The effect of synesthetic metaphor on music students in secondary instrumental ensembles

Taryn O'Keefe

University of Washington

Introduction

Musicians often describe music in metaphorical ways, insisting that minor mode pieces are somber, chords can be crunchy, and jazz music feels blue. While some musicians may simply be using metaphors to stimulate creativity, others may deeply resonate with these descriptions and physically experience them firsthand. The associations described in these metaphors represent perceptions of real people who experience synesthesia, which is a unique neurological condition where one type of sensory stimulation evokes the sensation of another (Hochel & Milan, 2008). Synesthetic musicians hear certain tones accompanied by visions of color, and structured melodies projected as shapes that move and change with the music. Synesthesia affects approximately 1 in 23 people (Simner et al., 2006), with an estimate of more than 150 forms of this condition in existence (Cytowic & Eagleman, 2009). Of all the different forms, musical synesthesia is one of the most common and dramatic. In addition, musicians are more likely to be aware of these unique perceptions than non-musicians (Sacks, 2008).

Research has provided an extensive debate centered on the question of whether or not synesthesia is a congenital property or a learned skill. Cytowic (1995) attempted to establish a series of diagnostic criteria in order to distinguish synesthesia from other phenomena, with the widely accepted claims that synesthetic perception is involuntary, automatic, and consistent over time. Cytowic (1993) also argued that only true congenital synesthetes are privy to these processes. Many agree that non-synesthetes may experience and recognize cross-modal correspondences, but believe that this is not true synesthetic perception (Marks & Mulvenna, 2013). This research suggested that synesthesia is a unique quality in some individuals and cannot be acquired.

In contrast, there has been evidence that synesthetic perceptions might be developed through interactions with one's environment. Early investigations into the idea of synaptic pruning failure support this theory, which posits that the number of synapses in sensory and association cortices peaks in childhood and declines thereafter (Huttenlocher & Dabholkar, 1997). This suggests that infants are typically born with synesthetic perceptions, but those perceptions get lost with maturity as they compartmentalize the five senses. While synesthesia is thought to arise in adults as a result of failure to prune some of these sensory connections, there may be possibilities in triggering those connections for adults who do not experience this phenomenon on their own.

The implications for bringing out lost sensory connections in non-synesthetes are supported by studies in cross-modal plasticity of the sensory impaired; the ability of the brain to adapt and reorganize in response to the removal of input from one sensory modality. Research indicates that reading braille activates the primary visual cortex in the visually impaired (Burton, Snyder, Conturo, Akbudak, Ollinger, & Raichle, 2001), and that sign language activates auditory cortical areas in the auditorily impaired (Finney, Clementz, Hickok, & Dobkins, 2003). As all adults possess these capabilities, there may be implications that such connections may be able to be purposefully reorganized in those with fully functioning sensory abilities. One study (Kadosh, Henik, Catena, Walsh, & Fuentes, 2009) tested this disinhibition between brain areas by purposefully inducing experiences similar to grapheme-color synesthesia in non-synesthetes through post-hypnotic suggestion, and found that anatomical differences were not a prerequisite for synesthesia. At the very least, this evidence may lead to the possibility of a lower, unconscious degree of synesthesia in non-synesthetes.

Metaphorical Language and Synesthesia

Bragança, Marques Fonseca, and Caramelli (2015) pointed out that non-sonorous sensory terms and emotional qualifiers are commonly used within musical settings, and that music perception is only achieved through interaction with other sensory fields. For example, a melody is often described as sad or happy, tone can be associated with “brightness” or “darkness,” and dynamics can evoke “big” or “small” imagery. Using other sensations seems necessary in describing music, and these metaphorical terms often reflect sensations perceived by synesthetes.

There appears to be some similarities between metaphor and descriptions of synesthetic experience, including the fact that both can highlight perceptual qualities. However, the main difference is that synesthetic experiences actually involve real perceptions, while metaphor only *suggests* perceptual qualities. Aristotle (1954 (c. 330 B.C.) laid the syntactic foundation for which we can support this argument by describing that metaphors are similes with the word “like” omitted. Ramachandran and Hubbard (2001a) gave the example that upon hearing the phrase, “Juliet is the sun,” we know that the speaker is suggesting that Juliet is *like* the sun in that they are both warm, nurturing, bright, and radiant because the brain instinctively forms these correct links. Thus, a simple metaphor such as this is a non-arbitrary similarity between two seemingly unrelated things.

Further, Aristotle (1954 (c. 330 B.C.) noted that metaphors must be proportional. In other words, the comparison must be reciprocal to either of its coordinate terms. Thus, the sun is also like Juliet, because they are both warm, nurturing, bright, and radiant. However, Day (1996) suggested that there are times when metaphors are not proportionate. For example, in the sentence, “The saxophone’s tone was bitter,” the underlying metaphor cannot be resolved. “Tone” may be described as “bitter,” but the sensation of “bitter” cannot be described as “tone,” because taste does not correspond with sound. Day (1996) proposed that in a case like this, we must reassess our definition of "bitterness." However, if we expand a sentence such as this, we can only get as far as, "The saxophone produced a tone that was similar to the bitterness of ___." The blank can be filled in with anything that is truly considered to be bitter in taste, however, this still leaves the metaphor unresolved because the original metaphor attempted to compare the tone of the saxophone with the sensation of bitterness, not the bitter taste of something else. This rule of proportion seems to be commonly broken by many of these cross-modal metaphors that involve the comparison of two different sensory associations, and yet they are incredibly common in everyday language. More importantly, this type of cross-modal metaphor seems to be inherently necessary when describing music.

For the sake of avoiding conceptual confusion and to promote clear communication, this paper will adopt the distinction between the terms "metaphor" and "synesthetic metaphor." To clarify, the term "metaphor" will be used to describe a figure of speech that expresses a proportionate comparison between two seemingly unrelated things. The term "synesthetic metaphor" will be used to describe a figure of speech that expresses a disproportionate comparison between two unrelated things using opposing sensory modes (e.g., "bitter sound"). The terms "synesthetic metaphor" and "synesthetic perception" differ in that synesthetic metaphor refers to the specific use of language to describe cross-modal perceptual qualities, and synesthetic perception is the actual experience of cross-modal sensory perceptions. Although there is a clear distinction, it may become evident upon further reading that synesthetic metaphor and synesthetic perception are not mutually exclusive, as research indicates that synesthetic metaphor might directly influence or cause synesthetic perception.

Evidence suggests that synesthetic metaphor and synesthetic perception are both formed in the angular gyrus, a region in the brain concerned with abstract numerical calculation, spatial cognition, complex language functions, and the ability to interpret metaphor (Ramachandran & Hubbard, 2001a). Ramachandran and Hubbard (2001a) proposed that excess cross-wiring between conceptions and perceptions within the angular gyrus might explain the penchant for some individuals to describe music with synesthetic metaphors, which might indicate that the use of synesthetic metaphors to describe music may result in an arbitrary association between sound and the other sensory perception that is being used to describe the sound. Thus, the use of synesthetic metaphors might actually evoke real perceptions of synesthesia.

Very early research looked into the cognitive dynamics between synesthesia and metaphor and produced some fascinating results. In one study (Karwoski & Odbert, 1942), non-synesthetes were given a verbal "metaphor test" in relation to describing simple melodic forms and produced the same relations displayed by synesthetes. These findings suggest a parallel alignment in cognitive processes of both color-music synesthesia and metaphorical use of language. More recently, Bragança et al. (2015) created an experiment to test the association of four adjectives ("Sweet," "static," "light," and "heavy") with four musical excerpts, and showed a 90.6% degree of agreement between the participants on which adjectives should be attributed to which songs.

While synesthesia certainly transcends simple metaphor, there is evidence to suggest that it may provoke synesthetic perception due to denotative terms actually conveying affective feeling-tones. For example, auditory pitch is often compared with visual size because it is characteristic of the real-world principle that large-sized resonators produce low frequency tones and small-sized ones produce high frequency tones (Osgood, 1981). Thus, treble tones produce smaller visual images and bass tones produce larger ones. In addition, the construction of these words may connote meaning. Shinohara and Kawahara (2010) found that vowel height, vowel backness, and voicing in obstruents affected the image of size of words consistently across participants of their study in four different languages. They also found that the vowel “i” evoked smaller images, while “a” and “o” were rated as larger than other vowels (Shinohara & Kawahara, 2010). Relating this back to common descriptors in music, this may explain why higher tones are often described as “light” and produce smaller images, whereas lower tones are “dark” and evoke bigger images.

Further, musical concepts can be associated with colors and emotions that are often used in synesthetic metaphors in similar ways. One study (Palmer, Schloss, Xu, & Prado-León, 2013) suggested that the human brain instinctively associates different types of music with certain colors, with a universal "emotional palette" that underlies the senses. Participants in this study were consistent in associating lively music in major keys with vivid yellowish colors, and somber music in minor keys to dark blues and grays. Despite idiosyncrasy being one of the common conditions and criteria of synesthetic perceptions, it appears to be inessential because many of these associations used in describing music are commonly shared and largely agreed upon. This regularity of color and mood associations in non-synesthetes might indicate that they are actually experiencing low levels of synesthetic perception, suggesting that everyone has the capacity to experience synesthesia. Thus, individuals might actually experience synesthesia on a spectrum in which synesthetic perceptions are experienced at varying degrees. In addition, the use of synesthetic metaphors to describe musical meaning may play a role in evoking synesthetic perception at different degrees on the proposed spectrum.

Synesthesia and Musical Achievements

Specifically relevant to the inquiry made by the author of this study is research that illuminates the effects of synesthetic perception on musical achievements. If synesthetic metaphor is commonly used in instructional settings to describe musical meaning, perhaps it is unconsciously used by teachers to produce a positive effect on their students' musical abilities and to aid in learning. Synesthetic perception exercises have been researched in real classrooms, showing an increase in aesthetic awareness, heightened concentration, and greater reception to music (Donnell-Kotrozo, 1978). In addition, creativity and interpretive-decision making have also been described as influenced by synesthetic perception in musicians (Glasser, 2015).

Another positive influence of synesthesia on learning is its role in facilitating memorization. While synesthetic thinking has been shown to enhance conscious memory of learned materials through means of explicit memory tasks (Gibson, Radvansky, Johns, & McNerney, 2012; Yaro & Ward, 2007), there is evidence that synesthetic perception can unconsciously aid in memorization of learned material as well. A recent study (Rothen, Scott, Mealor, Coolbear, Burckhardt, & Ward, 2013) demonstrated, by means of an implicit learning paradigm, that synesthetic experiences (specifically grapheme-color and sequence-space) can enhance memory performance relating to unconsciously acquired knowledge. Relating this to musical learning, synesthetic perception may prompt memorization of how to successfully execute certain musical concepts. For instance, if a student imagines an accented passage as a large blocky shape, unconscious memorization of this image may possibly transfer to the repeated success of executing accented articulations to other notes.

Although this research refines our understanding of the effects of synesthetic perception on learning and musical experience, there has been little done to test whether or not synesthetic perception leads to successful execution of very specific musical abilities. For example, can visual-sound associations yield positive results on a musician's intonation? Can tactile-sound associations alter the way musicians execute dynamics? Further, can this be prompted by teachers to supplement learning through the use of synesthetic metaphor? While qualitative studies have offered an inside look into these experiences of diagnosed synesthetes, there is a need for experimental data to examine if non-synesthetes can engage in synesthetic perception and use it to advance their musical abilities.

Purpose of the Study

The purpose of this study is to examine the effects of synesthetic metaphor on music learning. Specifically, the goal is to determine whether or not synesthetic metaphor used by teachers during the rehearsal of repertoire has an effect on the advancement of learning and the musical abilities of students in secondary band classes. The information collected from this study will add to the extant research by attempting to establish concrete evidence that unconscious levels of synesthetic perception can be purposefully induced in non-synesthetes through teacher influence, and that this type of perception can enhance musical ability. The initial hypothesis is that ensembles who are exposed to synesthetic metaphor during rehearsals will show greater improvement in musical ability and show a greater level of synesthetic perception than those who are not. The research questions are:

1. Is there an underlying degree to which non-synesthetes experience synesthetic perception?
2. Can synesthetic perception be prompted in students by means of their teachers using synesthetic metaphor when rehearsing repertoire?

3. Can synesthetic perceptions be transferred to other instances of learning without the aid of synesthetic metaphor?
4. Can synesthetic perception (prompted by synesthetic metaphor) have an effect on the musical achievements of students?

Methodology

To address the research questions, this study will employ an experimental design to yield quantitative data. The study will specifically look at the reactions of students in secondary band classes, as they have theoretically reached the age where synaptic pruning has already taken place (see Gardner, 1974), yet are still in a developmental stage that has many possibilities for the advancement of learning. To achieve appropriate statistical power, nine local secondary schools with well-established comprehensive instrumental band programs will be selected to take part, as volunteered by their band directors. Through random assignment, these bands will be equally divided into one of four groups (Group 1, Group 2, and Group 3, Group 4 respectively). Each band will be given the same two pieces of repertoire (labeled Song A and Song B for the purpose of this proposal) agreed upon between the researcher and participating band directors to rehearse during the treatment period. To account for reliability as recommended by Morrison, Montemayor, and Wiltshire (2004), these pieces of music will be rated of equivalent difficulty through personal evaluations by the researcher and band directors, categorization by music retailers, and published grade level.

Before the treatment period begins, each band will be required to spend one week (approximately three rehearsals) rehearsing the two pieces of repertoire without the teacher's use of synesthetic metaphor. As a pretest, they will then provide the researcher with separate recordings of their bands playing each piece. In addition, students in each band will be asked to anonymously complete the Synesthetic Experience Survey (SES), separately for each song, which is a newly designed Likert type scale that will be used to identify any levels of existing synesthetic perception involved in the processing of that repertoire. On the SES, participants will record their level of agreeance from 1 to 5, with 1 being the weakest level and 5 being the strongest. They will also have the opportunity to elaborate on any of their synesthetic experiences on this survey (see figure 1).

School: Teacher: Date: Song (circle one): Song A Song B Please answer the questions below by circling your level of agreement (with 1 being the weakest to 5 being the strongest) to the proposed statements.
1. Aspects of this song caused me to have visual experiences (For example: I saw the melody or entire song as yellow/I saw squares or moving lines in a particular section of the piece) 1 2 3 4 5 Additional comments:
1. This song triggered a specific taste in my mouth (For example: The chord progression tasted sour to me) 1 2 3 4 5 Additional comments:
2. This song had a specific personality (For example: This song was song was angry) 1 2 3 4 5 Additional comments:
3. I felt as though I could physically feel qualities of this song (For example: The melody was smooth or rough) 1 2 3 4 5 Additional comments:

Figure 1: Synesthetic Experience Survey

The treatment period will take place over the course of four weeks, with approximately 3 rehearsals each week. This means that there would be 12 opportunities for each band to rehearse.

Over the course of those 12 rehearsals, each band director will be asked to spend an equal amount of time on each piece of repertoire. Some words may evoke different types of synesthetic reactions, so the type of synesthetic metaphor used will be split up into four categories: Personification, taste, tactile, and visual terminology. To ensure equal and fair usage, a routine will be established for using the categories of terminology by randomly assigning one category to be used each day by band directors of the experimental groups.

During the treatment period, the band directors in Group 1 will be instructed by the researcher to use synesthetic metaphor in rehearsing both Song A and B. The band directors in Group 2 will be asked to use synesthetic metaphor only when rehearsing Song A, but not for Song B in order to test whether or not synesthetic perceptions can be transferred over without the aid of synesthetic metaphor. In contrast, Group 3 will be asked to use synesthetic metaphor only when rehearsing Song B, but not for Song A. Subsequently, the band directors in Group 4 will be instructed to use no synesthetic metaphor in either of the pieces, and rehearse their bands as normal as possible without using this type of language. When the treatment period concludes, teachers will once again be asked to record their bands playing each piece separately. In addition, the students in each band will be asked to complete the same SES as before for each separate piece.

The study will be piloted before being administered to others to check for reliability and validity of the SES instrument, which is intended to identify whether or not synesthetic perception is occurring, in addition to allowing the researcher to identify trends in which type of synesthetic associations are most prevalent. Further, pilot testing is necessary in order to observe if any of the questions may influence a participant's answer to another. The SES should also be checked for clarity and ease of use.

Analysis

To assess ensemble achievement, the pretest and posttest recordings from each band will be collected and analyzed by experts (experienced music teachers) and interdependently evaluated according the criteria of a Musical Achievement Scale (MAS) adapted from Morrison et al. (2004). The MAS will ask evaluators to rank ensembles' recordings on a scale anchored from 1 as the lowest to 5 as the highest score in terms of notes and rhythms, articulations and dynamics, intonation, and balance and blend of the ensemble. Scores of each separate song for each ensemble, as well as scores between the pre- and post- recordings will then be compared to identify any improvements over time.

The pre- and post- responses to the SES from students will be collected and analyzed to indicate any developments in synesthetic experience over the course of the procedure. An independent samples t-test will also be done to identify any significant differences in types of synesthetic arousal (tactile-sound, personification-sound, taste-sound, and visual-sound) among scores each group. In addition, difference scores will be used to evaluate possible synesthetic interactions between Song A and Song B in both the pre- and posttests. Free-responses to the additional comment section on the SES will be collected and coded to analyze possible trends in the types of synesthesia experienced. Further, an overall multivariate analysis of variance will be used to compare the mean of the experts' evaluations of each of the MAS criteria, type of treatment (of Group 1, Group 2, and Group 3), and degree of synesthetic reactions between all groups.

Discussion

The results of this study may yield insight into the dynamics between musical language and synesthesia, the potential cross-modal perceptions in non-synesthetes, and the effect of synesthetic perception on musical ability. The theoretical implications of expanding knowledge in this subject offers many more possibilities for further study. Future studies may look at what type of synesthetic metaphor produces specific results in musical abilities. For instance, what musical abilities does visual-spatial synesthetic terminology specifically affect? In addition to theoretical contributions, practical benefits for music education may arise from the results of this study by offering music educators evidence-based practice on the use of synesthetic metaphor in their band classrooms. As we better understand the cognitive and perceptive components of synesthetic metaphor in musical meaning, teachers may discover strategies to supplement their students' education through inter-sensory connections.

References

Aristotle. (1954 (c. 330 B.C.)). Rhetoric (W. R. Roberts, Trans.); Poetics (I. Bywater, Trans.). *New York: Modern Library.*

Bragança, G. F., Marques Fonseca, J. G., & Caramelli, P. (2015). Synesthesia and music perception. Dementia & Neuropsychologia, 9(1), 16-23.

Burton, H., Snyder, A. Z., Conturo, T. E., Akbudak, E., Ollinger, J. M., & Raichle, M. E. (2001). Adaptive changes in early and late blind: A fMRI study of Braille reading. *Journal of Neurophysiology, 87*(1), 589-607.

Cytowic, R. E. (1993). *The man who tasted shapes.* New York: Putnam.

Cytowic, R. E. (1995). Synaesthesia: Phenomenology and neuropsychology – a review of current knowledge. *PSYCHE, 2*(10).

Cytowic, R. E., & Eagleman, D. M. (2009). *Wednesday Is Indigo Blue : Discovering the Brain of Synesthesia.* Cambridge, MA, USA: MIT Press.

Day, S. (1996). Synaesthesia and synaesthetic metaphors. *Psyche: An Interdisciplinary Journal* *of Research in Consciousness,* 2(32).

Donnell-Kotrozo, C. (1978). Color Me Trombone. *Music Educators Journal, 65*(4), 32-37.

Finney, E. M, Clementz, B. A., Hickok, G., & Dobkins, K. R. (2003). Visual stimuli activate auditory cortex in deaf subjects: Evidence from MEG. *Neuroreport, 14*(11), 1425-7.

Gardner, H. (1974). Metaphors and Modalities: How Children Project Polar Adjectives onto Diverse Domains. *Child Development, 45*(1), 84-91.

Gibson, B., Radvansky, G., Johnson, A., & McNerney, M. (2012). Grapheme–color synesthesia can enhance immediate memory without disrupting the encoding of relational cues. *Psychonomic Bulletin & Review, 19*, 1172–1177.

Glasser, S. (2015). The impact of idiopathic synaesthesia on musical abilities. In: Timmers, R., Dibben, N., Eltan, Z., Granot, R., Metcalfe, T., Schiavio, A., & Williamson, V. (Eds.). *Proceedings of ICMEM 2015. International Conference on the Multimodal Experience of Music.* Sheffield: HRI Online Publications, 2015. ISBN 978-0-9571022-4-8. Available online at: <http://www.hrionline.ac.uk/openbook/chapter/ICMEM2015-Glasser>

Hochel, M., & Milán, E. G. (2008). Synaesthesia: The existing state of affairs. *Cognitive Neuropsychology, 25*(1), 93-117.

Huttenlocher, P. R., & Dabholkar, A. S. (1997). Regional differences in synaptogenesis in human cerebral cortex. *Journal of Comparative Neurology, 387*(2), 167–178.

Kadosh, R. C., Henik, A., Catena, A., Walsh, V., & Fuentes, L. J. (2009). Induced Cross-Modal Synaesthetic Experience Without Abnormal Neuronal Connections. *Psychological Science, 20*(2), 248.

Karwoski, T.F., & Odbert, H. S. (1942). Studies in synesthetic thinking: II. The rôle of form in visual responses to music. *Journal of General Psychology, 26*, 199-222.

Marks, L. E., & Mulvenna, C. M. (2013). Synesthesia, at and near its borders. *Frontiers in Psychology, 4*, 651.

Morrison, S. J., Montemayor, M., & Wiltshire, E. S. (2004). The Effect of a Recorded Model on Band Students' Performance Self-Evaluations, Achievement, and Attitude. *Journal of Research in Music Education,52*(2), 116-129.

Osgood, C. (1981). The cognitive dynamics of synesthesia and metaphor. *Review of Research in Visual Arts Education, 7*(2), 56-80.

Palmer, S. E., Schloss, K. B., Xu, Z., & Prado-Leon, L. R. (2013). Music-color associations are mediated by emotion. *Proceedings of the National Academy of Sciences of the United States, 110*(22), 8836.

Ramachandran, V. S., & Hubbard, E.M. (2001a). Synaesthesia: A window into perception, thought and language. *Journal of Consciousness Studies* 12(1): 3-34.

Rothen, N., Scott, R. B., Mealor, A. D., Coolbear, D. J., Burckhardt, V., & Ward, J. (2013). Synesthetic experiences enhance unconscious learning. *Cognitive Neuroscience, 4*(3-4), 231-238.

Sacks, O. (2008). *Musicophilia : Tales of music and the brain* (Rev. and expanded, 1st Vintage Books ed.). New York: Vintage Books.

Shinohara, K., & Kawahara, S. (2010) A cross-linguistic study of sound symbolism: The images of size. Tokyo University of Agriculture and Technology and Rutgers University.

Simner, J., Mulvenna, C., Sagiv, N., Tsakanikos, E., Witherby, S. A., Fraser, C., Scott, K., & Ward, J. (2006). Synaesthesia: The prevalence of atypical cross-modal experiences. *Perception, 35*(8), 1024-33.

Yaro, C., & Ward, J. (2007). Searching for Shereshevskii: What is superior about the memory of synaesthetes? *The Quarterly Journal of Experimental Psychology, 60*, 681–695.