

# Exploring the Influence of Cultural Familiarity and Expertise on Neurological Responses to Music

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**ABSTRACT:** Contemporary music education in many countries has begun to incorporate not only the dominant music of the culture, but also a variety of music from around the world. Although the desirability of such a broadened curriculum is virtually unquestioned, the specific function of these musical encounters and their potential role in children's cognitive development remain unclear. We do not know if studying a variety of world music traditions involves the acquisition of new skills or an extension and refinement of traditional skills long addressed by music teachers. Is a student's familiarity with a variety of musical traditions a manifestation of a single overarching "musicianship" or is knowledge of these various musical styles more similar to a collection of discrete skills much like learning a second language? Research on the comprehension of spoken language has disclosed a neurologically distinct response among subjects listening to their native language rather than an unfamiliar language. In a recent study comparing Western subjects' responses to music of their native culture and music of an unfamiliar culture, we found that subjects' activation did not differ on the basis of the cultural familiarity of the music, but on the basis of musical expertise. We discuss possible interpretations of these findings in relation to the concept of musical universals, cross-cultural stimulus characteristics, cross-cultural judgment tasks, and the influence of musical expertise. We conclude with suggestions for future research.

**KEYWORDS:** music; musical expertise; magnetic resonance imaging; culture; brain mapping; auditory comprehension

## INTRODUCTION

In recent years, music education in the United States and elsewhere has undergone a revolution with increased emphasis on the study of music of other cultures and increased sensitivity to the diverse cultural backgrounds of the student population.<sup>1-3</sup> This attention to multicultural music education raises questions about the nature of musicianship and its development. We do not know if studying a variety of world music traditions involves the acquisition of new skills or an extension and refinement of traditional skills long addressed by music teachers. In other words, is

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a student's familiarity with a variety of musical traditions a manifestation of a single overarching "musicianship" or is knowledge of the various musical styles similar to a collection of discrete skills much like learning a second language?

Research on the comprehension of spoken language has disclosed a neurologically distinct response among subjects listening to their native language compared to an unfamiliar language.<sup>4,5</sup> In a recent study, we hypothesized that an analogous distinction might be observed when comparing subjects' responses to music of their native culture and music of an unfamiliar culture.<sup>6</sup> The few neurological studies that have involved musical culture as a variable supported our hypothesis of a distinct "first music" response. Genç and associates reported a case in which epileptic seizures in a 48-year-old Turkish woman with no musical training were precipitated by both familiar and unfamiliar Turkish arabesques but not by other musical styles or by musical stimuli presented out of context.<sup>7</sup> Similarly, event-related potential (ERP) data have identified an increase in P3 amplitude, interpreted as indicating attention allocation and memory updating, among Turkish listeners when hearing a familiar instrument (ney) rather than an unfamiliar instrument (cello).<sup>8</sup>

#### AN fMRI EXPLORATION OF CULTURAL FAMILIARITY IN MUSIC

We compared the responses of six professional string players and six untrained control subjects to music from a familiar culture (Western) and an unfamiliar culture (Chinese traditional) while undergoing a functional magnetic resonance scan.<sup>6</sup> Our hypothesis was that activation would be associated with a comprehension response present for culturally familiar music and absent for culturally unfamiliar music. In addition, we were interested in differences related to musical training.

Contrary to our hypothesis, no overall differences in activation were observed for either subject group when activation responses to the two musical cultures were compared, although significant differences in later recall performance were based on cultural familiarity. There were also activation differences based on training. In a direct comparison between trained and untrained listeners' responses to music versus rest, significant activation in the right superior temporal gyrus was noted in professional musicians only. This difference was present regardless of the familiarity of the music. Prior research has identified areas in Heschl's gyrus adjacent and proximal to the right primary auditory cortex as critical to the processing of tonal information beyond basic pitch perception.<sup>9</sup> Musicians apparently involved these areas during listening to a greater degree than did untrained listeners. Musicians also demonstrated additional activation in the right and left midfrontal regions for Western music and Chinese music, respectively, when compared to rest.

This initial study provided no clear evidence of a distinct pattern of activation for culturally familiar versus unfamiliar music regardless of the degree of musical training. Although no distinct activation differences were observed, subjects could more accurately identify excerpts from the culturally familiar music in a post-scan recognition task. The conflict between activation and behavioral data leaves open the question of what processes may have contributed to superior recall performance and raises questions about what was or was not measured by the fMRI scans. Perhaps the task was too broad to elicit culturally based differences in activation discernible by functional imaging. It is interesting, however, that the nature of the task during and

after scanning was identical in many ways to studies of the comprehension of spoken language.<sup>5</sup> Analysis of an English/Cantonese speech comparison of these same subjects revealed language-based differences in activation. If we assume that our results are valid, that no difference in activation exists in subjects' responses while listening to culturally familiar and unfamiliar music, and that activation does differ by expertise, we may consider possible interpretations.

## INTERPRETATIONS

### *Musical Semantics*

The most obvious interpretation suggested by a lack of difference in activation is best expressed by the popular notion of music as a universal language without cultural boundaries. We can confidently reject this interpretation based both on results of previous cross-cultural research<sup>10,11</sup> and on differences in our own subjects' recall performance. It appears that cultural familiarity did play a role in music comprehension at some level. Perhaps culture-based differences in activation would have emerged had the recall task been performed in the scanner instead of afterwards or had a more specific musical judgment been required of the subjects. In the absence of a specific judgment task, musical semantics may be sufficiently broad to allow listeners to make sense of what they are hearing without shared comprehension. By this we mean to distinguish between the facile, dynamic comprehension of the encultured insider and the more negotiated comprehension of the cultural outsider. To a listener outside the Chinese musical tradition, the structures of an unfamiliar system of pitch organization may be understood as wrong or out-of-tune notes. The listener has made sense of the music, but on his or her own terms, however inappropriate they may be. In this way, the term "musical accommodation" might be more accurate than "musical comprehension." Rather than music acting as a universal language to all listeners, each listener, depending on his or her enculturation and possibly on training, may universally apply his or her own comprehension strategies to all music, although with varying degrees of success. Such an interpretation would account for both the neurological and the behavioral data we observed.

### *Stimulus Characteristics*

A second interpretation of our results focuses on the stimuli chosen for study. The fundamental differences found in some cross-cultural musical comparisons may be more covert than those in other more extreme pairings. Our selection of Western and Chinese musical examples—two traditions that are culturally distinct—may have resulted in stimuli that in some ways sounded quite similar.

For the purposes of experimental control, we were careful to match our chosen examples for external musical characteristics so that listeners' responses were not based simply on musical surface differences. Specifically, we controlled for instrumental timbre, texture, and tempo in choosing excerpts by Scarlatti and from the traditional piece, *Liu Qin Niang*. Had we chosen differently, Scarlatti contrasted with, say, an example of African drumming, listener responses may have differed simply because of differences in instrument color, de-emphasis of melodic content,

or the fact that half our subjects were professional string players rather than professional percussionists.

The arguable similarity among the examples we selected could have accounted for the lack of difference in neurological response, but it would not have predicted differential performance on our post-scan memory task. Despite some outward similarities, it appears that one set of examples, those from the home culture, were easier to recognize.

### *Musical Expertise*

Professional musicians exhibited greater activation in the right superior temporal gyrus than did untrained controls when processing both types of music, suggesting that formal training does influence brain activation. For the Western music versus rest comparison, additional activity was noted in the right midfrontal area. A recent reanalysis by Zatorre<sup>9</sup> suggested that areas of the right frontal lobe are involved in the storage and retrieval of tonal information in working memory. The present results might be interpreted as reflecting the trained listeners' use of tonal information to identify characteristics of the excerpts heard. They may then rely on stored information regarding features, such as melodic structure, to aid in the recall of excerpts during the post-test recognition task. Although prior research in this area was conducted among untrained listeners,<sup>12</sup> the researchers in that study specifically directed subjects to complete pitch-related tasks. In our study, subjects were only engaged in focused attending for later recall, leaving the strategies to be employed up to each subject. Musicians, perhaps as a result of their extensive training in such areas as tonal analysis and aural skills, may have more quickly turned to assessment of tonal relationships as a strategy to facilitate recall. In contrast, the Chinese music versus rest comparison elicited left midfrontal activation for trained listeners. Given the association of this region with verbal working memory, this may reflect subjects' attempts to apply verbal descriptors to less familiar musical stimuli. This interpretation is similar to recent observations of young students who demonstrated left frontal activity after receiving music instruction carried out using verbal, as opposed to performance-based, teaching strategies.<sup>13</sup> In our study, the difference in frontal activation did not appear in the direct comparison between trained and untrained listeners, however, suggesting that any strategic difference may only be one of degree rather than kind.

### **FUTURE RESEARCH**

While speculative at this point, these interpretations may be clarified by further research into cross-cultural responses to music. First, it is vital that researchers compare not only music but also listeners from other cultures. To that end, we are currently investigating responses of native Chinese listeners, again with varied degrees of formal musical training. Preliminary imaging data from untrained control subjects reveal no differences in activation between Western classical and Chinese traditional listening conditions, a finding that parallels that of Western listeners. Results of a post-test memory task, however, also reveal no difference in success at recalling Western or Chinese examples. Such results may reflect the inadvisability of using

Western music as an “unfamiliar” stimulus for non-Western subjects due to its ubiquity throughout many of the world’s societies. A better choice would be to use music of a non-Western subject’s own culture and music unfamiliar to both Western and non-Western subjects alike.

To minimize the potential for listeners accommodating rather than accurately comprehending musical information, it may be advisable to design specific judgment tasks that tease out or expose cultural differences (see Neuhaus, this volume, for an example). This is not without its perils, as many musical judgments are often culturally derived or require a certain level of expertise. Despite this challenge, there are some judgment tasks that may be amenable to cross-cultural investigation. For example, findings from the cognitive psychology literature propose musical enculturation as a key variable in an individual’s construction of tonal hierarchy<sup>14,15</sup> and establishment of tempo synchronization.<sup>16</sup> An examination of more specific, yet culturally neutral tasks could allow us to explore the degree to which culturally derived understandings of pitch and rhythm are manifested neurologically.

The surface similarity of our stimuli raises another interesting question. If subjects continue to demonstrate a consistent neurological response to music even when encountering musical styles or traditions far distant from their own, it would be useful to explore the limits of such a response, exploring the very conditions under which sounds are heard as music. It may be that a stimulus must include particular characteristics or combinations of characteristics before an individual independently codes it as music, but that once coded, the response is similar across cultures. If so, then varying the amount or type of “musical” characteristics in auditory stimuli during scanning might lead to interesting findings about the brain’s approach to categorizing and coding auditory information. Perhaps the need for these characteristics varies according to listening context or is subject to manipulation (see Griffiths, this volume). Is the boundary of “music” and “other,” neurologically speaking, determined more by culture or by expertise?

## CONCLUSION

In today’s music classrooms, teachers are choosing to perform songs and listen to recordings that allow students to interact with a wide range of musical styles and traditions. In many countries, classroom populations have become as diverse as the curriculum itself. It remains unclear how this new diversity of music and students will impact our concept of what it is to be musically educated. Drawing on the questions discussed here, we need to better understand the complementary roles played by enculturation and formal training in developing musical skills and concepts. It may be that students will need to develop new strategies to interact with unfamiliar musical styles or that new styles will emerge from the variety of musical systems encountered in the classroom.

As is often the case with the early stages of a research program, our findings raise more questions than they answer. The one conclusion of which we are confident is that those interested in discovering the biological foundations of human musical thought and behavior must employ stimuli, tasks, and subjects that encompass the world of music, not just a single culture. Only in this way can we avoid the perils and

pitfalls that characterized some of the earlier research into music psychology and avoid an ethnocentric view of the human musical brain.

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