

Music and Memory an Electrophysiological Study

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Abstract

It has been theorized that listening to Mozart improves certain cognitive functions such as memory, learning, and attention. Although, there have been numerous attempts to study these phenomena, most have been mere behavioral studies¹. By integrating Mozart sonatas into simple memory tasks given to subjects connected to an electroencephalogram, this study has attempted to explore the effects of music specifically on memory function by correlating differences in event related potentials (ERPs) to behavioral results.

Initial Hypotheses

If listening to Mozart does in fact increase one's ability and speed to recognize familiar stimuli then the music should have the following effects:

- Increase amplitude of components following recognition of familiar stimuli
 - Decrease latency of components following recognition of familiar stimuli
- **These effects should correlate to the behavioral results (scores on memory tasks)**

Methods

Three memory tasks, consisting of a study and test period, were administered in random order for each subject. Behavioral and Event-Related Potentials (ERP) data were recorded at this time. Each task included a study period where no data was recorded and participants were asked to memorize a set of thirty symbols. The symbols were displayed in a sequence that repeated once for each condition. In each testing condition which followed, familiar symbols were mixed randomly with an equal number of novel symbols. During the testing session, symbols were displayed in pairs separated by four seconds of music or no music. Participants were asked to type "1" for every familiar object and "3" for every unfamiliar object.

Participants

- 15 Participants were recruited through advertising in publications (CBD bulletin) and all-campus e-mails as well as word of mouth. All participants were promised and received monetary compensation for their time (\$10 for one study or \$15 for two)
- Participants were asked not to participate if they had imbibed in alcohol or other psychoactive chemicals in the last 48 hours or are on any medications for mental illness.
- Participants were all right-handed.
- 5 participants' data were removed due to poor quality data. 10 participants (4 male, 6 female) were used for final analysis.

Methods (cont.)

3 Memory Tasks

- Task 1:
 - Mozart Piano Sonata No. 6 in D Major playing continuously (2 min) in the study session and
 - Same music in the testing session, spliced into four-second segments.
- Task 2:
 - Mozart Piano Sonata No. 16 in C Major playing continuously (2 min) in the study session and
 - No music in the testing session.
- Task 3:
 - No music in either condition.

Results

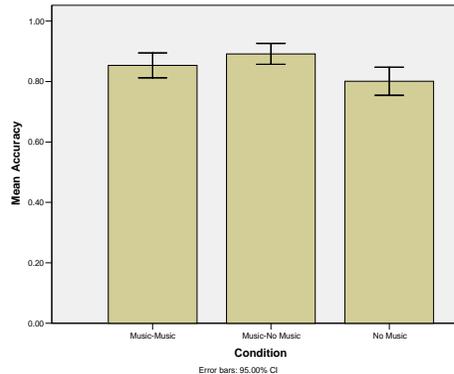
Mean Accuracy and Reaction Time Scores

| Condition | Mean Accuracy (%) | Mean Reaction Time (ms) |
|----------------|---|-------------------------------|
| Music-Music | 85.36 <i>SD</i> = 10.59 | 1026.99 <i>SD</i> = 238.95 |
| Music-No Music | 89.17 _a <i>SD</i> = 8.92 | 1119.46 <i>SD</i> = 349.77 |
| No Music | 80.12 _b <i>SD</i> = 12.02 | 1941.55 <i>SD</i> = 282.96 |

_{a, b} Letters indicate tasks with significant differences in relation to each other ($p < .01$)

Behavioral Data

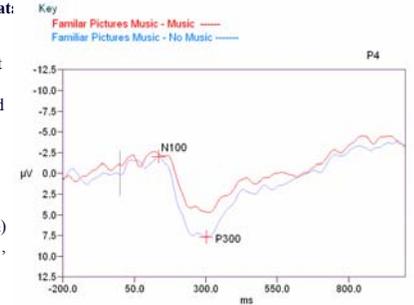
- Accuracy was significantly better in Task 2 (music-no music) compared to Task 3 ($p < .01$).
- Reaction times were not significantly different across tasks. ($p > .05$).



Results (cont.)

Electrophysiological Data:

- There was a significant difference in amplitude at the P4 electrode between Task 1 (music-music) and Task 2 (music-no music) * $t(14)=2.30, p=.037$
- There was a significant P300 across conditions. * 3 (electrodes FC,CZ,PZ) x 3 (Task) MANOVA, $F(2,46)=3.91, p=.027$



Discussion

- Behavioral results suggest that memory accuracy in Task 2 (music-no music) is greater compared to task 3 (no music). While not significantly correlated with behavioral data, the P300 amplitude was also greatest in Task 2. This may indicate that listening to Mozart during the encoding period strengthens the subject's neural connections involved in recognition memory. However, further study is needed.
- Although not significant, Task 1 showed smaller P300's as compared to Task 2. One hypothesis for this is that the musical cues before each memory test in Task 1 are distracting and reduce memory.
- There were no observed changes in component latencies among the three conditions and no significant differences in reaction times. This suggests these findings suggest no changes in speed of processing as a function the presence of music during study or test periods.

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