The Brain in Singing and Language

Valerie L. Trollinger

General Music Today 2010 23: 20
DOI: 10.1177/1048371309353878

MENC The National Association for MUSIC EDUCATION

General Music Today
23(2) 20–23

DOI: 10.1177/1048371309353878
http://gmt.sagepub.com

The Brain in Singing and Language

Valerie L. Trollinger[1]

Abstract

This article summarizes currently available brain research concerning relationships between singing and language development. Although this is a new field of investigation, there are findings that are applicable to general music teaching classroom. These findings are presented along with suggestions about how to apply them to teaching music.

Keywords:

singing; brain; language; bilingualism

For many years, scientists have investigated how the brain responds to music. The purpose of this article is to familiarize you with current research concerning how the brain works while processing and producing singing and language. The research in these areas is very recent and diverse, often leading to questions rather than definitive answers. However, there is enough information available now that can be helpful to music teachers. Unless otherwise identified, research cited in this article can be found in several compendiums: A. D. Patel's (2008) *Music, Language and the Brain*; S. Mithen's (2006) *The Singing Neanderthals*; and I. Peretz and R. Zatorre's (2005) *Brain Organization for Music Processing*.

The study of language in relationship to music perception shows strong relationships between musical perception and processing with language. Most of the research indicates that language processors in our brains also help us process harmony in musical relationships (Patel, 2008). Two language areas, Broca's Area (generally associated with processing grammar for languages) and Wernicke's Area (generally associated with vocabulary), are also engaged in musical processing and, in some cases, musical performance. These areas can be seen in Figure 1.

Most imaging research about the brain and music involves studies of instrumentalists, instrumental training, and musical development that shows a great amount of activity in Broca's area when processing musical melody, processing rhythm, and performing on an instrument. These findings have led many brain researchers to conclude that instrumental musical training, musical perception and processing, and language are strongly connected. More imaging research is available concerning the brain and language processing, which includes research about the importance of tone color in language. Currently, investigators are studying how language and singing share processing strategies in the brain.

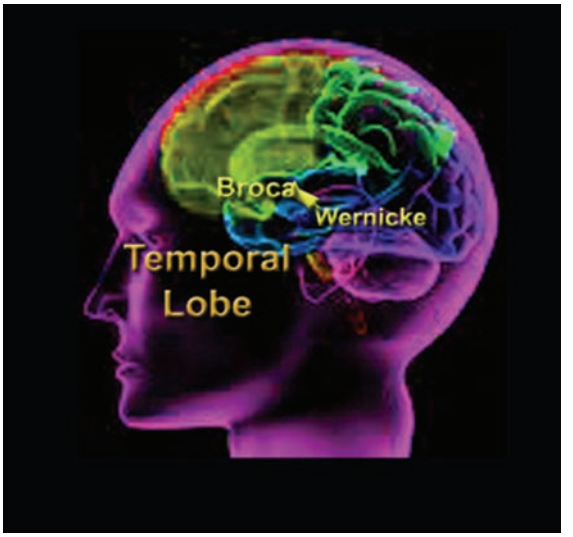

Figure 1. Temporal Lobe (Blue), Wernicke's and Broca's Areas of the Left Hemisphere

This article will present current information from these areas of research that yield helpful implications for music education. Each section is followed with "Applications for Music Teachers" to provide practical applications of the research. These applications may help the brain develop more neural connections between singing and language. Development of these stronger connections will help the brain work more efficiently and effectively and may enhance overall learning and provide some cognitive advantages in linguistic and musical processing. However, these activities may not contribute to an overall increase in intelligence.

[1]Kutztown University of Pennsylvania

The Brain and Singing

Singing activates the whole brain, but certain parts of it are more engaged when learning particular aspects of a song. For example, when the singer concentrates on learning the words of a song, the temporal region in the left side of the brain, where Broca's and Wernicke's areas are located, is more engaged, but when learning the melody, the right side is more engaged. For teachers, this finding illustrates why music teachers often teach the melody first on a neutral syllable, but then when adding the words, the melody often suffers.

Singing appears to have a positive effect on language development, speech, and comprehension. The brain behaves similarly when one is either reading out loud or singing. An interesting study by the German researchers Jentschke and Koelsch (2009) found that highly trained boy singers had an advantage in their language perception skills concerning grammar and comprehension. Two possible hypotheses emerge: (a) that singing may be a highly evolved skill that would be represented more complexly in the brain or (b) that singing is a fundamental skill and may be a precursor to language learning, as proposed by the eminent researcher Isabelle Peretz (see Peretz, Gagnon, Hébert, & Macoir, 2004).

Applications for Music Teachers

This research suggests that either the words are clearly learned before melody is added or that the melody is well learned before the words are added. In general music classes, addressing the melody on a neutral syllable first may be more helpful when learning a song, especially if the melody is complex. When the melody is learned, then adding simple repeated word phrases in the song would be a good second step. For example, in the song "Michael Row the Boat Ashore," having the children master the "Alleluia" lines will be easier. Finally, after the melody is secure and the repeated words or phrases are solid, adding the words to the more complex melodies will be an efficient last step before singing the entire song. Time limitations in choral rehearsals require directors to teach songs efficiently. Applying these strategies to teach parts of the songs with either difficult melodies or difficult words may be helpful.

Students may be able to create a song out of the tonal characteristics of words in an expressive reading. For example, if they were to speak—with meaning—"I feel tired today" and trace the tonal melody of the sentence (perhaps repeated several times for emphasis), they may be able to compose a simple song that expresses their tiredness melodically rather than verbally. The same can be done for songs about animals by deriving melody from animal voice sounds. These kinds of activities move from verbal to musical representations, which may aid the development of pitch and melodic sensitivity.

The Brain and Language

All languages follow the same sequence of development, starting with babbling and moving to the use of words and sentences (Oller, Eilers, Urbano, & Cobo-Lewis, 1997). Brain imaging studies of babbling infants and children show that Broca's area is more strongly activated when developing grammatical representations of language, while Wernicke's area is more activated when learning and categorizing vocabulary. The pathway between the two areas strengthens with practice to aid comprehension and speech. It is possible to hypothesize that the whole language process of instruction still used in some public schools follows the same function and sequence—children learn the structure of language and then deposit the vocabulary as words are learned. Musically, the immersion approach of teaching songs works the same way: the more the children hear the songs, the more they will imprint the melody and words in their memories.

Speaking more than one language may help children better understand music. Research in bilingualism indicates the brain maps all languages in an overlapping manner in both Broca's and Wernicke's area, drawing upon similarities among languages (Bialystok, Majumder, & Martin, 2003).

Young bilingual children have some advantages in pitch perception, but that advantage seems to disappear by the age of 7 years. The age that the second language is learned is not as important as how well the language is learned. The relationship between the languages also helps one learn another related language. For example, someone who speaks Latin will have little difficulty learning Spanish and Italian. The same cannot be said for someone whose native language is German and is learning to speak Mandarin.

In terms of musical understanding, it would make sense that the brain would process musical structure in much the same way it processes a language. Like language, the more one is familiar with the music, the easier it is to process. Processing unfamiliar music could be confusing, such as in music of a different culture that is different tonally and rhythmically from one's own native music.

Applications for Music Teachers

This research shows that musical engagement can help students develop language processing skills. Strategies include emphasizing the words in a song or using new vocabulary. For example, when teaching chants, emphasizing the words is important, but to help build stronger brain connections, adding a very simple melody after the chant is learned will

be helpful. When teaching songs where the melody is more complex, you can accommodate brain processing by teaching the melody on a neutral syllable first and then add verbal phrases that repeat rather than try to teach all the words in one lesson.

If children sing vocabulary lists, paragraphs from reading assignments, or poems in a recitative style, this may help develop comprehension, vocabulary, and grammatical understanding. Music teachers can have students sing passages out of their textbooks—but make sure this practice doesn't turn into a single note drone for vocal health reasons. Adding a simple melody or engaging in a call and response activity as a part of improvising on words in a textbook or a poem could be quite fun and will definitely engage more areas of the brain to help language development.

Children can also be encouraged to create their own special languages as a class or create their own words for specific items or directions. This can be most easily done by creating anagrams out of words they already know, like changing the word *opossum* to *supomos* to mean the same thing. Adding a tonal component, such as having the first part of the word higher than the second part, may indicate a female opossum, but the reverse (lower to higher relationship) could indicate a male opossum. Allowing children to experiment with language can help develop more sensitivity to melodic and pitch aspects of sound important for both music and language development.

Importance of Tone Color in the Brain, Language, and Singing

Tone color helps our brains decode the relevancy of words and sounds. Vocal tone color provides an identifiable characteristic that helps us identify voices. Children pay particular attention to the vocal timbre of vocal models when learning to speak: they closely watch faces and mouths as well as listen. Children learn to tell the difference between timbres of meaningful speech and nonmeaningful sounds that affect how the sounds are processed. Since the primary language center of the brain is located in the left temporal area, sounds that are perceived as not important are generally processed in the right side of the brain. Paying attention to vocal timbre also affects which regional accents are learned. Accents also affect pronunciation of words in nonnative languages because the words may lack some tone color nuances and add others that indicate the speaker is not native. For example, a young girl adopted from Russia at the age of 4 may learn English more readily but will still retain some timbre characteristics of her native Russian language that will still identify her as a nonnative English speaker. For older children and adults, the tone color differences may be more pronounced. Tone color is important in processing musical sounds, especially when teaching singing. For example, if the music teacher is British and teaches an American folksong with a strong British accent, then the American children may learn to sing the song with a British accent, too.

Students also imitate a teacher's vocal timbre. For example, if a female teacher sings or speaks too low for her voice in an unhealthy manner, children may imitate the tense sound because they think it is important to do so, especially in singing.

Applications for Music Teachers

Music teachers are encouraged to model good singing habits and enunciate the words of songs. By attending to vocal tone colors, children identify what is important and what is not important in speech and song, which trains their brains to imprint these cues. For teachers who teach American songs but with a clear accent of a different country, the accent may accidentally mask the tone color characteristics the children need to hear, or conversely the children may learn the songs with the accent.

Shared Connections Between Singing, Language, and Tone Color

With young children, there is a connection between singing in tune and vocal use with language (Mang, 2006; Trollinger, 2003, 2004). Children who speak both Chinese and English are at an advantage in singing in tune and using their voices healthfully. In these studies, the connections lie between the use of tonal (languages that include linguistic meaning based on where the words are pitched) and nontonal (languages that don't include pitch as part of a word's linguistic meaning) languages. Research concerning use of two nontonal languages (such as English and Spanish) are currently in progress.

Children who only spoke English showed that a wider speech range in spontaneous speech was a stronger predictor of pitch-matching accuracy. However, these monolingual English-speaking children also showed more vocal misuse behaviors (Trollinger, 2003). Another area of interest is vocal use in singing within vocal cultures. Perhaps connections between brain, language, tone color, and singing will be represented differently on the brain when one sings in a language or style that is not of one's native language.

Applications for Music Teachers

Having students learn words in a new language can also be useful in helping them develop pitch sensitivity. Tonal languages may be more helpful in this endeavor. For example, having an authentic Chinese speaker teach your

class some poems in simple Chinese (to make sure the tonal inflections are correct) can help your students learn to listen more carefully to and produce pitch differences, which may help them produce pitches more accurately in singing. If teaching tonal language words is not possible, then engaging the students in vocally healthy speech activities that allow them to explore the pitch parameters of their voices will have the same benefit. Some of these activities may include expressive reading exercises, creating sound effects with voices, and expressive chanting. Using the language exploration activities previously mentioned in this article will be useful in helping students develop more expressive vocal qualities that can help lead to better singing skill development.

Conclusion

This article has highlighted some of the current research concerning the brain in language and singing. We find strong and positive interactions in terms of language development, pitch sensitivity development, and singing development. Applying these emerging research findings about the interactions of language and singing to music teaching will provide children with rich musical experiences and help the brain develop more neural connections between singing and language. While current research specific to the interactions of the brain in language, speech, and singing is in the early stages, more is forthcoming that will further inform music teachers.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interests with respect to the authorship and/or publication of this article.

Financial Disclosure/Funding

The author(s) received no financial support for the research and/or authorship of this article.

References

Bialystok, E., Majumder, S., & Martin, M. (2003). Developing phonological awareness: Is there a bilingual advantage? *Applied Psycholinguistics*, *24*(1), 27-44.

Jentschke, S., & Koelsch, S. (2009). Musical training modulates the development of syntax processing in children. *Neuroimage*, *47*, 735-744.

Mang, E. (2006). The effects of age, gender and language on children's singing competency. *British Journal of Music Education*, *23*(2), 161-174.

Mithen, S. (2006). *The singing Neanderthals*. New York: Oxford University Press.

Oller, D. K., Eilers, R. E., Urbano, R., & Cobo-Lewis, A. B. (1997). Development of precursors to speech in infants exposed to two languages. *Journal of Child Language*, *24*, 407-425.

Patel, A. D. (2008). *Music, language and the brain*. New York: Oxford University Press.

Peretz, I., Gagnon, L., Hébert, S., & Macoir, J. (2004). Singing in the brain: Insights from cognitive neuropsychology. *Music Perception*, *21*(3), 373-390.

Peretz, I., & Zatorre, R. (2005). Brain organization for music processing. *Annual Review of Psychology*, *56*, 89-114.

Trollinger, V. (2003). Relationships between pitch-matching accuracy, speech fundamental frequency, speech range, age, and gender in American English-speaking preschool children. *Journal of Research in Music Education*, *51*(1), 78-94.

Trollinger, V. (2004). Preschool children's pitch-matching accuracy in relation to participation in Cantonese-immersion preschools. *Journal of Research in Music Education*, *52*(3), 218-233.

Bio

Valerie L. Trollinger, PhD, is assistant professor of Music Education & Bassoon in the department of Fine Arts at the Kutztown University of Pennsylvania.