



Crossmodal effects of Guqin and piano music on selective attention: An event-related potential study

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ABSTRACT

To compare the effects of music from different cultural environments (Guqin: Chinese music; piano: Western music) on crossmodal selective attention, behavioral and event-related potential (ERP) data in a standard two-stimulus visual oddball task were recorded from Chinese subjects in three conditions: silence, Guqin music or piano music background. Visual task data were then compared with auditory task data collected previously. In contrast with the results of the auditory task, the early (N1) and late (P300) stages exhibited no differences between Guqin and piano backgrounds during the visual task. Taking our previous study and this study together, we can conclude that: although the cultural-familiar music influenced selective attention both in the early and late stages, these effects appeared only within a sensory modality (auditory) but not in cross-sensory modalities (visual). Thus, the musical cultural factor is more obvious in intramodal than in crossmodal selective attention.

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It is believed that music, as a culturally specific phenomenon, is influenced strongly by social environment and cultural traditions. Recently, several studies on cross-cultural music were reported by cognitive neuroscientists: cognition processes, such as musical synchronization [6], music phrase perception [17], music scale structure [22], allocation of attention resources [1], epilepsy [12], and voluntary attention [18], were influenced by culture-specific factors outside the domain of music itself. In contrast, other researches drew an alternative conclusion: they found that the perception of musical temporal processing [7], meaning [30], semantics [5], emotion [2,10], and the activation of neural resources [19] were not culturally dependent. Although some conflicting viewpoints on cross-cultural musical effects remain, it was proved that cultural factors play a role not only in music perception but also in other cognitive processes [1,12,18].

There are many studies about the effect of music on attention [10,11,27,28,34]. However, the effect of cross-cultural music on attention has not been studied thoroughly. In our previous study [18], we explored the effects of Chinese (Guqin) and Western (piano) music on attention. We replicated previous results [1

of culture-familiar musical effect in Chinese subjects: larger P300 amplitudes were observed in the Guqin background compared with piano music. In addition, we found a smaller N1 in the Guqin condition compared with piano background. Most previous investigations of cross-cultural musical effects on attention have focused on intramodal (auditory) influence. In reality, however, our attention is coordinated crossmodally. As many objects in everyday life provide us with information in more than one modality, it is advantageous to process stimuli in other modalities coming from the attended region [20]. Several studies [8,9,20,33] found evidence of crossmodal links in voluntary attention between vision and audition. In our previous study [18], we found Mozart effects on visual attention using the visual oddball paradigm. Thus, we suggested: can we find a cross-cultural musical effect by using the visual oddball paradigm? Is there a cross-cultural musical effect on crossmodal (visual) attention? Is the cross-cultural musical effect on intramodal (auditory) attention the same as on crossmodal (visual) attention?

The aim of this study was to explore the cross-cultural musical effects on crossmodal attention and to compare the cross-cultural musical effect on crossmodal and intramodal attention. To perform the comparison with the musical effects on auditory attention, we used the same experimental paradigm employed in our previous study [18]. EEG was recorded in all subjects during a simple cognitive task (two-stimulus visual oddball paradigm) in different backgrounds (Guqin, piano, and silence). We selected Guqin and piano music for the experiment. Guqin music occupies the most prominent position in Chinese classical music. It has been

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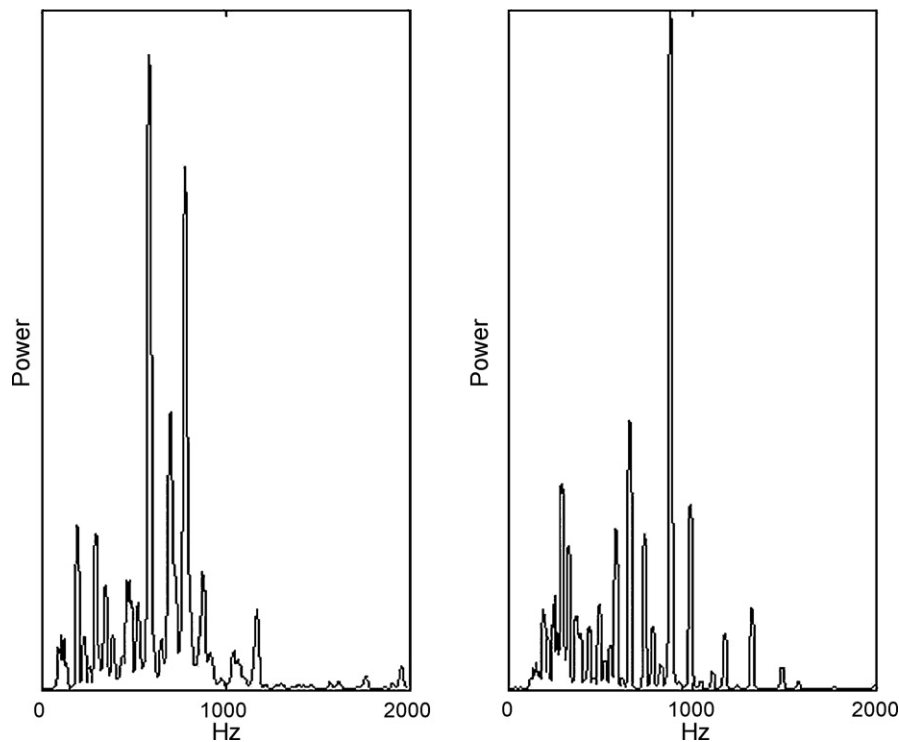


Fig. 1. Power spectra of Guqin musical pieces (left) and piano musical pieces (right) [18].

played since ancient times and has traditionally been favored by scholars and literati [15]. It is referred as “the father of Chinese music”. Thus, Guqin is considered as one of the symbols of Chinese civilization [24,35]. Finally, many studies used Guqin and piano music to represent Chinese and Western cultures, respectively [16,36].

Thirteen right-handed subjects participated in the visual experiment (seven females, six males). Their mean age was 22 years ($SD = 1.60$; range, 20–24). All subjects were from the same cultural background: they were reared in China and were educated at a formal university. They had not any formal training in music. Subjects reported normal hearing and vision, with no history of neurological disease. Subject was informed of the procedure of the experiment and provided a written consent to participate. The subjects were paid for their participation in the experiment.

All subjects performed a standard two-stimulus visual oddball task, which consisted of frequent standard stimuli ($P = 0.8$: green circle, which is a 1000 Hz tone in the auditory task) and infrequent target stimuli ($P = 0.2$: red square; which is a 2000 Hz tone in the auditory task) with a stimulus duration of 50 ms. The experimental session consisted of three blocks of 100 trials, with an inter-stimulus interval of 900–1100 ms, and the frequent and infre-

quent stimuli were presented randomly during each block. Subjects were instructed to press a button using the first right finger in response to the target stimulus.

EEG was recorded in three conditions: (1) Guqin condition, when subjects were listening to YangGuanSanDie, (2) piano condition, when they were listening to sonataK.311, and (3) silence condition. The order of conditions was balanced between the subjects. To decrease the physical differences between two music, the piano musical piece and the Guqin musical piece had similar physical properties, as their main powers were both concentrated around 700 Hz (Fig. 1) [1,18]. During the experiment, visual stimuli were presented on a computer screen positioned approximately 100 cm in front of the subjects, and the sound background (60 dB) was presented via headphones. The subjects were asked to keep static during the experiment. Subjects were trained before the actual experiment, to become familiar with the task.

The subjects were seated in a quiet room and fitted with a Quik-Cap (Neuroscan-USA). EEG was recorded using the Neuroscan system from 64 channels, based on the international 10–20 system. The montage included 8 midline sites (FPZ, FZ, FCZ, CZ, CPZ, PZ, POZ, OZ), 27 left hemisphere sites (FP1, AF3, F1, F3, F5, F7, FC1, FC3, FC5,

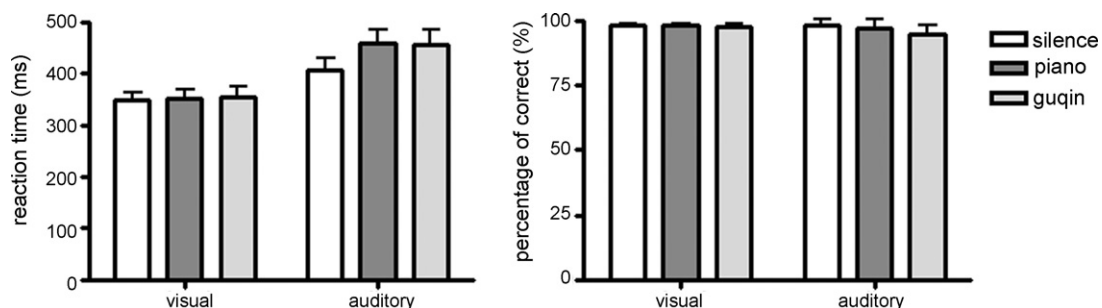


Fig. 2. Behavioral data of auditory and visual tasks: mean reaction time for target stimuli (left) and percentage of correct answers (right) in the three backgrounds.

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