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The use of singing to improve articulatory accuracy in a child with apraxia and dysarthria

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CONSERVATORY OF MUSIC

THE USE OF SINGING TO IMPROVE ARTICULATORY ACCURACY IN A CHILD WITH APRAXIA AND DYSARTHRIA

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ABSTRACT

A single subject, diagnosed as having severe oral apraxia and dysarthria, participated in an eight-week research experiment designed to study the effects of singing on speech articulation. A simultaneous treatment design was used in which the subject participated in both the experimental and control conditions. In the control condition spoken words were repeated by the subject, while in the experimental condition the words were sung. The words used were the lyrics to two popular folk songs. Articulatory accuracy (intelligibility) was judged by two graduate level speech therapists, based on audiotape samples of the subject's responses, recorded on a "Language Master" machine. Judges were also asked to rate their degree of confidence about their judgements. Results indicated significantly higher scores at the .05 level for the singing condition than for the non-singing condition. Degree of confidence ratings were similar for both conditions. It was also observed that a significantly greater number of consonant blends were correctly articulated in the singing condition than in the non-singing condition.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION

Purpose

The purpose of this research experiment was to examine a single case of a child with apraxia and dysarthria and the effects of singing on his speech articulation.

Interrelationship Between Speech and Music/Singing

In many ways, singing and speech are interrelated. Both involve complex thought processes, and possess many of the same qualities, including rhythm and intonation. Loven (1957) attributed positive effects of singing on speech development to the use of rhythm in providing a predictable structure or pattern for speech production.

There is evidence in the literature that there has long been a positive interaction between music and speech, especially when applied to the rehabilitation of handicapped individuals. As far back as the early 1800's, music was used in the diagnosis of hearing and speech impairment. One of the first accounts of this is in the work of Jean Itard, who used music with "the wild boy of Avyron" to help develop the child's auditory discrimination skills. Itard reported that music helped make learning more

enjoyable. It appeared to be a means of "appreciating all the modifications and variations of tone which make up the music of speech" (in Solomon, 1980, p. 237).

A similar observation to the above was made by Edouard Seguin, a student of Itard, who worked with mentally handicapped children. Seguin stated: "...above all...the teaching of music must soon be blended in that of speech, and first of voice...We have used music to give perspicuity and continuity to audition, and to support the organs of the voice in learning to speak" (in Solomon, 1980, p. 237).

In 1916, Shuttleworth and Potts found music to be an effective aid in enlisting attention "...when speech alone was disregarded...Music was often a stepping stone to speech for the mentally retarded... Children would frequently hum tunes before they were able to articulate words" (in Solomon, 1980, p. 240).

Rehabilitation

Current literature provides similar accounts of the use of music to enhance both speech and language rehabilitation.

Pirtle and Seaton (1973) stated that "many concepts basic to musical understanding are basic to

language development" (p. 293). In a study with neurologically handicapped children, Pirtle and Seaton found that teaching musical structure helped the children develop parallel concepts in both receptive and expressive language. Significant improvements were made in the areas of musical development, vocal integration, and verbal comprehension. The researchers concluded as follows:

> ...there may be a direct and beneficial relationship between musical growth and growth associated with language...For the neurologically handicapped child - who is frustrated with his attempts to structure his environment and to communicate verbally - music may be the one nonthreatening experience in which he can function...Music, by its very nature, is self-motivating and meaningful to a child (p. 300).

Other studies have discussed this motivational aspect of music. Seybold (1971) studied the value of music in the treatment of speech delayed children, based on the assumption that best results would be achieved if the child regarded speech training as an enjoyable experience. Despite limitations of the study, music appeared to be effective in teaching

language concepts. Seybold speculated that "Music provided a more comfortable atmosphere with less pressure placed upon the specific speech experience" (p. 110). Klinger and Peter (1963, in Walker, 1972), reported similar findings. Harding and Ballard (1982) found music to be an effective contingent reinforcer in promoting spontaneous speech in physically handicapped children.

Walker (1972) found that music and related audio-visual stimuli facilitated to a significant degree the learning of functional speech in a group of institutionalized severely retarded males.

The subject of this research experiment was a child with developmental apraxia of speech and dysarthria, both disorders of articulation. A description of the two follows.

DEFINITIONS

Apraxia

Apraxia is defined as "a sensory motor disorder of articulation and prosody...There is no apparent weakness when performing reflexive or automatic movements, but an impaired ability to program the positioning of the speech mechanism and to sequence

the movements for volitional speech" (Yorkston, 1984, p. 285). Developmental apraxia is a term used to describe "a unique pattern of severe articulatory defects in the absence of other serious problems... Auditory comprehension remains relatively intact" (Sommers, 1983, p. 26). Although the etiology is unknown, it appears to reflect a neurological dysfunction affecting the Broca's area of the brain.

In studies of the developmental histories of apraxic children, it has been observed that certain aspects of their development may be normal, while others are not. During infancy babbling may be present, but self-sound imitation and other echolalic responses may be limited or absent. Although sound localization and discrimination may be normal, expressive language skills are weak. In addition, apraxic children may be "lazy chewers" and clumsy, late walkers. Motor coordination is poor (Sommers, 1983).

Haynes (1985) summarizes symptoms of developmental apraxia as follows:

1. An inability to imitate speech sounds in the absence of abnormalities of the tongue, lips, or palate.
2. Difficulty initiating speech movements.
3. Unawareness of articulator positions.

4. Impairment in production of sound sequences.
5. Improved performance with visual feedback.
6. Occasional telegraphic speech.
7. Disturbances in repetition of speech and conversation.
8. Inconsistency of articulatory output, difficulty increasing with word length.
9. Consonants are misarticulated more frequently than vowels.

In addition, certain associative symptoms may appear, including disturbances in diction, grammar, syntax, or all three. Examples:

- Words may be omitted.
- Sounds may be substituted.
- Sounds may be reversed or misplaced within a word.
- Words may be reversed in a sentence.

Dysarthria

Dysarthria is defined as "a disorder of motor control of the speech mechanism resulting from damage to the central or peripheral nervous system,... characterized by weakness, slowness, and incoordination of the speech mechanism musculature" (Yorkston, 1984, p. 285). As with apraxia, auditory comprehension is usually intact.

Because of sluggish tongue functioning, the dysarthric speaker has difficulty moving the articulators from one position to another, and making repetitive

movements with it. Other symptoms include the following:

- Incorrect articulation of consonant sounds.
- Omission of consonant sounds.
- Substitution of consonant sounds.
- Reversal of consonant order within a sentence.
- Spasmodic interruptions in utterance.
- Sudden increases and decreases in volume.
- "Sloppy" speech.

The Dysarthrias

Rosenbek and LaPointe (1985) discuss the current concept of the dysarthrias. Rather than a single disturbance, the dysarthrias are a group of related motor speech disorders resulting from disturbed muscular control over the speech mechanism. Causes of the disrupted oral communication found in the dysarthrias include paralysis, weakness, abnormal tone, and incoordination of the muscles used in speech. Coexisting motor disorders affect respiration, phonation, resonation, articulation, and prosody.

Neuropathologies

Causes of the dysarthrias include a variety of congenital and acquired neuropathologies. Possible areas of damage include cortical areas, the cerebellum, the brainstem, and the peripheral nervous system.

The nature and degree of speech disturbance caused by neurologic damage depends on the site and extent of the lesion, as well as age of onset in the individual.

TREATMENT

Treating Dysarthria

Netsell and Rosenbek (1986) discuss attitudes toward the treatment of dysarthria. In the past, some believed that there were few options in terms of therapy...The speech disorder followed "the natural course of neurologic recovery or degeneration" (p. 123). However, research has shown that many dysarthric speakers can learn to speak more intelligibly. Speech improvement has been observed four to five years after the initial lesion.

The use of music with apraxia

Researchers have sought to discover effective strategies for remediating apraxia. Because of the uniqueness and severity of the disorder, traditional approaches to therapy may be ineffective.

Shane and Darley (1978) studied the effect of auditory rhythmic stimulation on articulatory accuracy in apraxia of speech. This study was based on observations of improved articulation during conditions of

patterned activity involving an underlying rhythm (i.e., body or speech rhythm). However, the study employed an external rhythmic source (metronome), which was found to be ineffective in improving articulation. In contrast, an internal source of stimulation--singing, was found by Rosenbek, Hansen, Baughman, and Lemme (1974) to be an effective facilitator for articulatory accuracy in apraxic children. Shane and Darley (1978) concluded that the greater the number of sensory modalities contributing to speech programming, "the more likely it may be that the programmer can use this information in executing its articulatory plans" (p. 449). They add that "the internally generated rhythm is subject to the speaker's control, and therefore, may be less stressful than a condition in which the speaker must track an external stimulus" (p. 449). Miller (1982) also stresses the importance of multisensory stimulation in helping the child voluntarily produce phonemes.

Melodic Intonation Therapy

Literature on apraxia discusses the area of cerebral dominance in attempting to explain the disorder. One theory attributes apraxia to a

developmental failure in the left (language dominant) hemisphere of the brain. One technique designed to compensate for this failure is called Melodic Intonation Therapy (MIT), and is based on the discovery that music is dominated by the right cerebral hemisphere. Krauss and Galloway (1982) state: "The rationale for MIT's effectiveness is based on the hypothesis that the damaged left (language dominant) hemisphere is aided, stimulated, and facilitated by exaggerating the intonation (rhythm, stress, and melodic contours) of speech inherent in the undamaged right hemisphere" (p. 103).

Although Melodic Intonation Therapy has in the past been proven effective with apraxic adults, Krauss and Galloway (1982) found significant improvement with apraxic children. Marked improvement was shown in both verbal output and verbal naming tasks.

The primary focus of Melodic Intonation Therapy is improving the patient's efficiency in retrieving meaningful language units. Only secondary concern is placed on quality of articulation. Sparks, Helm, and Albert (1974) add that the tempo of melodic intonation is slower than that of speech. Therefore, it can be useful to patients having dysarthric verbal output.

Development of a Singing Technique

The singing technique used in this research experiment has both similarities with and differences from the MIT technique.

The two techniques include the following similarities:

1) Both are based on the premise that rhythm and melody can be combined to improve speech production.
2) Both involve repetition.
3) Both involve a structured approach in which the therapist guides the patient (client) toward independent speech production.

Differences between the two techniques include the following:

1) The technique proposed by this researcher involves actual singing (see #3 below), whereas the MIT technique uses exaggerated intonation of speech ("Sprechgesang").
2) The primary focus of the singing technique in this research experiment is to improve quality of articulation, while this is only a secondary concern in Melodic Intonation Therapy.

3) The singing in this experiment uses nonpropositional phrases (i.e., lyrics from precomposed songs...see Appendix A), while the MIT program uses only propositional messages (e.g., "I am hungry."), and warns against using familiar melodies. MIT also has a limited range of pitch variation, using the natural prosodic pattern of the spoken sentence.

4) As noted earlier, the purpose of the present research study was aimed more toward articulatory accuracy, rather than retrieval efficiency, the primary purpose of MIT. The reason for this difference is largely the fact that the child in this experiment was diagnosed as having both severe apraxia and dysarthria. Therefore, his needs include increasing not only ease of production during volitional speech, but articulatory accuracy as well.

It should be noted that, because this child suffers from both disorders (apraxia and dysarthria), the problem is further complicated. Although research has shown positive results using music with apraxics, there is no evidence regarding its effects on dysarthria.

In the case of this multiple speech disorder, the positive effects of music on the apraxia may still be hidden or distorted by the neuromuscular complications of the dysarthria (i.e., muscle weaknesses which cannot be corrected).

Null Hypothesis

The null hypothesis used in this study was: "Articulatory accuracy (Intelligibility) during singing activities will not differ significantly from articulatory accuracy during non-singing speech activities in a child with severe apraxia and dysarthria."

METHOD

Subject

K. was a 15 year-old boy diagnosed as having severe oral and verbal apraxia and dysarthria. His hearing was normal.

K. had received speech therapy for over nine years. A recent evaluation revealed that K.'s production was best with imitated speech, then reading, and finally, spontaneous speech. During spontaneous speech K. was difficult to understand unless the listener was aware of the referent. His speech contained distortions, omissions, and substitutions of

one phoneme for another. However, with much effort K. was able to produce single syllable words which were intelligible.

K.'s voice quality was somewhat breathy and low pitched. He spoke with a decreased intensity level and his use of intonation was limited. Fluency and rate of speech were slow and labored because of his apraxia and dysarthria.

The following is an evaluation from a school for neurologically handicapped children, which K. attended for a brief period in 1983.

> Although K. is intelligent and interested in his world, he is unable to express his attitudes, ideas, and feelings in understandable words. Peer interactions are painful and humiliating. K. realizes that strangers assume his intellect is impaired as well as his speech. As might be expected, K. is often withdrawn and socially isolated. Our consulting psychiatrist ... feels that K. manifests an adjustment disorder ... secondary to his extreme expressive language disorder.

A (1983) classroom report from the same school addressed the question, "How can K. best learn to respond to and attend appropriately to the learning environment?" The response from K.'s teacher was that although he exhibited a severe language impairment

affecting performance in all verbal areas adversely, "...when given structured, routine, and familiar activities and materials, he does perform satisfactorily at the level presented." Finally, the teacher stated that "K. is able to perform most effectively when he is highly motivated by the subject matter and when the adult expectations are very clear."

In searching for a tool which would be "highly motivating" for K., this writer, drawing on clinical work as a music therapist, as well as research in the area of speech and language disorders, sought to explore the potential contribution of music to speech therapy. A description of the experimental design follows.

Design

The experiment had a single subject, simultaneous treatment design. Data was treated as in a counterbalanced design, because the subject engaged in both the control (speech) and experimental (singing) conditions.

Both conditions involved a phrase completion context. In the control condition, the words were spoken, while in the experimental condition, they

were sung.

In order to further counterbalance the design, the order of the two conditions was reversed each session (i.e., Session #1: Control - Experimental; Session #2: Experimental - Control).

Procedure

The subject met with the music therapist (experimenter) for 30 minutes one time per week for eight weeks. He continued to receive ongoing speech therapy treatment two times per week for 45 minutes. The following is a description of procedures for both the control and experimental conditions.

Speech Conditions (Control): The subject was instructed to complete each phrase by repeating only the designated words (see Appendix A) upon visual (point) cues from the therapist (i.e., "One day my goat was feeling fine."). Each underlined word was written on a card for the subject to read. The subject was instructed to repeat each designated word once (i.e., "I'm going to say the words to the song. I want you to listen first, and then repeat the word on the card.").

Singing Condition (Experimental): The experimental condition was the same as the control condition, except that the therapist sang each phrase. The subject

was instructed: "I'm going to sing the words to the song. I want you to listen first, and then repeat the word on the card." (See Appendix A for song lyrics and list of designated words.)

Evaluation

A clinical evaluation of articulatory accuracy (intelligibility) was performed by two graduate level speech therapists, based on audiotape samples of the subject's responses, recorded on a "Language Master" machine. A pilot study was first performed in order to determine the degree of agreement between judges, and to insure interjudge reliability.

Judges were instructed to write down each word they believed was spoken by the subject (see rating form, Appendix B). The order of words on each "Language Master" card was randomized before being given to the judges to insure a reliable evaluation. The number of correct responses per session was recorded, and compared for the control versus the experimental conditions. A correct response was defined as the exact word from the song.

In order to further prevent bias in the judges, the tapes contained only the subject's responses,

recorded on "Language Master" cards. The therapist's cues were not recorded.

In addition, judges were asked to rate their degree of confidence about their judgements. The following scale was used:

5 = 100% confident that judgement is correct

4 = Almost completely confident

3 = Some question of confidence

2 = Somewhat unsure about confidence

1 = Unconfident

In order to further insure reliability, two additional judges (not trained in speech therapy) were asked to rate one session. The reason for this was to compare the ratings of two trained judges versus two non-trained judges.

Test Instrument

The Wilcoxon matched-pairs signed-ranks test was used to determine statistical results, indicating the significance of difference between the two conditions (singing vs. non-singing) over time (see Appendix C for Test Instrument format).

Results

Data was analyzed using the Wilcoxon matched-pairs signed-ranks test (binomial probability for $n < 6$). The null hypothesis stated: "Articulatory accuracy (intelligibility) during singing activities will not differ significantly from articulatory accuracy during non-singing activities in a child with severe apraxia and dysarthria." This was rejected, based on significantly higher scores at the .05 level for the singing condition (see Figure 1 for a graphic comparison of scores).

Raw data showed significantly higher scores for the singing condition in 5 out of 8 sessions for Judge #1, and 6 out of 8 sessions for Judge #2 (see TABLE 1 for raw data).

There were significantly lower scores during session #2. A possible reason for this could be the presence of a third person in the therapy room. This person was selected to assist the therapist in manipulating the "Language Master" recorder. It was observed that the presence of this new person during the session seemed to distract the subject, thus contributing to the lower scores.

For each set of data (i.e., each session), judges were asked to rate their degree of confidence that their judgement was correct (see Rating Form, Appendix B). An analysis of this data indicates that Judge #1 rated the singing condition with a higher degree of confidence, based on the percentage of 4's (almost completely confident) and 5's (100% confident), while Judge #2 rated the non-singing condition more confidently (see bar graph, Figure 2). Overall scores (4's and 5's) were higher for Judge #2 than for Judge #1. A possible reason for this is the different personalities of the judges...While both are trained in speech therapy, it could be that Judge #2 is a more confident person and, therefore, rated her judgements more confidently.

A different analysis of the "Degree of Confidence" data draws different conclusions. When the total scores of both judges are computed, the average Degree of Confidence score is 3.55 for the singing condition, and 3.54 for the non-singing condition. This appears to indicate a high degree of reliability.

Another observation that appeared to strengthen reliability was the ratings of two additional (non-trained) judges, compared to the ratings of the two

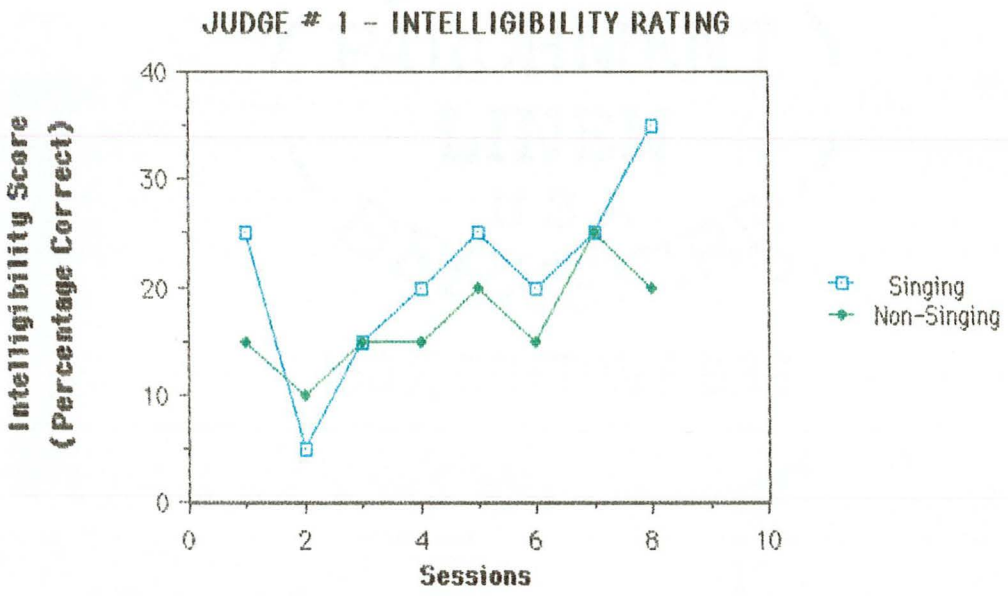
trained judges. Results indicated that, although the non-trained judges gave both conditions lower scores than the trained judges, they still rated the singing condition higher than the non-singing condition (see TABLE 1 for raw data). A possible explanation for the overall higher ratings by the trained judges is that they have had more experience in listening to different types of speech, and therefore may rate intelligibility higher than the average, non-trained listener.

In reviewing the raw data containing the specific words that were correctly articulated under both conditions, there are some interesting observations. It was found that 30% more consonant blends (i.e., "stick", "train", "clean", and "fright") were correctly articulated under the singing condition than under the non-singing condition (35% for Judge #1 and 25% for Judge #2**). This is especially meaningful because a major symptom of both apraxia and dysarthria is incorrect articulation of consonant blends. In apraxia, consonant blends are misarticulated more frequently than single consonants, and single consonants are misarticulated more frequently than vowels.

**(see TABLE 3 in Appendix D for data)

Figure Caption

Figure 1. Intelligibility ratings of two judges for control (non-singing) and experimental (singing) conditions over 8 sessions.


JUDGE # 1 - INTELLIGIBILITY RATING
Intelligibility Score
(Percentage Correct)
40
30
20
10
0
0
2
4
6
8
10
Sessions
Singing
Non-Singing

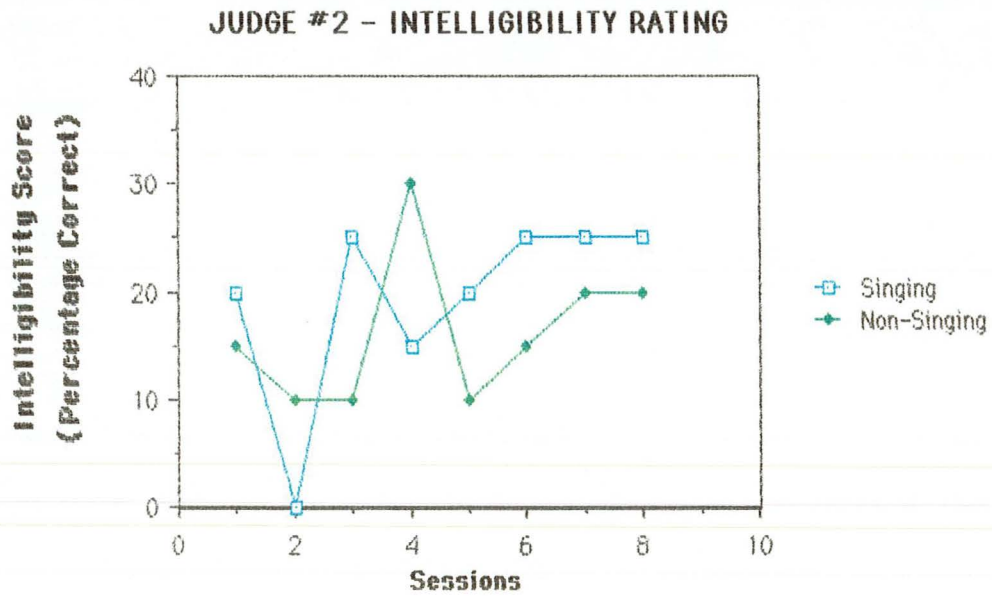
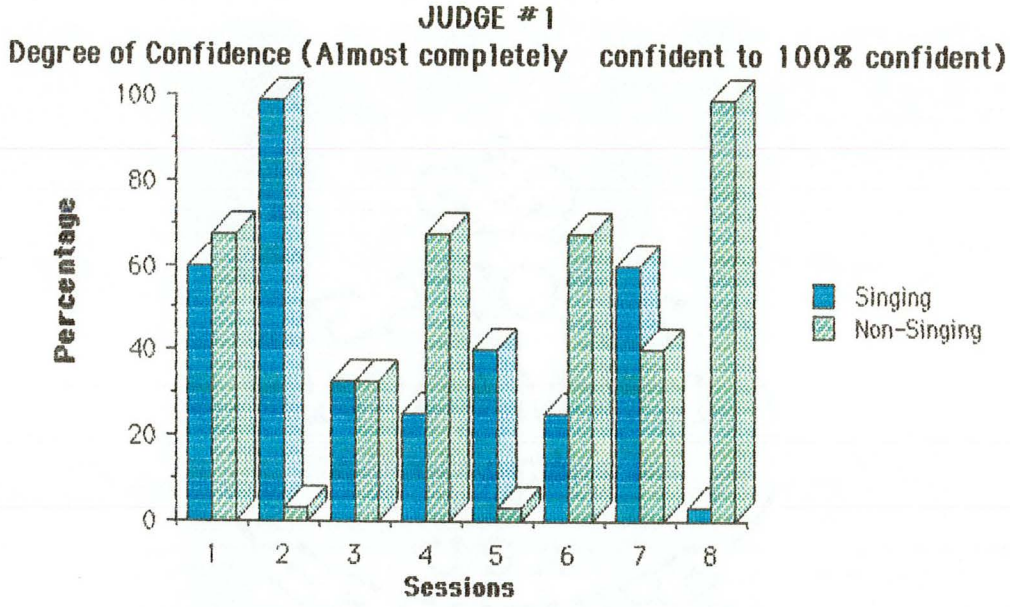

JUDGE #2 - INTELLIGIBILITY RATING
Intelligibility Score
(Percentage Correct)
40
30
20
10
0
0
2
4
6
8
10
Sessions
Singing
Non-Singing

Figure 1

Figure Caption

Figure 2. Degree of Confidence ratings of two judges, based on percentage of 4's (almost completely confident) and 5's (100% confident) for control (non-singing) and experimental (singing) conditions.


JUDGE #1
Degree of Confidence (Almost completely confident to 100% confident)
Percentage
100
80
60
40
20
0
1
2
3
4
5
6
7
8
Sessions
Singing
Non-Singing

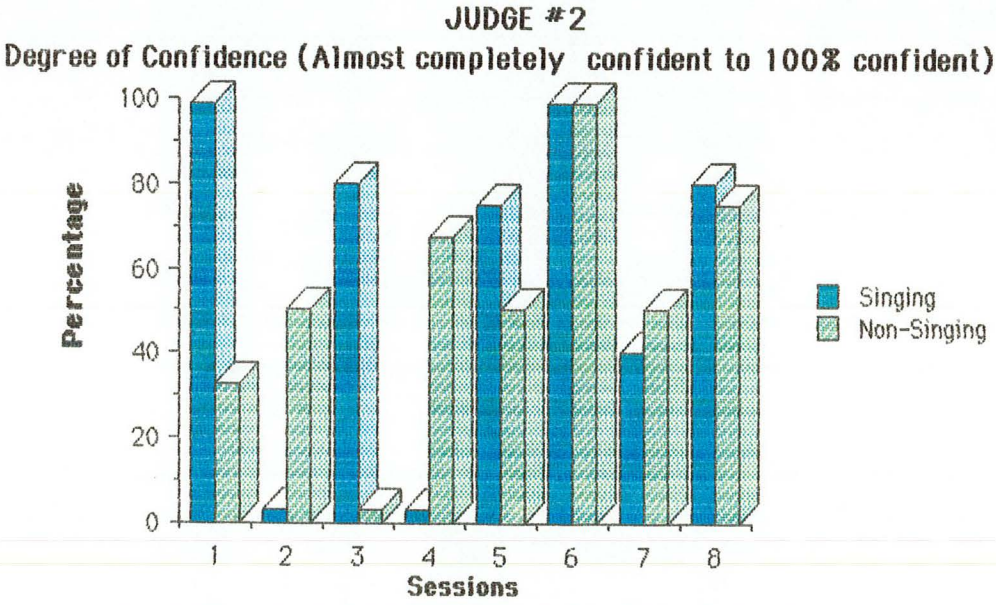

JUDGE #2
Degree of Confidence (Almost completely confident to 100% confident)
Percentage
100
80
60
40
20
0
1
2
3
4
5
6
7
8
Sessions
Singing
Non-Singing

Figure 2

Discussion

This study's null hypothesis stated: "Articulatory accuracy (intelligibility) during singing activities will not differ significantly from articulatory accuracy during non-singing activities in a child with severe apraxia and dysarthria." Results indicated significantly higher scores at the .05 level for the singing condition than for the non-singing condition. It was also observed that a greater number of consonant blends were correctly articulated in the singing condition than in the non-singing condition.

It should be noted that judgement of intelligibility in this study could have been influenced by the two primary judges having known and worked clinically with K. (the subject). In addition, the two judges, because of their clinical training, were accustomed to listening to disordered speech.

Considerable variability of the judges' ratings occurred from session to session. Reasons for this variability can only be hypothesized. However, in spite of the variability in the ratings of the two judges, the scores for the singing condition were significantly higher overall than for the non-singing condition.

Non-trained judges (not trained in speech therapy) also rated intelligibility higher in the singing condition than in the non-singing condition, although they rated overall intelligibility lower than the trained judges. The implication is that experience in listening to persons with disordered speech affects the rating of intelligibility.

Positive interaction between singing and speech has been cited in several research studies. Both the rhythmic and melodic qualities of singing have been found effective in providing a predictable structure for speech production.

Another quality of singing that aids speech is its motivational aspect. Pirtle and Seaton (1973) found that teaching music to neurologically handicapped children helped them develop parallel concepts in both receptive and expressive language, particularly vocal integration. They concluded that, for the speech-impaired child, "music may be the one nonthreatening experience in which he can function" (p. 300).

The subject of this study had apraxia of speech and dysarthria, both disorders of articulation. There have been several reports of effective treatment for dysarthria and apraxia (Haynes, 1985; Netsell & Rosenbek,

1986; Rosenbek & LaPointe, 1985; Sparks, Helm & Albert, 1974; Yorkston & Dowden, 1984).

One technique for apraxia called Melodic Intonation Therapy (MIT) (Sparks et al., 1974) is based on the hypothesis that impaired speech caused by damage to the left (language dominant) hemisphere of the brain can be remediated by exaggerating the rhythm, stress, and melodic contours of speech inherent in the undamaged right hemisphere. Krauss and Galloway (1982) used MIT with apraxic children and reported significant improvement in both verbal output and verbal naming tasks.

The singing technique used in this research experiment had both similarities with and differences from the MIT technique. Both were based on the premise that rhythm and melody can be combined to improve speech production. However, the primary purpose of the singing technique used in this study was to improve articulation rather than retrieval efficiency, the main objective of MIT.

While the present study made no conclusions regarding retrieval efficiency, it did appear to confirm the effectiveness of the singing technique in improving speech intelligibility. More specifically it was found that 30% more consonant blends were correctly articulated under the

singing condition than under the non-singing condition. This was particularly meaningful, since a major symptom of both apraxia and dysarthria is incorrect articulation of consonant blends.

Other researchers have reported positive effects of singing with apraxic persons. Rosenbek et al. (1974) found singing to be a facilitator for articulatory accuracy in apraxic children.

Although Krauss and Galloway (1982) did not administer a separate articulation test in their MIT study, they did find significant gains in intelligibility "when articulation, syntactic, and grammatical components were measured simultaneously" (p. 109). They also found that improvements in articulation led to improved fluency and speech prosody during verbalization. Finally, they recommended that future research include a separate test of articulation. It is hoped that by focusing on this need, the present study will further this goal and encourage others to do the same.

This writer stated a priori that because the subject suffered from a multiple speech disorder (i.e., apraxia and dysarthria), "the positive effects of music on the apraxia may still be hidden or distorted by the

neuromuscular complications of the dysarthria" (p. 13). Yet despite these complications, music (singing) still had a positive impact on the subject's speech articulation.

This study has attempted to investigate the potential role of a particular music technique in the rehabilitation of a severe speech disorder. In the course of therapy, the client inevitably reaches a plateau in which he/she has achieved his/her potential. When circumstances allow, music therapy can enhance speech therapy, and perhaps help the client extend that potential.

It should be noted that there are limitations in a single subject design. It can only suggest that a particular treatment format has merits for further investigation, or, clinically speaking, the treatment format may be judiciously applied to other cases. Therefore, future research in this area should investigate the application of the music treatment to other types of speech disorders, including isolated apraxia or dysarthria, and basic articulation disorders. Finally, a group design would extend the potential for generalization and possibly confirm the value of this

form of treatment in conjunction with more traditional speech therapy procedures.

Krauss and Galloway (1982) suggest that the use of MIT by both music therapists and speech pathologists "may offer potential for improving the services provided to children with special speech needs" (p. 113). It is exciting to consider the potential gains of a therapy program designed to utilize areas of strength, rather than weakness. Music, and in particular, singing, can be a powerful tool in expediating the rehabilitation of even the most severe speech disorders.

APPENDIX A

SONG LYRICS

"The Goat" *(American Folk Song, composer unknown)

ONE DAY MY GOAT WAS FEELING FINE.
ATE THREE RED SHIRTS
RIGHT OFF THE LINE.
I TOOK A STICK,
GAVE HIM A WHACK
AND TIED HIM TO THE RAILROAD TRACK.
BUT WHEN THE TRAIN CAME INTO SIGHT
MY GOAT WAS SCARED AND PALE WITH FRIGHT.
HE GAVE A YELL AS IF IN PAIN,
COUGHED UP MY SHIRTS AND FLAGGED THE TRAIN.

* Music from Reaching The Special Learner Through Music, by S.D. Nocera. (1979). Morristown, N.J.: Silver Burdett Company. Page 136.

"Miss Mary Mack" *(American Play-party song, arranged by E. Plant)

MISS MARY MACK
ALL DRESSED IN BLACK
WITH SILVER BUTTONS ALL DOWN HER BACK.
MISS LINDA LIGHT
ALL DRESSED IN WHITE
SHE SHINED HER SHOES
TILL THEY FIT TOO TIGHT.
MISS DINAH DEAN
ALL DRESSED IN GREEN
SHE WASHED HER CLOTHES TO KEEP THEM CLEAN.

* Music from Reaching The Special Learner Through Music, by S.D. Nocera. (1979). Morristown, N.J.: Silver Burdett Company. Page 167.

APPENDIX B

RATING FORM

INTELLIGIBILITY RATING FORM

PLEASE WRITE DOWN EACH WORD YOU HEAR THE SUBJECT SPEAK IN THE SPACE PROVIDED. NEXT TO EACH RESPONSE, RATE YOUR DEGREE OF CONFIDENCE ABOUT YOUR JUDGEMENT. USE THE RATING SCALE AT THE BOTTOM OF THIS PAGE.

	WORD	DEGREE OF CONFIDENCE (1-5)
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		
11.		
12.		
13.		
14.		
15.		
16.		
17.		
18.		
19.		
20.		

RATING SCALE

5 = 100% confident

4 = Almost completely confident

3 = Some question over confidence

2 = Somewhat unsure about confidence

1 = Unconfident

APPENDIX C

TEST INSTRUMENT

Test Instrument

The Wilcoxon matched-pairs signed-ranks test was used to determine statistical results, indicating the significance of difference between the two conditions (singing vs. non-singing) over time.

Pair	A	B	d	R	S
1a					
1b					
2a					
2b					
3a					
3b					
4a					
4b					
5a					
5b					
6a					
6b					
7a					
7b					
8a					
8b					
8c					
8d					

A = A Score (Singing)
B = B Score (Non-Singing)
d = difference between A and B
R = Rank of d
S = Sum of smaller rank

Pair a = Judge #1
Pair b = Judge #2
Pair c = Judge #3
Pair d = Judge #4

APPENDIX D

RAW DATA

TABLE 1

INTELLIGIBILITY RATINGS

RAW DATA

Sessions	Judge #1		Judge #2		Judge #3		Judge #4	
	S	NS	S	NS	S	NS	S	NS
1	25	15	20	15				
2	5	10	0	10				
3	15	15	25	10				
4	20	15	15	30				
5	25	20	20	10				
6	20	15	25	15				
7	25	25	25	20				
8	35	20	25	20	20	10	15	10

Key

S = Singing (Experimental Condition)

NS = Non-Singing (Control Condition)

Note

Judge #3 and Judge #4 were additional judges selected to rate one session in order to increase reliability.

TABLE 2

* DEGREE OF CONFIDENCE RATINGS

RAW DATA

Sessions	Judge #1		Judge #2		Judge #3		Judge #4	
	S	NS	S	NS	S	NS	S	NS
1	60	67	100	33				
2	100	0	3	50				
3	33	33	80	3				
4	25	67	3	67				
5	40	0	75	50				
6	25	67	100	100				
7	60	40	40	50				
8	0	100	80	75	50	50	33	0

* Judges were asked to rate on a scale of 1 to 5 their degree of confidence that their judgements were correct. The above figures are the percentage of 4's (almost completely confident) and 5's (100% confident).

Key

S = Singing condition

NS = Non-Singing condition

TABLE 3

Percentage of Consonant Blends Rated Correctly

Sessions	Judge #1		Judge #2	
	S	NS	S	NS
1	15	5	5	5
2	0	0	5	0
3	5	5	0	0
4	5	0	5	0
5	5	0	5	0
6	5	0	5	0
7	5	0	5	0
8	10	5	5	5
Total %	50	15	35	10
Difference (S-NS)	35%		25%	

Note

The above figures indicate the percentage of consonant blends out of the total # of words (i.e., 20 words) that were correctly articulated under both conditions.

S = Singing condition
NS = Non-Singing condition

TABLE 4

WILCOXON MATCHED-PAIRS SIGNED-RANKS TEST

RAW DATA

Pair	A	B	d	R	S
1a	25	15	+10	13	
1b	20	15	+ 5	6.5	
2a	5	10	- 5	- 6.5	6.5
2b	0	10	-10	-13	13
3a	15	15	0	1.5	
3b	25	10	+15	17	
4a	20	15	+ 5	6.5	
4b	15	30	-15	-17	17
5a	25	20	+ 5	6.5	
5b	20	10	+10	13	
6a	20	15	+ 5	6.5	
6b	25	15	+10	13	
7a	25	25	0	1.5	
7b	25	20	+ 5	6.5	
8a	35	20	+15	17	
8b	25	20	+ 5	6.5	
8c	20	10	+10	13	
8d	15	10	+ 5	6.5	

$T = 36.5$ $(36.5 \leq 40)$
$^*p = .05$

A = A Score (Singing)
B = B Score (Non-Singing)
d = difference between A and B
R = Rank of d
S = Sum of smaller rank

Pair a = Judge #1
Pair b = Judge #2
Pair c = Judge #3
Pair d = Judge #4

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VITA

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For the past year, the author has been working as a graduate assistant at the Alan Short Center, a creative arts center for developmentally disabled adults in Stockton. In May, she was inducted into Pi Kappa Lamda, a national music honor society. She has also been active in the Newman club at University of the Pacific.

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