한국음악치료교육학술지:음악치료교육연구
Korean Journal of Music Therapy Education
2005, Vol 2, No 2.

Tone Deafness and Implications for Music Therapy Strategies for Treatment

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This study was purported to examine the definition of tone deafness, various factors for the cause based on literature review of research findings, and to examine therapeutic application of music for treatment of tone deafness. With research, it was found that there can be three different kinds of tone deafness; amusia, agnosia, and asonia. Literature review showed that tone deafness has been frequently dealt in many research in order to verify the causal factors, such as gender, age, and environments. With time, the research trend on tone deafness has shifted towards neurological approach closely examining brain activity, presenting the statement that the brain's capacity to perceive modest pitch changes may be congenitally impaired. Also physiological factors contribute to tone deafness called diplacusis, which is a phenomenon wherein a given tone is heard as different pitches by the two ears, resulting in conflicting bilateral perception of pitch.

Music can be used for treatment of various factors causing tone deafness. The most efficient intervention was singing program. Pitch-matching training can be effective training using operant conditioning procedure. Successive approximation or reinforcement of correct response alone was more efficient procedure in helping uncertain singers to sing on pitch. Also progressive breathing exercises helped the training the pitch-matching where one had to coordinate hearing and voice.

[keyword] tone deafness, amusia, diplacusis, music therapy, pitch-matching

Definition of T one-deafness

In the traditional sense, much of music activity depends upon auditory perception. An individual must be able to hear tonal stimuli in order to exhibit any form of musical behavior. In a discipline such as music, the perception of tonal stimuli is required for both musical achievement responses. Hearing efficiency, especially the tissues and related organs commonly referred to as "the ear,"is sometimes taken for granted by music educators or other musicians.

Often the word tone deafness is used inappropriately and without accurate knowledge. According to Houghton Mifflin Dictionary, tone deaf is defined as the inability to understand or hear the difference between on e musical tone and another, so that it is impossible to sing or to play a stringed instrument in tune. With much of research in this area, different kind of tone deafness have been identified as following:

a) Amusia, loss or impairment of the ability to recognize or reproduce musical sounds

b) Agnosia, inability to interpret sensory impressions or loss of ability to recognize and identify familiar sensory impression

c) Asonia, lack of normal ability to discriminate pitch differences.

In the 1960s and 70s, studies on tone deafness have been actively performed in order to verify the cause and possible treatment. In the early research, studies examined various factors contributing to the tone deafness, such as age, gender, etc. Duell & Anderson (1967) examined the developmental issues, whether young children have a difficult time discriminating pitches of different intervals. In their study, it was discovered that out of forty-nine first graders, nearly 25 percent were not able to discriminate pitches closer than a minor third; 6 percent were not able to discriminate pitches a major sixth apart, and with third graders, only 3 percent were able to discriminate pitches separated by less than a quarter tone.

Another study on the gender factor on tone deafness indicated that there might be an influence of maturation and pitch-matching ability. Petzold (1966) and Klemmish(1974) observed significant improvement in singing accuracy between Grades 1 and 2, with

Petzold also demonstrating a plateau by Grade 3. Little improvement was noted in the upper grades. Regarding gender and age differences, Bently(1968), in his examination of 16,700 British school children found that the ability to match pitch improved as subjects grew older. His research showed that more children between the ages 7 t0 8 were uncertain singers than were those between the ages of 12 and 13. Furthermore, only a small proportion of the children (4-5%) carried the problem into adulthood. Roberts and Davies (1976) investigated the monotonism in school children at different age level through survey. Over the whole survey, boys were about two to three times as likely as girls to be described as monotones. This difference was highly significant. The age related trend had a significant linear component for both boys and girls and, in addition, a significant departure from linearity for girls. There was no significant departure from linearity in the curve for boys between age 5 and 6. The girls curve, however, shows a rapid decrease between ages 5 and 6, then a gentler decrease between 6 and 8, with steeper decline again at 9 to 10.

There are other studies which investigated the influence of maturation and gender of pitch-matching ability. In singing, tone deafness often applies to monotone singers who are often called "uncertain" singers. There are tow types of mono tones, first absolute monotone where one can sing only on one tones, and second, a partial monotone where one's voice is somewhat flexible, but unable to sing within the skip of major third interval.

Blind suggested that the cause of monotonism may be due to incorrect vocal technique, such as chest register, lack of concentration or poor tonal memory, muscular incoordination, hearing impairment, nonmusical home environment or heritage, and cognitive or sensory impairment. In addition, the listening experience may depend on a great deal of the person's mind and attention span.

In 2000s, specific topics on tone deafness, such as neurological and anatomical causal factors were researched. Hyde and Peretz(2004) reported that approximately 4% of the general population may have amusia or tone deafness. Congenital amusia is a lifelong disability for processing music despite normal intellectual, memory, and language skills. Here we present evidence that the disorder stems from a deficit in fine-grained pitch perception. Amusic and control adults were presented with monotonic and isochronous

sequences of five tones (i.e., constant pitch and intertone interval). They were required to detect when the fourth tone was displaced in pitch or time. All amusic participants were impaired in detecting the pitch changes, and showed no sign of improvement with practice. In contrast, they detected time changes as well as control adults and exhibited similar improvements with practice. Thus, the degraded pitch perception seen in the amusic individuals cannot be ascribed to nonspecific problems with the task or to poor hearing in general. Rather, the data point to the presence of a congenital neural anomaly that selectively impairs pitch processing (Hyde & Peretz, 2004).

Neurological factor of amusia was researched by Travis(2002) to examine whether the brains of people with amusia differ from those of people with normal musical aptitude. Using the magnetic resonance imaging(MRI), the research showed that the participants responded normally to noise, speech, and various aspects of language. When exposed to music, however, they had low-level neural activity throughout the brain, rather than higher activity focused in brain regions traditionally associated with music perception. This implies that man's brain does not process music correctly (Travis, 2002).

Likely, Bower(2004) states that brain's capacity to perceive modest pitch changes may be impaired from birth in persons with amusia, and such individuals also have difficulty in grasping the overall structure of musical passage. The same people who had great difficulty telling different melodies apart and remembering simple tunes – accurately tracked timed sequences of musical tones and noted slight changes in timing. On the other hand, Chande(2001) stated that up to 80% of tone deafness is attributable to genes rather than musical or educational environment. The team assessed the musical pitch-recognition abilities of 568 unselected female monozygotic and dyzigotic twins. The results indicated that pitch recognition is largely inherited across the population, and that it is a function of the brain and not peripheral hearing.

Consistent with this result, Peretz(2004) also discovered that people with congenital amusia show abnormal brain activity in the right half of the brain. It may be possible to compensate for amusia by training pitch discrimination abilities. However according to Peretz, it is likely that the intervention will only be effective in children, and difficult to see any improvement in adults.

Factors Contributing to Tone-Deafness

With various research, many causal factors contributing to tone deafness have been identified. Tone deafness can also result from diplacusis, which is a phenomenon wherein a given tone is "heard" as different pitches by the two ears, resulting in conflicting bilateral perception of pitch(Butler, 1992). There are two kinds of diplacusis: monoaural and binaural. In monoaural diplacusis, a single ear hears two or more pitches, noise or a combination of both. In the more common form, binaural diplacusis, each ear perceives a different pitch. It is very difficult to reveal the problem or test the severity of conflicting pitch perception. Both children and adults may exhibit excellent auditory acuity in either ear tested individually, but tests of pitch perception are not included.

This also involves a condition in which the pitch is possibly accompanied by noise and beats that are produced by interaction between the pitches. This does not depend on a change in hearing level, however, faulty function of the sense organ to hear the pitch correctly (Formby & Gjerdingen, 1982). Some individuals apparently fail to develop pitch recognition during childhood, just as some fail to become totally either right or left-handed. Others, who previously have enjoyed compatible ears, may later develop incompatibility in pitch for other reasons. The victims seldom identify their own hearing difficulty because they accept the information perceived by their higher brain after it has processed incoming messages from the two hemispheres. They cannot separate or asses the difference in pitch relayed by the two individual halves of their brain, and the higher brain is not able to integrate the tow messages. That is where the trouble lies. It is important to know that diplacusis can often be alleviated.

Diplacusis may be caused by a variety of factors, such as an infection or trauma; it may also be present in persons with normal hearing. Davis states that "most people have a little diplacusis for some parts of the frequency scale most of the time; but unless the condition becomes rather considerable, amounting to differences of a quarter of a tone or more, they are quite unaware of the inequalities. The brain can average small pitch differences between the ear just as it averages small differences in color vision between the two eyes (Davis, 1966)." However, diplacusis may have a profound effect on musical ability and may cause faulty intonation in instrumentalists and singers(Sherbon, 1975).

Acoustical characteristics of pitch can also trigger uncertain discrimination. The pitch of a pure, sinusoidal tone is clear and definite, on the other hand, a complex tones

consist of a fundamental and its series of harmonics. Most musical tones are complex, passable harmonic and partial of tones overlap at these intervals. For example, there might be a certain physical or physiological basis for perceptual regularity of the octave, probably a harmonic relations of tone partials(Butler, 1992). One of the common phenomena of pitch perception of a complex tone is aural harmonics, a distortion of harmonic upper partials produced by the auditory system as it processes a sine tone. Another possible phenomenon is the combination tone which includes difference tones and summation tone. Difference tone is one type of combination tone with a frequency equal to the combined tones produced. Summation tone is a combination tones with a evoked its perception. However, these phenomena are not consistent, since perceptual harmonic distortion may also occur depending on the listener's sensory capabilities(Butler, 1992).

Such pitch information is carried to the brain by the auditory nerve after the sound is "tuned out" by the basilar membrane. This leads to place principle of hearing, which describes how much of the membrane is vibrating in response to a particular frequency, and where the maximum amplitude and cut-off points are. Certain levels of frequency vibrate specific areas on the basilar membrane for high frequency, approximately 5000Hz – 2000Hz, only the part of the basilar member in the basal turn nearest the stapes and round window vibrates. With middle frequency tones, approximately, 800Hz – 5000Hz, the middle part of the basilar membrane in the second turn vibrates. The low frequency tones, approximately 200 Hz – 800Hz, will cause nearly all the membrane to vibrate, and the greatest amplitude of movement is near the apex. Therefore, the ear has to sensitive to detect the differences of pitch, various frequencies, harmonics or other forms in a complex sound which are sorted out and the cause the basilar membrane to vibrate in an equally complex pattern. One can play a tune that is easily recognized by the listener; however, it is up to the listener's interpretation or sensory capacity to detect the sound and analyze the meaning and form of the sound.

Yarbrough, Green, Benson, and Bowers(1992) posited that "although the relationship between pitch discrimination and pitch matching is not yet clear, it would seem logical to hypothetize that more time spent hearing correct pitches might produce more correct pitch singing. If the anatomy of the inner ear vibrates in relationship to frequencies of sound input, and if the brain needs time to translate those differential vibrations, then it seems important to analyze duration of correct pitch stimuli and responses (p.24)." Butler(1992) states that pitch is perceptually measured, where as frequency is physically measured, therefore there may be auditory limits of pitch perception for every listener.

Music Therapy Treatment Strategies

Davis(1966) stated that hearing is basically a psychological process, although this aspect of communication may use physical tools and have social aspects. This raises a question of what is sound and how does it function as an input for us? From the psychological point of view, sound is a sensation, something that exists only within ourselves. The sensation is aroused when physical sound waves tickle our ears and send nerve impulses running to the brain along the auditory nerve. Davis adds that a sound is a real but intangible, which can not be weighed or measured on a scale or meter.

People who are tone deaf but are not hearing impaired can be taught to match pitches and to sing in tune. There have been some efficient music therapy strategies developed for treatment of tone deafness. Firstly, In order to do so, they need to learn how different body parts function adequately without conscious control. One must monitor tension and relaxation in all areas of the body and should try to gain control over the muscles of the face, mouth, abdomen, and back. The most important aspect here is the conscious flexing and relaxing of specific muscle as an important conditioning exercise. Singing involves a lot of muscles functioning to control pitch. However, it results less from conscious control of the vocal apparatus than from the effect of musical imagination on that apparatus. Therefore, gaining awareness of the musical sensations and movement will certainly help to control the vocal function.

Secondly, progressive breathing exercises can be an effective intervention to facilitate attending skills. This involves training the pitch-matching where one had to coordinate hearing and voice. According to Sundberg(1987), vocal sound is produced when a flow of air from the lungs causes the vocal folds to vibrate, setting up a pattern of vibration in the air. Those vibrations are amplified through the resonators and projected to the ear of the listener. The pitch of the sound is determined by the vibrations of the vocal folds, the size of the glottal opening, and appropriately directed air pressure. It is important that the singer must become aware of and practice controlling his/her thoughts and impressions. One exercise is to concentrate on a single thought such as a color, sound, or word given by the teacher, and to give it complete attention. After practice, it becomes more automatic and natural, and one's concentration will then be free to combine accurate sound production and aural sensation.

Third, remedial program with structured singing activity may be efficient. For the remedial training program, different techniques were implemented to improve children's vocal skills of matching a single note, interval recognition, melody and rhythm

recognition, and singing skills. The remedial training involved singing a note within the child's speaking range; finding a "personal" note which the child could produce and sustain, followed by tone-matching exercise to expand the child's vocal range humming and echoing. These techniques helped the children to become aware of pitch fluctuations in the speaking voice, to extend and transfer these skills to pitch production in a musical context. Roberts and Davis(1995) studied ninety monotone children in three groups: a traditional training group, a remedial training group, and one control group. The study took eight weeks during which the control group received normal music lessons. In the traditional training group, the children received an extra two half-hour lessons every week. The experiment reported that such remedial program brought some improvement in pitch production among children who were initially rated as monotones. The two areas of shown improvements were single note production and interval production.

Fourth, using vibrato can be an effective intervention. Yarbrough, Bowers and Benson (1992) studied the effect of vibrato as variable affecting on the pitch-matching accuracy with both certain and uncertain singers. Ninety-one certain singers and one hundred and nine uncertain singers were tested before and after exposure to three different models; a child model singing a descending minor third (G to E) using the syllable "1a," a female model singing the same note but with vibrato; and female singing the same note without vibrato. The results indicated that vibrato does affect pitch matching. Uncertain singers had more correct response to the child model, and had the fewest correct responses to female vibrato model. For certain singers, the models did not have any significant effect on their correct response. It may imply that the vibrato affected the target pitch with accompanied fluctuations in the pitch which may impact the ability of uncertain singers to match the target pitch.

Fifth, teaching children to find their own vocal range can be an effective approach. Since the vocal range of the adult male is approximately and octave below that of children in the elementary classroom male vocal models singing in their own octave may find that some children have difficulty correctly imitating g the pitch an octave higher(Small & McCachernm, 1983). Sims, Moore and Kuhn(1982) have found that young children seem to have difficulty echoing sounds heard in a register other than the register in which their voices lie. These octave transposition abilities may require a level of sophistication not yet attained by 5 and 5 year olds however, these abilities might be improved by training. One research has also indicated that children respond more accurately to a female model. The result indicated that male as well as female teachers rely heavily on their voices to teach singing. This further indicated that female vocal

modeling has more positive effect than the male in pitch matching accuracy for the children.

Lastly, using operant conditioning procedures to implement in helping children with pitch problems may be efficient. Porter studied to determine whether successive approximation or reinforcement of correct response alone was more efficient procedure in helping uncertain singers to sing on pitch. The results indicated that the contingent use of high approval had a significant effect on children's learning behavior.

There are some considerations for potential causal factors of monotonism including family background and heritage(Chong, 1998). Singing ability of four out of nineteen students was inferior due to hereditary problems. This may also include functioning of vocalization such as ranges, and vocal control. Some children may have learned to sing low in their throats with the timbre of a male voice. Such children may have a higher singing range but have not found it or learned how to use it. The right placement of tone may be discovered by various vocal exercises. However, unless the teacher is persistent with these children, their voices will drop and they will continue to sing in this lower register.

Conclusion

In music therapy, one's attitude towards music plays an vital role in the level of participation. This not only effects one's self-esteem, but also The ability to match pitch and successfully sing in tune often determines the successor failure a child feels when participating in elementary music class. Music educators strive for a high success rate in their efforts to develop pitch accuracy for their students. In the instrumental ensemble, even seating arrangement may be very important, whether or not the child is sitting next to the conductor, near the flute section or in the rear of the rehearsal hall, next to tuba section. The pitches and timbres of the other instruments sound the child might not blend with one another and might compare the child.

Children who cannot sing a melody in tune pose special problems in a musical setting. Such children may be asked to stay quiet while the others sing these children may suffer humiliation in addition to their lacking an important mode of self-expression and enjoyment. According to Ramm(1947), it was discovered that there is a positive correlation between maladjustment in the school and monotonism in children. The

labeling of "tone deaf," "monotone" or "uncertain singer" can easily discourage new musical learning by eliminating an opportunity to alleviate the problem. Children or adults with specific pitch problem will continue to benefit from research on the causes of tone deafness and solutions to the problem.

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