Neural and Behavioral Evidence of Working Memory Differences in Musicians and Nonmusicians
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INTRODUCTION
While it has been suggested that music training improves working memory (e.g., Moreno & Besson, 2006), little research has been conducted to investigate the specifics of this relationship. For example, it is unclear which domain(s) of working memory might be affected: executive control, auditory, or visual working memory. The P300 component of the event-related potential (ERP) is sensitive to updates of working memory in oddball paradigms: In a series of standard stimuli, deviant targets reliably elicit more positive responses (P300) than standards (e.g., Polich, 2007). We measured and compared the P300 in visual and auditory oddball paradigms in musicians and nonmusicians.

METHODS
Participants
32 subjects: 16 musicians (8 female), 16 nonmusicians (8 female)
Average age: 20.1 (musicians); 20.4 (nonmusicians) (p = .617)
Monolingual; right-handed; no history of language, hearing, or neurological disorders; normal vision
Musicians: 9-16 years training, currently practiced 3-15 hours/week (none professional)
Nonmusicians: < 5 years training, prior to age 14

Standardized Behavioral Testing
Test of Memory and Learning (TOMAL-2)
Phonological Memory Subtests: Digits Forward (DF), Letters Forward (LF)
Visual Memory Subtests: Abstract Visual Memory (AVM), Memory for Location (MFL)
Executive Memory Subtests: Digits Forward (DF), Letters Backward (LB)

Stimuli
Auditory: 50 ms 800, 840 Hz tones; ISI 1450 ms
Visual: 50 ms; ISI 1450 ms
800 standards, 160 deviants per condition
Button press detection of deviants

EEG Recording
Bandpass .01-100 Hz
Sampling rate 4 ms
29 active electrodes

ERP Data Analysis
ANOВAs on ERPs to deviants [with factors group (musician, nonmusician), hemisphere (left, right), anterior-posterior (6 levels), lateral/medial]; main effects of group reported here
P300 peak amplitude and peak latency in auditory (250-550 ms) and visual (300-750 ms) conditions

RESULTS
Auditory P300 Peak Amplitude
Musicians: mean 5.62 µV (SD = 2.09)
Non-musicians: mean 3.49 µV (SD = 3.26)
Effect of group: p = .036

Auditory P300 Peak Latency
Musicians: mean 362.23 ms (SD = 37.34)
Non-musicians: mean 403.63 ms (SD = 55.97)
Effect of group: p = .01

Visual P300 Peak Amplitude
Musicians: mean 7.55 µV (SD = 2.44)
Non-musicians: mean 6.11 µV (SD = 2.78)
Effect of group: p = .131

Visual P300 Peak Latency
Musicians: mean 454.87 ms (SD = 52.81)
Non-musicians: mean 513.17 ms (SD = 64.99)
Effect of group: p = .004

Behavioral Tests: Effects of Group
Digits Forward (DF):
p = .06
Letters Forward (LF):
p = .07
Auditory Memory Average (AvgAM): p = .039

Visual Memory Average (AvgVM): p = .05

CONCLUSIONS
• Musicians demonstrated faster auditory and visual working memory updating
• Musicians allocated more neural resources, reflecting greater sensitivity to the standard/deviant difference, only in the auditory condition
• Musicians scored higher on standardized subtests of visual, phonological, and executive memory
• Music training was associated with selective improvements in working memory, on both neural and behavioral levels

REFERENCES

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