Brain Mechanisms of Musical Chord Categorization are Modulated by Expertise

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Introduction

We studied whether brain mechanisms in response to a complex chord categorization task differ according to the musical background and listening strategies of the participants. To this aim, the categorization task used high-level abstractions of pitch combinations (chords), called set-classes, in order to be neurocognitively demanding even for expert professional musicians (Kuusi, 2003). With the use of passive and active categorization conditions, we intended to see whether the type of musical expertise selectively enhances either passive or attentive forms of music-sound neurocognition.

Methods

21 participants with professional musical education were divided into 2 groups: 11 'theorists' (students and teachers from Composition and Music Theory departments of music academies) and 10 'instrumentists' (professional musicians from instrument departments of music academies).

The sounds used for the experiment were chords of five pitches representing 2set-classes, differing clearly in their degree of consonance. Each set-class was represented by 15 chords: 3 voicings and 5 transpositional levels.

In a 'passive' condition, the frequently repeated chords of set-class 5-1 ('standards') were infrequently replaced by chords of set-class 5-35 ('deviants'). Subjects' task was to concentrate in watching a movie. In an 'active' condition, the same chords were presented, and subjects had to press a button whenever they heard a chord deviating from the context.

We recorded the electroencephalograph (EEG) with a 64-electrode cap. In order to obtain the event-related potential (ERP), the portions of the EEG time-locked to the stimuli were divided into epochs, averaged according to the stimulus categories, filtered, and baseline corrected.

Results and Discussion

In the passive condition the deviant chords elicited a negative brain response of small amplitude (in the order of -0.8 μV) peaking at around 150 ms of similar morphology, latency and scalp topography for both instrumentists and theorists. The polarity, latency and fronto-central scalp distribution of this response correspond to the notion of the MMN component of the ERP (Näätänen & Winkler, 1999).

The deviant chords in the active condition evoked the P300 component of the ERP (Picton, 1992) peaking at around 450 ms for theorists and at around 380 ms for instrumentists. The P300 was also more posteriorly distributed over the scalp for theorists than for instrumentists.

In our study, we contrasted musicians with a 'procedural' musical training, focused on the motoric practice of playing an instrument, to musicians with an 'analytic' type of musical training, emphasizing theoretical and productive approaches to sounds. These different musical trainings and listening strategies were reflected in the latency and scalp topography of the brain responses elicited during a demanding active task of chord categorization but not during a passive condition. This may imply that the musical expertise and listening strategies modulated the brain mechanisms activated during conscious attentional effort, rather than the neural processes involved with automatic processing and categorization of musical chords.

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