CAH Interdisciplinary Research Award Final Report

"Music may improve brain functions" (Dr. Yonetani, Dr. Fiore and Dr. Sugaya)

This is still on-going research, and I, Ayako Yonetani, am reporting our effort and result so far.

Grant Submissions:

National Endowment for the Arts Creativity and Aging in America Submission Program
Only one from the university was allowed to submit the application for the NEA Creativity grant. Our application was not selected by the office of research.

Johnson & Johnson Grant
This was also a limited submission from UCF similar to the NEA Creativity grant. UCF office of research selected us to apply for this grant. However, we did not pursue the application since the university is not a member of the organization, and we needed to pay a membership fee to just apply for this grant. With the advice from ORC, we decided not to apply for the grant.

IFMR (The International Foundation for Music Research) Grant
The IFMR grant went through ORC. Principal investigator was Dr. Kiminobu Sugaya, since we had to go through non-profit organization or foundation to apply for the grant. The title of the proposal was "Effect of music on cognitive function in the elderly population"

Experiment 1
Our first study was conducted utilizing an elderly group with UCF ties through their organization LIFE. Although we observed that classical music affects the brains frontal lobe function, there were great variations. This may be due partially because there were so many uncontrolled conditions in our first experiment. The ratio of proctors to test takers was 12:200. The 12 student assistants that were used could not control the collection of the timed tests and as the Elderly people were too eager to achieve success, many of them continued answering past the allowed time. There were too many people who completed the test although it is less likely for any
human being to be able to finish the problems within the given time. However, we found some of the people significantly improved their cognition while some of them did not responded. This result indicates that people are responding to the music in the different manners.

Experiment 2
Two studies have been done with Honor’s students enrolled in the “Music and the Brain” class. This was a rather informal study, and the environment was not controlled well. However, they showed significant improvement in their brain function after listening music.

The above three experiments definitely show the difference in cognitive performance (simple math test) after people listen to music. Based on these studies, we hypothesized that music affects the brain function in a personal specific manner. After these experiments we started focusing on elderly people because such a study has never done conducted on the elderly population. We are currently trying to differentiate the responder and non-responders. The following study was originally scheduled to conclude in July, but due to the difficulty of setting in a community with elderly population, we had to postpone to the beginning of August.

Experiment 3

Methods

Participants
A total of 18 people participated in the study. Of those 18 participants, 4 of them either did not follow directions, or did not complete the study, and were, therefore, excluded from the analysis. Of the 14 remaining participants 3 were male and 11 were female. The average age of the male participants was 74.67 years (SD = 12.22), and the average age of female participants was 75.82 (SD = 6.42).

Design
A 2 x (2 x 2) mixed between and within design was used with mood (higher mood versus lower mood) as the between factor and with time of the test (pre versus post) and test type (Paper Folding Test versus Math Test) as within participant factors (refer to Table 1).
Table 1. Conceptual representation of experimental design.

<table>
<thead>
<tr>
<th>Mood</th>
<th>Timing of Test and Test Type</th>
<th>Pre-Listening</th>
<th>Post-Listening</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Math Test</td>
<td>Paper Folding Test</td>
<td></td>
</tr>
<tr>
<td>Lower Mood</td>
<td>Math Test</td>
<td>Paper Folding Test</td>
<td></td>
</tr>
<tr>
<td>Higher Mood</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Testing Stimuli
Cognitive Questions. Participants were asked to complete a short battery of tests assessing differing cognitive abilities. This included a subset of basic arithmetic questions and a test of visuo-spatial processing as assessed by the Paper Folding Test. These tests were divided in half for the pre- and post-test administrations.

Affective Questions. Following the procedure of Thompson, Schellenberg, and Husain (2001), to measure mood, participants were asked to provide a global rating of mood and arousal on a scale from 1 (sad) to 7 (happy). The specific instructions were as follows:
Please use the scale provided to circle a number that corresponds to your current mood state. Any “high-energy” mood you may currently have should be placed at the high end of the scale. Or, any “low energy” mood you may currently have should be placed at the low end of the scale. For example, feelings of meditation, contemplation, or melancholy should be assigned low ratings.

Music Listening Preference Scale. Participants were asked to rate the degree to which they like classical music on a scale from 1 (Dislike Strongly) to 7 (Like Strongly).

Results
Our overall goal with this pilot study was to determine if changes in mood resulting from listening to an arousing piece of classical music might lead to changes in cognitive performance. As such, in order to determine how classical music may affect cognitive functioning, we analyzed first how mood was affected by listening to the piece. Specifically, because the impact of music on cognition may be due to changes in mood states, we compared participant performance based upon the nature of their mood...
change. First, a difference score was determined based on pre and post ratings of mood. This was done by subtracting the mood score pre-listening from the mood score post-listening (so that a positive score would indicate an improvement in mood). Two of the participants did not make a mood rating (one at pre and one at post), and were therefore excluded from the analysis, leaving 12 participants for analysis. Second, a median split was made to create two groups, those whose difference score was above the median and those whose difference score was below the median. This then became the basis for the analyses that are discussed next.

Distribution of Difference Scores Based Upon Mood Change
A difference score was calculated for the Math Test and the Paper Folding Test such that a positive number indicated improvement in performance (i.e., post-performance – pre-performance). Figure 1 illustrates the distribution of performance scores across test type and mood change, that is, the difference scores calculated for the Math and the Paper Folding Test (PFT).

![Figure 1. Distribution of Difference Scores across Test Type and Mood Change](image-url)
Influence of Mood Changes on Cognitive Tests

We analyzed the difference scores with a 2 x (2) mixed between and within repeated measures ANCOVA with mood (high versus low) as the between factor and with test type (Paper Folding Test versus Math Test) as the within participant factor. Self-reported liking of classical music was entered as a covariate. There was no main effect of mood ($F < 1$), or of test type $F(1, 9) = 2.35, p > .05$. But, on difference scores, there was a significant 2-way interaction between test type and higher versus lower mood, $F(1, 9) = 6.56, p < .05$ (refer to Figure 2). As illustrated in Figure 2, for participants whose mood was lowered, there was a large increase in performance on the Paper Folding Test, but little change for the Math Test. For participants whose mood was raised, there was little change in the Paper Folding Test but more change in the Math Test.

![Figure 2](image_url)

**Figure 2.** Two-way Interaction between Test Type and Mood Change on Difference Scores

**Discussion**

With this pilot study we set out to determine if listening to classical music would demonstrate any changes in performance on a set of cognitive tests. Our goals were first, to identify those participants who responded and those who did not respond to listening to classical music, and second, to determine how changes in mood might influence cognitive performance. Based upon prior studies with young adults, it was hypothesized that, for those participants whose mood was elevated, there would be an increase
in performance. While we were able to determine whose performance changed based upon listening to classical music, the overall pattern of results was not as hypothesized. Specifically, counter to our expectations, while there were effects of mood changes, the largest impact was on those participants whose mood was lowered. There was a greater improvement in performance between pre and post tests on the Paper Folding Test for participants whose self-reported mood had been lowered. Although those reporting a positive mood change did better on the Math Test following listening to classical music, this change was not as great.

These data warrant additional experimentation to clarify the findings. First, a larger sample must be run in order to determine if the effects are consistent. Second, additional manipulations need to be included so as to determine the impact of listening to arousing versus depressing classical music (cf. Thompson et al. 2001). Third, a more carefully controlled setting should be used for the experiment; that is, one where participants are in a sound-proof room, free of external distractions. Specifically, the current data was collected in a large hall and with a group data collection format. As such, it is possible that this decreased the possibility of changes in performance after listening to music. In sum, the findings from this preliminary study suggest intriguing possibilities with regard to the influence of listening to classical music and cognitive functioning in the elderly.
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