Comparing Short-term Memory in Musicians and Non-musicians

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[1] YThis study was conducted in 2018 when the author was a high school student.

Abstract

This study investigated whether musical training is associated with enhanced short-term memory. A sample of 14 high school students, both musicians and non-musicians, completed four memory tasks measuring verbal and visual memory. Two tests were administered online using Human Benchmark tasks, and two were paper-based, assessing recall of word and letter sequences. Although overall group differences were not dramatic, musicians generally performed above the average in all four tasks, while non-musicians scored below the average. These findings suggest that musical training may contribute to improved short-term memory performance, possibly due to enhanced focus, auditory processing, and cognitive control developed through regular music practice. Participant engagement was high, and many showed curiosity about their scores. Future research could expand on these findings by including a larger and more diverse sample and exploring long-term memory differences as well.

Background

Music is known and practiced throughout every culture in the world. I want to see if music is associated with superior short-term memory. Music is a study of repeating patterns and memorising music, therefore, it is already related to short-term memory. Neuroscientific research shows that musical training has positive effects on the brain (Schellenberg, 2005). The benefits of musical training can last into adulthood. Showing a causal relationship between playing music and enhanced memory is challenging because memory plays an important role in musicianship. This begs the question of whether people with better memories are more likely to become musicians in the first place. This concern generalizes; for example, accountants are likely to have good raw ability in numeracy. This line of questioning quickly comes up against an even more vexing issue: it is not known what the nature of musical ability is. There is some research that associates environmental variables with later prowess in music (e.g., Swaminathan & Schellenberg, 2018). Perhaps a more ideal experiment would compare monozygotic twins where only one of the twins studied and played music from a young age while the other did not.

I am going to investigate correlations between musicianship and short-term memory. I am going to bring my participants into a quiet room with no distractions and take them through a series of tasks that will quantify their short term memory skills.

Review of Literature

In 2010, a study exploring auditory working memory was conducted by Pallesen et. al. In this study, musicians' and non-musicians' cognitive skills in auditory working memory were compared by measuring the blood oxygenation-level dependent (BOLD) activation signal. Musical sounds were used to determine the relation among performance, musical competence

and generally enhanced cognition. There were 10 non-musician participants from age 22-31 and 11 classical musicians from age 21-34. The stimuli used in the experiment were nine different chords in the categories of "major", "minor" and "dissonant". After each chord was played, participants pressed either the left or right button on a response pad. The participant pressed the left button when a chord matched one from the previous trial and the right button when a chord matched one from two trials back. In the previous two trials, the participants always pressed the right side. The data and oxygen levels were then collected. The authors hypothesized that musicians would perform better in the tests. It was found that musicians had a higher BOLD response and that they could react quicker and sustain attention and cognitive control better. The results confirmed that the brain's activity increases during enhanced working memory performance. They also imply that a musician's increase in working memory depends on previously gained cognitive skills.

Brandler and Rammsayer (2003) compared musicians and non-musicians by examining different aspects of intelligence, such as verbal comprehension, word fluency, reasoning, space, and perceptual speed and memory. The participants were divided into two groups: the musicians and the non-musicians. The musicians group comprised 20 females and 15 males (all in their mid to late 20s). The non-musician group comprised 19 females and 16 males (all in their late 20s to early 30s). The scree test[2] supported a four-factor solution. The first factor was characterized by verbal comprehension, space, perceptual speed and number. The second factor was characterized by reasoning. The third factor was related to memory. The fourth factor concerned word fluency and closure. Each of the participants took a comprehensive intelligence

[2] A method of deciding how many factors should be retained in any particular factor analysis.

test battery comprising several subtests, including verbal comprehension, word fluency, space, closure, and perceptual speed. They also took the short version of the German adaptation of Cattell's Culture Free Intelligence Test, Scale 3 (CFT). The results of each test did not show a significant difference in intelligence between musicians and non-musicians. However, it was shown that musicians had a much higher performance on verbal memory.

Franklin et. al. (2008) studied the effects of musical training on verbal memory. The study comprised two phases. In Phase 1, there were 12 musicians and 13 non-musicians. In Phase 2, there were 11 musicians and nine non-musicians. The musicians had to meet the following selection criteria: formal training in music beginning at age 10 or younger, at least nine years of continuous training in music, currently played and practiced at least 15 hours/week, enrolled in an undergraduate or graduate music program, and a self-rated sight-reading skill of 4 or better on a seven-point scale. The non-musicians had to have only ever played an instrument for one year or less. Participants were roughly equal in age, education, standardized testing scores (SATs), grade-point average (GPA), and scores on the Raven's Advanced Progressive Matrices Test. During Phase 1, a standardized memory test (the RAVLT) was used to test long-term verbal memory. In Phase 2, the same test was used, but there was articulatory suppression introduced. Working memory for verbal information was also tested using the reading-span and operation-span tasks. The Raven's Test showed no significant differences between musicians and non-musicians. However, Long-term Working and Verbal Working Memory tests showed a higher performance in musicians.

Taken together, the reviewed studies point to musical training correlating with increased verbal short-term and long-term memory, and these can be enhanced with practice. Each of the

three studies showed me that there is a slight difference between musicians and non-musicians intellectually. However, musicians tend to excel considerably more in short and long-term memory.

Methods

On January 17-22, 2018, I conducted my experiment. It took place in the library at Elphinstone Secondary School, during thee lunch periods. First, I took note of the participants' age and gender and whether they were musicians or not. I used four quizzes to test memory (see below). I gave the first two quizzes using a computer. One was called “The Verbal Memory Test”, from thehumanbenchmark.com. Words appeared one by one, and the participants' job was to decipher if the word had been repeated. I then gave them a different quiz from thehumanbenchmark.com. In that test a grid became larger at higher levels. White tiles would flash on the grid and then disappear again. The participants’ job was to remember and click where the white tiles had previously popped up. The second two quizzes I gave were written on paper. One was looking at a list of words and then writing them down by memory. In the last quiz, I held up a sheet of paper with a series of letters. The participant had to remember each of the letters in order and write them down on the provided sheet. Once all the participants had completed the quizzes, I gathered my data. I marked both of the written quizzes and recorded the achieved scores on the computer quizzes.

Written Quizzes

Trial #

1.

2.

3.

4.

5.

6.

7.

8.

Write down as many words as you can remember from the given list:

Trial #

1. U L

2. T Z M D

3. K X C E J O

4. A V C Y I S E H

5. L B F Q R P M U X

6. Z Q T C E B O U N R V

7. S Y W B O Z D L L G K O

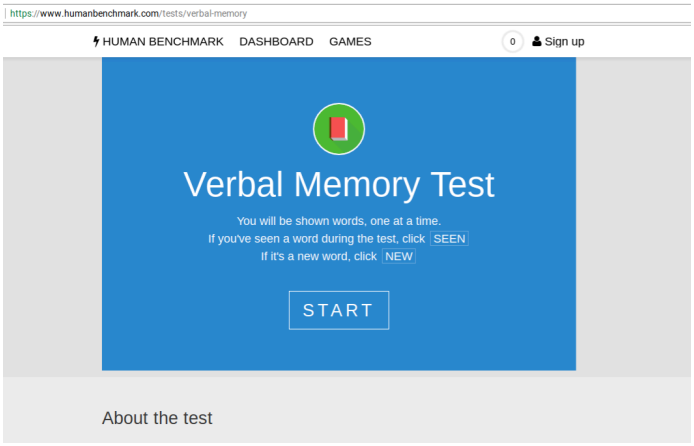
Answer Key

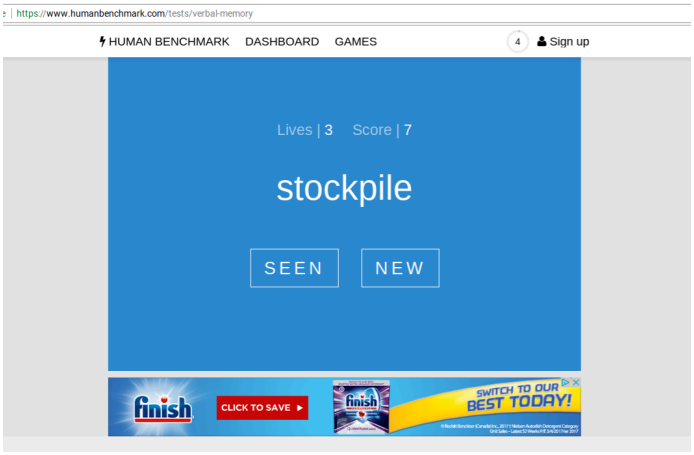
Write down as many words as you can remember from the given list:

Vase	Hat	House	Kangaroo
Tiger	Teapot	Orange	Shoes
Book	Camera	Lizard	Water
Cushion	Ice Cream	Pencil	Guitar
Piano	Card	Bedroom	Chair

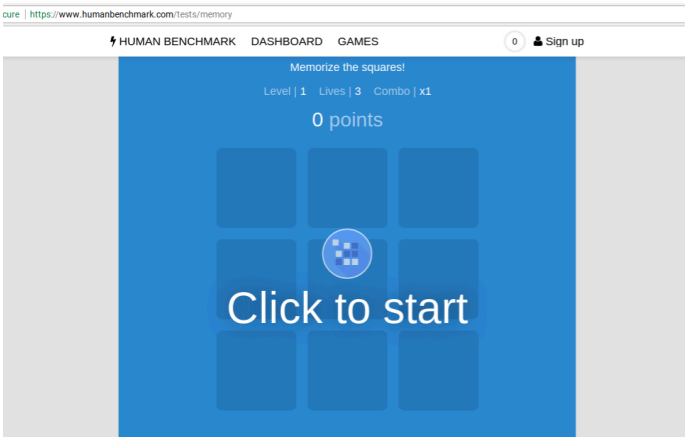
Answer Key

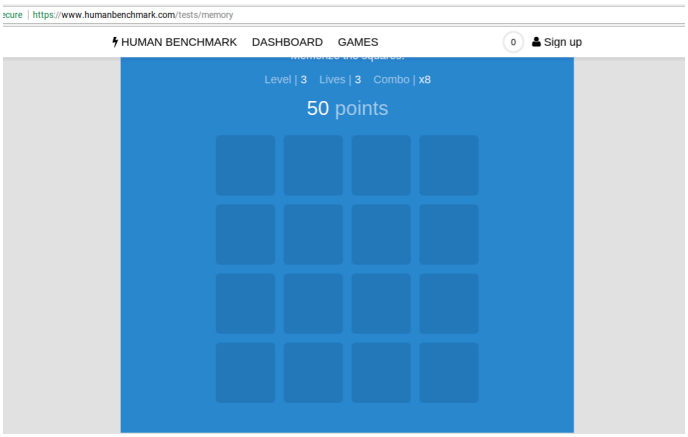
Verbal Memory Quiz

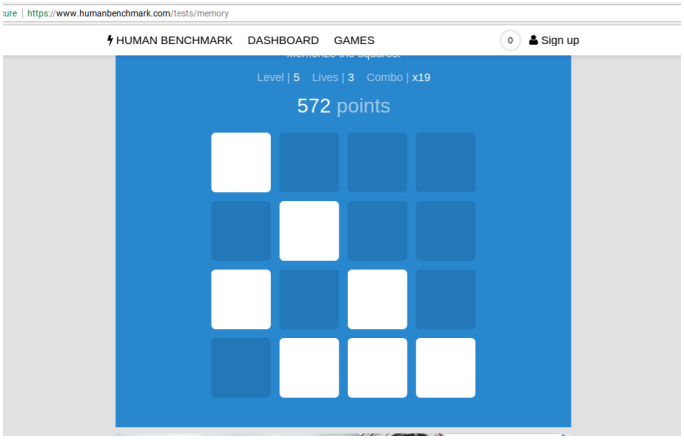




Visual Memory Quiz







Data

Participant	Age	Sex	Musician/ Non-musician	Verbal Quiz	Visual Quiz	Written Words	Written Letters
1	13	Female	Non	28	6534	16/20	48/52

2	13	Male	Musician	30	11871	20/20	39/52
3	13	Male	Non	82	5682	Incomplete	29/52
4	13	Male	Musician	57	16446	9/20	Incomplete
5	13	Male	Musician	47	7067	8/20	52/52
6	13	Male	Musician	58	9793	12/20	49/52
7	13	Male	Non	38	4239	9/20	39/52
8	13	Female	Non	13	3290	11/20	36/52
9	13	Female	Non	48	3412	7/20	33/52
10	15	Male	Musician	54	7713	10/20	46/52
11	15	Male	Musician	21	3789	9/20	44/52
12	15	Female	Non	50	10428	11/20	43/52
13	13	Male	Non	35	15751	12/20	48/52
14	15	Male	Non	63	14885	5/20	51/52

Averages: Verbal Quiz- 44.57

Visual Quiz- 8678.57

Written Words- 10.77/20=53.85%

Written Letters- 42.85/52=81.63%

Discussion

There were no large differences between musicians and non-musicians as evidenced in the quiz results. Nearly all of the quizzes taken by a musician scored higher than the average, while the non-musicians scored lower. Some of the musicians even had perfect or extremely high scores. This suggetss that the musicians may have had an advantage due to their musical training. Also, due to their musical training, it is possible that they have a better ability to maintain focus on task-relevant stimuli, a skill that is crucial to working memory. I found that often when participants were doing the written letters quiz, the non-musicians showed frustration and were discouraged. The musicians did not seem to show any signs of frustration. I found that a lot of the participants used a technique of making sounds and words out of the series of letters on the letters quiz. Many people enjoyed doing both of the quizzes on www.thehumanbenchmark.com. Nearly half of the participants wanted to know their score and if they got the highest one. If I had the chance to make any changes in my study, I would have gathered more participants of a larger age range. An additional experiment that could expand my study could be to determine the differences in musicians and non-musicians in long-term memory.

Conclusion

The results of my experiment suggest there is a modest difference in working memory between musicians and non-musicians. The distinction is not extreme but noticeable. The musicians displayed a higher skill in short-term memory.

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Swaminathan, S., & Schellenberg, E. G. (2018). Musical competence is predicted by music training, cognitive abilities, and personality. *Scientific Reports*, *8*(1), 9223.