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Reaction Times and Decision Making To Auditory Stimuli in Musicians and Non-Musicians

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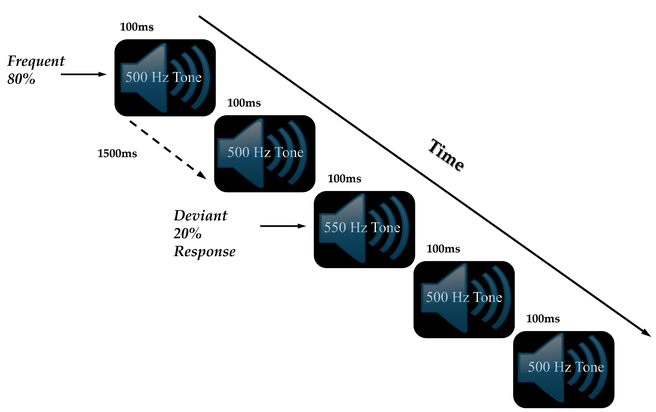
Introduction

Previous research investigating working memory functions between musicians and non-musicians has demonstrated differences related to music experience in auditory reaction tasks. This body of research suggests music experience may be related to faster reaction times to auditory stimuli. In addition to recording reaction times by clicking a mouse while listening to a tonal odd-ball, participants in the current study performed six subtests of the TOMAL-II, a standardized measure of working memory ability, documenting participants visual, auditory, and executive functioning. We hypothesized that the means of performance on all six subtests of the TOMAL-II will be higher in the musician group compared to non-musicians. Additionally, musicians will on average record faster reaction times to deviant tones. Results of the current study will contribute to the understanding of differences in cognitive processing related to long-term music experience.

Methods

- Participants: 18 neurologically healthy individuals. 6 Musicians (*M* age = 29.67, *SD* = 5.62) and 12 Non-Musicians (*M* age = 22.29, *SD* = 1.40). Musician's were defined as those that met criteria of at least 7 years of consistent practice in the same musical modality up to the time of the study and currently play in a group or take lessons.
- Stimuli: Auditory odd-ball detection task (see Figure 1)
- Behavioral Measures: TOMAL-II and Reaction time to deviant auditory stimulus recorded from a mouse click reaction.
- TOMAL-II Measures: Working memory performance on 6 subtests, Digits Forward (DF) and Letters Forward (LF) subtests targeting phonological memory, Abstract Visual Memory (AVM) and Memory for Location (MFL) subtests targeting visuospatial memory, and the Digits Backward (DB) and Letters Backward (LB) subtests targeting executive working memory.

Auditory Odd-Ball Task

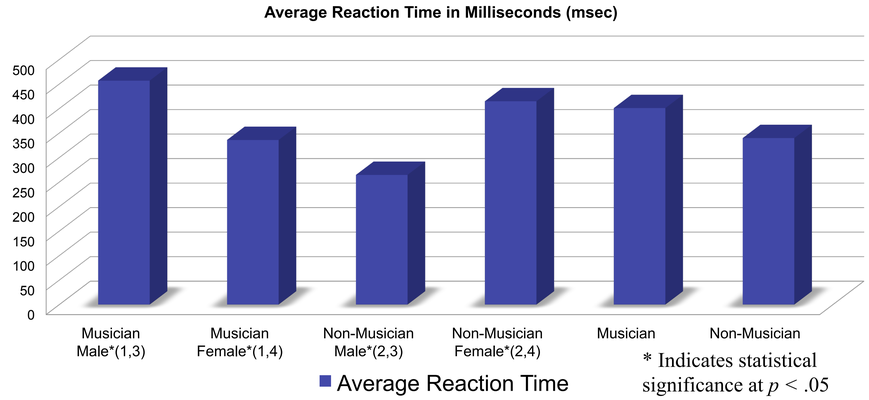


TOMAL – II Standard Scores [Mean and (SD)]

	AVM	MFL	AvgV	DF	LF	AvgP	DB	LB	AvgE
Musician	12	**13.38***	12.69	12.88	13.13	12.99	**12.26***	**12.88***	12.57
	(1.04)	(1.03)	(1.04)	(.92)	(1.16)	(1.04)	(.95)	(1.02)	(.99)
Non-Musician	10.68	**9.55***	10.12	10.9	10.2	10.55	**9.68***	**9.66***	9.67
	(.71)	(.7)	(.71)	(9.57)	(.8)	(5.19)	(8.30)	(.69)	(4.5)

* Indicates significance at $p<.05$

Mean Reaction Time Scores



Means and Standard Deviations

Table 1

Means and Standard Deviations for Participant Reaction Time

	M	*SD*
Musician	400.7	51.34
Non-Musician	339.53	35.071
Musician Male	**456.71***	**59.28***
Musician Female	**335.67***	**83.84***
Non-Musician Male	**264.433***	**59.28***
Non-Musician Female	**414.62***	**37.49***

* Indicates significance at $p < .05$

Results

- MANOVA on the combined 7 dependent variables (Abstract Visual Memory, Memory for Location, Digits Forward, Letters Forward, Digits Backward, Letters Backward and Reaction Time) showed a statically significant interaction of Musician Status and Gender [λ *(7,10)* = 3.513, $p < .05$, *partial eta* = *.71*].
- Follow-up ANOVA tests indicated statistical significance for an interaction of Musician Status and Gender on Digits backward [*F (1,16) = 8.392, p < .05, partial eta*^{2} *= .34*] as well as Reaction Time [*F (1,16) = 5.079, p < .05, partial eta*^{2} *= .24*]
- Main effect of Musician Status indicated Musicians scored significantly higher on tests of Memory For Location [*F (1,16) = 9.44, p < .05, partial eta*^{2} *= .37*], Digits Backward [*F (1,16) = 5.03, p < .05, partial eta*^{2} *= .24*], and Letters Backward [*F (1,16) = 6.89, p < .05, partial eta*^{2} *= .30*].

Discussion

Data demonstrates reaction time differences appear to be modulated by both music experience as well as gender differences. A trend toward statistical significance existed in the test of reaction times between musicians and non-musicians. Therefore, significant results for reaction time may be reached with greater amounts of participants and by using a more subtle auditory difference for the odd-ball stimulus. The current study adds support for research demonstrating improved processing of pitch information in individuals with greater amounts of music experience (Musacchia, Sams, Skoe, & Kraus, 2007). Furthermore, we partially replicated research suggesting individuals with greater amounts of music experience record higher scores on tasks related to spatial processing and executive functioning (George & Coch, 2011).

References

George, E. M., & Coch, D. (2011). Music training and working memory: an ERP study. *Neuropsychologia*, *49*(5), 1083-1094.

Musacchia, G., Sams, M., Skoe, E., & Kraus, N. (2007). Musicians have enhanced subcortical auditory and audiovisual processing of speech and music. *Proceedings of the National Academy of Sciences*, *104*(40), 15894-15898.

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