Working Memory in Musicians Versus Non-musicians: A Differential Study Using the N-back Task

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WORKING MEMORY IN MUSICIANS VERSUS NON-MUSICIANS: A DIFFERENTIAL STUDY USING THE N-BACK TASK

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The current study investigates whether long-term musical training and practice are associated with greater working memory abilities. Other studies have shown that musicians have cognitive advantages over non-musicians, including working memory. Forty-six college-aged participants were given an auditory-spatial N-back test. The N-back test requires participants to determine whether or not each auditory and spatial stimulus in a sequence matches the stimulus presented N stimuli ago. In this study, $N=2$. The score on this test serves as the dependent variable and whether or not the participant is a musician is the independent variable. Participants were classified as either a musician or non-musician based on their years of musical training. Comparing N-back scores between musicians and non-musicians showed no significant differences. Since other studies have shown that musicians do have better working memory skills, this study may have lacked true professional musicians and a large sample size.
INTRODUCTION

Short-term Memory vs. Working Memory (WM)
- Short-term memory helps us remember things from the near past
- WM is the ability to keep up with certain stimuli from the near past to achieve a goal

Types of WM
- Visuospatial
- Object
- Auditory
- Verbal

This study focuses mainly on visuospatial and auditory WM
INTRODUCTION

Working Memory in Musicians

- Other studies found that musicians perform better on tests of WM
- Musicians also excel in various complex cognitive abilities such as auditory WM, non-word span, musical sound, and central executive WM

Types of Musicians

- Improvisation
- Sheet music reading
- Improvisers rely more on creativity and aural skills than on the visuospatial aspect of reading music
THE PRESENT STUDY

Pallesen et al (2010) found that “musicians recall visual patterns of successive musical notes better than non-musicians,” and this will be tested using the N-back task because it is essentially the same pattern but with box locations.

Hypothesis

- Musicians will have a higher score on the N-back task due to a more developed working memory

Variables

- IV: Musicality
- DV: N-back score

Purpose

- Determine whether or not musicality is beneficial as a working memory enhancer
METHOD

Participants
- 47 college students from Cedarville University
- Randomly selected from general psychology courses
- Volunteered through campus e-mail

Experimental Design
- Differential design
  - Musicians (7+ years of music experience and practice)
  - Non-musicians (< 7 years of music experience and practice)

Measures
- N-back task
Figure 1. Example of the N-back task with the stimulus material used in Experiments 1 and 3. A response was required whenever the current stimulus matched the stimulus one, two, or three positions back in the sequence. The task was performed as a single task with auditory-verbal or visuospatial-nonverbal material only, but also as a dual task, where the attention had to be divided between two tasks presented simultaneously in each modality as shown in the example.
THE N-BACK TASK
A unique feature of sheet music is that a note on one line of the staff can represent several notes depending on the accompanying marks:

![Musical Staff with Sharp, Natural, and Flat Notes](http://upload.wikimedia.org/wikipedia/commons/7/7c/accidentals-and-octaves.png)

![Musical Staff with F# Notes](http://0.tqn.com/d/piano/1/0/I/G/-/-/accidentals_music.png)

Placed as:

F#  F#  F

Musicians must remember which note it should represent anywhere from 1 to 12 beats which is why WM is so important for musicians who read music.

In the same way that musicians must remember a note’s value from 1-to 12-back, participants of the N-back task must remember if a letter is the same as the one 1- to 4-back.
METHOD

Procedure

- Participants completed the task on a randomly selected computer in a computer lab.
- Each computer had a random number on it which served as the participants’ label.
- Participants watched the demonstration of the task.
- Participants completed three rounds of the task:
  - Dual
  - 2-back only
- Researchers recorded scores.
- When finished with the task, participants filled out a brief questionnaire:
  - Labeled with same participant number as computer.
  - Questionnaire determined musicality.

METHOD

Questionnaire

- Do you play piano?
- Do you play any instruments?
- Do you sing?
- Have you taken private music lessons? How many years?
- How often do you play your instrument/sing?
- Compare your musical ability to that of your peers
- Questionnaire also asked questions about participants' major and academic standing as well as athletic ability to hide the intent of the questionnaire
RESULTS

Table 1. Independent Samples t-test for Equality of Means

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<tr>
<th></th>
<th>Musicians</th>
<th></th>
<th>Non-Musicians</th>
<th></th>
<th>t*</th>
<th>df</th>
<th>Sig. (2-tailed)</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
<td>N</td>
<td>M</td>
<td>SD</td>
<td>N</td>
<td></td>
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<tr>
<td>R1A</td>
<td>15.5238</td>
<td>2.35837</td>
<td>21</td>
<td>15.5769</td>
<td>2.08179</td>
<td>26</td>
<td>-.112</td>
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<tr>
<td>R1V</td>
<td>14.4762</td>
<td>2.20497</td>
<td>21</td>
<td>14.8846</td>
<td>1.65715</td>
<td>26</td>
<td>.583</td>
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<tr>
<td>R2A</td>
<td>16.0952</td>
<td>2.23394</td>
<td>21</td>
<td>17.0385</td>
<td>2.00959</td>
<td>26</td>
<td>1.120</td>
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<tr>
<td>R2V</td>
<td>15.1429</td>
<td>2.55511</td>
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<td>16.0385</td>
<td>2.39133</td>
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<td>.961</td>
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<tr>
<td>R3A</td>
<td>16.3810</td>
<td>2.35534</td>
<td>21</td>
<td>16.2308</td>
<td>2.43816</td>
<td>26</td>
<td>-.532</td>
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<tr>
<td>R3V</td>
<td>15.7143</td>
<td>2.41128</td>
<td>21</td>
<td>15.5000</td>
<td>2.30217</td>
<td>26</td>
<td>-.761</td>
</tr>
</tbody>
</table>

*P > .05


After conducting an independent samples t-test, no significant differences were found.
DISCUSSION

Limitations

- Expert musicians surpass amateurs’ scores on WM tests (Hansen, Wallentin, & Vuust, 2012), so the extent to which one immerses in auditory and visuospatial greatly affects the extent to which WM will be elevated.
- Small sample size

Implications and future research

- Future research should be done using professional musicians
  - Play by ear v. play with sheet music
  - Years of practice v. ability
- No other studies have been done utilizing both musicians and the N-back task
REFERENCES


