A SYSTEMATIC REVIEW OF MELODIC INTONATION THERAPY RESEARCH THAT INVOLVED MUSIC THERAPISTS

A THESIS

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS

FOR THE DEGREE OF MASTER OF MUSIC THERAPY

IN THE GRADUATE SCHOOL OF THE

TEXAS WOMAN'S UNIVERSITY

DIVISION OF MUSIC

COLLEGE OF ARTS AND SCIENCES

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MAY 2023

ABSTRACT

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MAY 2023

The purpose of this systematic review was to identify the number of studies that included music therapists, their role in research, and their contributions. A literature search was conducted of studies published between January 1973 to July 2022. Based on the results, 14 studies (N = 14) involved at least one music therapist. Music therapists most frequently had the role of author and practitioner (n = 4) and practitioner (n = 4). The ratings for level of evidence were lower due to the low number of participants in all studies. Nevertheless, music therapists contributed to research by testing modified versions of MIT for a wide range of diagnoses. The results of each study indicated that modified versions of MIT were effective in improving speech output and levels of participation, among other benefits. While a limited amount of research included music therapists, their involvement contributed to the growth of MIT practice.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION

Music Therapy Defined

Music therapy is an evidenced-based practice that uses music to treat a wide range of age groups and diagnoses. According to the American Music Therapy Association (AMTA, 2005), *music therapy* is defined as the "clinical use of music interventions to accomplish individualized goals within a therapeutic relationship by a credentialed professional who has completed an approved music therapy program" (para. 1). Music therapists are trained to use the elements of music to improve sociological, physiological, neurological, and psychological functions. This is accomplished while the therapist develops a meaningful professional relationship with the patient (AMTA, 2005).

Music Therapy Background

In the United States, the practice of music therapy was initiated during the 1940s and was successfully established as a profession in 1950. According to Beyers (2016) "the formation of the profession of music therapy is accepted as having begun during World War II with the United States Army's establishment of music programs for wounded servicemen" (p. 5). Music was used to boost morale and to improve the health outcomes of soldiers. The efficacy of this program was so significant that it led to the active engagement of music therapy personnel in veteran's hospitals by the end of World War II (Byers, 2016). Other historical events included the first academic program for music therapy established in 1944 at Michigan State University and the founding of the National Association for Music Therapy (NAMT; AMTA, 2005). Music therapy has been rooted in social science concepts but has "undergone some dramatic shifts since the early 1990s, driven by new insights from research into music and brain function" (Thaut et al., 2014, p. 1). Research in neuroscience and music resulted in the development of a specialization known as *Neurologic Music Therapy* (NMT) in the mid-1990s.

Neurologic Music Therapy

According to Thaut et al. (2014), Neurologic Music Therapy is defined as "the therapeutic application of music to cognitive, affective, sensory, language, and motor dysfunctions due to disease or injury to the human nervous system" (p. 2). This specialization is based on research and includes music protocols that address the neurological functions of the brain (Thaut, 1999). One of these protocols is known as *Melodic Intonation Therapy*

(MIT), which uses music to restore speech functions for patients with Broca's aphasia. According to The National Aphasia Association (2020):

> Broca's aphasia results from injury to speech and language brain areas such as the left hemisphere inferior frontal gyrus, among others. Such damage is often a result of a stroke but may also occur due to brain trauma.

Patients who are diagnosed with Broca's aphasia have difficulty with expressive speech, but their comprehension is generally preserved (The National Aphasia Association, 2020.). This type of aphasia remains the diagnostic criteria for patients that receive MIT (Sparks & Holland, 1976; Norton et al., 2009; Thaut & Hoemberg, 2014).

Melodic Intonation Therapy

MIT was developed in the early 1970s by neuroscientists and researchers Albert, Helm-Estabrooks, and Sparks. While practicing in a veteran's hospital, the researchers observed that patients with aphasia could not talk in speech therapy sessions, but could sing in music therapy sessions (Albert et al., 1974). By 1976, MIT was developed and a manual for the protocol was published (Sparks & Holland, 1976).

Music Therapy and Melodic Intonation Therapy

Since MIT is based on music, a natural pairing exists with music therapy. However, the protocol has traditionally been used by speech therapists (Albert et al., 1974; Hough, 2010; Koenderman et al., 2018; Moses, 1997; Van Der Meulen et al., 2016; Zumbansen et al., 2014a) and only been gradually implemented by music therapists (Cohen, 1992; Cohen & Ford, 1995; Lucia, 1987, Thaut, 1999). Overall, an extensive amount of literature exists on MIT (Albert et al., 1974; Belin et al., 1996; Curtis et al., 2020; Darland et al., 2022; Ghareeb et al., 2018; Haro-Martínez et al., 2019; Mauszycki et al., 2016; Merrett et al., 2014; Pastuszek-Lipinska et al., 2013; Vines et al., 2011). However, it is unclear how involved music therapists were in MIT research. Therefore, a systematic review was necessary to identify and investigate all MIT research that involved music therapists.

Purpose of Study

Systematic reviews of the literature have been conducted on MIT (Hoffman, 2018; Zhang et al., 2022; Zumbansen et al., 2014b), but no reviews of literature existed that focused on the inclusion of music therapists. A need existed to determine how music therapists were involved in MIT research. Were they the author, clinician, or both? Did they work independently or in collaboration with paraprofessionals, such as speech therapists? Another

area of interest was exploring how music therapists applied the protocol. There are two standardized formats of melodic intonation therapy, the original MIT, and a version for neurologic music therapy (Albert et al., 1973; Thaut et al., 2014). Both versions are practiced within strict guidelines and diagnostic criteria. It was unknown whether music therapists had stayed within the guidelines of either version of MIT or if they implemented modifications or adaptations based on client preferences and need. When the contributions of music therapists in MIT have been established, other researchers may have better indications for future studies. The purpose of this study, therefore, was to conduct a systematic review of the literature targeting MIT that included music therapists. The following research questions were explored in this systematic review:

1. What clinical research targeting melodic intonation therapy involved a board-certified music therapist?
2. How was the board-certified music therapist (or the equivalent) involved in the study?
3. In the identified research studies:
    a. How was the MIT protocol applied?
    b. What were the targeted clinical diagnoses?
    c. What were the results?

CHAPTER II

LITERATURE REVIEW

The following literature review was conducted to provide a description of music therapy, NMT, and MIT. Literature about the neurological functions of music and the outcomes of research were also reviewed. The overall purpose was to provide a clear explanation on the process of MIT and how it related to music therapy.

Music Therapy

Board-certified music therapists are educated musicians and trained clinicians who provide music therapy services for a wide range of individuals. Additionally, music therapy is an evidence-based practice (Certified Board for Music Therapists Handbook, 2020). As part of their undergraduate education, music therapy students are required to take courses in composition, music theory, vocal training, music performance, ear training, and percussion (AMTA, 2005). Music therapists often use these musical skills to address non-musical and musical goals.

Music Therapy and Speech Recovery

Speech recovery has been a goal targeted by music therapists (Cohen, 1992; Elefant et al., 2012; Torppa & Huotilainen, 2019; Yakupov et al., 2019). Elefant et al. (2012) researched the effects of choral singing for patients with *Parkinson's disease* (PD). PD is defined as "a progressive disorder that is caused by degeneration of nerve cells in the part of the brain called the substantia nigra, which controls movement" (American Association of Neurological Surgeons [AANS], 2022). Speech impairment is one of the symptoms of PD and is characterized by slow speech rates, low voice volume, and an expressionless tone. Since brain regions of music and speech share neural connections, the researchers postulated that singing would be effective for PD speech recovery (Elefant et al., 2012). Since there are shared connections, it was suggested that singing would improve the participant's expressive tone. Elefant et al. (2012) tested the effects of singing for 10 participants with PD. The protocol included:

- breathing exercises,
- vocal exercises,
- singing exercises, and
- closing conversations (Elefant et al., 2012, p. 285).

There were significant improvements with five out of six participants. The participants' speech improved in volume, pitch accuracy, consistency of intensity, decreased voiceless sounds, and an increase in pitch range. An

unexpected finding was that for every participant, speech did not deteriorate after 20 weeks of treatment. Therefore, singing not only improved speech, but also lessened the deterioration of speech function. (Elefant et al., 2012). Other researchers have provided evidence on the benefits of singing for speech recovery (Azekawa & Lagasse, 2018; Lim, 2009; Tamplin et al. 2013). Moreover, researchers confirmed that there was a positive effect of music therapy on speech recovery for participants with Broca's aphasia.

Music Therapy and Broca's Aphasia

Broca's aphasia occurs when a stroke or head injury causes damage to the Broca's area in the brain. The Broca's area is responsible for language processing and is in the prefrontal cortex on the left hemisphere (Ramachandran, 2002). As a result, those with Broca's aphasia "have trouble speaking fluently but their comprehension can be relatively preserved" (The National Aphasia Association, 2020). Although individuals with Broca's aphasia have disrupted speech areas in the brain, music areas are usually not disrupted. As a result, individuals with Broca's aphasia can sing even though their speech is disrupted (Albert et al., 1974; Cortese et al., 2015; Curtis et al., 2020; Thaut & Hoemberg, 2014; Zumbansen et al., 2014b).

Cohen (1992) implemented a repeated design measure to test singing instruction on "speaking fundamental frequency variability, vocal intensity, rate of speech, and verbal intelligibility of the neurologically impaired persons" (p. 91). The participants were diagnosed with Broca's aphasia, apraxia, and dysarthria. The music therapy procedure included physical exercises to music, vocal exercises, rhythmic speech drills, and the singing of familiar songs (Cohen, 1992). The researcher (Cohen, 1992) reported that 67% of treatment participants improved in "the areas of speaking fundamental frequency variability, speech rate, and verbal intelligibility. It does not appear that the singing instruction caused any change in the treatment subjects' speaking fundamental frequency over time" (p. 100). Therefore, the author provided evidence that singing can improve speech production for participants with neurological impairments

Additionally, Sivohnen et al. (2020) showed the effects of music therapy on speech recovery and memory enhancement for participants with aphasia. The authors compared the effects of "daily listening to self-selected vocal music, instrumental music, and audiobooks during the first 3 post-stroke months" (p. 2272). The results indicated that, compared to audiobooks and instrumental music, vocal music listening enhanced the recovery of verbal memory and language (p. 2282). The researchers suggested that for individuals with aphasia, listening to vocal music could facilitate early language recovery.

As new imaging technology became available over time, researchers have discovered the effects of music on neurological processes (Ballantyne, 1977; Belin et al., 1996; Sjolund & Rushford, 1977; Thaut, 2008; Warren & Warren, 1979). Such research has led to the development of a specialized area of music therapy known as NMT.

Neurologic Music Therapy

NMT is a specialization that is based on neuroscience. NMT emerged in the 1990s when music therapists partnered with neuroscientists to conduct research. (Thaut et al., 2014). The purpose of NMT was to shift the foundation of music therapy from a social sciences framework to a neurological framework (Thaut, 2008). Music therapists who complete the training earn an additional credential (NMT) and are called Neurologic Music Therapists (NMTs). NMTs are trained in protocols centered around the neurological effects that music has on the brain (Thaut et al., 2014). A protocol known as MIT is often implemented by NMTs in clinical settings.

Melodic Intonation Therapy

MIT is a music-based protocol for patients with Broca's aphasia. The protocol was designed to help patients progress from singing phrases to speaking phrases. A patient with Broca's aphasia may have difficulty saying phrases for everyday use (e.g., 'I need a drink of water' or 'Can you help me?'). During MIT, these phrases are paired with a melody and taught to the patient. As a result, the patient's ability to sing becomes a method of speech recovery.

The History of Melodic Intonation Therapy

The first study of MIT was piloted by Albert and colleagues 1973. At a veteran's hospital, the researchers noticed that patients with Broca's aphasia could sing in group music therapy sessions. Thus, began the endeavor to create a standardized protocol for singing and speech rehabilitation (Albert et al., 1973). MIT was not yet established as a protocol, but the clinical principles were tested. The study was conducted with three participants at the Aphasia Research Center of the Boston Veterans Administration Hospital. All participants were unable to verbally communicate (Albert et al., 1974). The researchers reported that the participant's responses were immediately improved with singing and "remarkably good if the melody patterns used bore no resemblance to popular songs or universally known "jingles"" (Albert et al., 1974, p. 304).

In their next study (Albert et al., 1974), the authors hypothesized that singing could be used to restore damaged neural pathways in the brain. They stated that a *language therap*y with singing needed to be created because:

> the role of the right hemisphere in the processing and perception of non-verbal stimuli, such as music, does suggest that the development of a language therapy which uses some form of singing as a means of improving the production of propositional language would be valuable. (p. 304)

Therefore, the language therapy protocol, known as MIT was created for the study. MIT was first structured as a two-level protocol with five steps per level. The study included eight participants who were diagnosed with Broca's aphasia. Prior to MIT, the participants experienced no improvement in verbal output after six months of speech therapy. Thus, the researchers compared the verbal output of participants pre-MIT and post-MIT. The participants were divided into "three groups as to degree of improvement of verbal output. The three groups were:

1. Best recovery;
2. Moderate recovery;
3. No significant recovery" (p. 306).

The researchers (Albert et al., 1974) reported that four participants were in the 'best recovery' group. They had gained three- or four-worded phrases that were clearly articulated. Three participants were in the 'moderate recovery' group and had gained one- or two-worded phrases. Those patients had pauses in their delivery, but the linguistic quality was sufficient. Lastly, two participants were in the 'no significant recovery' group (Albert et al., 1974). There were three areas of significant speech improvement according to The Boston Diagnostic Aphasia Examination (BDAE) scores. Those areas were response naming, confrontation naming, and phrase length, with the most dramatic change in the phrase length. The authors (Albert et al., 1974) postulated that "improvement in auditory comprehension and reading comprehension may also have occurred as a result of MIT" (p. 311). The authors' rationale for the efficacy of MIT was that "the right hemisphere may be dominant for certain aspects of non-linguistic processing, including some components of melody" (p. 313). After this study, the manual of MIT was established in 1976. The protocol was expanded from two levels of treatment to four levels (Sparks & Holland, 1976). After the manual was released, a natural increase occurred in research about MIT (Belin et al., 1996; Bellapu & Wisco, 2022; Moses, 1977; Norton et al., 2009; Tabei et al., 2016).

Moses (1977), a speech therapist, noted in their dissertation that they had experienced challenges when treating patients with aphasia. Moses (1977) stated that "too often, extensive therapy is provided by the speech pathologist and improvement in verbal output is either minimal, or there is no improvement, using conventional

speech therapy techniques such as naming pictures, forming phrases and sentences, imitation, etc." (p. 2). The purpose of their study was "to investigate the effectiveness of Melodic Intonation Therapy with two aphasic patients with whom other therapy approaches had failed" (p. 3). The author used a pre-test and post-test study design. After three months of MIT, the results were measured with The Porch Index of Communicative Ability (PICA) and the BDAE. With the PICA results, the author reported that MIT was significantly effective for both patients in facilitating language improvements. In contrast, the author reported that the BDAE results did not reflect significant improvements (Moses, 1977). The author noted that there was a carryover effect for both participants. After completing MIT treatment, the participants maintained functional language at home and in other therapy sessions. The author was self-taught in the process of MIT in preparation for the study (Moses, 1977). The founders of MIT developed specific steps to ensure that the patient's speech abilities would improve.

The Melodic Intonation Therapy Protocol

MIT was designed as a strict protocol that required the therapist to follow specific steps (Sparks & Holland, 1976). The protocol increased in difficulty across four levels and was hierarchically structured (Schlaug, 2016). The goal for the patient was to progress from humming, to singing, to sprechgesang (in-between speech), and then to speaking (Zumbansen et al., 2014b). For each level, there were five consecutive sessions, and the patient was to participate in 20 sessions total (Cortese et al., 2015; Norton et al., 2009; Schlaug, 2016; Sparks & Holland, 1976; Thaut et al., 2014). For patients to qualify for MIT treatment, they needed to meet the following criteria:

1. The patient should have good auditory comprehension and the facility for self-correction;
2. The patient should have a good attention span and demonstrate emotional stability;
3. The patient should have significantly limited verbal output;
4. The patient should have poor repetition skills; and
5. The patient should have restricted, but clearer articulation skills present. (Albert et al., 1974; Thaut et al., 2014)

After the patient qualified for MIT, the therapist would conduct the protocol in the following manner: In preparation for MIT, the therapist would choose a short phrase (e.g., 'I need help') then compose a melody for that phrase. The chosen phrase would address the patient's speech goals. The therapist would then begin MIT with the patient. Cortese et al. (2015) described the four levels of MIT:

1. The therapist introduces the melody to the patient by humming. The patient listens, then hums the melody in unison with the therapist. During this process, the patient taps their left hand to the beat. The therapist's assistance of humming with the patient decreases over time.
2. The patient is ready to progress from humming to singing the phrase. The therapist introduces the phrase to the patient by singing. The patient listens, then sings the phrase in unison with the therapist. During this process, the patient taps their left hand to the beat. The therapist decreases from full assistance in singing to moderate assistance. The goal is for the patient to slowly gain independence in singing without the therapist modeling the music. After the patient has met their clinical goals in gaining moderate independence, they are ready to progress to the next level.
3. The patient sings the same phrase with minimal to no assistance from the therapist. The patient's hand tapping continues. After the patient has gained complete independence in singing, the therapist adds more phrases for the patient to learn. The phrases increase in length and complexity. As the patient begins to master the phrases, *sprechgesang* is introduced. Sprechgesang is known as rhythmic speaking.
4. The patient has completely progressed from singing to sprechgesang. The phrases the patient has been singing are now spoken in rhythm. At this level, the musical phrases are transitioned to normal speech. MIT is complete when the patient can use the phrases in a conversation (Cortese et al., 2015, p. 2).

In summary, the patient would progress from humming, to singing, and then finally to speaking. When additional phrases were added for the patient to learn, (e.g., 'Hi, how are you?' and 'I need a drink of water') different melodies would be composed for each additional phrase. Since MIT involves musical cues, the different melodies would make each phrase distinct. As a result, the patient could recall the words assigned to each melody. This protocol has been frequently used by speech therapists due to benefits of improved language production for clients (Carlomagno et al., 1997; Goldfarb & Bader, 1979; Hough, 2010; Van der Meulen et al., 2016; Wilson et al., 2006;). MIT gradually became adopted by music therapists in practice and in research (Thaut, 1999). Furthermore, research has been conducted to determine why MIT has worked and how participant's neurological functions have improved with MIT.

Melodic Intonation Therapy and the Brain

According to Thaut and Hoemberg (2014), the use of MIT directly repairs and rewires damaged speech pathways in the brain. This type of recovery is also called *neuroplasticity*. The clinical description of neuroplasticity is the capacity of the brain to adapt and change in response to new experiences (De Oliveira, 2020). These changes occur at physiological and biochemical levels. Alterations in neural networks include changes in neural pathways, connectivity, dendritic remodeling, and the generation of new neurons. Neuroplasticity induces adaptive changes that lead to functional recovery (De Oliveira, 2020). Researchers have reported these neurological effects of MIT in literature (Belin et al., 1996; Darland et al., 2022; Martzoukou et al., 2021; Thaut, 2008).

Neuroplasticity becomes possible during MIT because the patient repetitively sings the melodic phrases. Belin et al. (1996), examined the neurological effects of MIT with Positron Emission Tomography (PET) scans. The authors were medical doctors, and the study was an experimental research design. They tested the changes in cerebral blood flow (CBF) between the experimental group and the control group. The participants were adults diagnosed with Broca's aphasia. The experimental group was treated with MIT and the control group had speech tasks. In the control group, PET scans showed that speech tasks unusually activated the right hemisphere and deactivated left hemisphere language zones. In contrast, MIT reactivated the Broca's area and left prefrontal structures, while deactivating the Wernicke's area in the right hemisphere. Therefore, the participant's recovery process induced by MIT was likely caused by the reactivation of left prefrontal structures (Belin et al., 1996).

The researchers hypothesized that singing with MIT would activate the right hemisphere, which was presumed to be the only hemisphere that processed music. However, the results indicated that multiple areas of the brain were activated instead, particularly the left hemisphere. Belin et al. (1996) stated that "MIT reactivated essential motor language zones, such as Broca's area in the left hemisphere, while reducing abnormal activations in the right hemisphere" and deemed this as a paradox (p. 1510). The authors provided evidence that music not only induced aphasia recovery but functioned as a global process in the brain. However, one limitation of the study was the execution of MIT was unclear, specifically whether the practitioner was trained in MIT. The methodology did not seem to follow the standardized procedures of MIT. For example, an unidentified "investigator read the words of a new list with an MIT-like intonation, and the subjects were instructed to repeat each word with the same intonation" (Belin et al., 1996, p. 1506). MIT was designed with strict procedures to ensure clinical efficacy. The repetition of a consistent melody causes the restoration of neural pathways. Moreover, the levels of MIT were

designed in a hierarchical progression to further support the restoration of neural pathways to speech areas (Albert et al., 1974; Thaut et al., 2014). Therefore, MIT training and strict implementation of MIT has been required. Belin et al. (1996) did not state an intent to modify MIT for research purposes. Therefore, the results of the study are less reliable. The consistent implementation of MIT is further supported by the *Hebbian theory*, one of the fundamental principles of neuroscience (Choe, 2014). The Hebbian theory is a form of learning that occurs when a repeated activity leads to synaptic plasticity. For example, when we when we learn something new, neurons are activated and connected to other neurons, forming a neural network. The connections begin weak, but each time an activity is repeated, the connections grow stronger (Choe, 2014). Similarly, when MIT is repeated consistently, neural connections to speech centers in the brain are re-formed and strengthened.

Additional MIT studies with neuroimaging procedures have provided evidence that MIT promoted neuroplasticity (Schlaug et al., 2009; Tabei et al., 2016; Zhang et al., 2022). These studies have been relevant for the clinical use of MIT. However, the diagnostic criteria have often been limited to Broca's aphasia (Hough, 2010; Martzoukou et al., 2021; Van der Meulen et al., 2016; Zumbansen et al., 2014a). While MIT was designed for Broca's aphasia, researchers (Baker, 2000; Conklyn et al., 2012; Hurkmans et al., 2015) have questioned if MIT could benefit other diagnoses. As a result, researchers expanded the parameters of MIT and tested modifications to the protocol (Baker, 2000; Conklyn et al., 2012; Hurkmans et al., 2015).

Modifications to Melodic Intonation Therapy

Modifications to MIT have been researched since the protocol's initial development. In the literature, there have been two areas of modification. First, diagnoses other than Broca's aphasia were treated with MIT. Diagnoses included mild to severe apraxia of speech, Wernicke's aphasia, global aphasia, and Down syndrome. Researchers accomplished this by modifying various elements of MIT and testing the changes (Carroll, 1996; Conklyn, et al., 2012; Hough, 2010; Hurkmans et al., 2015; Slavin & Fabus, 2018). Second, NMTs modified and incorporated MIT into their clinical practice (Baker, 2000, 2011; Thaut et al., 1999; Thaut et al., 2014).

The Neurologic Music Therapy Version of MIT

Thaut et al. (2014) re-designed the original MIT version to a compressed version for clinical efficiency. Instead of each level occurring over several months, all levels occur in a single session with six steps. The steps are as follows:

1. The therapist presents an intoned statement via humming while hand tapping their left hand to the beat with the patient. A metronome is played to maintain the beat. The patient listens.
2. The therapist sings the statement, repeats, then continues hand tapping, and the patient listens.
3. The therapist continues singing, then invites the patient to join in. The patient and therapist sing the phrase together. The phrase is repeated together several times. The hand tapping continues.
4. The therapist fades during singing with the patient. The hand tapping continues.
5. The patient sings the statement independently.
6. The process ends, and the therapist asks the patient to answer at least one question about the practiced phrase. The patient answers by intoning or with normal speech. (Thaut et al., 2014)

This version has been taught by the Academy of Neurologic Music Therapy (2002) and is now standardized within the field of NMT. Proceeding further, it should be noted that this NMT version of MIT will be referred to as the NMT version and the traditional four level version of MIT will be referred to as the original MIT.

Music Therapy and Melodic Intonation Therapy

NMTs are valuable to the MIT process because the therapist is required to compose music and sing a demonstration for the patient. The administration of MIT must be musically accurate to provide sustainable results. For example, if a patient is relearning how to speak two phrases (e.g., 'Hi, how are you?' and 'I need a drink of water'), the two phrases of music must sound different from each other. This prevents the patient from experiencing confusion. In contrast, if both phrases had the same music sound, speech retrieval would be difficult. They would not be able to distinguish which musical cue belonged to which musical phrase. As a result, progress would be hindered. Therefore, it takes musical training to compose phrases with speech-like rhythms, unique melodies, and a variety of musical keys that are within the vocal range of the client (AMTA, 2005; Lim et al., 2013; Zhang et al., 2021). Since NMTs maintain the following music therapy competencies, they can implement the musical components of MIT accurately and consistently:

- Music theory training to compose musical rhythms that mirror natural rates of speech.
- Ear training to compose phrases in musical keys that would best match the patient's natural voice range.
- The ability to maintain a moderate tempo during MIT (e.g., not too fast or slow).

- Music theory training to compose phrases with an appropriate melodic range so that the patient can easily sing it themselves (e.g., no large leaps within the melody line).
- Vocal training to sing the targeted phrase in a consistent manner (e.g., singing the phrase in the same key and rhythm every time; Albert et al., 1974; AMTA, 2005; Thaut et al., 2014)

During MIT, if the therapist were to unintentionally change the musical key or sing the wrong notes, it could take longer for the patient to learn the phrase. Additionally, if the melody line was not appropriately composed, the phrase could be more difficult for the patient to learn. Therefore, a music therapist's training is integral to the process of MIT. As MIT is not strictly limited to be used by speech therapists, music therapists can receive training in MIT to collaborate with speech therapists or to practice independently.

One of the earliest reports of music therapy and MIT was a clinical example and review by Lucia (1987). The author stated a brief history of MIT and promoted the use of MIT in music therapy practice. The author then presented a clinical example of a program known as "the Music Therapy Vocal Skills Group designed by the author for head trauma patients at a large, mid-western rehabilitation hospital" (Lucia, 1987, p. 36). This program was based on the principles of MIT and modified to "capitalize on preserved right brain functions for singing, an automatic, non-propositional speech skill that generally precedes functional speech recovery" (Lucia, 1987, p. 36). However, no quantitative research was reported on this program and the author stated that reports of clinical applications by music therapists were lacking (Lucia, 1987). Therefore, studies that involving music therapists were investigated for the purposes of this systematic review.

Summary

In summary, music therapists have used singing as a method of speech recovery as found in literature (Cohen, 1992; Elefant et al., 2012). Research on music and neuroscience has led to the establishment of NMT, which includes the use of MIT (Thaut et al., 2014). Albert et al. (1973) created MIT. MIT began with the involvement of speech therapists, then NMTs (Thaut et al. 2014) adopted and modified the protocol. The skills of music therapists are integral to the process of MIT, yet little is known about how music therapists have been involved in research. Therefore, this systematic review was completed to determine which MIT studies involved music therapists and how they were involved.

CHAPTER III

METHODOLOGY

The research was conducted in a stepwise process and the data was selected according to inclusion and exclusion criteria. Moreover, the data was gathered and evaluated based on Cooper's (1998) stepwise process for systematic reviews and the American Occupation Therapy Association (AOTA, 2020) guidelines.

Study Procedure

The researcher referenced Cooper's (1998) stepwise process for synthesizing research into a formal, integrated review. Cooper (1998) had five stages for the process of research synthesis. These stages include:

1. problem formulation
2. literature search and data collection
3. data evaluation, in this case assessing the quality of studies
4. analysis of the data
5. presentation of results (Cooper, 1998, p. 5)

Problem Formulation

Problem formulation was the first stage of this systematic review. There was a gap in literature, for no systematic reviews had been completed that targeted music therapists' involvement in MIT research. As a result, the following research questions were formulated:

1. What clinical research targeting melodic intonation therapy involved a board-certified music therapist?
2. How was the board-certified music therapist involved in the study?
3. In these identified research studies
    a. How was the MIT protocol applied?
    b. What were the targeted clinical diagnoses?
    c. What were the results?

Literature Search

The literature search stage involved "conducting a search for reports describing past studies relevant to the topic of interest" (Cooper, 1998, p. 40). Since MIT was founded in 1973, a literature search was conducted from the year 1973 through the year 2022 (Albert et al., 1973). Peer-reviewed studies were gathered from the following sources:

- *The Journal of Music Therapy* online database,
- *Music Therapy Perspectives* online database,
- The Academy of Neurologic Music Therapy website,
- Texas Woman's University Blagg-Huey Library online database, and
- the Cochrane Library online database.

Other sources were not used due to the researchers limited access and funds. The researcher examined MIT studies that included music therapists. The researcher located these studies with search engines from the identified sources. Search engines were conducted with the following exact terms related to the study topic:

- Melodic Intonation Therapy
- Melodic Intonation Therapy and music therapy
- Melodic Intonation Therapy with a music therapist
- Melodic Intonation Therapy and board-certified music therapists
- Neurologic Music Therapy and Melodic Intonation Therapy
- Neurologic Music Therapy and aphasia
- Neurologic Music Therapy and speech recovery
- Modified Melodic Intonation Therapy

The search criteria were not limited to any participant diagnoses. Additionally, the search criteria were not limited to any participant age range. Data collection was the next stage of this systematic review.

Data Collection

The data collection stage occurred with the stepwise investigation of peer-reviewed studies by the researcher. A PRISMA (Preferred Reporting Items for Systematic reviews and Meta-Analyses) flow diagram was used to document the data (Stovold et al., 2014). The data was collected according to a two-phase evaluation of inclusion and exclusion criteria.

Phase One: Initial Screening

Phase one involved the initial screening of each study. The researcher documented the total number of studies identified through the database search. Additionally, studies identified through other sources were documented (e.g., a hard copy of an article). After the duplicate studies were removed, the author screened each

study for phase one of the inclusion and exclusion criteria. The studies that met at least one of the inclusion criteria would be evaluated further in the next phase. The inclusion criteria were as followed:

1. The phrase Melodic Intonation Therapy was included in the title of the study,
2. The phrase Melodic Intonation Therapy was included in the abstract, or
3. The study topic was related to MIT.

The exclusion criteria were used to determine the ineligibility of literature. Duplicates were automatically excluded. The exclusion criteria for the ineligible studies were as followed:

1. The literature was an index or a bibliography of music therapy, music education, or a music-related topic.
2. The phrase Melodic Intonation Therapy was not listed in the title or in the abstract, the study targeted speech therapy only or, the study purpose was unrelated to the targeted topic.
3. There was no available translation to the English language with the study.
4. The study was a book review or a literature review.
5. The literature was a book, erratum, or a position paper.

After phase one of the initial screening, the literature that met the inclusion criteria were evaluated in phase two.

Phase Two: Eligibility

In phase two, the author assessed the full text of each study for eligibility. A separate round of inclusion and exclusion criteria were used to evaluate each study. The inclusion criteria were as followed:

1. The study directly targeted MIT.
2. A board-certified music therapist was involved in the study (e.g., as the contributing researcher, the practitioner, or the author).
3. The study was available in English.

The exclusion criteria were based on the following criteria:

1. MIT was not used as a protocol.
2. A board-certified music therapist was not involved in the study.
3. Data on MIT was not collected or reported in the study.
4. The study was not published in a peer-reviewed academic journal.

5. MIT was only included as a literature reference.
6. Music was used to improve speech recovery, but MIT was not used or modeled in the procedure.

Further screening on the author's background was conducted if a music therapist was not listed in the study. The researcher also investigated to ensure that the author was a music therapist at the time of the study. A search was conducted on the Certification Board for Music Therapists website (www.cbmt.org) to determine if the author was a board-certified music therapist at the time of the study. If that search was inconclusive, a Google search was conducted on the author's professional background. After the eligible studies were identified, the data was evaluated in the next stage.

Data Evaluation

In the data evaluation stage, qualified studies were evaluated by the researcher. The data was evaluated across three areas according to the AOTA's (2020) guidelines for systematic reviews. Those three areas included: the level of evidence, strength of evidence (level of certainty), and risks of bias.

Level of Evidence

The purpose of rating studies on level of evidence was to assess the quality of data and evaluate the effectiveness of the tested interventions (Burns et al., 2011). The researcher used the level of evidence to rank studies based on hierarchies. "The hierarchies rank studies according to the probability of bias. RCTs are given the highest level because they are designed to be unbiased and have less risk of systematic errors" (Burns et al., 2011, p. 2). Case series or expert opinions were ranked at the lowest level.

Table 3.1 was used to determine the level of evidence for each study. The table was based on the AOTA (2020) guidelines and the *Oxford Centre for Evidence-Based Medicine: Levels of Evidence* guidelines (Phillips et al., 2020).

Table 3.1

Level of Evidence for Study Inclusion

Level	Type of Evidence
1A	Systematic review of homogeneous RCTs (similar population, intervention, etc.) with or without a meta-analysis.
1B	Well-designed individual RCT (not a pilot or feasibility study with a small sample).

Level	Type of Evidence
2A	Systematic review of cohort studies.
2B	Individual prospective cohort study, low-quality RCT (e.g., < 80% follow-up or a low number of participants; pilot and feasibility studies); ecological studies; and two-group, nonrandomized studies.
3A	Systematic review of case-control studies.
3B	Individual retrospective case-control study; one-group, nonrandomized pre-posttest study; cohort studies.
4	Case series (low-quality cohort and case-control study).
5	Expert opinion without explicit critical appraisal.

Note. RCT: randomized control trial; Adapted from the "Oxford Centre for Evidence-Based Medicine: Levels of Evidence" guidelines by Phillips, B., Ball, C., Badenoch, D., Straus, S., Haynes, B., Dawes, M., & Howick, J., 2020, Centre for Evidence-Based Medicine (CEBM), University of Oxford, https://www.cebm.ox.ac.uk/resources/levels-of-evidence/oxford-centre-for-evidence-based-medicine-levels-of-evidence-march-2009. Copyright 2015 by University of Oxford.

Strength of Evidence (Level of Certainty)

Eligible studies were then evaluated on the strength of evidence (also known as level of certainty). This was based on the guidelines of the U.S. Preventative Services Task Force (USPSTF, 2018). According to USPSTF (2018), strength of evidence (level of certainty) is defined as:

> The likelihood that the USPSTF assessment of the net benefit of a preventive service is correct. The net benefit is defined as benefit minus harm of the preventive service as implemented in a general, primary care population. The USPSTF assigns a certainty level based on the nature of the overall evidence available to assess the net benefit of a preventive service. (para. 3)

Table 3.2 demonstrated the strength of evidence (level of certainty) for the studies in this systematic review.

Table 3.2

Strength of Evidence (Level of Certainty) Guidelines for Study Inclusion

Strength	Description
Strong	Two or more level 1A/B studies. The available evidence usually includes consistent results from well-designed, well conducted studies. The findings as strong and they are unlikely to be strongly called into question by the results of future studies.
Moderate	At least one Level 1A or Level 1B high-quality study or multiple moderate-quality studies (Level 2A/B, Level 3A/B, etc.). The available evidence is sufficient to determine the effects on health outcomes, but confidence in the estimate is constrained by such facts as: • The number, size, or quality of individual studies • Inconsistency of findings across individual studies As more information (other research findings) becomes available, the magnitude or direction of the observed effect could change, and this change may be large enough to alter the conclusion related to the usefulness of the intervention.
Low	Small number of low-level studies, flaws in the studies, etc. The available evidence is insufficient to assess effects on health and other outcomes of relevance to occupational therapy. Evidence is insufficient because of • The limited number or size of studies, • important flaws in study design or methods, • inconsistency of findings across individual studies; or • lack of information on important health outcomes. More information may allow estimation of effects on health and other outcomes of relevance to occupational therapy.

Note. Adapted from "Levels of Certainty Regarding Net Benefit" by the US Preventative Task Force, 2018, *https://www.uspreventiveservicestaskforce.org/uspstf/about-uspstf/methods-and-processes/grade-definitions.*

Risks of Bias

Risks of bias for eligible studies were evaluated in this systematic review. Risks of bias are defined as "the likelihood that features of the study design or conduct of the study will give misleading results. This can result in wasted resources, lost opportunities for effective interventions or harm to consumers" (National Health and Medical Research Council, 2019, para. 2). For risks of bias evaluation, the types of studies were separated into two groups:

1. Randomized control trials (RCTs) and non-randomized control trials (non-RCTs), and
2. before-after (pre-post) studies with no control groups.

The studies were assessed in separate groups to ensure that every study was rated for risks of bias.

Risks of Bias for RCTs and Non-RCTs

The risks of bias were assessed for randomized controlled trials and non-randomized controlled trials. These studies were rated according to the AOTA (2020) guidelines. The following nine areas were rated in the results:

1. random sequence generation
2. allocation concealment (until participants enrolled and assigned)
3. baseline differences between intervention group (suggests problem with randomization)
4. anonymization of participants during the trial
5. anonymization of study personnel during the trial
6. anonymization of outcomes assessment: self-reported outcomes
7. anonymization of outcome assessment: objective outcomes (assessors aware of intervention received)
8. incomplete outcomes data (data for all or nearly all participants)
9. selective reporting (results being reported selected based on the results? (AOTA, 2020)

In each of these nine categories, the studies were rated and identified with symbols as:

- low risk of bias (+),
- unclear risk of bias (?), or
- high risk of bias (-). (AOTA, 2020)

Risks of Bias for Before-After (Pre-Post) Studies With No Control Group

The risks of biases were assessed for before-after (pre-post) studies with no control group. These studies were rated according to the AOTA (2020) guidelines. The following 11 areas were rated in the results:

1. study question or objective clear
2. eligibility or selection criteria clearly described
3. participants representative of real-world patient
4. all eligible participants enrolled
5. sample size appropriate for confidence in findings
6. intervention clearly described and delivered consistently
7. outcome measures pre-specified, defined, valid/reliable, and assessed consistently

8. assessors' anonymization to participant exposure to intervention
9. loss to follow-up after baseline was 20% or less
10. statistical methods examine changes in outcome measures for before to after intervention
11. outcome measures were collected multiple times before and after intervention

In each of these 11 categories, the studies were rated with the following scoring system:

- *Y* = yes: If the study included the criteria.
- *N* = no: If the study did not include the criteria.
- *NR* = not reported: If the criteria was not found in the study.

The scoring system was as followed:

- 0-3 *N* = low risk of bias (*L*)
- 4-8 *N* = moderate risk of bias (*M*)
- 9-11 *N* = high risk of bias (*H*) (AOTA, 2020)

Analysis of Data

Descriptive Statistics: Percentages

In the analysis of the data stage, the author determined the percentage of eligible studies that included a music therapist. The percentage was calculated with the number of eligible studies divided by the total number of studies, then multiplied by 100% (Korb, 2013, para. 5). This was conducted to evaluate the frequency at which music therapists were included in Melodic Intonation Therapy research.

Presentation of the Results

The final stage of the study procedure was the presentation of data. The data was presented in a PRISMA flow diagram and a series of tables for visual display (see Chapter 4). A PRISMA flow diagram as the process to determine which studies met all inclusion criteria. The tables of results included the answers to the research questions, the data evaluation results of each study, and two tables for the risks of bias evaluations. For each table, the studies were presented in alphabetical order by the author's last name.

Summary

The researcher referenced Cooper's (1998) stepwise process for synthesizing research into a review. The study procedure was conducted in five stages. Stage one was the determination of research questions for the study. The second step was a search for literature about MIT. The data was then collected in two phases according to

inclusion and exclusion criteria. The third phase was the data evaluation based on the quality of each study. The data was then analyzed based on descriptive statistics. Lastly, the results for this systematic review were presented with a flowchart and a variety of tables.

CHAPTER IV

RESULTS

This chapter includes the presentation of results, the final stage of Cooper's (1998) stepwise process for synthesizing research into a formal review. The results are presented in

1. a PRISMA flow diagram,
2. a table with the results of the systematic review
3. a table with the risks of bias results for RCTs and non-RCTs,
4. a table with the risks of bias for before-after (pre-post) studies with no control group
5. a table with the data evaluation of the level of evidence and the strength of evidence (levels of certainty) for each study.

PRISMA Flow Diagram

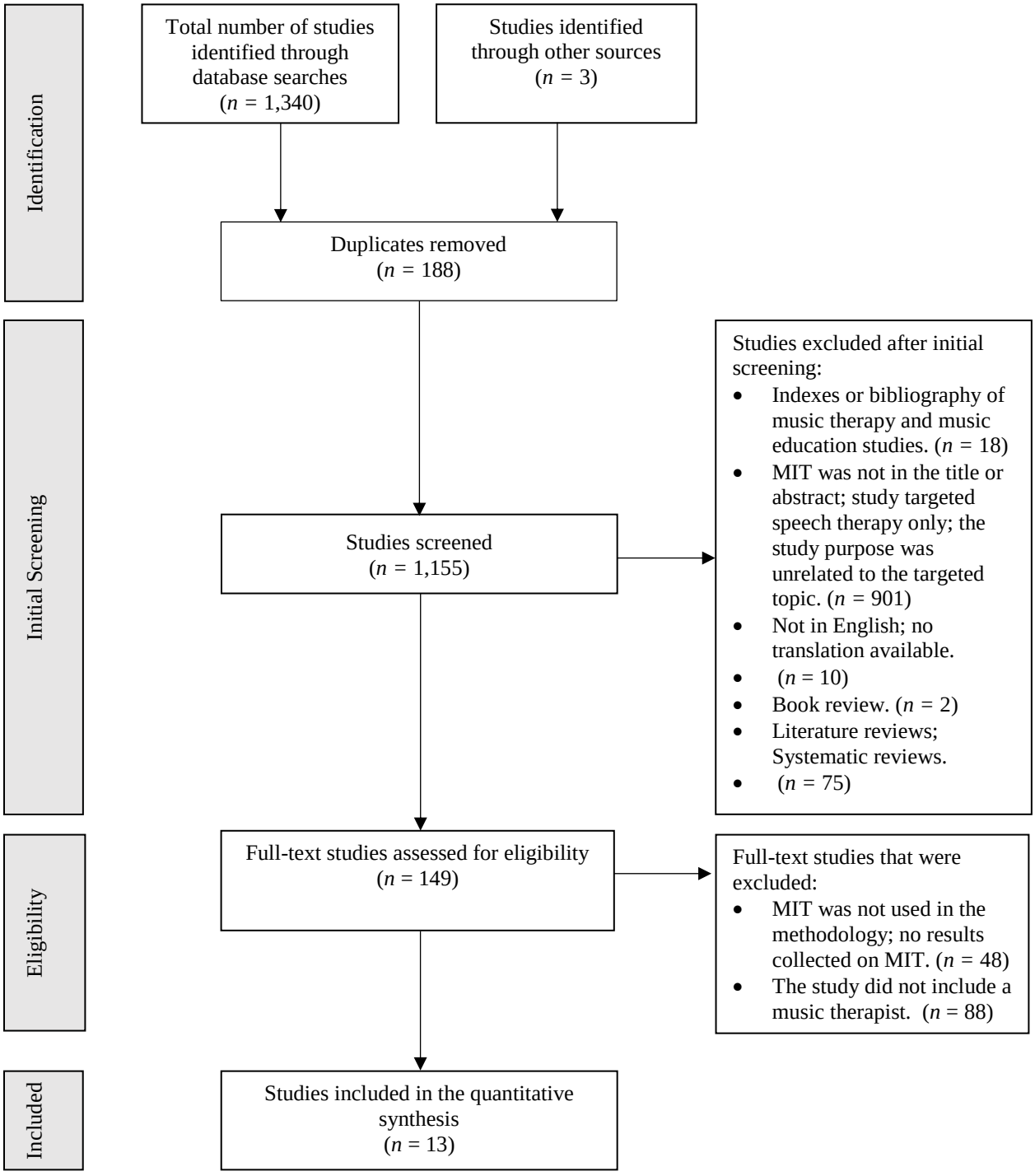
A PRISMA flow diagram was completed according to the AOTA (2020) guidelines for systematic reviews. This diagram is displayed in Figure 4.1 to show the number of studies that qualified for each section. There are four sections in the diagram that were used in the following manner:

1. Identification: The total number of studies were identified through the appropriate database searches. This also includes studies that were identified through other sources. Duplicate studies were also identified and were removed.
2. Initial screening: The studies were then screened according to phase one of the inclusion and exclusion criteria. The studies that met phase one of the inclusion criteria were screened in the next section.
3. Eligibility: The full text of studies was reviewed according to phase two of the inclusion and exclusion criteria. The studies that met phase two of the inclusion criteria were screened in the next section.
4. Included: Studies in this section met all the inclusion criteria and are included in the quantitative synthesis of this systematic review.

Figure 4.1 demonstrates the PRSIMA flow diagram that includes the results of the author's evaluation of inclusion and exclusion criteria for each study.

Figure 4.1

PRISMA Flow Diagram



Descriptive Statistics

Descriptive statistics answer the research questions created by the author. The first research question asked how music therapists were involved in MIT research. The results of the PRISMA flow diagram indicate that music therapists are not significantly involved in MIT research from January 1973 to July 2022. This conclusion was drawn from the percentages calculated with numbers in the PRISMA flow diagram.

Percentages are defined as a form of descriptive statistics that use numbers to summarize data. Percentages are calculated by taking the frequency of a category divided by the total, then multiplied by 100% (Korb, 2013). The total number of studies identified through the database searches, plus outside sources, is N = 1,340. The number of studies included in this systematic review are n = 13. Therefore, 1% of all searched literature include music therapists. The number of studies that meet the inclusion criteria for full text evaluation are n = 149. These studies include data on the efficacy of MIT and the findings are reported, respectively. Out of these studies, 8.7% include music therapists over the past 49 years and 6 months.

Results of the Systematic Review

Data pertaining to the research questions are presented in a table format according to the AOTA (2020) guidelines. The studies in Table 4.2 meet phase one and phase two of the eligibility criteria. The title headings on Table 4.2 reflect the research questions:

1. What was the author and the year of publication?
2. How was the board-certified music therapist involved in the study?
3. What version of Melodic Intonation Therapy (MIT) was used in the study?
4. How was the MIT protocol applied?
5. What were the targeted clinical diagnoses?
6. What were the results of the study?

The authors are listed in alphabetical order, and the answers to the research questions are presented in each category.

Table 4.1

Results of the Systematic Review

Author (year)	Role of the music therapist	Version of MIT	Application of MIT	Targeted diagnoses	Results
Baker (2000)	Author and practitioner	Modified MIT	Phrase lengths were increased. Pitch ranges exceeded four notes. A beginning step of singing familiar songs was added at the start of the protocol. Melodies were accompanied by the therapist with an instrument.	Participant 1: An adult with severe Broca's aphasia, multiple traumatic brain injuries, and dyspraxia. Participant 2: An adult with a traumatic brain injury in the left hemisphere.	Participant 1: Significant gain of functional language 3 years posttest with 148 words/phrases. Participant 2: Significant improvement in short term gain of functional language. 30 words with strong carryover were gained 4 months posttest.
Bitan et al. (2018)	Practitioner, co-creator of the protocol with a speech therapist, and co-author	Neurologic Music Therapy version named melody-based therapy	Melodies were accompanied on the keyboard. Rhythmic cues and modeling cues were added. The protocol was reduced from 6 steps to 5 steps. Additionally, the participant progressed through 5 treatment phases that increased in difficulty. 10 minutes of daily singing was assigned to the participant.	Experimental group: One adult with two moderate to severe traumatic brain injuries, left frontal and subdural hematoma lesions and moderate apraxia. Control group: One adult with one moderate to severe traumatic brain injury, left temporal subarachnoid hemorrhage and an intraventricular hemorrhage.	Experimental group: MRI results showed a significant increase in connectivity between the regions involved in speech motor control and right frontal language areas. Significant improvements in syllable production. This was maintained at the 8-week posttest.

Author (year)	Role of the music therapist	Version of MIT	Application of MIT	Targeted diagnoses	Results
Carroll (1996)	Author and practitioner	Modified version of the original MIT	MIT was modified for children. 3 levels of MIT were used instead of 4: Level 1: the practitioner used linguistic and non-linguistic cues. the participants responded in unison with the target word or phrase; level 2: the participant repeated the target after modeling; level 3: the participant elicited a conversational response with the target word/phrase. Bongos used instead of hand-tapping, no chanting, and body actions were added to describe words/phrases.	Down Syndrome	Significant increase in the number of participant responses: The experimental group gained 84-129 responses and the control group gained 96-120 responses. Significant improvements in MLU: *n*=2 in the experimental group. Significant increase in rate of response for the experimental group, but infrequently in the control group.
Clements-Cortes & Haire (2018)	Two music therapists as co-authors, one practitioner	Neurologic Music Therapy version of MIT plus Therapeutic Singing (TS) and clinical improvisation	Therapeutic singing (TS) and clinical improvisation were added to MIT. Songs that the participant had an emotional connection to were included. TS was used to facilitate speech and increase participant motivation. Clinical improvisation was added to allow the patient to increase emotional expression.	An adult with Broca's aphasia due to a stroke. Sustained a neurologic injury to the frontal region of the left hemisphere.	Significant increase in the participant's activity level and family involvement. Improvement in the participant's emotional expression and his willingness to engage in therapy. The participant gained a sense of autonomy with the addition of TS. Regained 5 long phrases with moderate cues.
Conklyn et al. (2012)	Practitioner and two music therapists as consults	Modified melodic intonation therapy (MMIT)	Therapists composed and used novel melodic phrases with expanded pitch ranges and rhythms. The participants sing full speech phrases. Applied during the acute treatment phase 2 weeks post-stroke.	Adults with Mild to severe Broca's aphasia	Experimental group: significant and immediate improvements in speech output (repetition and response) after one session. From visit 1 to visit 2, the control group had significant gains in repetition

Author (year)	Role of the music therapist	Version of MIT	Application of MIT	Targeted diagnoses	Results
					scores only, whereas the experimental group had similar gains in repetition scores and significant gains in responsiveness scores.
Hurkmans et al. (2015)	Co-practitioner with a Speech Therapist	A modified version of MIT known as Speech-Music Therapy for Aphasia (SMTA)	The musical line follows a structured progression from singing to rhythmical chanting, then to speaking. A 2-level protocol: Level 1: phonemes are practiced with musical scales; level 2: the music therapist composed novel melodies.	Mild and severe apraxia of speech (AoS). Broca's aphasia, global aphasia, and Wernicke's aphasia, MCA left lesion, MCA right region, ICVA, PCA left lesion, SAH, and HCVA	Intelligibility improved for $N = 5$; Comprehensibility improved for $n = 4$; Significant improvements in speech accuracy, consistency, and fluency of articulation for $n = 3$
Lagasse (2012)	Author, practitioner, and assistant practitioner for the assessment	Modified Neurologic Music Therapy version of MIT	MIT was modified for children. 1-3 min of playtime was added before MIT. 5 min of MIT, then 5 min of "play" breaks involving music therapy with instruments	Developmental apraxia of speech	Case 1 had improved speech sequencing when involved in MIT and had fewer substitution errors. Scores after MIT sessions were higher than SLP sessions. Case 2 also showed improved sequencing when engaging in MIT, although his speech production was more inconsistent.
Lim et al. (2013)	Practitioner	Neurologic Music Therapy (NMT) version plus therapeutic singing (TS).	NMT included melody intonation and rhythmic left-hand tapping on a drum. TS included respiratory training, voice training, and automated singing via familiar songs. Automated speech training was also applied.	Subacute Broca's aphasia with an onset of stroke 3 months or less and chronic Broca's aphasia with an onset of stroke for at least 180 days.	Experimental group 1 (NMT-chronic group): significant improvements in AQ, spontaneous speech, repletion, and naming. Experimental group 2 (NMT-subacute group): significant improvements in AQ, spontaneous speech, comprehension, and naming.

Author (year)	Role of the music therapist	Version of MIT	Application of MIT	Targeted diagnoses	Results
Magee (1999)	Author and practitioner	Modified melodic intonation therapy	Consistent use of tapping the rhythm by the patient and was not faded out as done in traditional MIT practice; Used 3-5 worded phrases.	TBI, global aphasia, and dyspraxia	Improvement in verbal phrase production after three months. The participant's emotional expression and participation in therapy also improved.
Rhee (2009)	Author and practitioner	Original MIT plus therapeutic singing (TS)	Hand tapping replaced with a castanet plus the addition of TS.	Broca's aphasia, mild apraxia	Significant improvement in functional communication skills between pre-and post-tests.
Tabei et al. (2016)	Practitioner	MIT-J	Japanese version of MIT as developed by Seki and Sugishita (1983). This version is based on the original but modified for the unique grammatical and phonological characteristics of Japanese.	Severe chronic Broca's aphasia (3yrs post-onset) and right hemiparesis associated with left putaminal hemorrhage.	MIT-J improved spontaneous speech, repetition, naming, auditory comprehension, and the response time for figure naming.
Wilson et al. (2006)	Co-Practitioner with a speech pathologist and a consult for the researchers	Modified version based on the original MIT protocol	MIT was modified to six levels per session that increased in difficulty and decreased in assistance per level. The participant was allowed three attempts before progressing to the next level. MIT phrases were pre-recorded for the participant to practice outside of sessions.	One adult with severe Broca's aphasia characterized by a left middle cerebral artery tertiary stroke for 4 years.	Compared 3 methods of training: Method 1 was MIT, method 2 was repetition training, and method 3 was unrehearsed speech training. Method 1 was more significant than method 2 on independent phrase production. Method 1 (MIT) had a significant effect on correct word production from baseline to follow-up 1. The use of pitch in Method 1 was more

Author (year)	Role of the music therapist	Version of MIT	Application of MIT	Targeted diagnoses	Results
					significant in producing long-term effects compared to method 2 and method 3.
Zhang et al. (2021)	Multiple registered music therapists were practitioners	MIT-C based on the neurologic music therapy version	Language adaptation to Chinese Mandarin; 6 step protocol; Instruments used to accompany singing during MIT.	Adult left ischemic stroke or hemorrhagic stroke, Broca's aphasia, global aphasia, and transcortical mixing.	The experimental group improved significantly on spontaneous speech (which included information and fluency) and repetition compared to the control group. The experimental group also performed significantly better in spontaneous naming tests on abstract thinking.

Note. MRI = Magnetic Resonance Imaging. MLU = mean length of utterance and is defined as the average number of morphemes per utterance for children (Gabig, 2013). MCA = middle cerebral artery; ICVA = ischemic cerebrovascular accident; PCA = posterior cerebral artery; SAH = subarachnoid hemorrhage; HCVA = hemorrhagic cerebrovascular accident. SLP = speech and language pathology; TS = therapeutic singing, a Neurologic Music Therapy technique. AQ = Autism spectrum quotient; SLT = speech and language therapy; MT = music therapy. MIT-J = Japanese version of Melodic Intonation Therapy. MIT-C = Chinese version of Melodic Intonation Therapy.

The Risks of Bias Results for RCTs and Non-RCTs

The risks of bias for this subgroup of studies were assessed. Presented in Table 4.2 are studies that involve a control group. These studies are identified as either RCTs or non-RCTs. The table is formatted according to the AOTA (2020) guidelines and adapted from Higgins et al. (2019). To determine the reliability of each study, it is necessary to assess the risks of bias. Each study is scored under one of the following qualifications:

1. low risk of bias (L),
2. moderate risk of bias (M), or
3. high risk of bias (H).

Studies that are classified as having a low risk of bias have more reliable results. Studies that are classified as having a moderate or high risk of bias have less reliable results. There are seven studies that involve a control group. Four of the studies are classified as having a low risk of bias and three of the studies are classified as having a moderate risk of bias. There are no studies that are classified as having a high risk of bias. On Table 4.2, there are nine categories that determine risks of bias. Each of these nine categories are rated by the researcher with the following symbols:

- low risk of bias (+),
- unclear risk of bias (?), or
- high risk of bias (-). (AOTA, 2020)

Furthermore, the studies are listed in alphabetical order according to the author's last name and the results are displayed on Table 4.2. The table is to be read horizontally from left to right. The final score is shown on the far-right end of the table.

Table 4.2

Risks of Bias for RCTs and Non-RCTs.

Citation	Selection Bias (risks of bias arising from randomization process)			Performance Bias (effect of assignment to intervention		Detection Bias		Attrition Bias	Reporting Bias	Overall risk-of-bias assessment (low, moderate, high risk)
	Random Sequence Generation	Allocation Concealment (until participants enrolled and assigned)	Baseline differences between intervention group (suggest problem with randomization)	Anonymization of Participants During the Trial	Anonymization of Study Personnel During the Trial	Anonymization of outcomes assessment: Self-reported outcomes	Anonymization of outcome assessment: objective outcomes (assessors aware of intervention received)	Incomplete Outcomes Data (data for all or nearly all participants	Selective Reporting (results being reported selected based on the results?)	
Carroll (1996)	+	+	-	+	-	-	+	-	-	M
Conklyn et al. (2012)	+	+	+	+	+	+	?	+	?	L
Hurkmans et al. (2015)	+	+	-	-	+	-	+	+	+	L
Lagasse (2012)	-	-	-	+	+	-	-	?	?	M
Lim et al. (2013)	-	?	-	?	-	-	-	+	+	M
Zhang et al. (2021)	+	+	-	+	+	+	+	-	+	L

Note. The categories for the risks of bias are: low risk of bias (+), unclear risk of bias (?), high risk of bias (-). Scoring for the overall risks of bias assessment is as follows: 0–3 minuses (-) = low risk of bias (L); 4–6 minuses = moderate risk of bias (M); 7–9 minuses = high risk of bias (H). Adapted from "Cochrane

Handbook for Systematic Reviews of Interventions Second Edition" by J.P.T Higgins, J. Thomas, J. Chandler, M. Cumpston, T. Li, M. J. Page, V.A. Welch, 2019, https://doi.org/10.1002/9781119536604.ch8. Copyright 2019 by The Cochrane Collaboration.

The Risks of Bias Results for Before-After (Pre-Post) Studies With No Control Group

The risks of bias for this subgroup of studies were assessed. Presented in Table 4.3 are studies that did not involve a control group. These studies are identified as before-after (pre-post) studies with no control group. Table 4.3 is formatted according to the AOTA (2020) and is adapted from National Heart Lung and Blood Institute (2013). To determine the reliability of each study with no control group, it is necessary to assess the of risks of bias. Each study is scored under one of the following qualifications:

- low risk of bias (L),
- moderate risk of bias (M), or
- high risk of bias (H).

Studies that are classified as having a low risk of bias have more reliable results. Studies that are classified as having a moderate or high risk of bias have less reliable results. There are seven studies that are before-after (pre-post) studies with no control group. Four of the studies are classified as having a low risk of bias and three of the studies are classified as having a moderate risk of bias. There are no studies that are classified as having a high risk of bias. In Table 4.3, there are 11 categories that determined risks of bias. Each of these 11 categories are scored by the researcher with the following acronyms:

- *Y* = yes;
- *N* = no;
- *NR* = not reported.

Moreover, the studies are listed in alphabetical order according to the author's last name and the results are displayed on Table 4.3. The table is to be read horizontally from left to right. The final score is shown on the far-right end of the table.

Table 4.3

Risk of Bias for Before-After (Pre-Post) Studies With No Control Group

Citation	Study question or objective clear	Eligibility or selection criteria clearly described	Participants representative of real-world patient	All eligible participants enrolled	Sample size appropriate for confidence in findings	Intervention clearly described and delivered consistently	Outcome measures pre-specified, defined, valid/reliable, and assessed consistently	Assessors anonymization to participant exposure to intervention	Loss to follow-up after baseline 20% or less	Statistical methods examine changes in outcome measures for before to after intervention	Outcome measures were collected multiple times before and after intervention	Overall risk of bias assessment (low, moderate, high risk)
Baker (2000)	Y	N	Y	Y	N	Y	NR	N	Y	Y	Y	L
Bitan. (2018)	Y	Y	Y	Y	N	Y	Y	N	Y	Y	Y	L
Clements-Cortes and Haire (2018)	Y	Y	Y	Y	N	N	N	N	NR	NR	NR	M
Magee (1999)	N	N	Y	Y	N	N	N	N	NR	N	NR	M
Rhee (2009)	Y	Y	Y	NR	N	Y	Y	N	N	Y	N	M
Tabei et al. (2013)	Y	Y	Y	NR	N	Y	Y	NR	NR	Y	Y	L
Wilson et al. (2006)	Y	Y	Y	NR	N	Y	Y	N	Y	Y	Y	L

Note. *Y* = yes; *N* = no; *NR* = not reported. Scoring for overall risk of bias assessment is as follows: 0-3 N = Low risk of bias (L); 4-8 N = Moderate risk of bias (M); 9-11 N = High risk of bias (H). Adapted from "Quality Assessment Tool for Before-After (Pre-Post) Studies with No Control Group" by the National Heart Lung and Blood Institute, 2013, https://www.nhlbi.nih.gov/health-topics/study-quality-assessment-tools.

Strength of Evidence

The following results in Table 4.4 represent the level of evidence and strength of evidence (level of certainty) ratings for each study. The authors are listed in alphabetical order.

Table 4.4

Level of Evidence and Strength of Evidence (Level of Certainty) Results

Author (year)	Level of Evidence	Strength of Evidence (Level of Certainty)
Baker (2000)	4	Low
Bitan et al. (2018)	2B	Moderate
Carroll (1996)	2B	Moderate
Clements-Cortes & Haire (2018)	4	Low
Conklyn et al. (2012)	2B	Moderate
Hurkmans et al. (2015)	4	Low
Lagasse (2012)	2B	Moderate
Lim et al. (2013)	2B	Moderate
Magee (1999)	5	Low
Rhee (2009)	3B	Moderate
Tabei et al. (2016)	3B	Moderate
Wilson et al. (2006)	3B	Moderate
Zhang et al. (2021)	1B	Moderate

Note. See Table 3.1 for the level of evidence criteria and Table 3.2 for the strength of evidence (level of certainty) criteria.

Level of Evidence

The results indicate that one study is rated with a level of evidence of 1B (Zhang et al., 2021). This is the highest rating for all studies in this systematic review. This study was a well-designed RCT. There are no studies

that are rated at a higher level of evidence of 1A, which are systematic review of homogeneous RCTs. This occurred because systematic reviews were excluded from the results of this study. Five studies are rated as 2B, which are individual prospective cohort studies or low-quality RCTs (Bitan et al., 2018; Carroll, 1996; Conklyn et al., 2012; Lagasse, 2012; Lim et al., 2013). Most studies in this systematic review are rated as 2B due to the low number of participants. Three studies are rated as 3B (Rhee, 2009; Tabei et al., 2016; Wilson et al., 2006). These studies are either case-control studies, one-group studies, pre-posttest studies, or cohort studies. Three studies that are case series are rated as a 4 (Baker, 2000; Clements-Cortes & Haire, 2018; Hurkmans et al., 2015). One study is based on an expert opinion and is rated as a 5 (Magee, 1999).

Strength of Evidence (Level of Certainty)

No studies in this systematic review have a strong level of certainty. Nine studies have a moderate strength of evidence (Bitan et al., 2018; Carroll, 1996; Conklyn et al., 2012; Lagasse, 2012; Lim et al., 2013; Rhee, 2009; Tabei et al., 2016; Wilson et al., 2006; Zhang et al., 2021), and four studies have a low strength of evidence (Baker, 2000; Clements-Cortes & Haire, 2018; Hurkmans et al., 2015; Magee, 1999). The strength of evidence (level of certainty) is constrained overall because the sample size is low in every study. This indicates that music therapists are not involved in MIT research with a large sample size.

Targeted Diagnoses

The following participant diagnoses were included in the eligible studies. One study (n = 1) included participants with Broca's aphasia, multiple traumatic brain injuries (TBIs) and dyspraxia (Baker, 2000). One study (n = 1) included participants with multiple TBIs and apraxia (Bitan et al., 2018). One study (n = 1) included children with Down syndrome (Carroll, 1996). Five studies (n = 5) included participants with Broca's aphasia with varying degrees of severity, from mild to severe (Clements-Cortes & Haire, 2018; Conklyn et al., 2012; Lim et al., 2013; Tabei et al., 2016; Wilson et al., 2006). One study (n = 1) included participants with Broca's aphasia, global aphasia, Wernicke's aphasia, and apraxia (Hurkmans et al., 2015). Lagasse (2012) was one study (n = 1) that included participants that were children with developmental apraxia of speech. One study (n = 1) included participants with TBI, dyspraxia, and global aphasia (Magee 1999). One study (n =1) included Broca's aphasia and mild apraxia (Rhee, 2009). The final study (n =1) included participants with Broca's aphasia, global aphasia, and transcortical mixing (Zhang et al., 2021).

Results of the Eligible Studies

Most of the eligible studies (n = 8) have significant results related to speech improvements (Baker, 2000; Bitan et al., 2018; Carroll, 1996; Clements-Cortes & Haire, 2018; Conklyn et al., 2012; Hurkmans et al., 2015; Lim et al., 2013; Zhang et al., 2021). The use of modified versions of MIT improved functional language in a variety of areas. These include:

- language output (Baker, 2000; Clements-Cortes & Haire, 2018; Conklyn et al., 2012);
- syllable production (Bitan et al., 2018);
- rate of response, mean length utterance (Carroll, 1996);
- speech repetition (Conklyn et al., 2012; Lim et al., 2013);
- speech intelligibility, comprehensibility, speech accuracy, consistency, and fluence of articulation (Hurkmans et al., 2015);
- spontaneous speech and naming (Lim et al., 2013, Zhang et al., 2021).

Although music therapists used modified version of MIT with a variety of participants, speech improvements were still significant.

Summary

The results indicate that music therapists are not significantly involved in MIT research. The studies that do include music therapists are rated with lower strengths of evidence (levels of certainty) due to the consistent low number of participants and the lack of music therapist involvement in well-designed RCTs. However, music therapists expanded the parameters of MIT research by frequently testing modified protocols. Furthermore, music therapists use their musical and clinical expertise to conduct studies for a wide variety of diagnoses.

CHAPTER V

DISCUSSION

The purpose of this systematic review was to identify and analyze MIT research that involved music therapists. Thirteen studies (N = 13) included a music therapist and met the inclusion criteria. This chapter focuses on the researcher's interpretation of the findings from the research questions. This chapter also includes the limitations of this study and the implications for future research.

How Music Therapists Were Involved in MIT Research

The researcher sought to determine how music therapists were involved in MIT research. This included the frequency of music therapy involvement and the roles of music therapists.

Frequency of Involvement

According to the results, music therapists were not frequently involved in MIT research. Over the past 49 years and 6 months, only 8.7% of all MIT-related studies included a music therapist. This is an unanticipated finding, for MIT is not solely practiced by a single profession (Belin et al., 1996, Moses, 1977, Thaut et al. 2014). Since music therapy is an evidence-based profession, it is unclear why music therapists were less involved in MIT. A reason could be the availability of resources and barriers to research. For example, music therapists conducting research on MIT may not have access to an institutional review board (IRB). In this systematic review, most studies (n = 9) took place in rehabilitation centers, rehabilitation units, or hospitals (Baker, 2000; Carroll, 1996; Conklyn et al., 2012; Hurkmans et al., 2015; Lim et al., 2013; Magee, 1999; Raglio et al., 2016; Tabei et al., 2016; Zhang et al., 2021). This indicates that these music therapists had access to settings where IRBs were likely available. In fact, the study with the highest level of evidence of 1B (Zhang et al., 2021) was conducted at a rehabilitation research center. Waldon (2015) researched the barriers to music therapy research in the United States. The researcher reported that music therapists in a medical or rehabilitation setting were more frequently engaged in research compared to other settings (Waldon, 2015). The researcher also reported that surveyed music therapists "view constraints of the work environment and perceived inaccessibility of the research as interfering with putting research into practice." (Waldon, 2015, p. 188). Therefore, barriers to research could be a reason for the lack of music therapy involvement in MIT research.

Additionally, the researcher anticipated that music therapists would be more involved in MIT research due to findings in the literature review. Past literature indicates that a version of MIT exists to be implemented by NMTs

(Thaut et al., 2014). As a requirement of the NMT specialization, NMTs are trained in this version. Since NMTs practice MIT, it was anticipated that NMTs would be significantly involved in MIT research. However, this is not the case. Furthermore, the researcher did not anticipate the results since MIT entails the clinical use of music, composition, and music performance (Albert et al., 1974; Thaut et al., 2014). It should be noted that the inspiration for MIT came from the MIT founders' observations of stroke patients who sang during music therapy sessions, as stated in Chapter 2 (Albert et al., 1974). Since the discovery of MIT involved music therapy, it was anticipated that music therapists would be frequently involved with paraprofessionals in MIT research. In contrast, music therapists are less involved with paraprofessionals in MIT research.

Roles of the Music Therapist

Other unexpected findings involve the roles of music therapists in MIT research. The results indicate that music therapists were co-practitioners with speech therapists in only three studies (n = 3; Bitan et al., 2018; Hurkmans et al., 2015; Wilson et al., 2006). The separation of speech therapy and music therapy as practitioners was unanticipated because MIT involves music therapy skills. For example, music therapists are required to be competent in music composition and singing abilities, both of which are required during MIT (Albert et al., 1947; Thaut et al., 2014). Co-treating in research would allow both disciplines to use their clinical strengths together, potentially increasing the reliability of the results. While the two disciplines can practice MIT separately, the combined skills of both professionals would result in best practice in research.

The Targeted Diagnoses

A significant finding is the variety of targeted diagnoses. The most notable diagnoses are children with Down syndrome and developmental apraxia of speech (Carroll, 1996; Lagasse, 2012). These are notable because MIT was originally designed only for adults with Broca's aphasia and not for children (Albert et al., 1974; Thaut et al., 2014). This is true for the original MIT and the NMT version (Albert et al., 1974; Thaut et al., 2014). According to Thaut et al. (2014) adults with Broca's aphasia are recommended for MIT because of their abilities to self-correct themselves as well as their intact abilities to process language. Therefore, no version of MIT has been established for children. However, therapists have initiated research to expand MIT benefits to children.

Other notable diagnoses were types of aphasia other than Broca's aphasia, including Wernicke's aphasia, global aphasia, and transcortical mixing (Hurkmans et al., 2015; Magee, 1999; Zhang et al., 2021). These are unrecommended diagnoses for MIT. According to Thaut et al. (2014), unrecommended diagnoses include

Wernicke's aphasia, global aphasia, transcortical aphasia, conduction aphasia, and other brain injuries that compromise cognitive function (Thaut et al., 2014). Patients who have a decrease in language comprehension are not recommended candidates. However, music therapists modified the MIT protocol to expand these recommendations. As a result, participants had significant improvements in speech intelligibility, speech accuracy, consistency, fluency of articulation, repetition, spontaneous naming, and abstract thinking (Hurkmans et al., 2015; Magee, 1999; Zhang et al., 2021). Such results provide evidence that a wider range of clients can benefit from modified MIT.

Modifications to Melodic Intonation Therapy

A significant finding is that, in all research (N = 13), music therapists tested modifications to MIT. Many of these modifications were music-based.

Pitch Ranges

Pitch ranges are often increased to fully recruit the right hemisphere of the brain during MIT (Baker, 2000; Conklyn et al., 2012; Hurkmans et al., 2015; Magee, 1999). Conklyn et al. (2012) stated that MIT in its traditional form has limitations. One limitation is the use of small pitch ranges, often just two pitches separated by a minor or major third. According to imaging research, prosody of speech is predominantly processed in the right hemisphere. By limiting the pitches and rhythms in a melodic phrase, a therapist fails to fully incorporate the intact right-brain structures responsible for prosody and melody. When Conklyn et al. (2012) modified the pitch ranges, the experimental group had significant gains in speech output compared to the control group.

Phrase Lengths and Rhythms

The phrase lengths and rhythms were also modified to sound more melodic and less speech-like. Music therapists composed phrases to have unique musical sounds (Baker, 2000; Bitan et al., 2018; Clements-Cortes & Haire, 2018; Lim et al., 2013). Overall, the participants' recall improved with unique melodies. The more unique the sound, the better the participant could distinguish each MIT phrase. This increased the efficacy of MIT. Since the music therapists are educated in music composition, they were able to make these musical modifications to best meet the participant's needs.

Familiar Songs

Multiple studies indicate that the addition of singing familiar songs increased the patient's participation level and their speech outcomes (Clements-Cortes & Haire, 2018; Lim et al., 2013; Rhee, 2009; Zhang et al., 2021).

These modifications contributed to the participant's success with MIT. It should be noted that adding familiar songs to therapy requires training. Music therapists are trained to determine appropriate song selections for clinical purposes since familiar songs may have negative connotations (e.g., being connected to a negative memory) (Heiderscheit & Murphy, 2021). Music therapists conduct assessments to decrease such contraindications in therapy.

Modifications for Children

Music therapists contributed to research by testing MIT modifications for children. Carroll (1996) had significant results in a study for children with Down syndrome. The researcher modified MIT in multiple ways. To maintain child participation, the researcher replaced hand tapping with bongos. Call and response methods replaced the therapist fading out assistance during MIT. Additionally, body actions and puppets were paired with music to describe each target word or phrase. As a result, children in the experimental group had a significant increase in the number of verbal responses, an increase in response rates, and improvements in speech clarity. The study by Lagasse (2012) modified MIT for children with DAS by inserting play-breaks throughout the protocol. The results revealed that children with DAS had fewer substitution errors after MIT treatment.

Professional Competencies

Since music therapists specialize in the clinical use of music, they were able to make modifications to MIT that provided significant results. Examples of music therapists' clinical skills can be seen in the AMTA (2013) professional competencies. The AMTA (2013) professional competencies are organized by topics. There are four topics that are most associated with MIT. The first topic is musical foundations. According to the AMTA (2013), qualified music therapists are required to:

- Retain the skills to compose songs with simple accompaniment.
- Adapt, arrange, transpose, and simplify music compositions for small vocal and non-symphonic instrumental ensembles.

The second topic is major performance medium skills. According to the AMTA (2013), qualified music therapists are required to:

- Perform appropriate undergraduate repertoire.
- Demonstrate musicianship, technical proficiency, and interpretive understanding on a principal instrument or voice.

The third topic is functional music skills. According to the AMTA (2013), qualified music therapists are required to:

- Demonstrate a foundation on voice, piano, guitar, and percussion.
- Lead and accompany proficiently on instruments including, but not limited to, voice, piano, guitar, and percussion.
- Sing in tune with a pleasing quality and appropriate volume both with accompanied instruments and a capella.
- Develop original melodies, simple accompaniments, and short pieces extemporaneously in a variety of moods and styles, vocally and instrumentally.

The fourth topic is music therapy foundations and principles. According to the AMTA (2013), music therapists are required to know:

- The psychological aspects of musical behavior and experience including, but not limited to, perception, cognition, affective response, learning, development, preference, and creativity.
- The physiological aspects of the musical experience including, but not limited to, central nervous system, peripheral nervous system, and psychomotor responses.

It is apparent that when music therapists are involved in research, their competencies allow them to make changes to MIT that accommodated a wider range of populations. Despite the natural pairing of music therapy and MIT, there is a lack of music therapy inclusion in research.

Limitations

There are several limitations existed during this systematic review. Potential studies that qualified for this systematic review could have been unavailable to the researcher. Unpublished studies and studies restricted to public use may have been eligible for this systematic review. There could also be existing literature that test MIT but do not mention so in the title or abstract of the study. These limitations were considered when conducting this review.

Suggestions for Future Research

Researchers are recommended to include larger sample sizes in future studies. The number of participants in each study did not exceed 40 (N = 40; Zhang et al., 2021). As a result, the levels of evidence and strengths of evidence are lacking. A greater number of participants could increase the reliability of the results. Additionally, researchers could explore why music therapy has been lacking in MIT studies. Another suggestion is to continue testing MIT modifications with children. The studies that included children in this review reported benefits of MIT

and speech development (Carroll, 1996; Lagasse, 2012). However, a version of MIT for children has not yet been created. A final suggestion is for paraprofessionals and music therapists to collaborate in future research.

Applications to Music Therapy Clinical Practice

The results indicate that MIT can be used for a variety of diagnoses and age groups when musical elements are modified. The music therapist could use the results to determine which modifications would benefit a client. Furthermore, a clinician could evaluate the MIT literature and determine which topics need to be researched.

Conclusion

The results of this systematic review determine that little research has involved music therapists and MIT. Despite the low number of studies, music therapists expanded the boundaries of MIT to present significant findings. Music therapists frequently used their professional competencies to modify MIT to meet the needs of a wide range of populations. Lastly, the findings of this systematic review provide implications for future research, such as MIT modifications for children, and the collaboration of music therapists and paraprofessionals.

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