ and the V-group was $p = 0.2145$. Considering each group had the same letters, this is a substantial difference in test score enhancement. Possible reasons for greater auditory memory enhancement from dance could be the action of doing steps after a teacher simply says them aloud, or it could be connected to the usage of memorizing steps to music.

Looking deeper into the individual scoring, more can be revealed as well as bring up new questions. In particular, I noticed when grading the auditory round two tests that almost every participant got the same letter wrong. Referring to table 1, even participants like C and D who had scored a 10/10 the first test dropped to a 9/10, both getting that same letter wrong. Re-evaluating the audio, I heard that the letter pronunciation had sounded similar to the way a previous letter was pronounced. This may have led participants to mark that they had already heard the letter and could be a flaw in the auditory memorization portion. An important point to realize is that in the visual memory tests there was not an instance such as this where many people got the same wrong answer, showing that mixing up the letters was less common.

Conclusion

A new understanding in the field of dance and memory can be recognized. Sensory memory's connection to dance had not been evaluated prior to this study. Ultimately, the experiment demonstrated that both auditory and visual memory are enhanced by dance for those ages 9-17. To clarify, the age range itself can also be considered a new understanding, since there is a lack of studies investigating dance and memory in this age range. The enhancement of both types of memory proved the first part of the hypothesis, which was driven by the idea that dance's exercise and cognitive components combined would strengthen sensory memory as a whole.

An additional understanding can be derived from the experiment; the auditory memory enhancement was greater than the visual memory enhancement. This contradicted my original hypothesis, as antecedent research found that general exercise seemed to have a strong enhancement on visual memory with only a slight enhancement on auditory memory. The cognitive thinking component of a dance class could have been what separated the large visual memory enhancement in general exercise from the small visual memory enhancement in dance.

Limitations

In order to gather the most reliable information, I made the deliberate decision to gather participants who went to the same dance studio. While the number of participants in my study was similar to the amount of participants found in prior studies relating to this topic, a larger sample size could have given me more accurate data. Additionally, a sample that included both males and females could make even more conclusive discoveries on sensory memory and dance.

Another limitation could be unfamiliarity of the test. Directions on how to take the test were explained verbally and written on the top of testing sheets for both groups. In spite of this, it must be remembered that the N-back test is not commonly used among this age group. First time exposure could have left participants overwhelmed and led them to answer incorrectly. Thus, the results could have been tainted by simple confusion.

Implications

The results obtained from this experiment add to the body of knowledge of dance's specific effect on memory. With this in mind, it can be incorporated into real life to positively change the way people memorize in-

formation.

Firstly, since the study focused on those who are part of a competitive dance team, applying the results to these teams is a good way to start. In essence, dance teachers could start incorporating more auditory methods of delivering choreography to their students for memorization. For instance, since auditory memory was found to be more enhanced during a dance class, presenting new choreography by saying the moves could prove to be more effective than simply showing them. Dance routines that are used for a competition team are normally rehearsed once a week, and must be learned and perfected on a tightly packed schedule. Therefore, being able to teach dancers choreography as fast as possible is important.

For broader implications, the information that dance enhances auditory and sensory memory can be incorporated into education. Adding dance and movement into classrooms should be encouraged in order to activate parts of the brain associated with memory. Teachers should apply the new understanding gathered from this experiment, which was deliberately run on people in the midst of their years of schooling, and try to use it to their advantage. Having students do dance type movement before being exposed to new information has been scientifically proven to help them retain more information. Moreover, connecting the results of the study with what is known through the literature review, dance type movement also has the potential to help memory retention in a wider variety of ages, including adults and seniors.

Future Directions

Memory itself is complex, especially when combined with a specific type of physical activity. This opens many doors pertaining to areas of future research. For starters, this study was unable to provide a definitive explanation for the patterns in memory enhancement found. Future research using MRI technology could potentially pinpoint what parts of the brain are the reason for increased sensory memory following a dance class.

As mentioned above in the limitations section, only females were able to be obtained for this study. Future research comparing male and female memory enhancement with dance could be another interesting angle for this topic. In addition, changing the variable from type of memory to type of dance class is another area that can be further studied. For example, there could be an experiment investigating a certain type of memory enhancement following a ballet class compared to a hip hop class.

Lastly, a researcher could run this experiment but focus on an older age group such as adults or even the elderly. This data compared to the data obtained from my experiment would determine if auditory and sensory memory enhancement with dance differs by age. The possibilities will help add to the conversation of preserving one of the most essential factors of a successful life: memory.

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