Stuttering and Music Therapy

An Honors Thesis (HONR 499)

by

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Abstract

A connection between speech and music dates back several hundred years; for many of those years, music has been discovered to be a valuable method for treating various disorders of speech, including stuttering. Stuttering is a disorder of fluency that affects one percent of the world’s population. In children, it often develops between the ages of two and five, and it causes one to experience a disrupted flow of speech and difficulty coordinating necessary muscle movements to create normal speech. Specifically, a stutterer often repeats whole words or syllables, prolongs certain speech sounds, and has blocks or pauses in his speech. These struggles can cause a stutterer to experience much anxiety and fear in his everyday life, and he may even avoid speaking in general as much as possible. Stuttering’s concrete causes are unknown, although many theories have been researched and discussed; genetics and neurophysiology often affect stuttering’s onset. Two types of music therapy, rhythmic speech cueing (RSC) and therapeutic singing (TS) are common methods of incorporating music into the speech therapy setting in order to improve fluency in children and prevent the issue from persisting into adulthood. This paper analyzes the specific brain physiology involved in incorporating music therapy for children with developmental stuttering, why such therapy is so beneficial, and how the two aforementioned types of music therapy specifically work.

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Introduction

Stuttering is a disorder of the fluency of speech that affects children and adults all over the world in all races and cultures. It has existed for over forty centuries and is in no way a reflection of a person’s intelligence (Guitar, 2014, p. 5). Its effects often interfere with a person’s social, work, and academic life, and they can also create much anxiety, fear, and frustration involved with speaking. As with other disorders of speech and language, stuttering often requires therapy and treatment to help prevent it from turning into a more chronic problem that lasts long into adulthood. Although a person’s development of stuttering arises from his or her own unique factors (ASHA, 2015a, Stuttering section, para. 1), treatment typically involves teaching various behaviors and skills that help improve oral communication (ASHA, 2015c, What treatments are available for stuttering section, para. 1).

According to Michael H. Thaut, music is often thought of as being an “offspring” of speech, and he claims that the connection between music and speech expands “back over many hundreds of years” (2008, p. 165). Music has been discovered to be a “valuable tool for the treatment of speech disorders,” including stuttering (Thaut, 2008, p. 166). This paper will discuss the positive outcomes and brain physiology involved in incorporating music therapy into speech-language therapy for English-speaking children with developmental stuttering. To accomplish this, a review of the symptoms and causes of stuttering, comparative brain physiologies of stuttering and nonstuttering patients, the beneficial connections between music and fluency, and types of music therapy for stuttering will all be examined.
Research

Symptoms

Stuttering currently affects one percent of the world’s population; 3 million people in the United States are stutterers, males four times more frequently than females. (Howland, 2013, p. 110). It is a disorder of fluency; therefore, it disrupts the graceful and unforced flow of speech that nonstutterers experience. Fluency involves how various moving speech structures control variables such as rate, stress, rhythm, pauses, and intonation (Guitar, 2014, p. 6). Problems with fluency result from difficulty stringing together the necessary muscle movements to produce sentences (ASHA, 2015c, What causes stuttering section, para. 1). Stuttering typically arises in children between ages two and five—when they are learning speech and language; when symptoms appear in this manner as the child develops, it is considered developmental stuttering (Guitar, 2014, p. 5 & 11). Stuttering is often developmental in nature because a child is more likely to stutter when beginning to learn more grammatically complex sentence structures (ASHA, 2015c, What causes stuttering section, para. 2). A child that begins stuttering at age three and a half or later is more at risk for chronic stuttering, or stuttering that may last into adulthood (ASHA, 2015a, Risk factors for persistent stuttering section, para. 5).

According to the American Speech-Language-Hearing Association (ASHA), stutterers experience symptoms of repeating whole words or syllables, pauses/blocks in speech, and prolongations of speech sounds. In addition, accessory behaviors such as head nodding, facial grimaces, excessive blinking, clearing of the throat, leg tapping, fist clenching, and circumlocution can accompany primary symptoms. Symptoms are more severe when a person undergoes much stress or pressure, and severity can even fluctuate
throughout a given day. In addition, a person usually stutters more frequently in narrative speech than in conversation. Symptoms can be so severe as to cause a person to avoid certain social situations or speaking in general (ASHA, 2015b, Stuttering section, para. 4). Just as symptoms can look slightly different from person to person, the cause of stuttering is not the same for everyone and includes a diverse number of theories.

Causes

Many clues can point to possible causes of stuttering, but no established, official theory exists. Genetics and neurophysiology can both play roles in causing the onset of stuttering (ASHA, 2015a, Stuttering section, para. 1). In 60% of patients who stutter, a genetic predisposition is accounted as the underlying cause (Howland, 2013, p. 110). Regarding genetics, it is not conclusively known whether chromosomes, genes, or sex factors are the more primary causal agents (ASHA, 2015a, Stuttering section, para. 4). One particular chromosome may carry a genetic mutation that is associated with controlling motor movements and regulating emotions (Guitar, 2014, p. 26). Genetically, breaks or obstacles may exist in the neural pathways for normal speech and language flow of information (Guitar, 2014, p. 5). In cases of familial stuttering, mutations of the genes GNPTAB, GNPTG, and NAGPA are mutated in ten percent of cases; these mutations affect the enzymes of the cells. In regards to neurophysiology, in patients who stutter, the left hemisphere contains less gray matter volume and less white matter integrity; stutterers have more white matter connections in the right hemisphere as opposed to the left (ASHA, 2015a, Stuttering section, para. 5). If a person has a family history of stuttering, he is more at risk for developing neuromotor instability. Although genetics can be a potential cause, 40 to 70% of stutterers have absolutely no family
history of stuttering; a genetic predisposition for stuttering may exist and show up as stuttering further down the lineage, but stuttering could also be the result of a congenital disorder or problem. A combination of difficulties with “speech motor control, sensory processing, language planning and execution, and/or emotional vulnerability” can also contribute to the onset of stuttering (Guitar, 2014, p. 26-27).

Research has determined that emotional problems or poor parenting as independent factors do not cause stuttering, but a person’s environment plays a significant part in combination with potential genetic factors. The onset and growth of stuttering can be triggered in a person with a genetic predisposition to stutter by his environment, particularly his various stressors or emotions (Guitar, 2014, p. 68). Poor parenting itself does not directly cause stuttering, but the communication style of a child’s parents can be extremely influential; language that is too complex for the child can overwhelm him and increase his likelihood to stutter (Guitar, 2014, p. 69). After the onset of stuttering, adjustment and ability to cope are made much more difficult when the person exhibits trouble regulating emotions or succumbs to various stressors. In addition, just as emotional troubles can contribute to the onset of stuttering or its delayed recovery, the reverse can occur where the onset of stuttering results from overwhelming emotional problems (ASHA, 2015a, Stuttering section, para. 2). As noted briefly earlier, stuttering patients show significant distinctions in neurophysiology compared to nonstutterers; these neuroanatomical differences are of significant importance in relation to music therapy, and they will be discussed more in depth in the following sections.
Neurophysiology in stutterers vs. nonstutterers

In 2008, neuroimaging techniques became safe and available for use on children (Guitar, 2014, p. 28); various technologies are used to conduct brain research and showcase neuroanatomical variances among people. Some of the most common technologies include: Positron emission topography (PET), Magneto encephalography (MEG), Magnetic resonance imaging (MRI), Functional magnetic resonance imaging (fMRI), Near-infrared spectroscopy (NIRS), and Direct current stimulation (DCS) (ASHA, 2015a, Stuttering section, para. 11). Research through these technologies has determined that whatever the underlying cause of stuttering (genetic predisposition, congenital problem, trauma, injury, etc.), it results in a change in brain structure that disrupts normal speech and language processing (Guitar, 2014, p. 28).

Compared to nonstuttering individuals, areas in the left hemisphere develop differently in stutterers, particularly the sensory, motor, and planning areas; the right hemisphere appears to take over several functions that the left hemisphere normally initiates. Stutterers' brains show larger volumes of white matter in the superior temporal gyrus, inferior frontal gyrus, and precentral gyrus in the right hemisphere. This is believed to be compensatory for the deficits in similar structures in the left hemisphere. Instead of the right hemisphere compensating for left hemisphere inadequacies, another theory hypothesizes that a stutterer's brain originally develops with more white matter tracts in the right hemisphere, being the primary speech and language area and connecting sensory and motor functions that are typically seen in the left hemisphere. The former theory is more often favored because right hemisphere activation is most commonly seen in patients with moderate stuttering as opposed to patients with severe
stuttering; it is also discovered that as patients become more fluent in therapy, right regions of the brain often become more active (Guitar, 2014, p. 48 & 51).

Certain white matter tracts in the left hemisphere are less dense in stutterers, but in the right hemisphere, the same tracts are denser compared to nonstutterers. Much of this white matter is in the arcuate fasciculus, which helps send phonological representations to the Broca’s area where execution takes place. Additionally, the operculum is an area of the brain containing fibers that connect sensory, planning, and motor areas necessary for speech; diffusion tensor imaging has particularly shown that the white matter fibers in these tracts are less dense compared to fluent patients (Guitar, 2014, p. 47). According to Guitar, “the most robust difference between stutterers and nonstutterers is in left-hemisphere fiber tracts that communicate between the inferior parietal cortex (sensory integration) with the ventral frontal cortex (motor planning)...certain nerve fibers aren’t structured as effectively to conduct impulses along the directional flow of the nerve bundle. Thus, conduction is not as fast as it might be” (2014, p. 29).

Some researchers theorize that the less sufficient white matter tracts result from delayed myelination of nerves in pathways of the superior longitudinal fasciculus (SLF III), which connects output planning in the frontal cortex to sensorimotor integration areas of the inferior parietal lobe. Incomplete myelination is a commonly posited reason for stuttering because less coordinated and precise actions result from less insulation of nerves (Guitar, 2014, p. 49). During a cerebral blood flow (CBF) study, a radioactive tracer is injected in the blood, and pictures are taken that analyze the amount of radioactivity given off; the more radioactivity shown, the more blood flow and neural
activity present. One CBF study showed that stutterers’ left hemispheres were less
dominant compared to controls in areas that are believed to be associated with language
processing (the middle temporal lobe), speech motor control (the inferior frontal lobe),
and motor initiation (the anterior cingulate). However, since stutterers often exert extra
effort while speaking, an over activation in certain left hemispheric areas responsible for
motor control of speech is often noticeable (Guitar, 2014, p. 50-51).

The planum temporale (PT) is a part of the Wernicke’s area of the brain, which is
associated with higher level auditory processing. In nonstutterers, the PT is often larger in the left hemisphere than the right, but in stutterers, it is symmetrical in size in both hemispheres—in some cases, it is larger in the right hemisphere. In addition, there are differences shown in the gyri (folds) in the speech/language areas of the brain between stutterers and nonstutterers, and this likely affects the quality of information flow between the Wernicke’s and Broca’s areas (Guitar, 2014, p. 47). High levels of activity in certain midbrain structures can also influence speech. In stutterers, structures of the basal ganglia are overly active; the basal ganglia send signals to the sensory motor area (SMA), which initiates movement. If the basal ganglia send too many signals, the SMA can become inhibited (Guitar, 2014, p. 51). As aforementioned, many over-activated areas in the right hemisphere of the brains of stutterers are the result of several under-activated areas needing compensation.

Research reveals that in both hemispheres of stutterers’ brains, there is less
activity in the ventral premotor, rolandic opercular, and sensorimotor cortex areas, which are zones that relate to sensory and motor information and help plan sequential movements necessary for speech. Under-activity is also shown in the Heschl’s gyrus,
which is vital for processing speech sounds; therefore, stutterers often have difficulty performing auditory processing tasks and can improve their fluencies by improving the way they hear their own speech. Auditory and proprioceptive self-monitoring can be beneficial for this reason, as well as therapies that focus on slow speech and gentle onsets. Other under-activated areas in stutterers’ brains are the Wernicke’s area, which stores phonological representations of words, and central auditory processing areas (Guitar, 2014, p. 51, 52, & 53). In areas that deal with auditory proprioception of speech, such as the Broca’s and bilateral temporal lobe, there are reduced amounts of gray matter (Guitar, 2014, p. 29).

Since many areas of the left hemisphere are in need of reactivation, therapy for stutterers helps condition previously underactivated areas, and it also helps reduce activity in certain areas in the right hemisphere. Music therapy cannot only aid in strengthening these left hemispheric areas, but also improve ability to process visual and tactile information, which are often lacking in stutterers (Guitar, 2014, p. 33). When considering what types of therapy to utilize for stuttering patients, it is important to note that sensory and motor input are both necessary elements for fluent speech, and they involve developing and controlling muscles used for speech, coordination, and sequencing sounds at a certain rate. In addition to articulatory movements of speech, nonspeech motor tasks such as finger tapping are planned and organized in the SMA of the brain (Guitar, 2014, p. 33 & 35). Music involves rhythm, motor coordination, and prescribed/organized sequences; therefore, in many ways, speech therapy that incorporates music can be extremely beneficial to patients who stutter. The following sections of this review will discuss elements of music that relate to speech, music
therapy's emotional and neuroanatomical benefits for stutterers, and types of music therapy that can be applied for stuttering.

Music and speech

Several similarities exist between speech and music, many of which serve as appropriate foundations in combining music into stuttering therapy. Music and language both work in relationships—one with between sounds and the other between sounds and other external phenomena (Ockelford, 2013, p. 169). Michael Thaut states, “With the many similarities between music and speech, it has often been assumed that music, and especially singing, is a valuable tool for the treatment of speech disorders” (2008, p. 166). The relationship between brain function and music was discovered in the mid 1990s, and findings suggest that music can affect cognitive and sensorimotor processes that can be generalized into therapy applications (Thaut, 2008, p. 62). Thaut also claims that music and speech share several prosodic features, including pitch, timbre, accents, intensity, duration, and inflection patterns (Thaut, 2008, p. 1). The grouping structure of music, such as melody, closely relates to patterns of pitches in an utterance (Patel, 2008, p. 191). Furthermore, studies show that an interaction between syntactic processes of both music and language exists, likely because they both depend on shared processing resources in the brain. The neural mechanisms involved with such processes can be amended with music (Koelsch, 2012, p. 144 & 150).

Timing and accents are a large focus in both music and speech; in music they are a construct, but in speech they are a consequence (Patel, 2008, p. 150). A connection between syntax and pragmatics also exists in both systems because they each organize certain patterns of sound into structures based on rules (Thaut, 2008, p. 2). Music, like
language, is very complex, sensory, and rule-based; they both also share the function of communication, including the communication of time. Producing rhythms is dependent on the brain’s ability to organize time (Thaut, 2008, p. 33 & 39). Patel defines rhythm as being “the systematic patterning of sound in terms of timing, accent, and grouping” (2008, p. 96), and this type of systematic patterning, whether temporal, accentual, or phrasal, is exhibited by both speech and music; the way that speech and music are rhythmically organized is quite similar (Patel, 2008, p. 96 & 139).

Rhythm

Rhythm, especially in Western music, is often thought of as having an isochronous beat; however, several types of music exist that do not have any time markings or steady sense of beat. For example, the Ch’in instrument in China merely tells the musician which strings and types of gestures to use. Ghanian drumming in West Africa and Balkan folk music in Eastern Europe also share in this sense of irregularly spaced beats and intervals (Patel, 2008, p. 98). Therefore, types of music exist that more closely reflect the irregular rhythm of speech. In addition, speech can sometimes sound more similar to singing, as exhibited in the speeches of Martin Luther King; many art forms also represent a mix of both speech and song (Koelsch, 2012, p. 246). Just as “beat perception is fundamental to music” (Patel, 2008, p. 102), each language has its own rhythm. Once a young child can detect his language’s rhythm, he can begin to transition from segmented words to connected speech (Patel, 2008, p. 128). Even as infants, humans are “sensitive to speech rhythm and use it to guide learning of fine-grained sound patterns of language” (Patel, 2008, p. 137).
Although language often has a more irregular rhythm, English is considered a “stress-timed” language, where there are equal temporal intervals between stresses in a given sentence. Intervals between stressed syllables are approximately equal, even when the number of syllables changes (Patel, 2008, p. 120). In this way, duration of rhythm in music relates to duration of rhythm in speech because vowels are able to change duration when other syllables are added or taken away (Patel, 2008, p. 126-127). Rhythm and several other areas of music are incorporated into therapy for stutterers because of numerous neuroanatomical and emotional benefits for patients.

Rhythm is introduced into speech therapy for stutterers because it increases “efficiency of the organism” (Hahn, 1956, p. 58) and can “enhance intelligibility and overcome deficiencies in fluency” (Thaut, 2008, p. 69). A rhythmic beat can coordinate synchronized movement necessary for speech (Patel, 2008, p. 99). Many researchers believe that problems with stuttering are associated with a disorder of timing, therefore involving rhythm. The programming of muscle movements is disrupted in stutterers; mechanisms in the brain control rate of speech, order of movements, and timing relationships among sounds, syllables, and phrases for speech. This can be directly compared to timing in music; a musician has to control speed and tempo, among many other coordination tasks (Guitar, 2014, p. 92). Michael Thaut believes that various elements in music, including rhythm, are sensory experiences that change the brain for the better. He declares, “the brain that engages in music is changed by this engagement” (Guitar, 2014, p. 62). He also asserts, “Rhythm provides temporal structure through metrical organization, predictability, and patterning.” Music can serve as a “language of
time,” distinctively engaging the brain to enhance areas of motor learning (Guitar, 2014, p. 83).

Music enriches the sensory environment, which helps construct synaptic connections in the brain and an increased production of neuronal pathways. Training and exposure to music help develop the brain into an increasingly dynamic and powerful executive system. Thaut states, “rhythm in music, the element of temporal order, has a unique and profound influence on our perceptual processes related to cognition, affect, and motor function. Rhythm may be one of the central processors to optimize our gestalt formation in the basic processes of learning and perception” (Guitar, 2014, p. 16-17). Thaut acknowledges that anatomically, music functions are widely distributed throughout the brain, and they can retrain certain behavioral and neural functions that can be applied non-musical contexts (Guitar, 2014, p. 2 & 40).

Rhythmic training and exposing the brain to rhythmic cues also activates parts of the brain that deal with “direct motor entrainment” (Guitar, 2014, p. 49). A study using brain imaging and MEGs concluded that brain-wave responses of the auditory cortex changed proportionally to changes in rhythmic duration presented, whether or not it was perceived consciously. Therefore, some rhythmic discrimination occurs at the auditory cortex level, and the auditory cortex directly contributes and projects directly to various motor outputs. (Thaut, 2008, p. 46, 48, & 57). In particular, rhythm speech cueing in therapy has been shown to have one of the highest improvement rates (Thaut, 2008, p. 69). For stutterers in particular, rhythm in music therapy can positively affect “speech rhythms, fluency, rate control, intelligibility, articulatory control, and respiratory
function” (Thaut, 2008, p. 72). Music is beneficial for stuttering patients in general, for other reasons besides just rhythm.

Music is able to communicate information to the brain through neurologic processes that can profoundly benefit aesthetic engagement, learning, recovery of function, and development (Thaut, 2008, p. 57). Music helps connect the senses to motor control; performing a musical piece is a unique way to help regulate sensory-guided motor movements (Thaut, 2008, p. 35). As an artistic expression, music exercises essential brain structures and formulates distinct patterns of perceptual input that the brain requires, yet cannot produce on its own; this helps the brain function optimally in regards to all cognitive, sensory, and motor processes (Thaut, 2008, p. 25).

**Singing**

Singing can be beneficial in music therapy as well. The Australian singer-songwriter Megan Washington is a wonderful exhibition of this fact. She claims that while singing, it is one of the few times where she ever feels fluent (“From Megan,” 2014). Singing was utilized in one of the first applications of music therapy in the 1970s for Broca’s aphasia patients. Imaging data and lesion studies have proven that singing can help verbal output because the areas that it involves in the brain are more diffuse, causing rerouting to occur so that damaged neural pathways are bypassed and the encoding process verbal output shifts to a different hemisphere. Language and singing share aural and production features, and both language and music systems share the ability to embed communicative functions in the auditory modality. (Thaut, 2008, p. 68-69). Singing has an extremely beneficial fluency-enhancing effect because of its increased phonation duration, often familiarity of lyrics, and intonation. In a study requiring participants to
sing songs for ten minutes, the frequency of stuttering was reduced by over 90%.
Furthermore, a neuroimaging study proved that singing improves fluency because compensatory processes are at work; they robustly activate the left hemisphere, specifically the auditory motor mechanism (Wann, Ruber, Hohmann, & Schlaug, 2010, p. 289).

Music’s neural pathways in the brain are more distributed; therefore, engaging the brain in music helps activate areas in the brain that are weaker for stutterers. “The neuroanatomy and neurophysiology of music processing show shared, parallel, and distinct neural processing systems relative to nonmusical functions” (Thaut, 2008, p. 83). Music arouses the brain and regulates attention in a bilaterally distributed manner. Different neural networks are accessed when verbal material is exhibited through song; an alternative information-processing route is utilized in the brain (Thaut, 2008, p. 84). Typically, motor areas of the brain are larger in musicians than in nonmusicians. Music has the ability to increase the size of the auditory and motor cortexes, and it causes the two motor areas in the left and right hemispheres of the brain to connect and form thick fibers. Even though music is a largely right-hemispheric activity, brain-imaging research does show that it actively involves the left hemisphere as well (Jun, 2011, para. 3, 4, & 5).

**Emotional benefits of music**

Depending on the severity of a person’s stuttering, it can affect his self-consciousness, cause him to avoid various speaking situations, and fill his life with unnecessary or debilitating fear. Stutterers go so far as to limit their social and work lives to where speaking is at a bare minimum. People who stutter often experience negative
feelings and even find it difficult to adequately express their emotions. Through music, a person is able to better communicate emotion and meaning; many see this as being music’s primary function. Music is powerful, and it has a strong influence on a person’s affective states, and these affective states in turn affect learning, attention, and executive functioning abilities (Thaut, 2008, p. 84). When thinking about types of therapy to be utilized for stutterers or any speech client, it is important to consider what therapy may best benefit the client and help improve his overall quality of life. In the school setting, children are often reluctant to come to therapy; this is often because they simply do not enjoy it (Guitar, 2014, p. 269). For many children, music is an appropriate method for children to have fun in therapy, activate their brains, and develop a discipline that they can relate to improving fluency ability. According to Kathleen Howland, “...music therapy is an ideal clinical intervention, especially with young children.” Sounds are able to capture a child’s visual and auditory attention, and experimenting with volumes, improvisation, prompting, and movement in music can also help strengthen and sustain attention (Howland, 2013, p. 117). A few specific types of music therapy exist for stuttering patients in particular.

**Treatment philosophies**

First of all, in beginning treatment, success is based on age of onset and other genetic factors; therefore, it is important to begin therapy as young as possible. In approaching stuttering treatment with music, two general techniques are often applied. One teaches a person how to stutter more easily, and the other helps the client work toward eliminating the stutter altogether by building fluency abilities that can be
generalized into all contexts (Howland, 2013, p. 110). In music therapy, both rhythmic speech cuing and therapeutic singing are techniques utilized for stuttering patients.

*Rhythmic speech cuing*

Rhythmic speech cuing, or RSC, is a technique that controls rate and uses auditory rhythm in order to address motor skills related to speech production (Howland, 2013, p. 119). This rhythm cues speech through use of either a metronome or rhythm that is embedded in the music. Oftentimes, stutterers have difficulty starting sounds; RSC helps initiate speech through the anticipation of the rhythmic sequence. RSC covers two different categories, which are metric cuing and patterned cuing. Metric cuing involves matching rhythmic beats to syllables, which causes each syllable to be of equal duration in a given utterance. Therefore, this does not reflect natural time patterns of speech, but it helps a stutterer overcome his interrupted speech flow that often results from poor timing and sequencing; intelligibility improves as well. Creating pauses in between words can be beneficial as well because it allows the speaker to prepare for the beginnings of words (Thaut, 2008, p. 170).

RSC’s other category, patterned cuing, involves stressing patterns of normal speech inflection through the use of beat patterns. The beats presented within an utterance are asymmetrical in length, and depend on the normal rhythmic pattern of speech utterances. This reflects more normal speech prosody compared to metric cuing. Asymmetrical fluency cues can be incorporated through singing in music; however, not all patients that achieve fluency in singing can transfer it over into speech. In addition, sometimes a simple metronome cue instead of singing is more beneficial, depending on whether a patient has a brain lesion in a certain area (Thaut, 2008, p. 171). Therefore, to
actually implement RSC into therapy for a stuttering patient, the therapist must first
determine which level of RSC is most appropriate for that client. Some trial and error of
the two techniques is often necessary to accomplish this.

In order to actually elicit speech samples to combine with the rhythmic cuing, it
is helpful to provide a topic of conversation relevant to the client, or involve the client in
some form of play. Hands-on activities are typically useful, and they help encourage a
natural, comfortable environment for speech and communication. When actually
observing and listening to the client, the therapist should record the patient’s productions
both with and without the rhythmic cuing. For stutterers, the therapist needs to take note
of the frequency and characteristics of the client’s dysfluencies. To begin with the RSC
technique, call-and-response productions between the therapist and client are effective.
Basic patterns in the beginning should eventually be varied to challenge the client and
should progress from the word level to the phrase and sentence levels. Various
instruments can be utilized as well, such as a drum, xylophone, or piano/keyboard; if no
instruments are available to the therapist, simple hand tapping is also useful. For very
young clients, using physical objects to represent the syllables and rhythms can help the
child focus and better understand the task at hand (Howland, 2013, p. 128-129).

**Therapeutic singing**

Therapeutic singing (TS) is another form of music therapy beneficial to stuttering
patients. It simply involves a nonspecific use of singing activities to facilitate speech and
language; this can be applied either in groups or one-on-one therapy (Thaut, 2008, p.
175). Singing is so beneficial in treating speech-motor difficulties and other neurologic
disorders because the continuous voicing helps connect syllables and words and also
slows the rate of syllables (Howland, 2013, p. 129). Therapeutic singing helps with "initiation, development, and articulation" in clients' speech, as well as functioning of the respiratory system. TS is often used to address a wide range of general functions, and it can also help reinforce goals from other training exercises by integrating several elements of various therapeutic techniques and supporting them. TS allows a client to put all elements of speech together, focusing on the musical outcome as a whole as opposed to just specific exercises (Thaut, 2008, p. 175).

TS can also help the therapist assess the client's progress and ability to perform with other various therapy techniques (Thaut, 2008, p. 175). The client can integrate and apply techniques from other therapies into the context of singing (Howland, 2013, p. 129). Before entering a new stage of therapy, TS helps summarize and conclude a previous stage in preparation for the next; it focuses on success and motivation, while providing functional enhancement for the client (Thaut, 2008, p. 176). Fluency improvement during singing is often due to increased "phonation, duration, intonation, and familiarity." Neurologically, singing has been proven to benefit clients because singers tend to have more dense arcuate fasciculi than nonsingers; these are white matter tracts that connect temporal and frontal regions of the brain, as well as perceptual and production areas of the brain for speech. Therefore, incorporating singing into therapy can improve motor production of speech by causing neural changes. In addition, singing is "a fun, engaging, natural activity," and it is likely to be a technique that parents practice with their children at home to improve generalization (Howland, 2013, p. 129).

As with any other therapeutic technique, before beginning therapy, the clinician should assess the client's abilities and needs; fluency and breath control should
particularly be assessed in stutterers, and then various songs should be selected to match those capabilities. If breath control is an issue, therapy can center on length of phrases per breath; if speech needs to be slowed down, therapy should focus on rate of syllables. As the clinician models proper singing for the child, he/she should face the child directly and create proper visual positioning. As the child continually progresses, support from the therapist should gradually decrease. While actually observing the child, the therapist should assess the client’s awareness, response to prompts, performance with less modeling, effort exerted, frustration level, and ability to correct himself. Hand-tapping or percussive instruments are auditory cues that may help the client improve vocal output (Howland, 2013, p. 129-130).

When actually incorporating therapeutic singing into therapy, it can be made the focus of the entire session or merely serve as a segment. Oftentimes, it is best for the client to alternate between TS and other activities; although the singing may be extremely enjoyable for many clients, it is still critical for the child to practice speaking and neurally engage in other challenging activities. Frequent time spent singing, however, increases changes in the white matter tracts and can be an easy, fun activity to do at home with a recording of a song accompaniment. Recordings should include tracks with and without the therapist singing along, and should also include tracks to be used in the car. Intense, frequent practice, especially outside of therapy, is what creates optimal improvement and gains in fluency ability (Howland, 2013, p. 130).

**OMREX**

Since stutterers sometimes struggle with respiratory strength, another form of music therapy called oral motor and respiratory exercises (OMREX) can be applied. This
technique involves sound vocalizations and use of wind instruments to enhance respiratory strength and overall function of the speech structures. OMREX can be useful for any disorder that affects speech motor control. Common wind instruments often used for this technique are "flutes, kazooos, slide whistles, or tin whistles." Playing these instruments helps develop control and strength of the respiratory system. Blowing wind into various instruments can be directly adapted into facilitating real speech sounds. Various melodies and rhythms can be added to shape exercises and improve pitch; they can also regulate rates of speech production and repetition, therefore enhancing overall speech mechanism strength and control. OMREX incorporates both singing and rhythm, which are two previously discussed techniques that help improve fluency by prolonging voicing and facilitating motor planning and execution (Thaut, 2008, p. 172-173).

Generalization and benefits

Generalization of acquired abilities in therapy is extremely important in order for clients to fully overcome stuttering. Some music therapy techniques can be taught to parents and teachers in the schools to they can be utilized in other contexts for the client. Parents of children who stutter should be reminded that it is okay if they cannot sing well; they should sing with their child on a regular basis and encourage musical involvement. If speech-language pathologists (SLPs) do not incorporate music in their private therapy sessions, they can collaborate with music therapists and share knowledge through collaboration. In addition, after therapy may transfer from a group setting to a one-on-one setting, it may move to the classroom where the teacher can implement music activities for the entire class. In this scenario, a SLP can consult with both a music therapist and teacher. Overall, music therapy is often extremely advantageous for stuttering patients
because it is relevant, can compel them, frees them to express themselves, and boosts self-esteem. It activates areas of the brain that are necessary for speech motor control and fluency, and allows the child to have fun while doing so. Additional research is certainly needed to continue discovering the usefulness and application of music therapy, but current findings point to its potential to enrich children’s experiences with speech and language, a critical area of development in a person’s life (Howland, 2013, p. 133).

Conclusion

Stuttering is a disorder of fluency that can affect a person’s overall quality of life, affecting success in social situations, academics, and work. It can also create much fear and anxiety in speaking contexts, potentially causing a person to avoid them at all costs. Stuttering often develops in children between the ages of two and five, while speech and language are initially being acquired. No established, official cause of stuttering exists, but genetics and neurophysiology can play important roles in its onset. In addition, the progression of stuttering can be triggered by a person’s environment in combination with a genetic or familial disposition. It is important to implement therapy in children who stutter as early as possible so it does not chronically persist into adulthood. One extremely beneficial treatment approach for stuttering encompasses the involvement of music, as music and speech share many structural and neural similarities. Various neuroimaging techniques and modern technologies showcase that various changes in brain structure are responsible for disrupting normal speech and language processing in stutterers. Music therapy aids in strengthening underactivated areas of the brain in stutterers, and this can be accomplished through rhythmic speech cuing (RSC) or therapeutic singing (TS). Implementing various music therapy techniques into speech
intervention for children who developmentally stutter can not only be enjoyable and familiar for the child, but can also significantly enhance speech motor functioning, teach the child a new form of discipline, and be a truly rewarding, enriching experience that can change the course of his or her life.
References


