To the Graduate Council:

I am submitting herewith a thesis written by Virginia Ellen Erkert entitled "Imitation of Words and Nonsense Syllables with Similar Suprasegmental Patterns." I recommend that it be accepted in partial fulfillment of the requirement for the degree of Master of Arts, with a major in Speech Pathology.

Carl W. Asp, Major Professor

We have read this thesis
and recommend its acceptance:

Accepted for the Council:

Vice Chancellor
Graduate Studies and Research

# IMITATION OF WORDS AND NONSENSE SYLLABLES WITH SIMILAR SUPRASEGMENTAL PATTERNS

A Thesis

Presented for the

Master of Arts

Degree

The University of Tennessee, Knoxville

Virginia Ellen Erkert

March 1980

ACKNOWLEDGEMENT

The author wishes to acknowledge and sincerely thank Dr. Carl W. Asp, chairman, for his guidance, time and effort towards the completion of this study.

Appreciation is also extended to the following persons:

Dr. Harold A. Peterson and Dr. Sol Adler, the members of this committee, for their advice and concern.

John S. Berry for his assistance with my test stimuli.

Kuz Koike for his continuous advice.

Leslee Archer, Madaline Kline, Wayne Kline, Barbara Spletzer, Pam Gutmacher and Anne Multer for evaluating the responses to the T-TWANS-P.

Richard W. Franklin for his support and understanding during this undertaking.

To my parents who have encouraged and supported my graduate work.

VEE

## ABSTRACT

The ability of three- and five-year old normal-hearing children to imitate suprasegmental patterns was measured by the Tennessee Test of Words and Nonsense Suprasegmental Patterns (T-TWANS-P). The T-TWANS-P consisted of twenty pre-recorded test items ranging from three to ten syllables. Ten items had words in sentences and 10 items had nonsense syllables with suprasegmental patterns that were similar to the sentences. Twenty children imitated (reproduced) the rhythm and intonation patterns they heard. The stimulus-response pairs were recorded and judged by two separate panels and the tester. One panel judged each response as correct-incorrect, and the other panel judged the responses on a 5-point similarity scale. The 5-year olds did significantly better than the 3-year olds. The word subtest was easier than the nonsense syllable subtest for both groups. Five-year olds did noticeably better than 3-year olds on the word subtest. The difficulty of the test items increased as the number of syllables increased (e.g., 3 versus 10 syllables). Females seemed to do better than males.

TABLE OF CONTENTS


| CHAPTER | | PAGE |
|---|---|---|
| 1. | INTRODUCTION | 1 |
| 2. | METHODS | 3 |
| | Subjects | 3 |
| | Test Stimuli | 3 |
| | Testing the 3- and 5-year Olds | 7 |
| | Evaluation by Panel 1 and Panel 2 | 9 |
| 3. | RESULTS AND DISCUSSION | 10 |
| | Reliability | 10 |
| | Age Level | 11 |
| | Nonsense Syllable and Word Subtests | 16 |
| | Mean Similarity Score For Individual Test Items | 19 |
| | Relationship Between Boys and Girls | 22 |
| | A Comparison Between Nonsense Syllable Subtest and the T-TRIP | 23 |
| | Conclusion | 23 |
| BIBLIOGRAPHY | | 25 |
| APPENDIXES | | 32 |
| A. | NULL HYPOTHESES | 33 |
| B. | REVIEW OF LITERATURE | 34 |
| C. | PILOT DATA | 43 |
| D. | SPECTROGRAMS FOR THE T-TWANS-P | 46 |
| VITA | | 66 |

LIST OF TABLES


| TABLE | | PAGE |
|---|---|---|
| 1. | Test Scores of T-TWANS-P Judged by the Panel and the Tester in Percent Correct . . . . . | 12 |
| 2. | Test Scores of T-TWANS-P Judged by the Panel and the Tester on the 1-5 Point Similarity Scale . . . . . | 13 |
| 3. | Two Factor Mixed Design: Repeated Measures on One Factor For Similarity Scaling . . . . . | 14 |
| 4. | Two Factor Mixed Design: Repeated Measures on One Factor For Percent Correct . . . . . | 15 |
| 5. | Percent Correct and Similarity Score for Each Test Item and Each Age Group . . . . . | 20 |

LIST OF FIGURES


| FIGURE | | PAGE |
|---|---|---|
| 1. | Tennessee Test of Word and Nonsense Suprasegmental Patterns (T-TWANS-P) . . . . . | 4 |
| 2. | Mean Percent Correct Scoring and Similarity Scaling as a Function of Age . . . . . | 17 |
| 3. | Mean Percent Correct Scoring and Similarity Scaling as a Function of Subtests . . . . . | 18 |
| 4. | Mean Similarity Score for 3- and 5-year Olds for Nonsense Syllable and Word Subtests . . . . . | 21 |
| 5. | Mean Percent Correct In the Nonsense Subtest and the T-TRIP for 3- and 5-year Olds . . . . . | 24 |

# CHAPTER 1

## INTRODUCTION

Speech is characterized by segmental phonemes and suprasegmental patterns (McElroy, 1972; Tonkova-Yampol'skaya, 1973). Segmental phonemes are the articulatory components of speech, generally referred to as vowels, semi-vowels and consonants (Vetter, 1969). Numerous segmental tests are available (Templin, 1953; Templin and Darley, 1969; and Goldman and Fristoe, 1972) to measure articulation skills of children with communication problems.

Suprasegmentals are characterized by the following features: (1) stress which is perceived as a change in loudness, (2) intonation which is perceived as pitch change (Lehiste, 1970), and (3) quantity which is perceived as duration. There is evidence that suprasegmental patterns are produced early in the course of speech and language development in children (Kaplan, 1969; Lewis, 1951). Suprasegmentals first appear in the young infants' intonational patterns which they vary in order to express their needs. As the child develops, these suprasegmental patterns appear to play an important role in syntactic development (Lewis, 1951; Crystal, 1969; Minifie, 1973); and these suprasegmental patterns also contribute to the intelligibility of speech (Braine, 1963; Maskowitz, 1970).

The Tennessee Test of Rhythm and Intonation Patterns (T-TRIP) was designed to measure children's ability to imitate suprasegmental patterns (Koike, 1977; Koike and Asp, 1977; Koike and Asp, 1978; Koike and Asp, 1980). The T-TRIP has 25 test items that varied in

rhythm and/or intonation, and used the repeated nonsense syllable /ma/.

Several investigators have used the T-TRIP on the following population and/or topics: children with inadequate articulation (Shadden, B., et al., 1978), hearing-impaired children (Williams, D., 1978, and Williams, V., 1978), elderly people (Newsom-Clark, S., and Asp, C., 1979), adult apraxic speakers (Tonkovich et al., 1977), and a comparison to music and language ability with young children (Klinedinst, S., 1979). The studies reported that the T-TRIP is sensitive to measuring differences as function of age level and different speech proficiencies. In addition, it is a reliable test instrument. However, it is not clear if the test items of the T-TRIP are representative of the rhythm and intonation patterns of speech.

As a result, the purpose of this study was to develop a test that included both a word and nonsense syllable subtests that reflected the rhythm and intonation patterns in speech. Then, the test would be used to evaluate the imitation ability of young children. Appendix A lists the hypotheses of this study.

# CHAPTER 2

# METHODS

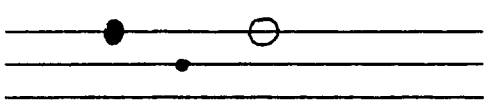
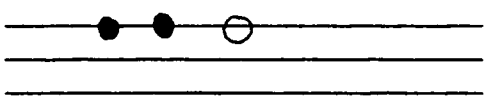
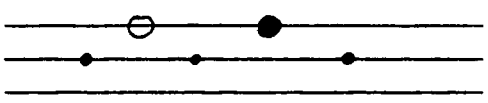
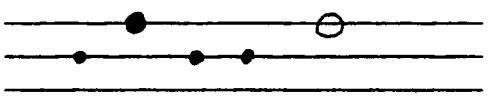
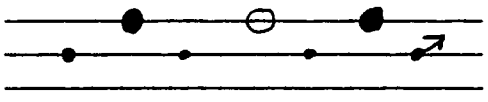
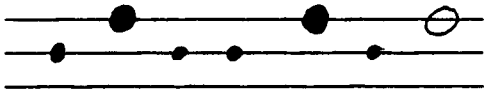
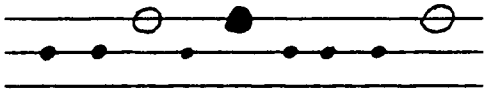
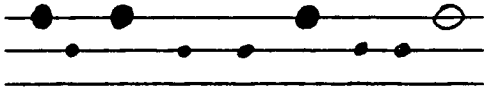
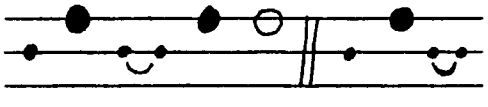
## A. SUBJECTS

Ten children from 3-0 to 3-11 years of age, and ten children from 5-0 to 5-11 years of age served as subjects. Each age level had five males and five females. All of the children had: (1) normal articulation as measured by the Templin-Darley Test of Articulation (Templin and Darley, 1969), (2) normal voice quality and rhythm and intonation as judged by the tester, (3) normal hearing as measured by a hearing screening test at 25 dB HTL (ANSI, 1969) for 500, 1000, 2000, and 4000 Hz., (4) spoke standard English and lived in a home in which only standard English was spoken, (5) "normal" intelligence as judged by the classroom teacher, and (6) attended a middle-class, private day care center near the University of Tennessee, Knoxville campus.

## B. TEST STIMULI

The Tennessee Test of Word and Nonsense Suprasegmental Patterns (T-TWANS-P) was constructed with a word subtest and nonsense syllable subtest (See Figure 1). For the word subtest, ten sentences were selected that represented the "naturalness" of intonation and rhythm patterns found in speech and that seemed appropriate for preschool children. The ten sentences were grouped (e.g., 1 and 2, 3 and 4, etc.) according to 3, 5, 7, 9, and 10 syllables. (See Figure 1).

Notations were used to identify the suprasegmental patterns of the sentences. The rhythmical patterns had two levels of stress

| Sentences | Number of Syllables | Suprasegmental Pattern |
|---|---|---|
| 1. Please sit down. | 3 |  |
| 2. Go home now. | 3 |  |
| 3. The boy is sitting. | 5 |  |
| 4. I got home from work. | 5 |  |
| 5. Has Daddy finished dinner? | 7 |  |
| 6. The cat is behind the desk. | 7 |  |
| 7. If it rains, we won't go to the beach | 9 |  |
| 8. Mother told me to play in the house. | 9 |  |
| 9. I stopped at his front door and rang the bell. | 10 |  |
| 10. Bring me the pillow that is on the chair. | 10 |  |

KEY:

Stress: Stressed= ● ; ○ Stressed with longer duration;
Unstressed= •
Intonation: rising = ↗
Pitch: Low=1; Mid=2; High=3
Pause: ||
Tempo: Regular •• ; Quick •◡•

Figure 1. Tennessee Test of Word and Nonsense Suprasegmental Patterns (T-TWANS-P)

(stressed / ● / or unstressed / • /). A stressed syllable with longer duration was identified by a whole note —𝅝—. There were two levels of tempo (regular / • • / or quick / ◡ /). The regular tempo had one beat for each syllable, whereas, the quick tempo had one beat for both syllables. A pause was identified by a double bar ( // ). The intonational patterns had three levels of pitch: (1) low-pitch, bottom line, (2) mid-pitch, middle line, and (3) high-pitch, top line. A rising pitch was identified as / ↗ / (See Figure 1, item #5).

For the nonsense syllable test, the syllable /ma/ was selected for the following reasons: (1) it is acquired early by young children (Jakobson, Fant, and Halle, 1972; Menyuk, 1972,; and Williams, 1972), and (2) it was used for the Tennessee Test of Rhythm and Intonation Patterns (T-TRIP). The latter allowed the subtest to be compared with other studies (Koike, 1977; Koike and Asp, 1977; Koike and Asp, 1978, 1980; D. Williams, 1978; V. Williams, 1978; Shadden et al., 1978; Tonkovitch, 1977; Newsom-Clark and Asp, 1978; Klinedinst, 1979).

An experienced Verbo-tonal clinician, who spoke standard English, was selected for recording the test items. He spoke each of the 10 sentences five times with the suprasegmental pattern indicated in Figure 1. These utterances were tape recorded (Ampex, model AG-440) at approximately 75dB (Bruel and Kjaer, model 2203) in a sound-treated room (IAC booth).

A panel of three Speech Pathologists rated each of the 10 sentences with a 5-point similarity scale. The panel compared the utterances with the suprasegmental patterns (symbols) in Figure 1.

Number 1 represented the greatest similarity between the symbol and the utterance; whereas, number 5 represented the greatest dissimilarity. Numbers 2 through 4 represented degrees of similarity. For each sentence, the utterance with the best similarity score was selected. These 10 pre-recorded sentences were analyzed with a spectrograph (VII Voice Identification, Inc., 700 Series) by using wide-band, narrow-band, and amplitude display (See Appendix D). The acoustical analysis verified the perceptual judgments of the panel.

Then, the same clinician listened to each of the 10 sentences he had recorded earlier. After each sentence, he imitated the suprasegmental pattern by using the nonsense /ma/. He practiced the task until the imitations were accurate, and used the spectrograms for visual cues. He spoke and recorded three nonsense syllable patterns for each sentence.

Three normal-hearing listeners were used for the panel. The listeners were experienced clinicians in the University of Tennessee Verbo-tonal Program that emphasized the development of "normal" suprasegmental patterns for hearing-impaired children. The panel listened and compared the intonation and rhythm of the three separate nonsense syllable patterns to the pattern of the corresponding sentence (e.g., Please sit down-ma ma ma). The panel judged each nonsense syllable pattern on a 1-5 similarity scale as described earlier. The criterion for acceptance was that at least two panel members assigned a 1 or 2 to the nonsense pattern. Some utterances were re-recorded and re-evaluated until all 10 nonsense test items satisfied the criterion.

Then, the 10 test items (nonsense syllable subtest) were analyzed with the same spectrograph and compared to the spectrograms of the 10 items in the word subtest. Appendix D shows the wide and the narrow-band display for each test item of the word pattern and the nonsense syllable pattern. Each pair had a similar duration and intonation patterns. The spectrograms verified the perceptual judgment of the panel.

## C. TESTING THE 3- AND 5-YEAR OLDS

Four groups of five children each, were taken from the classroom to meet the examiner for a 20 minute "rapport" session. The examiner had a puppet who talked to the children and asked them questions in an area which had been judged to be relatively quiet by the principal. The next day each child was individually screened to satisfy the criterion for subject selection that was specified earlier. For the hearing screening, each child was conditioned to respond to the pure tone by dropping a block into a bucket when he heard the tone.

Approximately one-week later a training session was held prior to testing with the T-TWANS-P. Three pre-recorded practice sentences and three nonsense syllable patterns were presented from language master card and recorder (Bell and Howell, model 1757). The practice items had 3, 5, and 10 syllables respectively. The child listened to the test item and attempted to imitate the rhythm and intonation pattern. The training session continued until each child made an appropriate response to 2 out of the 3 training items.

After the training session, each child was tested with the 20 test items of the T-TWANS-P. To control the effect of the subtests, half of the children received the word test items first and half of the children received the nonsense syllable test items first. Tables 1 and 2 includes this information. For example, if a child received a word test item first, the next test item was a nonsense syllable item with the similar pattern. The same rule applied when a nonsense item was presented first. The child listened to each test item and attempted to imitate (reproduce) the rhythm and intonation pattern. The 20 test items were presented on pre-recorded language master cards at the comfortable loudness level. Both the stimulus and response were recorded on a tape recorder (Sony, model TC-106). Each test item was presented twice, and the child responded to each presentation.

Extra visual and auditory cues such as tapping and hand movements were not used. The children were verbally reinforced (e.g., "good") periodically by the examiner to keep them interested in the task.

During the testing, the tester scored each response as correct or incorrect. If the child's response was similar to the test item it was scored correct. If the response was dissimilar to the test item, it was scored incorrect. For a correct response, the criterion was the correct number of syllables, stress, pause, duration and intonation. The intelligibility and accuracy of the segmental phonemes was not used for these judgments.

A test item was considered correct if at least one of the two responses was correct. The percent correct for the 10 test items of the word subtest and the percent correct for the 10 items in the nonsense subtest represented each child's test scores.

## D. EVALUATION BY PANEL 1 AND PANEL 2

The tape recorded productions of 20 children were randomized and judged by two panels of judges. Panel 1 consisted of a Speech Pathologist (CCC-SP), a graduate student in Speech Pathology and a teacher of the Deaf. Their task was to judge each child's response as correct-incorrect according to the same criterion used by the tester.

Panel 2 consisted of the three experienced Verbo-tonal clinicians. Their task was to judge each child's response on the 1-5 similarity scale described earlier. The criterion of similarity was similar to that used by the tester and Panel 1.

For the judgments of Panel 1, the child's response was considered correct if at least two listeners judged it correct. The percent correct for the 10 test items of the word subtest and the percent correct for the 10 items of the nonsense syllable subtest represented the criterion measure for each child.

For the judgments of Panel 2, the response with the best (lowest) similarity score was chosen for each of the 20 test items. The mean similarity score for the 10 items of the word subtest and the 10 items of the nonsense syllable subtest served as the criterion measure.

# CHAPTER 3

## RESULTS AND DISCUSSION

### A. RELIABILITY

For the word subtest and nonsense syllable subtest, two subjects, one three-year old and one five-year old, were selected randomly for evaluating reliability. At the level of the test items, the intra-judge agreement was based on percent agreement for the correct-incorrect scoring. There was 100 percent (Judge A of panel 1), 97 percent (Judge B of panel 1), and 98 percent (Judge C of panel 1) agreement for a 3-year old child (S-9), and 95 percent, 100 percent and 97 percent agreement for a 5-year old child (S-10), respectively.

The intra-judge agreement for the 1-5 similarity scale was analyzed with a Pearson-correlation coefficient (Bruning and Kintz, 1968). The correlation coefficient was $r = 0.82$ (Judge A for panel 2), $r = 0.74$ (Judge B of panel 2), and $r = 0.44$ (Judge C of panel 2) for a 3-year old child (S-9), and $r = 0.80$, $r = 0.78$ and $r = 0.86$ for a 5-year old child (S-10), respectively.

The inter-judge agreement for panel 1 using the percent agreement for a 3-year old child was 97 percent (A vs B), 90 percent (A vs C), and 85 percent (B vs C). For the five-year old child (S-3), the agreement for the same judges was 90 percent, 100 percent and 90 percent, respectively.

For the inter-judge agreement of panel 2 using the similarity scaling, the correlation coefficient between the judges was $r = 0.62$ (A vs B), $r = 0.71$ (A vs C), and $r = 0.82$ (B vs C) for a 3-year old

child (S-9), and for a 5-year old child, the correlation coefficients were r = 0.86, r = 0.58, and r = 0.63, respectively.

The agreement between the tester and the panel 1 was 65 percent for the 3-year old child and 90 percent for the 5-year old child. The agreement between the tester and panel 2 was r = 0.74 for the 3-year old child and r = 0.46 for the 5-year old child. The agreement was higher with panel 1 than with panel 2. The tester usually gave better scores (higher percent and lower similarity score) than either panel (see Tables 1 and 2).

In summary, for panel 1, the results revealed a high intra-judge agreement of 95 to 100 percent, and a high inter-judge agreement of 85-100 percent. For panel 2, lower correlation coefficients were obtained for both intra-judge agreement (r = 0.44 to r = 0.86) and inter-judge agreement (r = 0.58 to r = 0.86). These agreements were judged adequate for this study.

For the following, the panel's judgments (See columns on the left in Table 1 and 2) were used for all the statistical analysis to insure more objectivity.

## B. AGE LEVEL

Table 3 and 4 shows the results of a two-factor mixed design with repeated measures on one factor (Bruning and Kintz, 1968) for both measures.

The mean percent correct for the 5-year old group (52 percent) was significantly greater ($F = 9.39$; $df = 1/18$; $p < 0.01$) than the 3-year old group (35 percent) (See Table 2).

TABLE 1

TEST SCORES OF T-TWANS-P JUDGED BY THE PANEL AND THE TESTER IN PERCENT CORRECT

| SOURCE | PANEL | | TESTER | | PANEL vs TESTER | |
|---|---|---|---|---|---|---|
| 3-Year-Olds | N.S. | WORDS | N.S. | WORDS | N.S. | WORDS |
| 1 | 20 | 60 | 40 | 70 | 20 | 10 |
| 2* | 40 | 60 | 40 | 80 | 0 | 20 |
| 3 | 40 | 30 | 50 | 30 | 10 | 0 |
| 4 | 50 | 60 | 80 | 100 | 30 | 40 |
| 5* | 30 | 60 | 50 | 100 | 20 | 40 |
| 6* | 10 | 50 | 20 | 70 | 10 | 20 |
| 7 | 10 | 40 | 50 | 90 | 40 | 50 |
| 8* | 0 | 20 | 10 | 50 | 10 | 30 |
| 9* | 20 | 40 | 50 | 60 | 30 | 20 |
| 10 | 20 | 30 | 30 | 50 | 10 | 20 |
| X = | 24 | 45 | 42 | 70 | 18 | 25 |
| SD = | 15.8 | 15.1 | 19.3 | 23.1 | 12.3 | 15.1 |
| Range = | 10-50 | 20-60 | 10-80 | 30-100 | 0-40 | 0-50 |
| X(N.S. and WORDS) = | 35 | | 56 | | 22 | |
| 5-Year-Olds | | | | | | |
| 11 | 60 | 90 | 60 | 100 | 0 | 10 |
| 12 | 30 | 50 | 50 | 90 | 20 | 40 |
| 13* | 40 | 60 | 60 | 100 | 20 | 40 |
| 14* | 20 | 50 | 50 | 70 | 30 | 20 |
| 15 | 40 | 60 | 50 | 80 | 10 | 20 |
| 16* | 50 | 70 | 70 | 100 | 20 | 30 |
| 17 | 50 | 60 | 70 | 80 | 20 | 20 |
| 18* | 50 | 80 | 80 | 100 | 30 | 20 |
| 19 | 40 | 50 | 60 | 100 | 20 | 50 |
| 20* | 20 | 70 | 40 | 80 | 20 | 10 |
| X = | 40 | 64 | 59 | 90 | 19 | 26 |
| SD = | 13.3 | 13.5 | 11.9 | 11.5 | 8.8 | 13.5 |
| Range = | 20-60 | 50-90 | 40-80 | 70-100 | 0-30 | 10-50 |
| X(N.S. and WORDS) = | 52 | | 75 | | 23 | |

* Subjects receiving the Word test items first.

TABLE 2

TEST SCORES OF T-TWANS-P JUDGED BY THE PANEL AND THE TESTER ON THE 1-5 POINT SIMILARITY SCALE

| SOURCE | PANEL | | TESTER | | PANEL vs TESTER | |
|---|---|---|---|---|---|---|
| 3-Year-Olds | N.S. | WORDS | N.S. | WORDS | N.S. | WORDS |
| 1 | 4.0 | 2.8 | 3.2 | 2.7 | 0.8 | 0.1 |
| 2* | 3.3 | 2.5 | 3.4 | 2.2 | 0.1 | 0.3 |
| 3 | 4.0 | 3.6 | 3.5 | 3.9 | 0.5 | 0.3 |
| 4 | 2.3 | 1.3 | 2.0 | 1.4 | 0.3 | 0.1 |
| 5* | 3.4 | 1.5 | 3.6 | 1.5 | 0.2 | 0 |
| 6 | 4.8 | 2.7 | 4.5 | 2.8 | 0.3 | 0.1 |
| 7 | 3.1 | 2.0 | 3.1 | 1.5 | 0 | 0.5 |
| 8* | 4.5 | 3.3 | 4.7 | 3.2 | 0.2 | 0.1 |
| 9* | 3.4 | 2.7 | 3.2 | 2.6 | 0.2 | 0.1 |
| 10 | 3.6 | 2.9 | 3.8 | 3.7 | 0.2 | 0.2 |
| X = | 3.6 | 2.5 | 3.5 | 2.5 | 0.28 | 0.18 |
| SD = | 0.71 | 0.73 | 0.75 | 0.90 | 0.22 | 0.14 |
| Range = | 2.3-4.8 | 1.3-3.6 | 2.0-4.7 | 1.4-3.9 | 0.8-.1 | 0.5-.1 |
| X(N.S. and WORDS) = | 3.1 | | 3.0 | | 0.23 | |
| 5-Year-Olds | | | | | | |
| 11 | 2.6 | 1.6 | 2.5 | 1.3 | 0.1 | 0.3 |
| 12 | 3.1 | 2.3 | 3.2 | 1.7 | 0.1 | 0.6 |
| 13* | 3.1 | 2.3 | 3.1 | 1.8 | 0 | 0.5 |
| 14* | 3.5 | 2.7 | 3.1 | 2.7 | 0.4 | 0 |
| 15 | 3.7 | 2.5 | 2.9 | 2.1 | 0.8 | 0.4 |
| 16* | 2.8 | 1.2 | 2.5 | 1.1 | 0.3 | 0.1 |
| 17 | 3.2 | 1.8 | 2.6 | 1.7 | 0.6 | 0.1 |
| 18* | 2.2 | 1.6 | 1.8 | 1.0 | 0.4 | 0.6 |
| 19 | 2.8 | 1.5 | 2.3 | 1.1 | 0.5 | 0.4 |
| 20* | 2.7 | 1.6 | 3.5 | 1.1 | 0.8 | 0.5 |
| X = | 2.9 | 1.9 | 2.7 | 1.5 | 0.40 | 0.35 |
| SD = | .44 | .49 | .50 | .54 | 0.28 | 0.21 |
| Range = | 2.2-3.7 | 1.2-2.7 | 1.8-3.5 | 1.0-2.7 | 0.8-0.1 | 0.6-0.1 |
| X(N.S. and WORDS) = | 2.4 | | 2.1 | | 0.38 | |

* Subjects receiving the Word test items first.

TABLE 3

TWO FACTOR MIXED DESIGN: REPEATED MEASURES ON ONE FACTOR FOR SIMILARITY SCALING

| SOURCE | SS | df | ms | F | p |
|---|---|---|---|---|---|
| Between Group | 15.96 | 19 | - | - | - |
| AGE (3 vs 5 Yr) | 4.16 | 1 | 4.16 | 6.30 | 0.02 |
| Subject within Groups | 11.8 | 18 | 0.66 | - | - |
| Within Group | 13.52 | 20 | - | - | - |
| TESTS (N.S. vs WORDS) | 11.77 | 1 | 11.77 | 121.34 | 0.001 |
| Tests x Age | 0 | 1 | 0 | 0 | n.s. |
| Tests x Subjects Within Groups | 1.75 | 18 | 0.097 | - | - |
| Total | 29.48 | 39 | - | - | - |

TABLE 4

TWO FACTOR MIXED DESIGN: REPEATED MEASURES ON ONE FACTOR FOR PERCENT CORRECT

| SOURCE | SS | df | ms | F | p |
|---|---|---|---|---|---|
| Between Group | 8,927.50 | 19 | - | - | - |
| AGE (3 vs 5 Yr.) | 3,062.50 | 1 | 3,062.50 | 9.39 | 0.01 |
| Subject | 5,865.00 | 18 | 325.83 | - | - |
| Within Group | 6,750.00 | 20 | - | - | - |
| Tests (N.S. vs WORDS) | 5,062.50 | 1 | 5,062.50 | 225.00 | 0.001 |
| Tests x Age | 22.50 | 1 | 22.50 | 0.234 | n.s. |
| Tests x Subject Within Groups | 1,665.00 | 18 | 92.50 | - | - |
| Total | 15,667.50 | 39 | - | - | - |

On the 1-5 similarity scale, the mean score for 5-year olds (2.4) was significantly more similar ($F = 6.30$; $df = 1/18$, $p < 0.02$) than the mean score for 3-year olds (3.4) (See Table 3). Hypotheses 1a and 1b were rejected at the $p < 0.05$ level (See Appendix A).

Figure 2 displays the mean score for both groups on the two measures. Both methods of judging the responses are sensitive for detecting differences between 3- and 5-year olds.

These results suggest that both 3- and 5-year olds are still developing the ability to perceive and produce rhythm and intonation patterns. For example, most 5-year olds perceived and produced at least 50 percent on the nonsense subtest and 60 percent on the word subtest. It appears that additional maturation is needed to achieve a higher score on the T-TWANS-P.

## C. NONSENSE SYLLABLE AND WORD SUBTESTS

The same two-factor mixed design (See Table 3 and 4) revealed more accuracy for imitating word patterns (55 percent and 2.2 similarity score) than nonsense syllable patterns (32 percent and 3.8 similarity score). These means are displayed in Figure 3. The F-ratios were significant (percent correct: $F = 225.00$; $df = 1/18$; $p < 0.01$; and similarity scale: $F = 121.34$; $df = 1/18$; $p < 0.0001$). Hypotheses 2a and 2b were rejected at the $p < 0.05$ level (See Appendix A). The syntax and semantic cues of the word subtest seemed to make it easier than the nonsense subtest for perceiving and producing (imitating) rhythm and intonation patterns (See Figure 3).

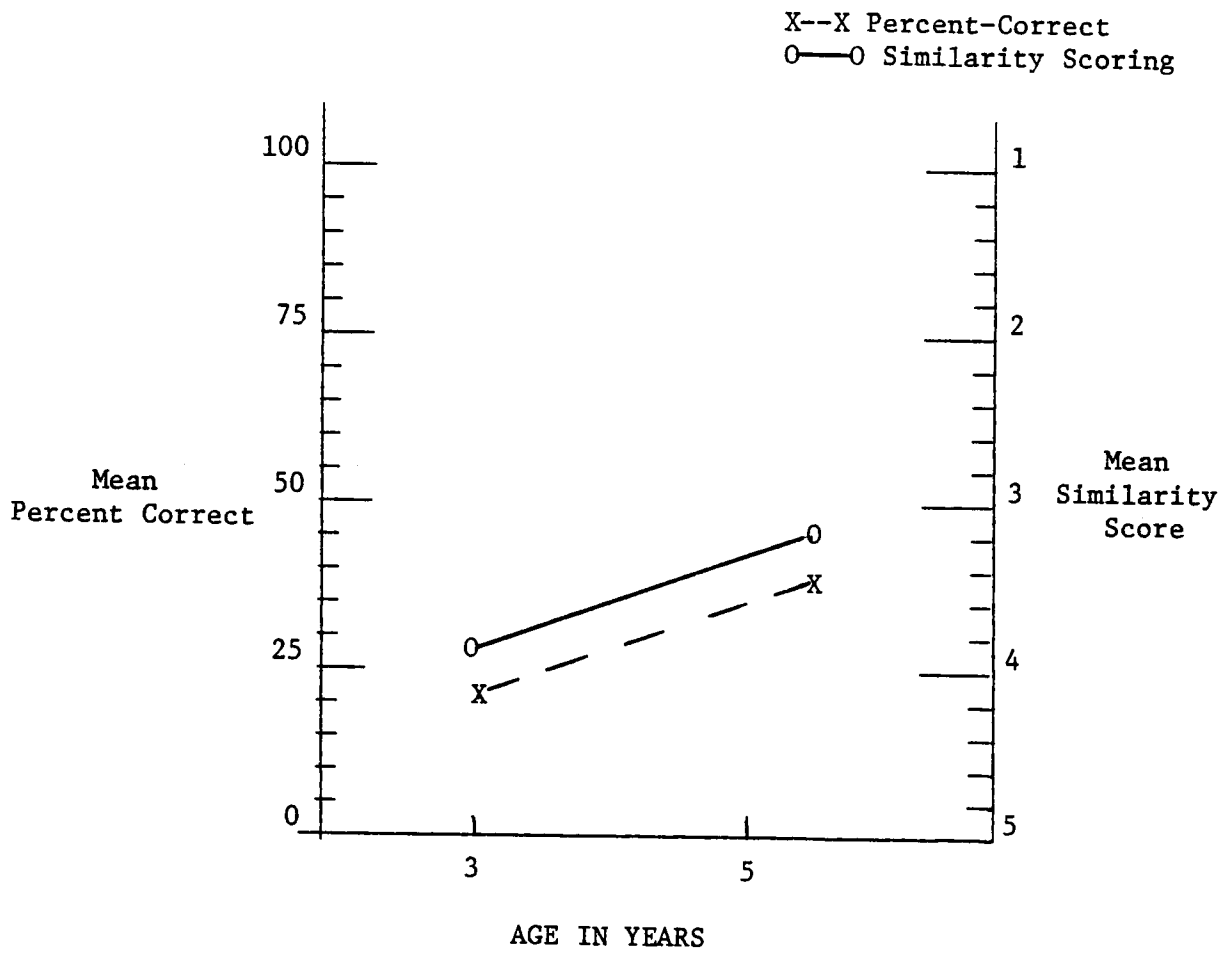



Figure 2. Mean percent-correct Scoring and Similarity Scaling as a function of age.

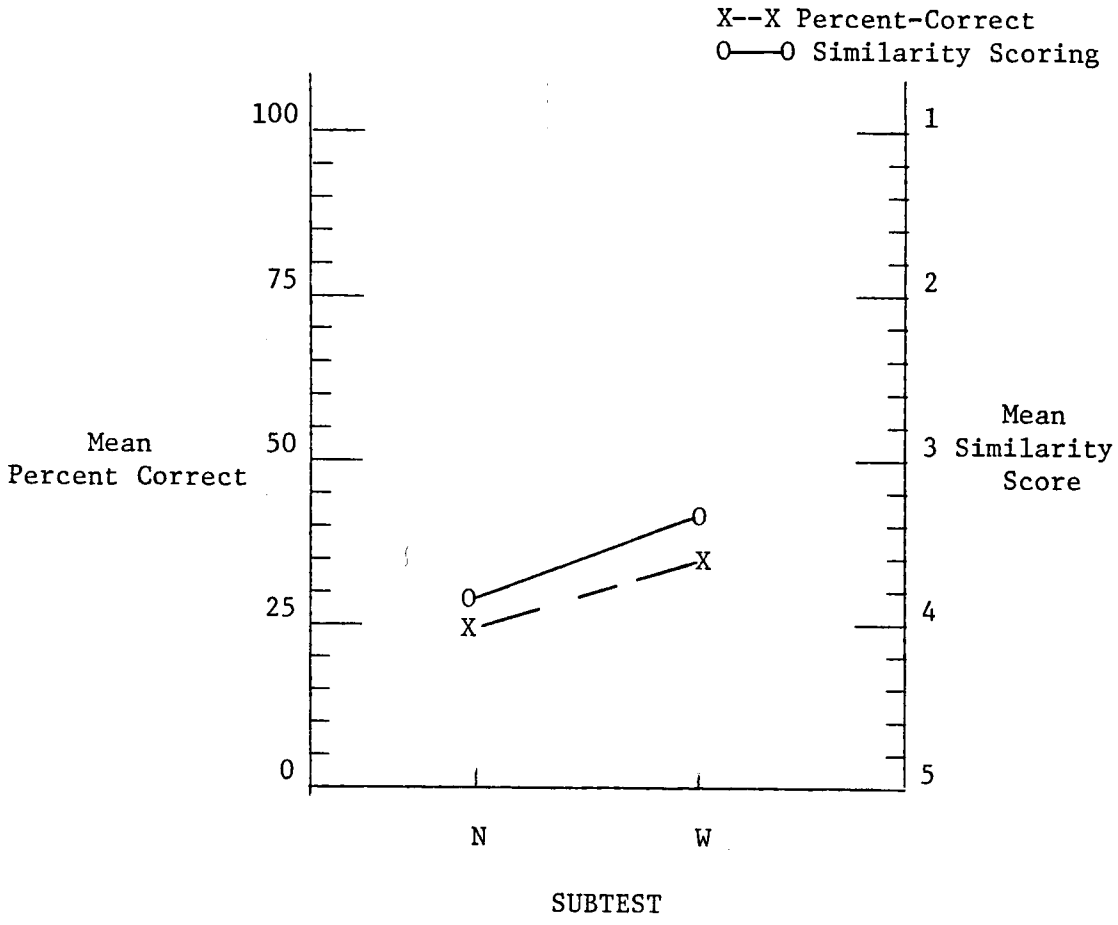



Figure 3. Mean Percent correct Scoring and Similarity Scaling as a function of subtests.

As indicated earlier, half of the children received the word test items first and half received the nonsense test items first (see Tables 1 and 2). When the test items were presented first, the scores were slightly higher than the same test items in the second presentation. The possible learning effect from first to second presentation was not apparent. However, there seemed to be some advantage to presenting the easier items (word subtest) before the harder items (nonsense items).

## D. MEAN SIMILARITY SCORE FOR INDIVIDUAL TEST ITEMS

Table 5 lists the mean similarity score and the percent correct for 3- and 5-year olds for each test item. Five-year olds achieved a better (lower) similarity score and higher percent correct than 3-year olds for all the test items on both the nonsense syllable and word subtests. These differences were greater on the word subtest than on the nonsense syllable subtest. It appears that the linguistic skills of the 5-year old made a greater difference on the word subtest.

As the number of syllables increased, the degree of difficulty increased (See Table 5 and Figure 4). For 3-year olds, test items with 3 syllables (Items 1 and 2) had a combined mean similarity score of 1.4 for the nonsense syllable and for the word subtests; items with 5-syllables had means of 2.7 and 2.1; and items with 7-syllables had means of 4.0 and 2.7, respectively. For the nonsense syllable subtest, the test items were noticeably more difficult at seven syllables ($\bar{X} = 4.0$); whereas, the word subtest was more difficult at nine syllables ($\bar{X} = 3.3$). Both of these subtest scores seem to exceed the expected 3- digit memory span for 3-year olds

TABLE 5

PERCENT CORRECT AND SIMILARITY SCORE FOR EACH TEST ITEM AND EACH AGE GROUP

| SENTENCE | NUMBER OF SYLLABLES | NONSENSE SUBTEST | | | | WORD SUBTEST | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 3 Yr. Olds | | 5 Yr. Olds | | 3 Yr. Olds | | 5 Yr. Olds | |
| | | 1-5 | % | 1-5 | % | 1-5 | % | 1-5 | % |
| 1. Please sit down. | 3 | 1.2 | 90 | 1.1 | 100 | 1.3 | 90 | 1.1 | 100 |
| 2. Go home now. | 3 | 1.7 | 60 | 1.1 | 100 | 1.5 | 90 | 1.0 | 100 |
| 3. The boy is sitting. | 5 | 2.9 | 40 | 2.0 | 70 | 1.9 | 60 | 1.4 | 80 |
| 4. I got home from work. | 5 | 2.6 | 60 | 2.6 | 60 | 2.4 | 50 | 1.5 | 90 |
| 5. Has Daddy finished dinner? | 7 | 3.7 | 30 | 2.4 | 20 | 2.3 | 60 | 1.9 | 80 |
| 6. The cat is behind the desk. | 7 | 4.3 | 0 | 3.9 | 20 | 3.1 | 20 | 2.3 | 60 |
| 7. If it rains, we won't go to the beach. | 9 | 4.8 | 0 | 4.6 | 0 | 3.4 | 20 | 2.6 | 90 |
| 8. Mother told me to play in the house. | 9 | 4.8 | 0 | 4.2 | 10 | 3.2 | 30 | 2.1 | 70 |
| 9. I stopped at his front door and rang the bell. | 10 | 4.8 | 0 | 4.5 | 0 | 3.6 | 0 | 2.5 | 90 |
| 10. Bring me the pillow that is on the chair. | 10 | 4.6 | 0 | 3.7 | 10 | 2.9 | 10 | 2.4 | 40 |

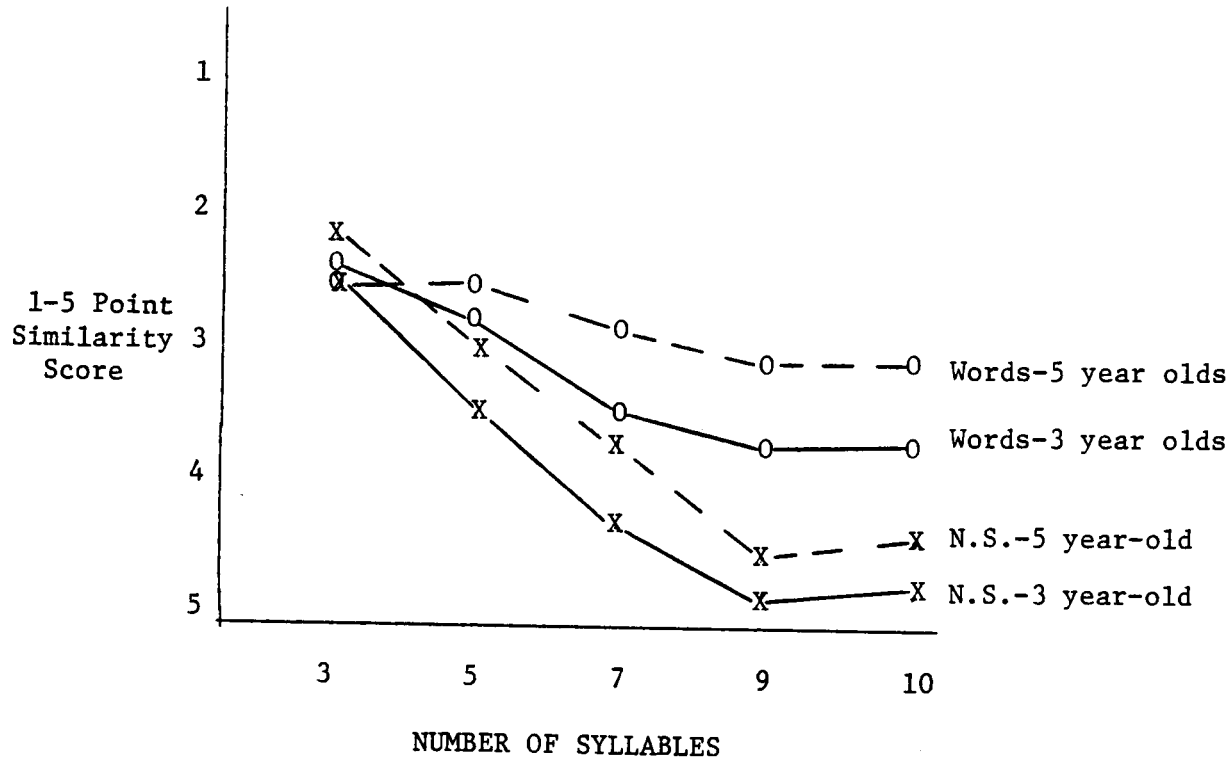



Figure 4. Mean Similarity Score for 3- and 5-year olds for Nonsense Syllable and Word Subtests.

to exceed the expected 3-digit memory span for 3-year olds (Kirk, McCarthy and Kirk, 1965).

For the 5-year olds, the nonsense syllable items were more difficult at nine syllables ($\bar{X} = 4.4$); whereas, the word subtest at ten syllables was only ($\bar{X} = 2.5$). The word subtest scores were not noticeably affected by the number of syllables. Thus, for both age groups the number of syllables affects the nonsense syllable scores more than the word scores (See Figure 4).

Some of the test items with the same number of syllables were easier than others. This was more apparent in the word subtest. For example, item 5 was easier than item 6, item 8 easier than 7, and item 10 easier than 9, for both age levels. The linguistic cues and suprasegmental patterns appear to be easier for these test items.

In comparison, the percent correct for each test item are also listed in Table 5. The correct-incorrect judgements seemed to have more variation than the similarity scores.

## E. RELATIONSHIP BETWEEN BOYS AND GIRLS

In both age groups, the girls performed better than the boys. For the girls, the 3-year olds mean similarity score was 3.5, and 2.4 for the nonsense syllable and word subtest, and the 5-year olds scored 2.6 and 1.6, respectively. For the boys, the 3-year olds had 3.8 and 2.7 and the 5-year olds had 3.2 and 2.1 respectively. These results agree with Young's (1941) study that girls tend to surpass boys in length of response, amount of comprehensible speech and the use of the parts of speech.

## F. A COMPARISON BETWEEN NONSENSE SYLLABLE SUBTEST AND THE T-TRIP

The T-TRIP consisted of the nonsense syllable /ma/ in 25 test items ranging from 1 to 9 syllables. The T-TWANS-P nonsense syllable subtest has 10 test items of 3 to 10 syllables. For the percent-correct, the T-TWANS-P nonsense syllable subtest is more difficult (lower mean scores) than the T-TRIP for both 3- and 5-year olds (See Figure 5). However, the mean scores for the two tests are parallel as function of age level. It appears that the tests are measuring similar skills.

## G. CONCLUSIONS

The following conclusions were drawn from this study. Five-year olds did significantly better than 3-year olds both on the word and nonsense subtests. This suggests that additional maturity and semantic and syntactic skills are needed to achieve higher scores on the T-TWANS-P. The word subtest was easier than the nonsense subtest for the imitation of rhythm and intonation patterns. For both age groups the number of syllables affects the nonsense syllable subtest more than the word scores. The girls' performance in both groups was better than the boys. The nonsense syllable subtest are parallel to the test scores of the T-TRIP. The T-TWANS-P appears to be a reliable and sensitive test for measuring the imitation ability of young children.

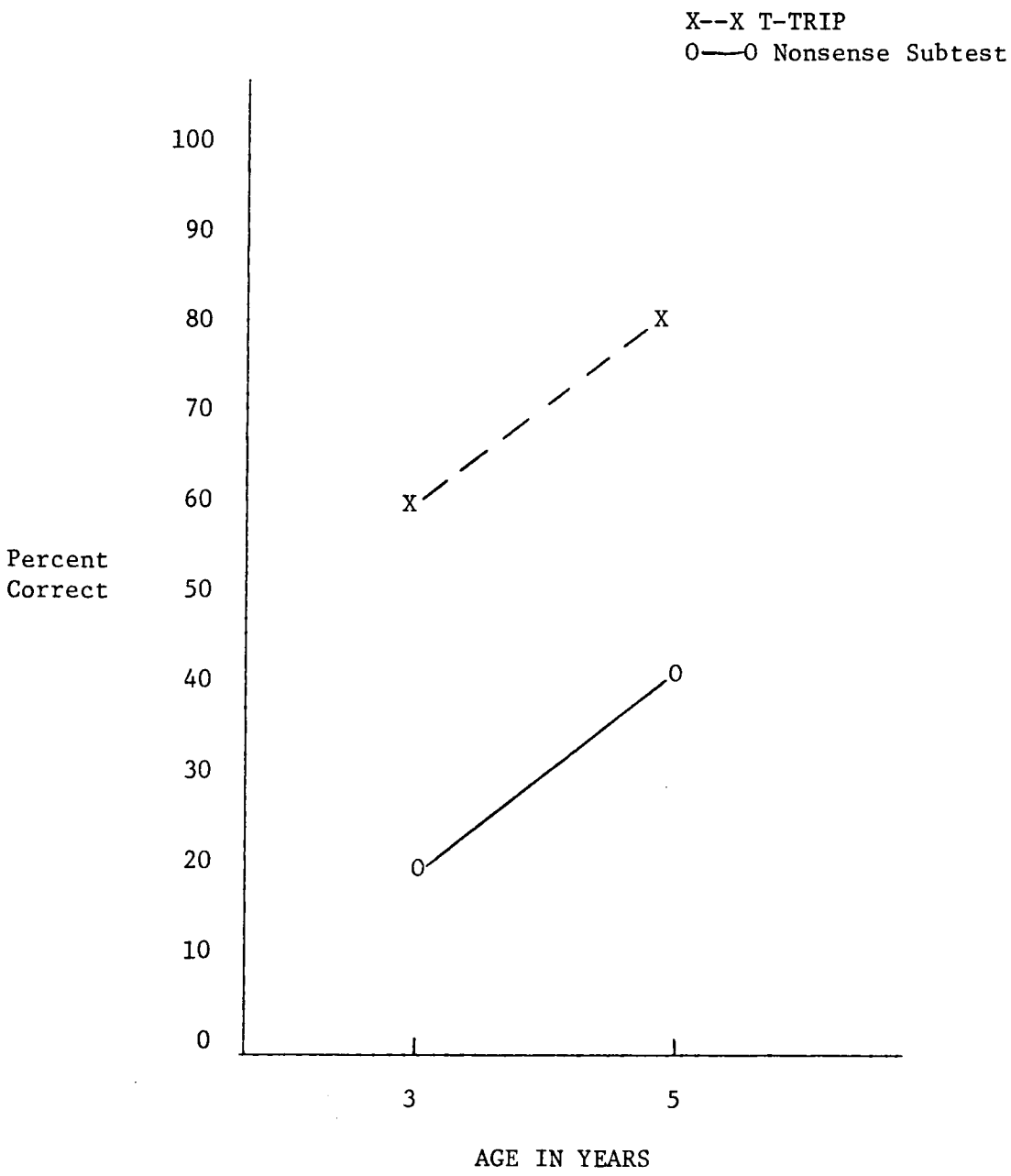



Figure 5. Mean Percent Correct In the Nonsense Subtest and the T-TRIP for 3- and 5-year olds.

# BIBLIOGRAPHY

BIBLIOGRAPHY

Asp, C. W., The Verbo-tonal Method. An unpublished manuscript. The University of Tennessee, Knoxville (1973).

Badsen, D., and Higgins, J., Memory and organization, category recall and retrieval capacity. J. of Verb. Learn and Verb. Behav., II, 157-163 (1972).

Berry, M., and Eisenson, J., Speech Disorders. New York: Appleton-Century Crofts (1956).

Betts, E. A., Stress phenomena: A delineation. Spelling Progress Bulletin, 16 (4), 3-4 (1976).

Bolinger, D. L., Intonation as a universal. Proceedings of the 9th International Congress of Linguists. Cambridge, Mass: Hague-Mouton and Co. (1962).

Braine, M., The ontogeny of English phrase structure: The first phrase. Language, 39, 1-13 (1963).

Bruning, I., and Kintz, B., Computational Handbook of Statistics. Glenview: Scott Foresman and Co. (1968).

Carroll, J. B., The Study of Language. Boston: Harvard University Press (1953).

Carrow, E., Carrow Elicited Language Inventory. Austin, Texas: Learning Concepts (1975).

Crystal, D., Prosodic Systems and Intonation in English. Cambridge: University Press (1969).

Crystal, D., Non-segmental phonology in language acquisition. The English Tone of Voice. London: Edward Arnold Ltd. (1975).

Dale, P., Language Development: Structure and Function. Illinois: Dryden Press (1972).

Dale, P., Language Development: Structure and Function. New York: Holt, Rinehard and Winston (1976).

Epstein, W., The influence of syntactical structure on learning. Am. J. of Psych., 74, 80-85 (1961).

Epstein, W., A further study of influence of syntactical structure on learning. Am. J. of Psych., 74, 80-85 (1962).

Fairbanks, G., Voice and Articulation Drillbook. Evanston: Harper and Row (1940).

Garnica, O. K., The development of phonemic speech perception. In T. E. Moore (Ed.), Cognitive Development and the Acquisition of Language. New York: Academic Press (1973).

Garrett, M., Bever, T. G., and Fodor, J., The active use of grammar in speech perception. Perception and Psychophysics, II, 30-32 (1966).

Goes, A., The Stress System of English. Stockholm: K. L. Beckmans Tryckeri (1974).

Goldman, R., and Fristoe, M., Goldman-Fristoe Test of Articulation, Examiner's Manual. Circle Pines: American Guidance Service (1972).

Goodglass, H., and Kaplan, E., The Assessment of Aphasia and Related Disorders, Examiner's Manual. Philadelphia: Lea and Febiger (1972).

Guberina, P., (1963), Verbo-tonal method and its application to the rehabilitation of the deaf. In, C. W. Asp, The Verbo-tonal System. Knoxville: The University of Tennessee (1971).

Hudgins, C., and Numbers, F., An investigation of the intelligibility of the speech of the deaf. Genet. Psychol. Mono., 25, 289-392 (1942).

Huggins, A., On the perception of temporal phenomena in speech. J. Acoust. Soc. Am., 51, 1279-1290 (1972).

Humpstone, J., Some Aspects of the Memory Span Test: A Study of Associability. Philadelphia: Psychological Clinic Press (1917).

Hunter, I., Memory: Facts and Fallacies. Baltimore: Penguin Books (1962).

Jacobs, J., Experiments on comprehension. Mind, 12, 75-79 (1887).

Jakobson, R., Fant, G., and Halle, M., Preliminaries to Speech Analysis: The Distinctive Features and Their Correlates. Cambridge: M. I. T. Press (1972).

Kaplan, E. L., The role of intonation in the acquisition of language. Doctoral Dissertation, Cornell University, Ithaca, New York (1969).

Kaplan, E. L., and Kaplan, G. A., Is there any such thing as a prelinguistic child. In, J. Eliot, Human Development and Cognitive Processes. New York: Holt, Rinehart and Winston (1970).

Kirk, S., McCarthy, J., and Kirk. W., Illinois Test of Psycholinguistic Abilities. University of Illinois Press (1965).

Klinedinst, S., The relationship of suprasegmentals, language, and music abilities. Unpublished Master's Thesis. The University of Tennessee, Knoxville (1979).

Koike, K., A test of rhythm and intonation patterns for young normal hearing children. Unpublished Master's Thesis. The University of Tennessee, Knoxville (1977).

Koike, K., and Asp, C., A test of rhythm and intonation patterns. A pilot study, J. Acoust. Soc. Am., 62 (1), 547 (a) (1977).

Koike, K., and Asp, C., Tennessee test of rhythm and intonation patterns. Accepted paper for ASHA in San Francisco (1978b).

Koike, K., and Asp, C., Tennessee test of rhythm and intonation patterns, J. Speech Hearing Dis., accepted for publication (1980).

Kressin, L., Speech production in two- to three-year-old children, a perceptual analysis of selected segmental features. Unpublished Master's Thesis, The University of Tennessee, Knoxville (1976).

LaBelle, J., Sentence comprehension in two age groups of children as related to pause position or absence of pause. J. Speech Hearing Res., 16, 231-238 (1973).

Lee, G., Northwestern Syntax Screening Test. Northwestern University Press, 1971.

Lehiste, I., Suprasegmentals. Cambridge, Mass: M. I. T. Press (1970).

Lenneberg, E. H., Biological Foundations of Language. New York: John Wiley and Sons (1967).

Lewis, M., Language, Thought, and Personality in Infancy and Childhood. London: S. G. Harrap (1936).

Lewis, M., Infant Speech: A Study of the Beginnings of Language. London: Routledge and Kegan Paul (1951).

Lieberman, P., Intonation, Perception, and Language. Cambridge, Mass: M. I. T. Press (1967).

McCarthy, D., Language development in children. In L. Carmichael (Ed.), A Manual of Child Psychology. 476-581 (1946).

McClay, H., and Osgood, C. E., Hesitation phenomena in spontaneous English speech. Word, 15, 19-44 (1959).

McDade, H., An evaluation of methods for testing auditory retention abilities of moderately retarded mongoloid subjects. Unpublished Master's thesis,The University of Tennessee, Knoxville (1974).

McElroy, C. W., Speech and Language Development of the Preschool Child. Illinois: Charles C. Thomas (1972).

Mandler, G., Word lists and categories: An experimental view of organized memory. In J. L. Cowan (Ed.) Studies in Thought and Language. Tucson: University of Arizona Press (1970).

Maskowitz, A. I., The two-year-old stage in the acquistion of English phonology. Language,46, 426-441 (1970).

Menyuk, P., Comparison of grammer of children with functional-deviant and normal speech. J. Speech Hearing Res., 7, 109-120 (1964).

Menyuk, P., The Development of Speech. Indianapolis, Indiana: Bobbs-Merrill (1972).

Metreaux, R., Auditory memory span for speech sounds: Norms for children. J. Speech Dis., 9, 31-38 (1944).

Metreaux, R., Speech profiles of the preschool child -- 18 to 54 months. J. Speech Hearing Dis., 15, 35-53 (1958).

Miller, G. A., The magical number seven, plus or minus two: some limits on our capacity for processing information. Psychol. Review, 63, 81-97 (1956).

Minifie, F. D., Hixon, T. J., and Williams, F., Normal Aspects of Speech, Hearing and Language. Englewood Cliffs, New Jersey: Prentice-Hall, Inc. (1973).

Nakatani, L. H., and Schaffer, J. A., Hearing words without words: Prosodic cues for word perception. J. Acoust. Soc. Am., 63 (1), 234-245 (1978).

Neisser, U., Cognitive Psychology. New York: Appleton Century Crofts, Inc., 1967.

Newsom-Clark,S., and Asp, C., The imitation of suprasegmental patterns by 40, 50, and 60 year old adults with normal hearing. A research project. The University of Tennessee, Knoxville (1979).

Nooteboom, S. G., Contributions of prosody to speech perception. Language, 11, 34-54 (1976).

Oberly, H. S., A comparison of the spans of attention and memory. Am. J. of Psych., 40, 295-302 (1928).

Pollack, I., The assimilation of sequentially encoded information. Am. J. of Psych., 66, 421-435 (1953).

Robbins, S., The relations between short auditory memory span disability and disorders of speech. Laryngoscope, 45, 545-553 (1935).

Schafer, P. (1922), Beobachtungen und versuche an einem Kinde, cited in M. Lewis, Infant Speech: A Study of the Beginning of Language. London: Routledge and Kegan Paul (1951).

Shadden, B., Asp, C., Tonkovitch, J., and Mason, D., Imitation of suprasegmental patterns by five-year-old children with adequate and inadequate articulation. Submitted and accepted for publication in J. Speech Hearing Dis., (1978).

Spitz, H., The role of input organization in the learning and memory of mental retardates. In N. R. Ellis. International Review of Research in Mental Retardation. New York: Academic Press, 1966.

Stark, J., Poppen, R., and May, M., Effects of alternation of prosodic features on the sequencing performance of aphasic children. J. Speech Hearing Res., 10, 849-855 (1967).

Templin, M., Norms on a screening test of articulation for ages three through eight. J. Speech Hearing Dis., 18, 323-331 (1953).

Templin, M., and Darley, F., The Templin-Darley Tests of Articulation. Iowa City: University of Iowa Bureau of Educational Research and Service (1969).

Tonkova-Yampol's Kaya, R., Development of speech intonation in infants during the first two years of life. In, C. Ferguson and D. Slobin, Studies of Child Language Development. New York: Holt, Rinehard and Winston (1973).

Tonkovitch, J., Asp, C., Shadden, B., and Mason, D., Imitation of suprasegmental patterns by apraxic and normal adult speakers. Unpublished study. The University of Tennessee, Knoxville (1977).

Tulving, E., and Patkau, J., Concurrent effects of contexual constraint and word frequency on immediate recall and learning verbal material. Can. J. of Psych. 16, 83-95 (1962).

Van Riper, C., Speech Correction: Principles and Methods. New York: Prentice-Hall (1949).

Vetter, H. J., Language Behavior and Communication: An Introduction. Illinois: F. E. Peacock (1969).

Wicklegren, W. A., Size of rehearsal group and short term memory. J. of Exper. Psych., 68, 413-419 (1964).

Williams, D., Suprasegmental patterns and word intelligibility of hearing-impaired children trained with the verbo-tonal method. Unpublished Master's Thesis, The University of Tennessee, Knoxville (1978).

Williams, V., Suprasegmental skills, segmental skills, and word intelligibility of hearing-impaired and normal hearing children. Unpublished Master's Thesis, The University of Tennessee, Knoxville (1978).

# APPENDIXES

## APPENDIX A

## NULL HYPHOTHESES

The following null hyphotheses were tested:

1. There is no difference between the ability of three and five year-old normal hearing children to imitate the suprasegmental patterns for both the word and nonsense subtests of the T-TWANS-P as judged by panels using:

   (a) 1-5 similarity scale

   (b) correct/incorrect

2. There is no difference between the word subtest and the nonsense subtest of the T-TWANS-P for measuring the imitative ability of three and five year-old normal hearing children as judged by panels using:

   (a) 1-5 similarity scale

   (b) correct/incorrect

## APPENDIX B

## REVIEW OF LITERATURE

The suprasegmental parameters of intonation, duration and stress appear to contribute and affect linguistic structure (Vetter, 1969; Minifie, 1973; Crystal, 1969) and speech intelligibility (Braine, 1963). As a result this review of literature investigates the following: (1) the development of suprasegmentals in normal children, (2) the role of suprasegmentals, (3) auditory memory, chunking and (4) imitation of sentences.

### A. DEVELOPMENT OF SUPRASEGMENTALS IN NORMAL CHILDREN

#### Birth to 12 Months

Several investigators (Crystal, 1975; and Lieberman, 1967) have agreed that suprasegmentals begin to develop early with the "birth" cry. This cry is a rhythmical pattern with rising and falling contours which gives it human attributes (Berry and Eisenson, 1956; Lieberman, 1967). By two months of age, the infant varies his intonational patterns to express physiological and emotional needs (Kaplan, 1969). McCarthy (1946) studied the development of intonational patterns in infants and found that discomfort, pain, and hunger cries are differentiated by two months; pleasure develops by four months; eagerness at five months; satisfaction between six and seven months; and recognition between seven and eight months. During the three to six month period, the babbling (non-cry vocalizations) vary in rhythm pitch and stress which are continuously reduplicated (Dale, 1976; Berry and Eisenson, 1956).

At five to six months of age, the infant responds discriminatively to differences in intonation and rhythm patterns in adult speech. This discrimination ability is an essential feature to later use and comprehension of language (Lewis, 1951). Between nine- and twelve-months of age, the infant's perceptual abilities continue to be refined. He continues to cue on suprasegmental patterns with little regard for the phonetic forms or linguistic meaning (Schafer, 1922; Lewis, 1936).

One to Two Years

Suprasegmental features continue to play an important role in speech development during the one- to two-year old period, but these suprasegmentals become secondary to phonetic production (Lewis, 1951). Children begin to produce one-word utterances at about 1-year of age which serves the function of a sentence. To express an idea, the child will vary his intonation and rhythm patterns (Dale, 1972; Lenneberg, 1967; Menyuk, 1972). Around one year six months, the infant is also beginning to experiment with his voice and pitch (Metreaux, 1958). Children two and three years of age will make less than 3 percent errors when imitating simple falling and rising intonational patterns (Kressin, 1976).

Three Years to Five Years

At three years of age, intonational patterns are becoming controlled and the expressive rising inflection of surprise and pleasure are established. By the age of five, these intonational patterns are stable with inflection similar to adult speech (Metreaux, 1958). Their expressive speech is influenced by the segmental features.

Gubernia (1963) suggested that the suprasegmental parameters helps the perception of segmentals (speech sounds). Shadden (1978) reported that the acquisition of adequate articulation may be partially dependent upon prior acquisition of adequate suprasegmental skills.

## B. ROLE OF SUPRASEGMENTALS

Suprasegmentals can be measured by means of acoustic or perceptual analysis. Perceptually, suprasegmentals are changes in duration, loudness, stress and pitch which extends over one segment (Carroll, 1953). The acoustic parameters of these suprasegmental features are fundamental frequency, intensity and amplitude (Lehiste, 1970).

Stark (1967) studied the perception of segmentals and supra-segmentals in words and found that suprasegmentals occupy a higher position in the process of perception than segmental cues. In hearing-impaired children, Asp (1973) has suggested that the level of suprasegmentals may be an important determinent of their intelligibility level of speech. Stark (1967) used suprasegmentals in the training of sequencing of items in aphasic children. In this procedure, when the first item in a sequence was stressed, it enhanced the recall of the entire sequence and therefore aided linguistic sequencing.

### Intonation

An intonation pattern is the product of varying tone and pitch (Crystal, 1975) and is present in all speech activities. Intonational patterns are considered to be one of the earliest paralinguistic features a child uses in the processing of verbal stimuli (Lewis, 1951). An intonational pattern usually spans several morophemes (Maclay and

Osgood, 1959). Initially, intonation and pause assist in the comprehension of words and syntactical structures. Intonation allows the child to segment the relatively continuous speech signal into isolated syntactic or semantic components (Kaplan and Kaplan, 1970; Lieberman, 1967). Without the intonation segmentation, it would be difficult for a child to produce a syntactic pattern (Garnica, 1973). Braine (1963) suggests that intonation is therefore a vehicle for learning syntax. Intonation also helps to carry emotional as well as attitudinal information (Bolinger, 1962).

Stress, Rhythm and Duration

Stress is the amount of energy given to a syllable in a speech utterance (Goes, 1974). Listeners appear to be particularly sensitive to the rhythm onset of stressed syllables when listening to speech and when tapping the rhythm during their own speech (Huggins, 1972). Stress is an important component in determining meaning in a sentence, and it affects sentence comprehension (Betts, 1976; Nakatani, 1978). Nooteboom (1976) studied rhythmic contributions to speech perception and found that the speech rhythm carries information of lexical, syntactic and semantic aspects of the message.

Duration and timing of a phoneme, syllable, word or sentence can be accoustically measured. The duration of these elements are important factors in speech perception. In conversational speech, adults speak approximately five syllables per second (Asp, 1973). The duration of individual sounds can affect the pitch and loudness. The speech sounds of deaf children are usually longer in duration (Hudgins and Number, 1942) than the speech sounds of normal hearing

children. Sometimes shortening the duration can facilitate the perception while at other times it may be better to increase the duration.

These suprasegmental parameters as well as auditory memory span all play an important role in the child's perception and production of speech. If the child has a restricted auditory memory capacity, it could affect his suprasegmental skills.

## C. AUDITORY MEMORY SPAN AND CHUNKING

Memory span refers to the maximum number of items an individual is able to reproduce (recall) in proper order. Digit span, speech span and word span are used to label the memory span for these particular types of stimuli (McDade, 1974). For digit span, Van Riper (1949) reported that a five-year old child with normal intelligence should be able to retain up to 4 digits. Kirk, McCarthy and Kirk (1965) reported a 3 and 5 digit span for 3- and 5-year olds, respectively. Miller (1956) found that the average adult can recall as many as seven digits (puls or minus two) at least 50 percent of the time. According to Humpstone (1917), there is a 0.50 correlation between age and digit span.

Metreaux (1944) studied auditory memory for vowels and consonants, separately. The auditory memory span for 5- to 12-year olds increased as age increased. For vowels the maximum memory span was 10 years of age, whereas for consonants it was at 12 years of age. The memory span for boys and girls was similar.

Epstein (1961) discovered that sequences of nonsense syllables were easiest to learn when they were organized in orderly English syntax. Jacobs (1887) proposed that if an individual could repeat 6 nonsense syllables, he would most likely be able to repeat as many as 7 letters and 9 numbers. Tulving and Patkau (1962) reported that adults have a memory span of 5 monosyllablic words, whereas Hunter (1962) found that college students could repeat 3 nonsense syllables, 6 nouns, or 8.5 digits.

Robbins (1935) studied auditory memory span for logical sentences and found it longer than the span for digits, consonants or nonsense syllables. Jacobs (1887) reported that with these above results it is obvious that there is a limit to the power of short term memory regardless of the material.

This limit is overcomed by various grouping stategies called "chunking," which refers to the organization of a verbal stimulus into discrete segments of information for storage and recall. According to Mandler (1970), this segmentation, or organization process is the most important determinent in the recall of a verbal stimulus. The absence of this ability to segment results in an impairment of the listener's ability to store and recall the information contained within the stimulus (Spitz, 1966).

The exact mechanism used by the listener in the organization of verbal stimulus for recall has not been established. As a result, research has attempted to answer this question through studies involving digit sequences, word lists, and sentences.

Digit Sequences

The segmentation of a digit sequence is one of the most common organizational process encountered in daily living (e.g., telephone and social security numbers). Oberly (1928) revealed that subjects "grouped" the digits contained in a sequence according to the intonational and pausal patterns employed by the speaker. Neisser (1967) claimed that the use of these patterns in the organization of digit sequences created a more organized pattern for use in storage and recall activities rather than unsegmented or unorganized sequence of digits. Wicklegren (1964) studied the affects of segmenting stimuli into 2 to 5 digit segments. His results indicated that stimuli sequences organized into segments containing three digits were correcly recalled more frequently than sequences which were organized into two, four, and five digit segments.

Word Lists

The organization of word lists for recall does not differ from the recall of digit sequences, however, studies have revealed that the recall of word lists involves factors which do not occur in the organization of digit sequences. These factors include: the number of words contained in each category, the number of categories, the strength of the association between words, and the frequency of occurance (Mandler, 1970). Badsen and Higgins (1972) revealed that the number of words a listener recalled increased as the number of categories increased. The strength of the words contained in the category determined the number of chunks used for recall. Mandler (1970) revealed that an adult listener recalls approximately 5 chunks (plus or minus two).

Sentences

The length of most sentences contained in conversational speech usually exceeds the immediate memory span of the listener (Pollack, 1953). In contrast to digit sequence and word lists organizational processes, the organizational process for sentences is strongly influenced by the syntactical structures contained in each sentence (Epstein, 1962). Garret (1965) found that listeners are more actively involved in the organization of a sentence into syntactical structures for storage and recall, rather than simply responding to intonational and pausal cues which also occur within a sentence. To organize a sentence according to its syntactical structures allows a listener to rehearse segments of the stimuli during the pause intervals thus improving storage and recall (LaBelle, 1972).

## D. IMITATION OF SENTENCES

Menyuk (1964) used a test of sentence repetition (imitation) for evaluating 3- to 5-year olds. She found that the ability to imitate sentences was related to the child's spontaneous speech.

In order to test the understanding of sentence structure, Lenneberg (1967) had the subjects repeat sentences. When the grammatical structure was not clear the subjects behaved as if a string of random words had been presented. This task of repetition appeared to be a good method for testing the understanding of sentences.

In conclusion, it appears that the imitation of sentences is a useful method of assessing linguistic skills in children. Auditory

memory span, chunking, and the complexity of the linguistic structure affect the child's ability to imitate sentences. In addition, a string of nonsense syllables are more difficult to imitate (repeat) than meaningful test items, such as digits or words.

# APPENDIX C

## PILOT DATA

Six children from three to eight years of age imitated thirty-one sentences and two nonsense-syllable patterns. Each sentence or nonsense pattern was spoken by the examiner. The sentences were selected from the Northwestern Syntax Screening Test (Lee, 1971), Carrow Elicited Language Inventory (Carrow, 1975), Boston Diagnostic Aphasia Examination (Goodglass and Kaplan, 1972). (See Appendix C).

The results revealed that the children could imitate these sentences and nonsense syllable patterns. Five-year olds scored better than the three-year olds. The sentences were easier than the nonsense syllable patterns (See Appendix C).

APPENDIX C

Sentences taken from the BOSTON TEST OF APHASIA, the NORTHWESTERN SYNTAX SCREENING TEST, and the CARROW ELICITED LANGUAGE INVENTORY.

Similarity Scale: 1-----2-----3-----4-----5
(similar) (dissimilar)

| Sentences | Number of Syllables | 3-0 | 4-0 | 5-0 | 6-0 | 7-0 | 8-0 |
|---|---|---|---|---|---|---|---|
| 1.*The boy is sitting. | 5 | 2 | 1 | 5 | 5 | 1 | 1 |
| 2. The boy is not sitting. | 6 | 2 | 1 | 1 | 3 | 1 | 1 |
| 3. The cat is under the chair. | 7 | 2 | 1 | 1 | 3 | 1 | 1 |
| 4. The deer is running. | 5 | 2 | 1 | 1 | 3 | 1 | 1 |
| 5. The boy sees the cat. | 5 | 1 | 1 | 5 | 1 | 1 | 1 |
| 6. This is her dog. | 4 | 4 | 1 | 3 | 1 | 1 | 1 |
| 7.*Has Daddy finished dinner? | 7 | 2 | 2 | 3 | 2 | 1 | 1 |
| 8. Daddy has finished dinner. | 7 | 4 | 3 | 3 | 1 | 1 | 1 |
| 9. This is my hat. | 4 | 4 | 1 | 1 | 1 | 1 | 1 |
| 10. That is my hat. | 4 | 1 | 1 | 4 | 4 | 1 | 1 |
| 11. The car is in the garage. | 7 | 3 | 5 | 1 | 1 | 1 | 1 |
| 12. Is the car in the garage? | 7 | 2 | 1 | 1 | 3 | 1 | 1 |
| 13. The boy washes himself. | 6 | 2 | 3 | 3 | 1 | 1 | 1 |
| 14.*The cat is behind the desk. | 7 | 1 | 3 | 4 | 4 | 1 | 1 |
| 15. The cat is under the desk. | 7 | 2 | 1 | 1 | 5 | 1 | 1 |
| 16. The baby is sleeping. | 5 | 1 | 1 | 1 | 1 | 1 | 1 |
| 17. The baby is not sleeping. | 7 | 1 | 1 | 1 | 1 | 1 | 1 |
| 18. This is a baby doll. | 6 | 4 | 1 | 1 | 1 | 1 | 1 |
| 19. That is my dog. | 4 | 2 | 1 | 3 | 1 | 1 | 1 |
| 20.*Please sit down. | 3 | 2 | 1 | 1 | 1 | 1 | 1 |
| 21.*I got home from work. | 5 | 2 | 1 | 1 | 1 | 1 | 1 |
| 22. You should not tell her. | 5 | 3 | 1 | 1 | 1 | 1 | 1 |
| 23. Near the table in the dining room | 7 | 3 | 1 | 1 | 3 | 1 | 1 |
| 24. They heard him speak on the radio last night. | 9 | 3 | 3 | 4 | 1 | 1 | 1 |
| 25.*I stopped at his front door and rang the bell. | 10 | 3 | 4 | 1 | 3 | 2 | 2 |
| 26.*Go home now. | 3 | 1 | 1 | 1 | 1 | 1 | 1 |
| 27.*Bring me the pillow that is on the chair. | 10 | - | 1 | 1 | 1 | 1 | 2 |
| 28. The car stopped before I could call. | 8 | - | 4 | 4 | 5 | - | 2 |
| 29. Daddy asked me to read my book. | 8 | - | - | 1 | 5 | - | 1 |
| 30.*Mother told me to play in the house. | 9 | - | - | 2 | 1 | - | 1 |
| 31.*If it rains, we won't go to the beach. | 9 | - | - | 3 | 3 | - | 1 |
| | $\bar{X}$= | 2.26 | 1.17 | 2.19 | 2.19 | 1.03 | 1.06 |

| TWO NONSENSE SYLLABLE PATTERNS | | 3-0 | 5-0 |
|---|---|---|---|
| 1. ↗ You ↘ know ↗ how - ↗ ma ↘ ma ↗ ma. | 3 | 2 | 1 |
| 2. I stopped at his front door and rang the bell. | 10 | 5 | 4 |
| | $\bar{X}$= | 3.5 | 2.5 |

*Sentences 1, 7, 14, 20, 21, 25, 26, 27, 30, 31 were used for the T_TWANS-P.

APPENDIX C

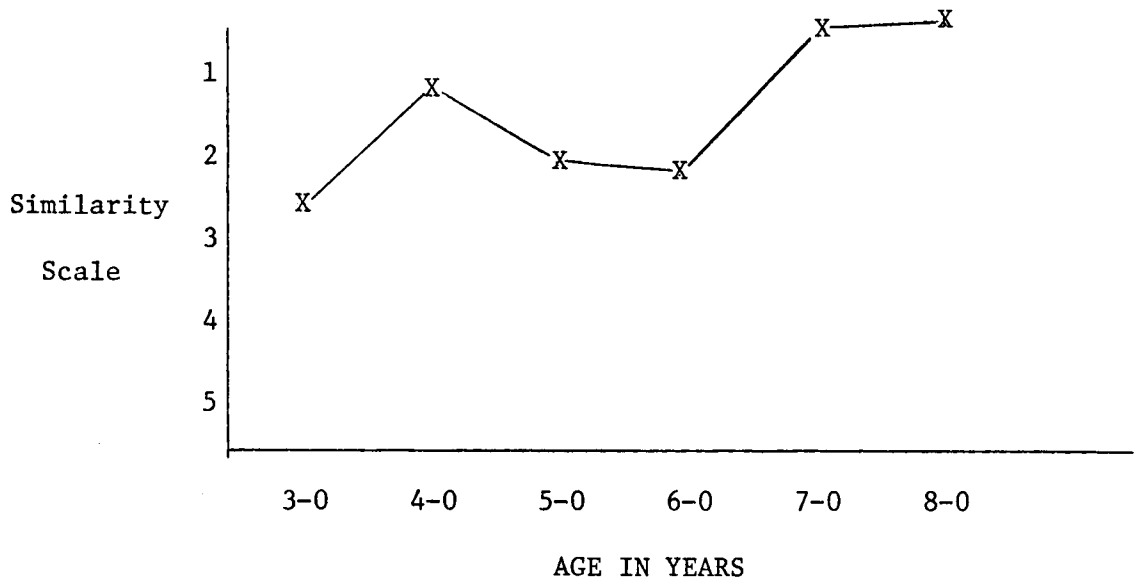



Figure A. Mean similarity score for 3-0 to 8-0 year olds for the word subtest: Pilot Data.

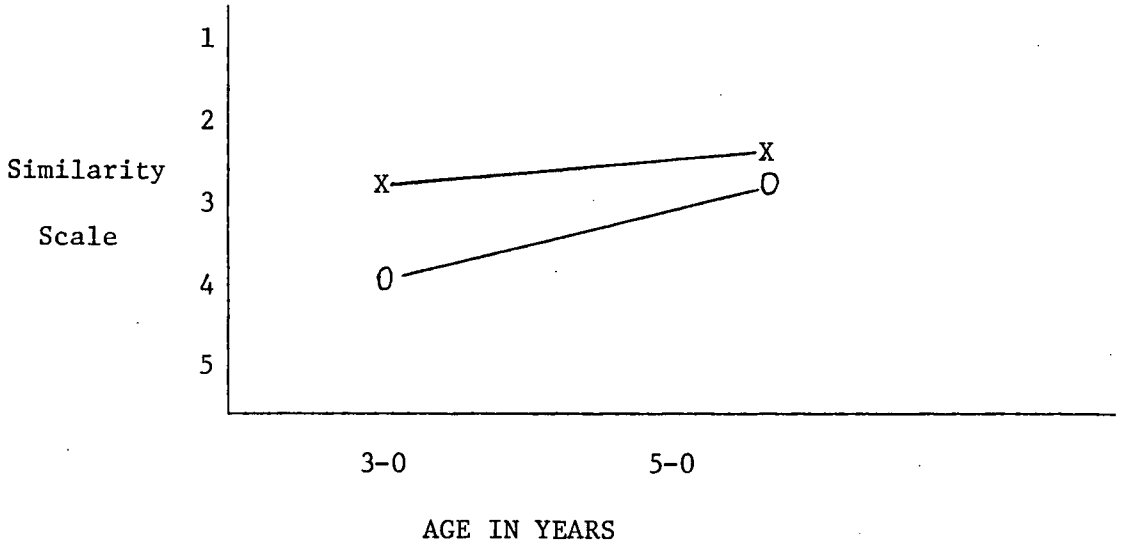
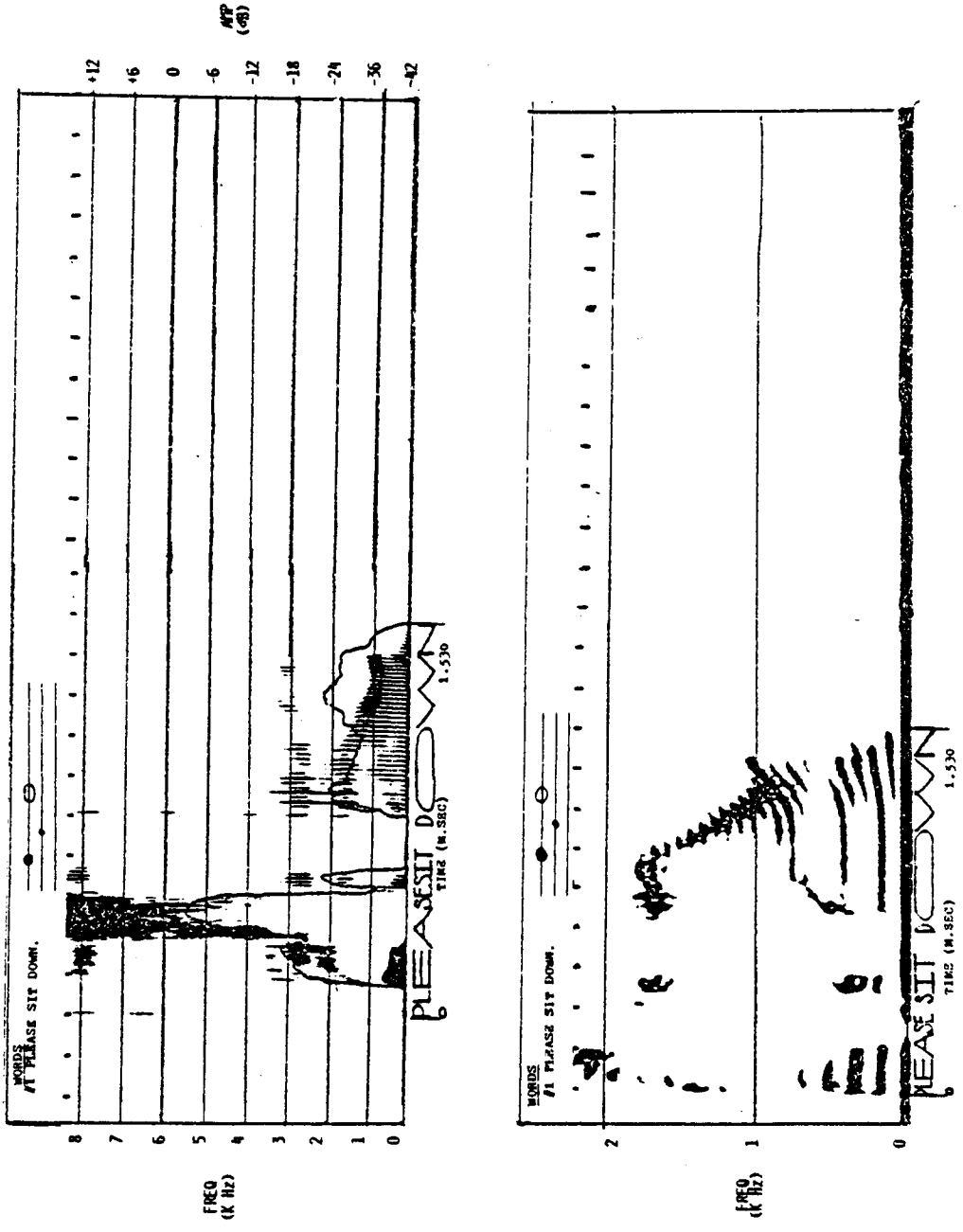
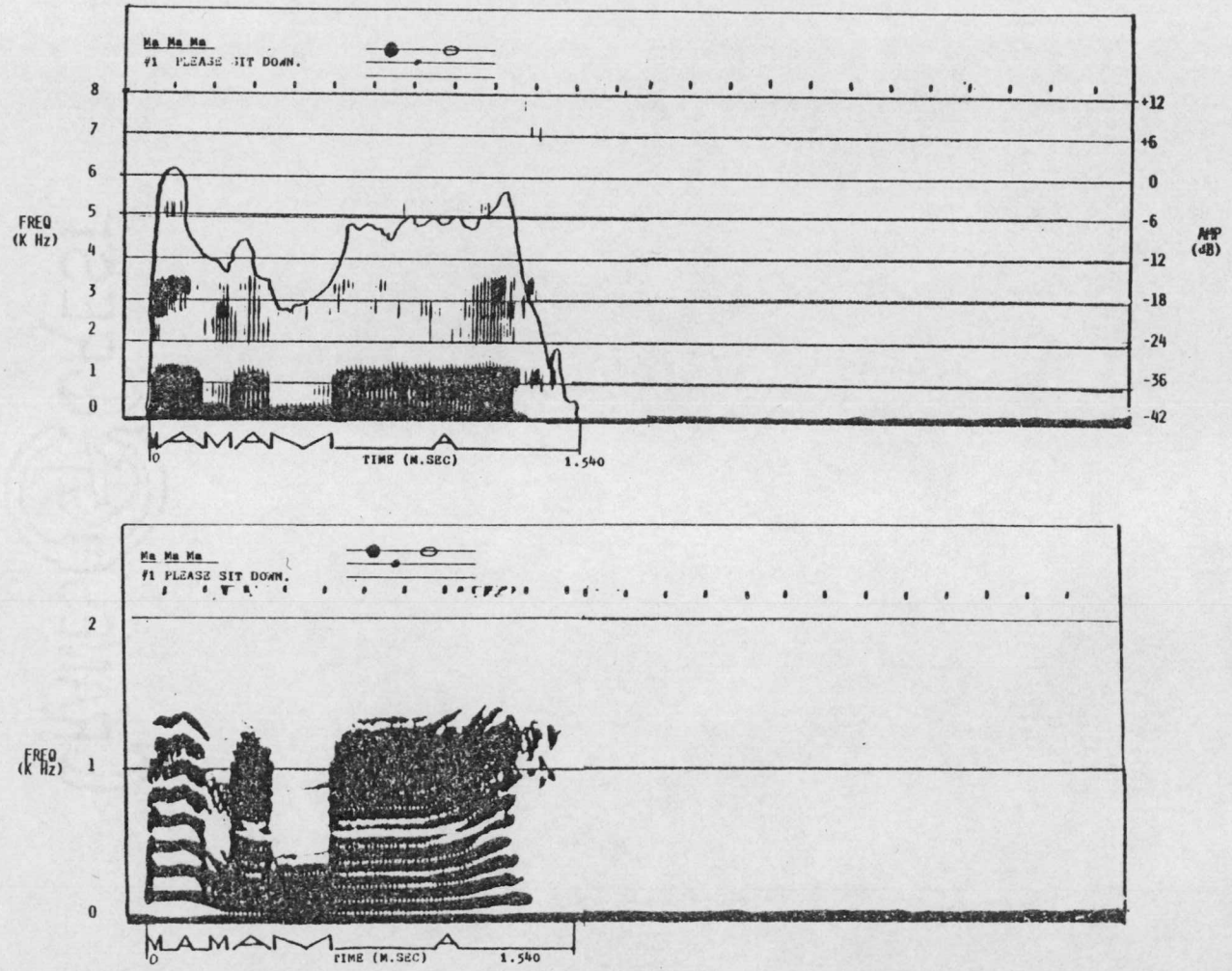


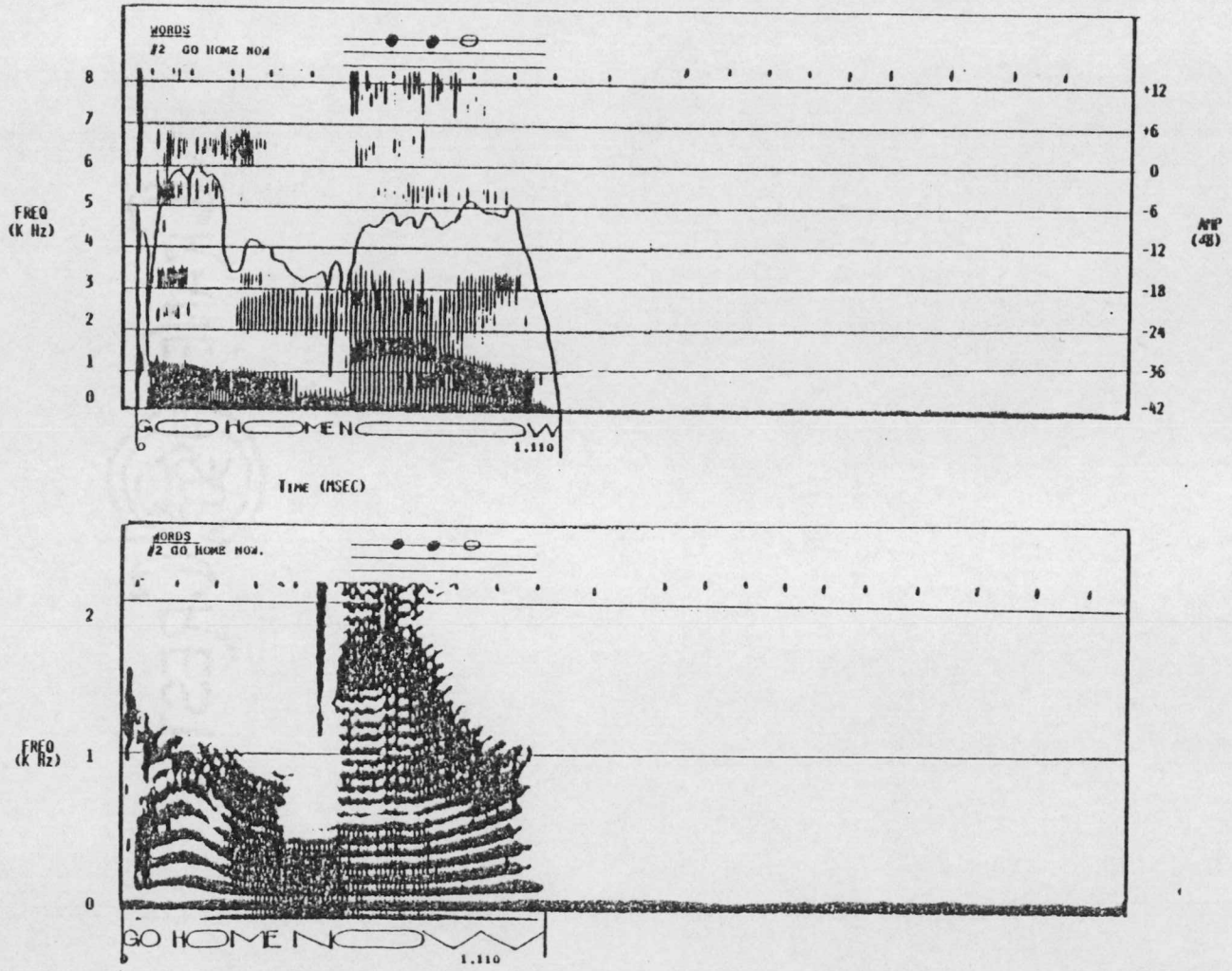

Figure B. Mean similarity score for the word subtest (X) and the nonsense subtest (0) for 3-0 and 5-0 year olds: Pilot Data.

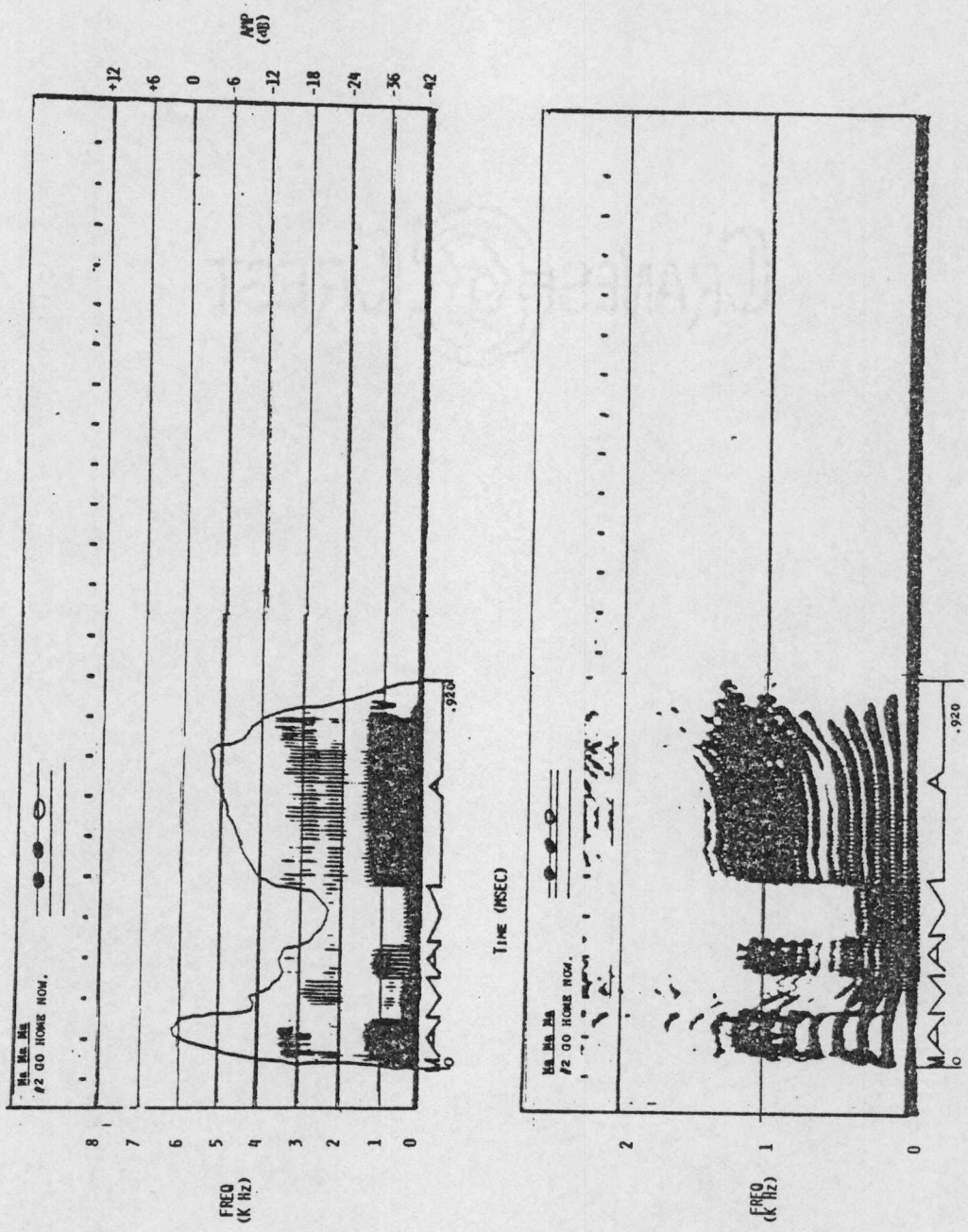
APPENDIX D

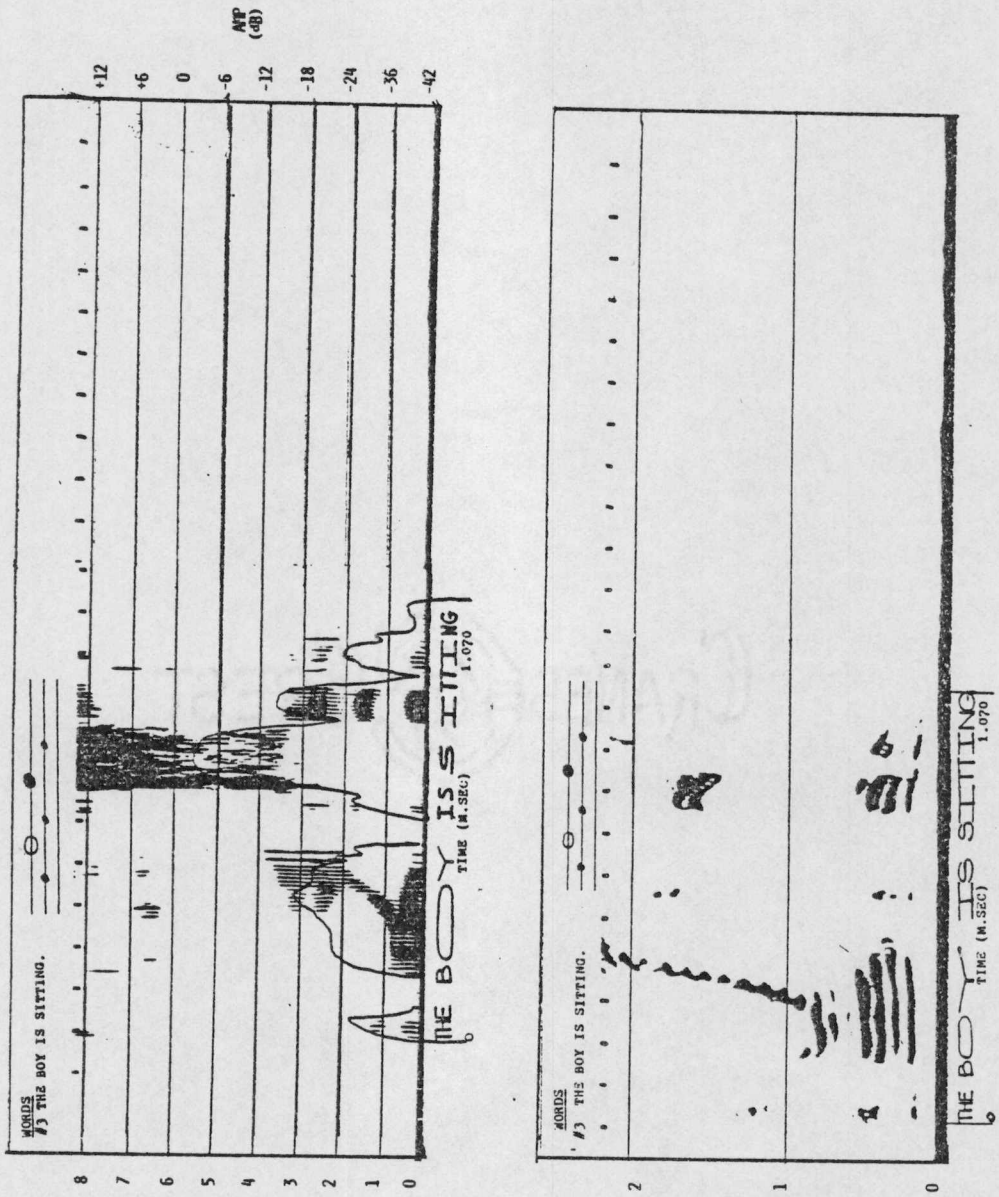
SPECTROGRAMS FROM THE T-TWANS-P

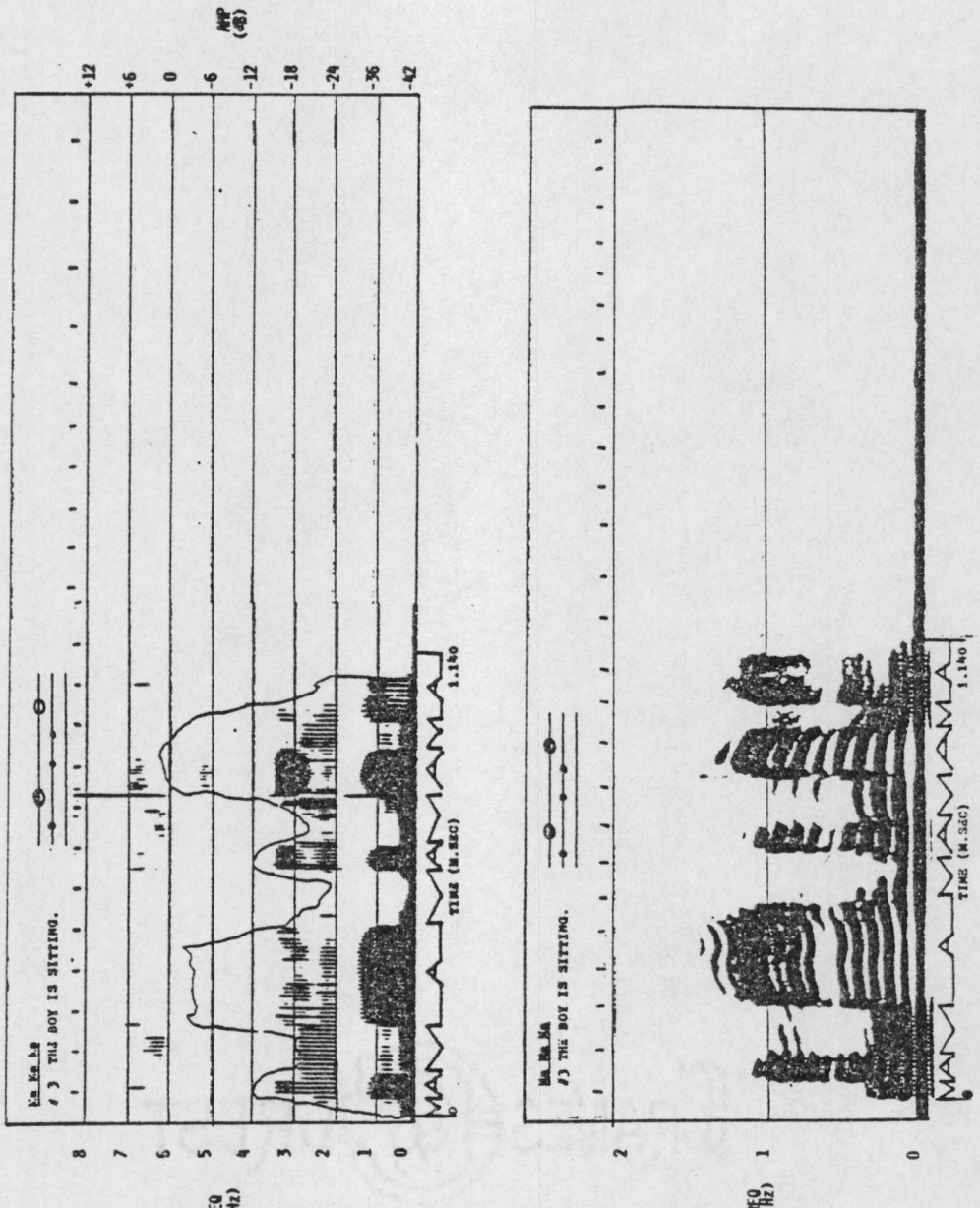


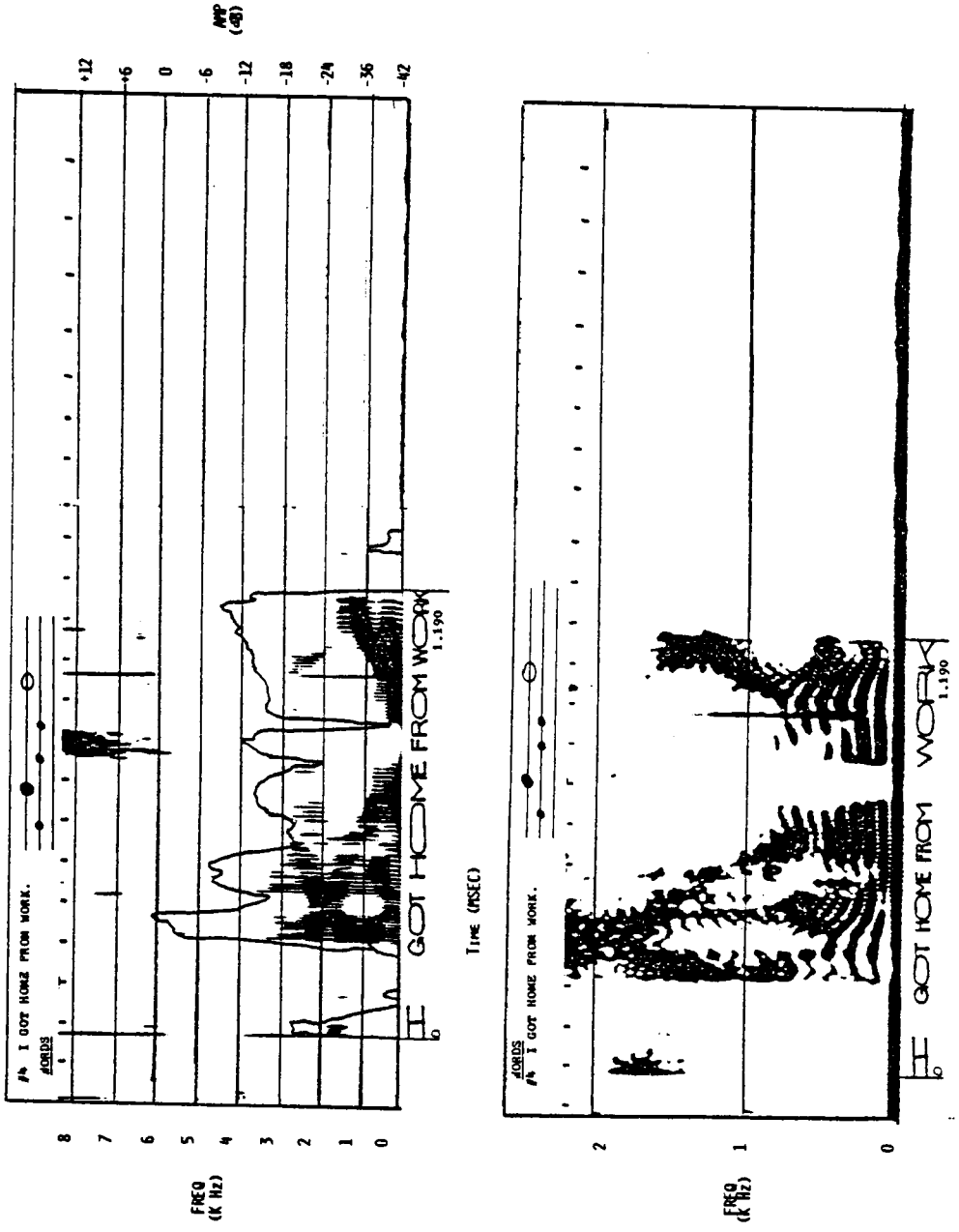

Ma Ma Ma
#1 PLEASE SIT DOWN.
FREQ (K Hz)
8
7
6
5
4
3
2
1
0
+12
+6
0
-6
-12
-18
-24
-36
-42
AMP (dB)
MAMAMA
0
TIME (M.SEC)
1.540
Ma Ma Ma
#1 PLEASE SIT DOWN.
FREQ (K Hz)
2
1
0
MAMAMA
0
TIME (M.SEC)
1.540

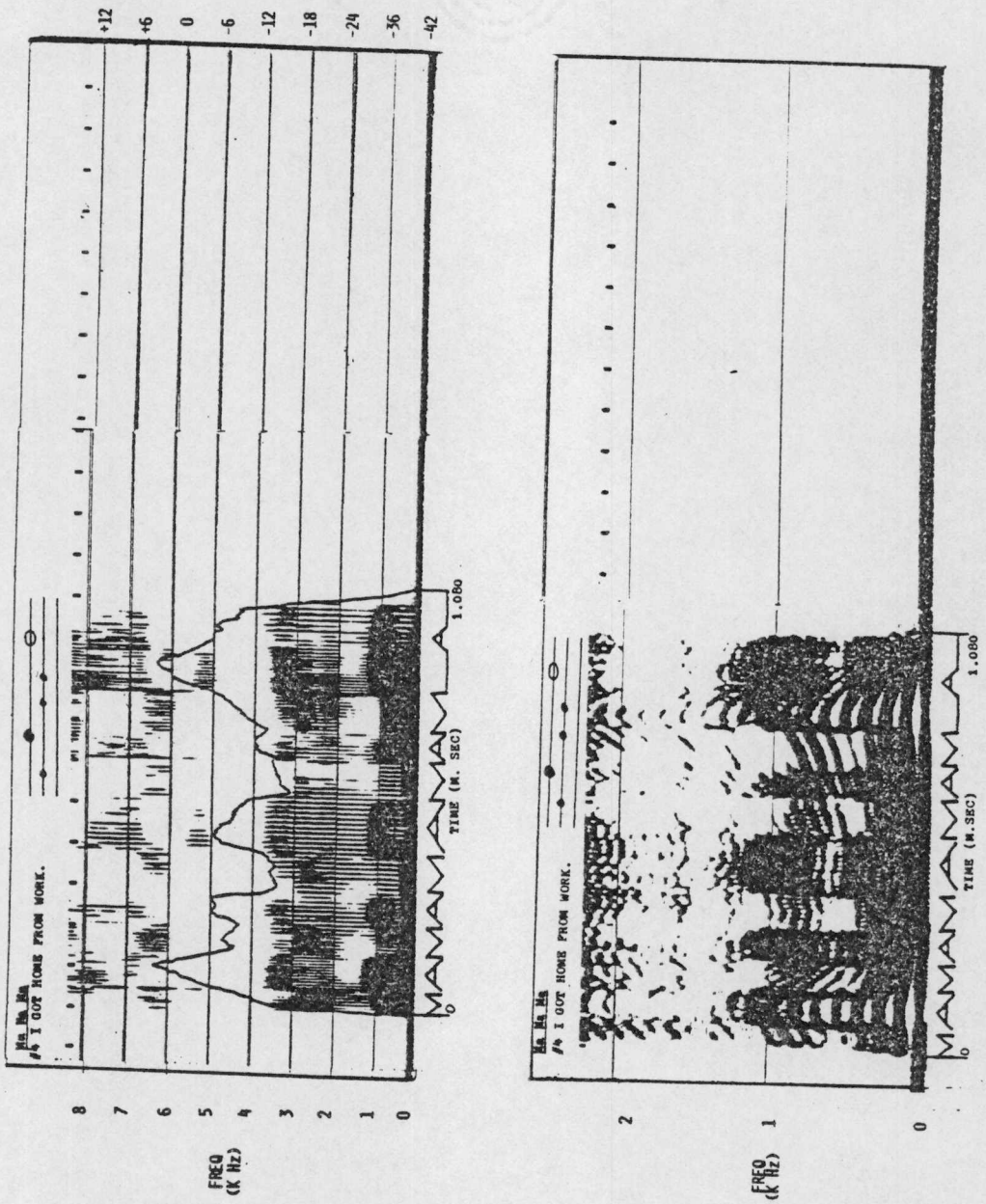

WORDS
#2 GO HOME NOW
FREQ
(K Hz)
8
7
6
5
4
3
2
1
0
+12
+6
0
-6
-12
-18
-24
-36
-42
AMP
(dB)
GO HOME NOW
1.110
TIME (MSEC)
WORDS
#2 GO HOME NOW.
FREQ
(K Hz)
2
1
0
GO HOME NOW
1.110
TIME (MSEC)


Ma Ma Ma
#2 GO HOME NOW.
AMP (dB)
+12
+6
0
-6
-12
-18
-24
-36
-42
FREQ (K Hz)
8
7
6
5
4
3
2
1
0
.920
TIME (MSEC)
Ma Ma Ma
#2 GO HOME NOW.
FREQ (K Hz)
2
1
0
.920
TIME (MSEC)

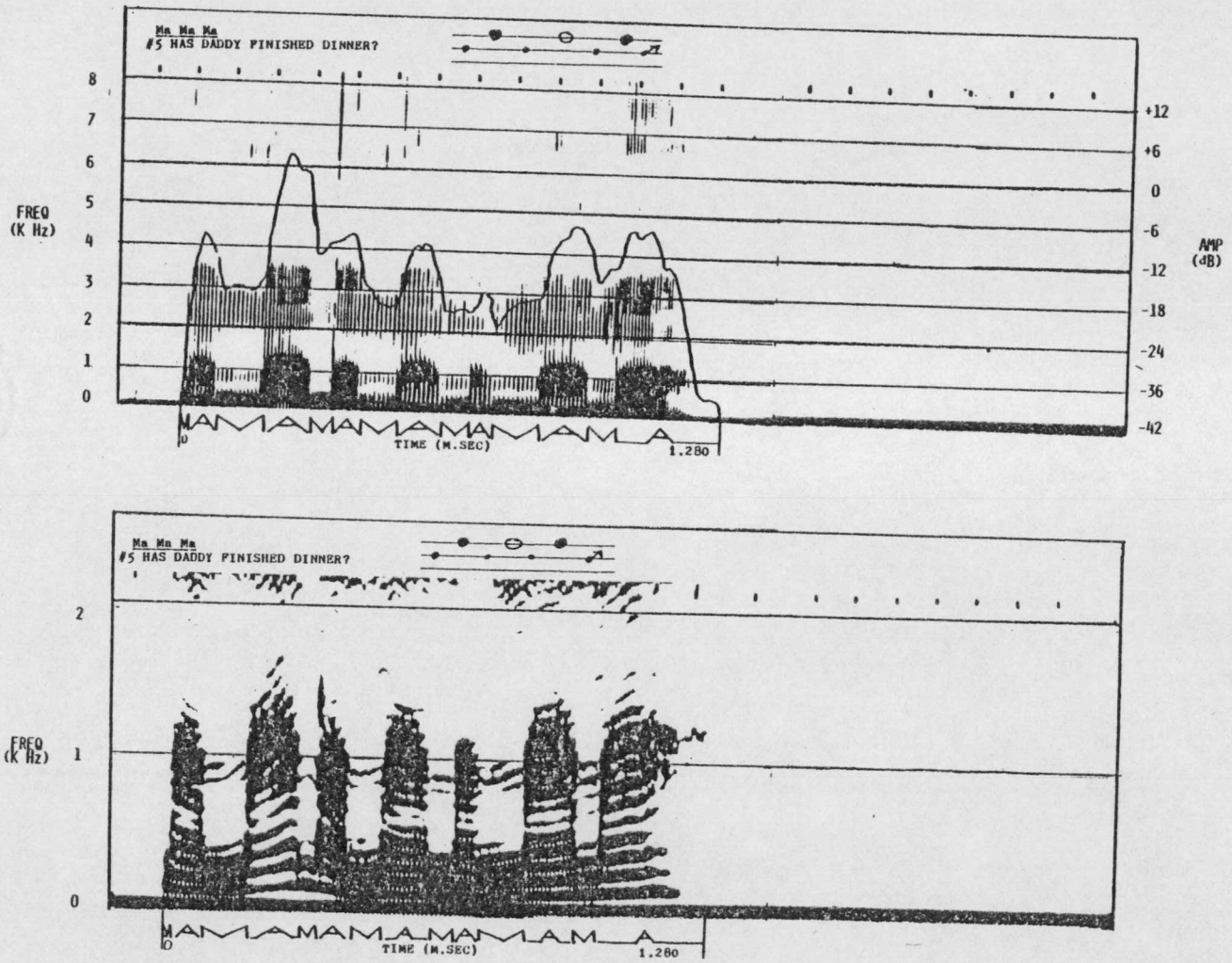

WORDS
#1 THE BOY IS SITTING.
AMP (dB)
+12
+6
0
-6
-12
-18
-24
-36
-42
FREQ (K Hz)
8
7
6
5
4
3
2
1
0
THE BOY IS SITTING
TIME (M.SEC)
1.070
WORDS
#1 THE BOY IS SITTING.
FREQ (K Hz)
2
1
0
THE BOY IS SITTING
TIME (M.SEC)
1.070

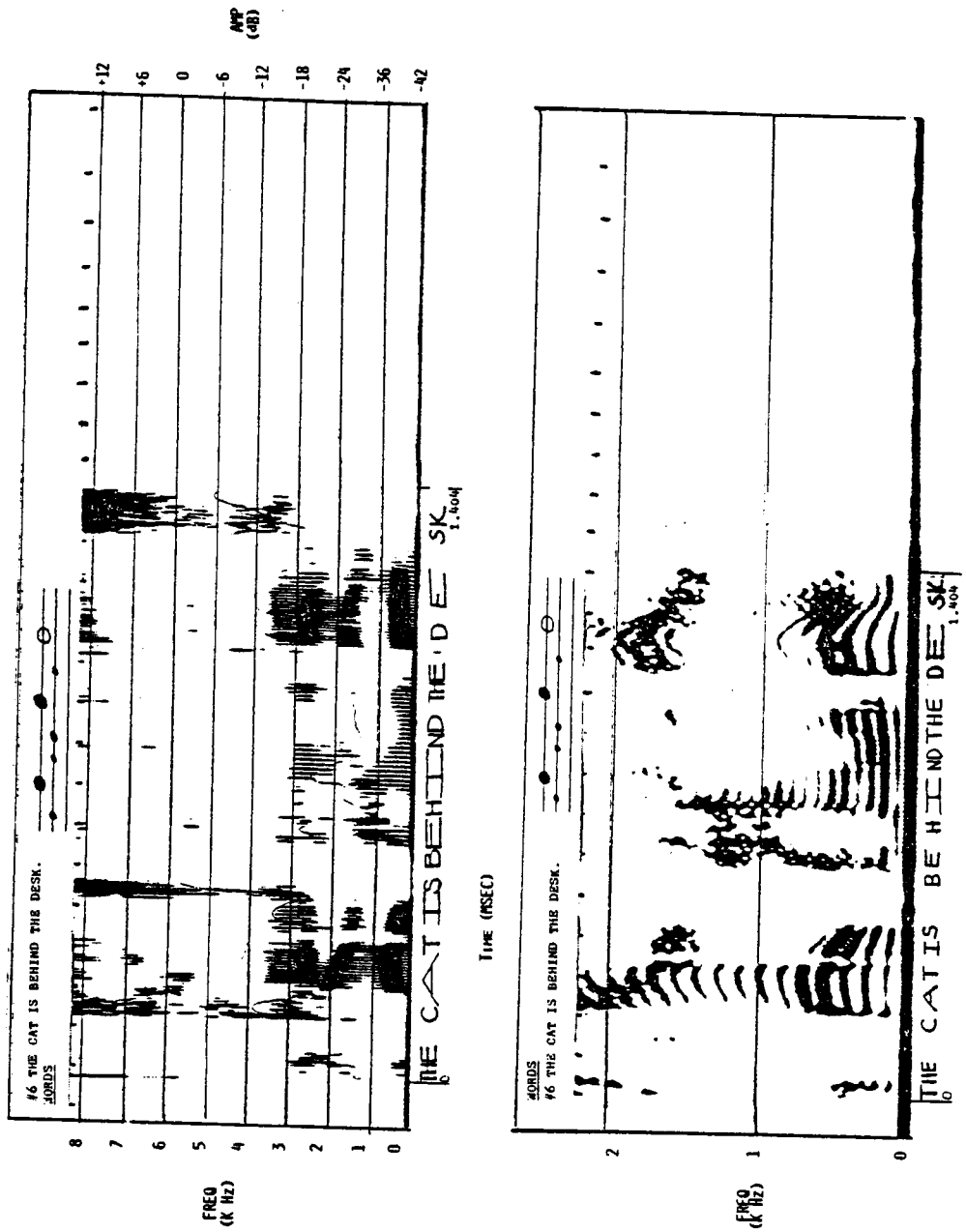

FREQ (K Hz)
AMP (dB)
TIME (M.SEC)
1.140
MAMA MAMAMA

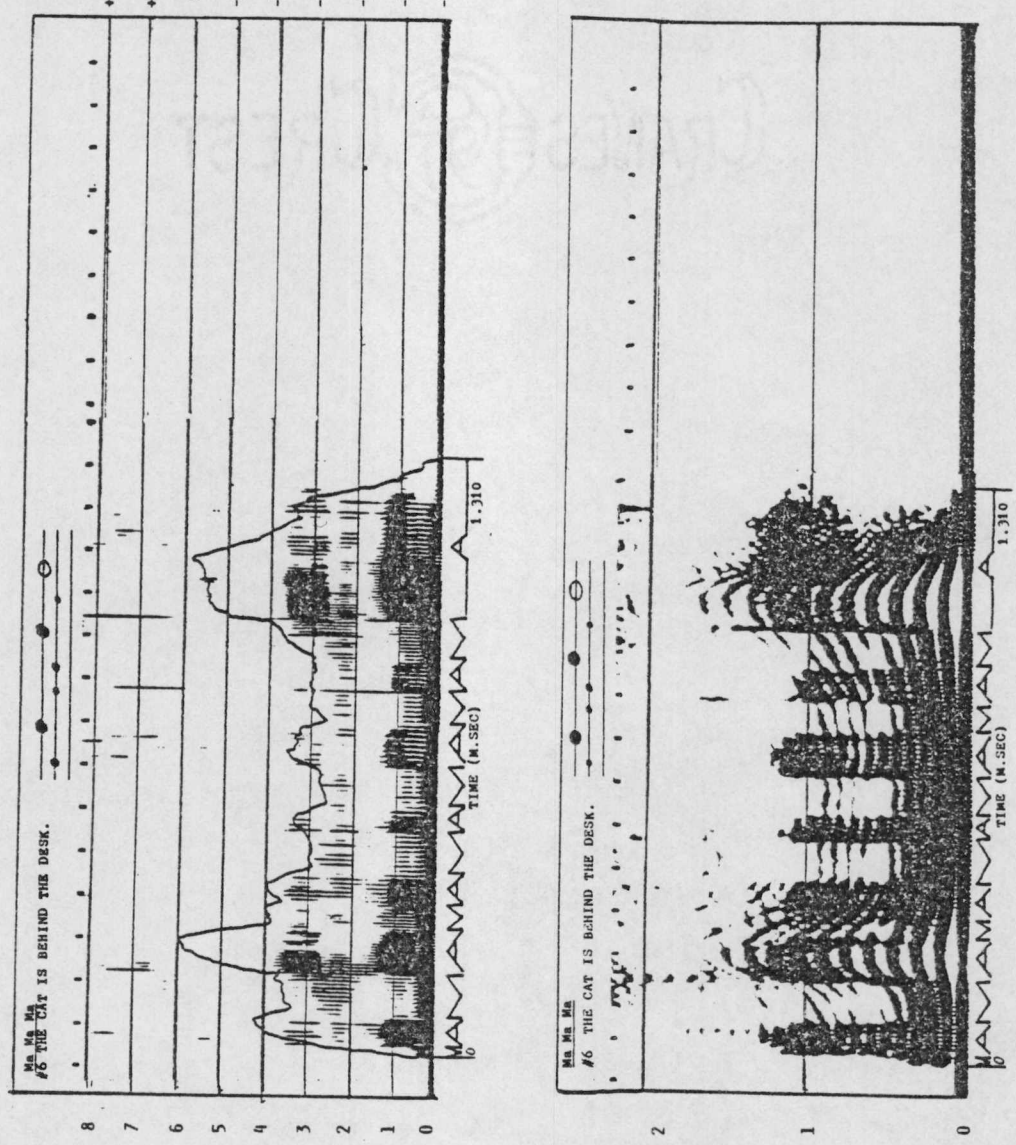

AMP (dB)
+12
+6
0
-6
-12
-18
-24
-36
-42
WORDS
I GOT HOME FROM WORK.
GOT HOME FROM WORK
1.190
FREQ (K Hz)
8
7
6
5
4
3
2
1
0
TIME (MSEC)

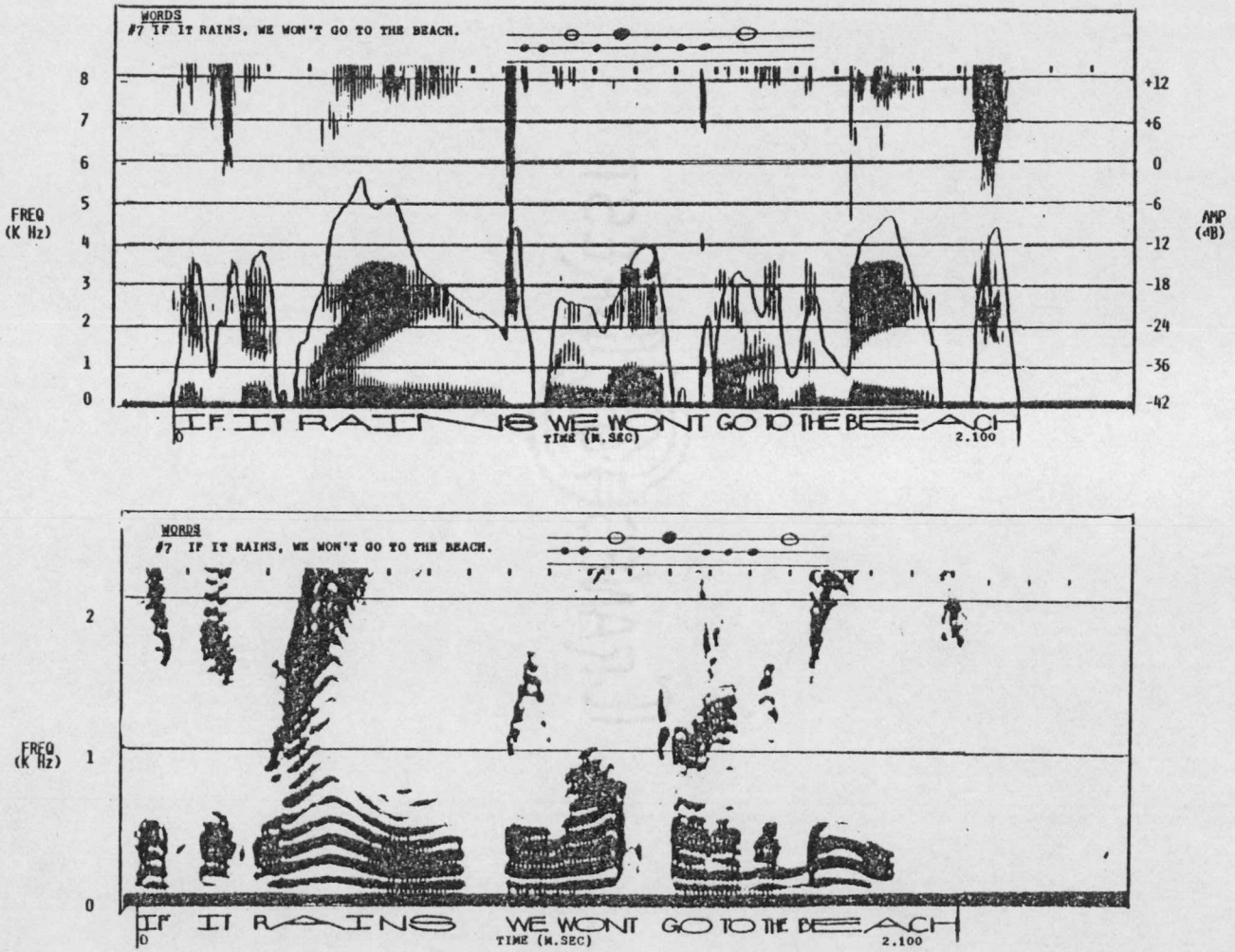

Ma Ma Ma
I GOT HOME FROM WORK.
AMP (dB)
+12
+6
0
-6
-12
-18
-24
-36
-42
FREQ (K Hz)
8
7
6
5
4
3
2
1
0
MAMAMAMAMA
1.080
TIME (M. SEC)
Ma Ma Ma
I GOT HOME FROM WORK.
2
1
0
FREQ (K Hz)
MAMAMAMAMA
1.080
TIME (M.SEC)

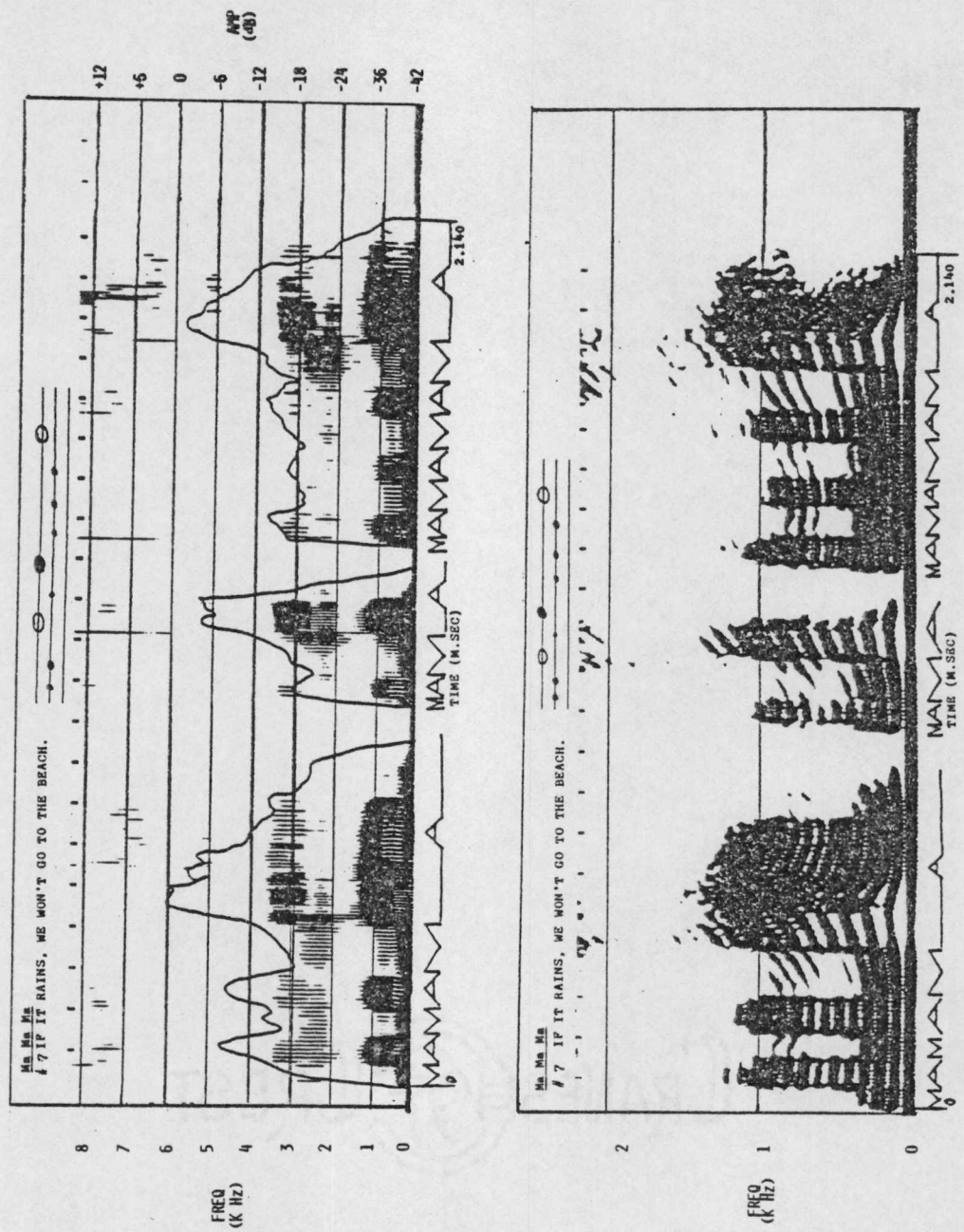

WORDS
IS HAS DADDY FINISHED DINNER?
HAS DADDY FINISHED DINNER
1.380
TIME (M.SEC)
AMP (dB)
+12
+6
0
-6
-12
-18
-24
-36
-42
FREQ (K Hz)
8
7
6
5
4
3
2
1
0

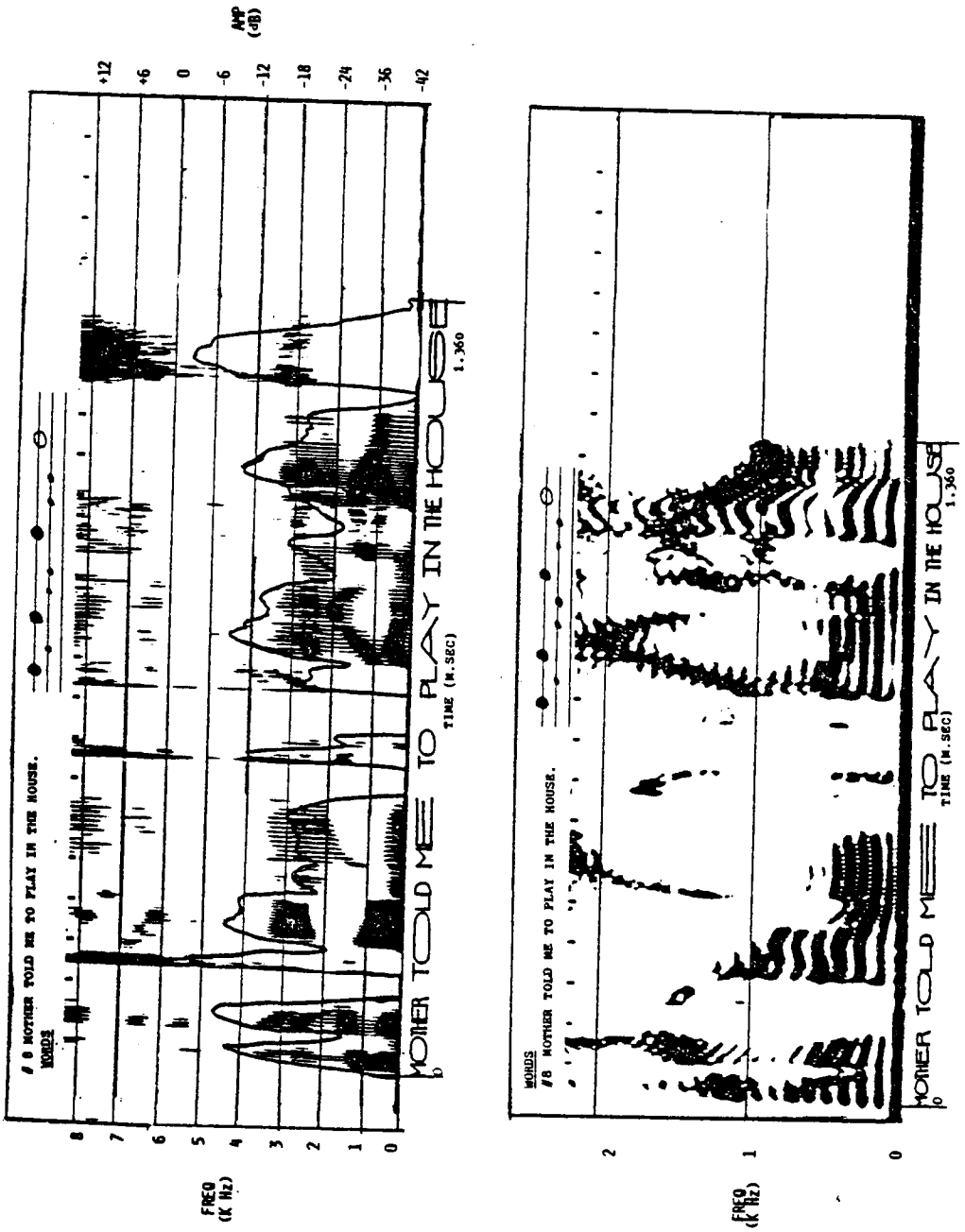

Ma Ma Ma
#5 HAS DADDY FINISHED DINNER?
FREQ
(K Hz)
8
7
6
5
4
3
2
1
0
+12
+6
0
-6
-12
-18
-24
-36
-42
AMP
(dB)
MAMAMAMAMAMAMAMA
0
TIME (M.SEC)
1.280
Ma Ma Ma
#5 HAS DADDY FINISHED DINNER?
FREQ
(K Hz)
2
1
0
MAMAMAMAMAMAMAMA
0
TIME (M.SEC)
1.280

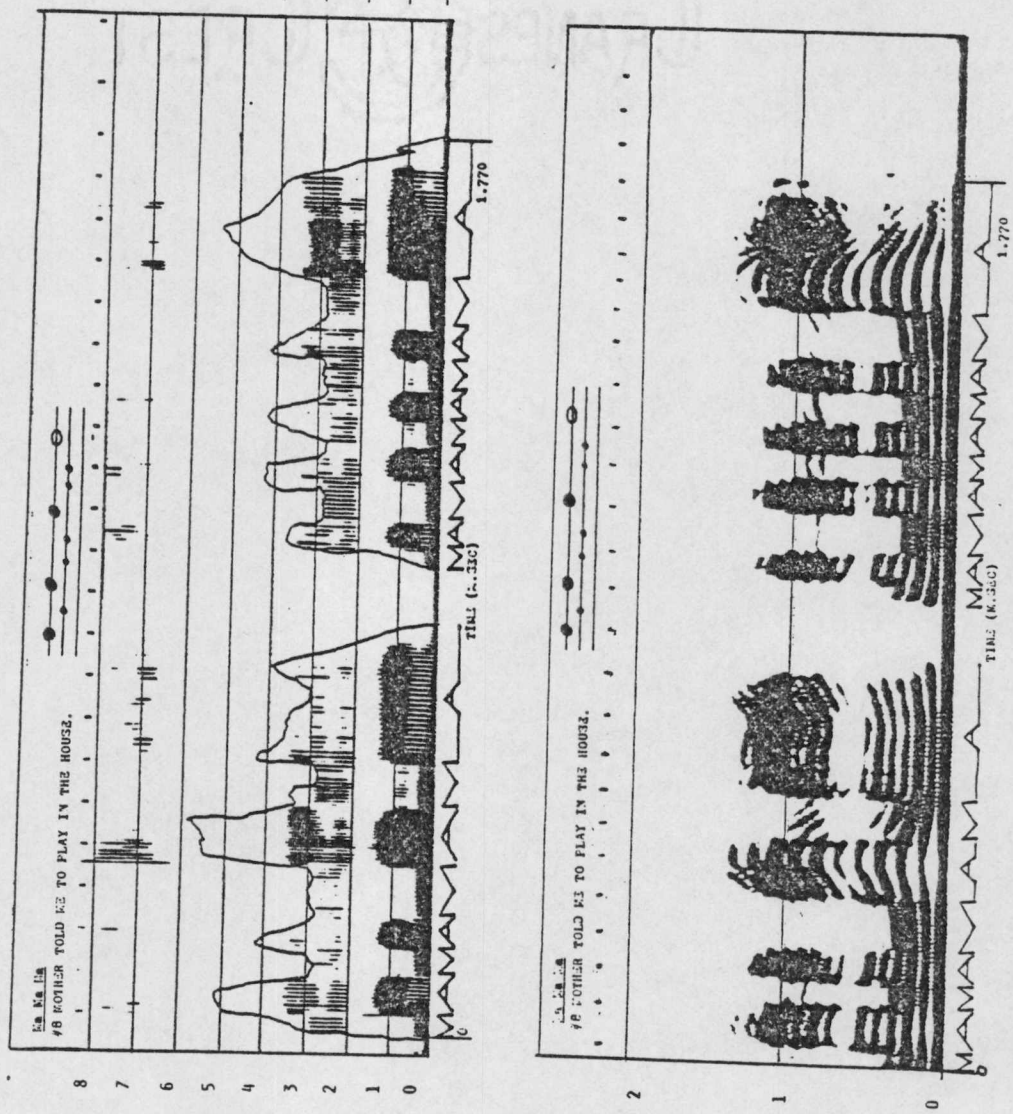

#6 THE CAT IS BEHIND THE DESK.
WORDS
AMP (dB)
+12
+6
0
-6
-12
-18
-24
-36
-42
FREQ (K Hz)
8
7
6
5
4
3
2
1
0
THE CAT IS BEHIND THE DESK
1.404
TIME (MSEC)
#6 THE CAT IS BEHIND THE DESK.
WORDS
2
1
0
THE CAT IS BEHIND THE DESK
1.404
TIME (MSEC)

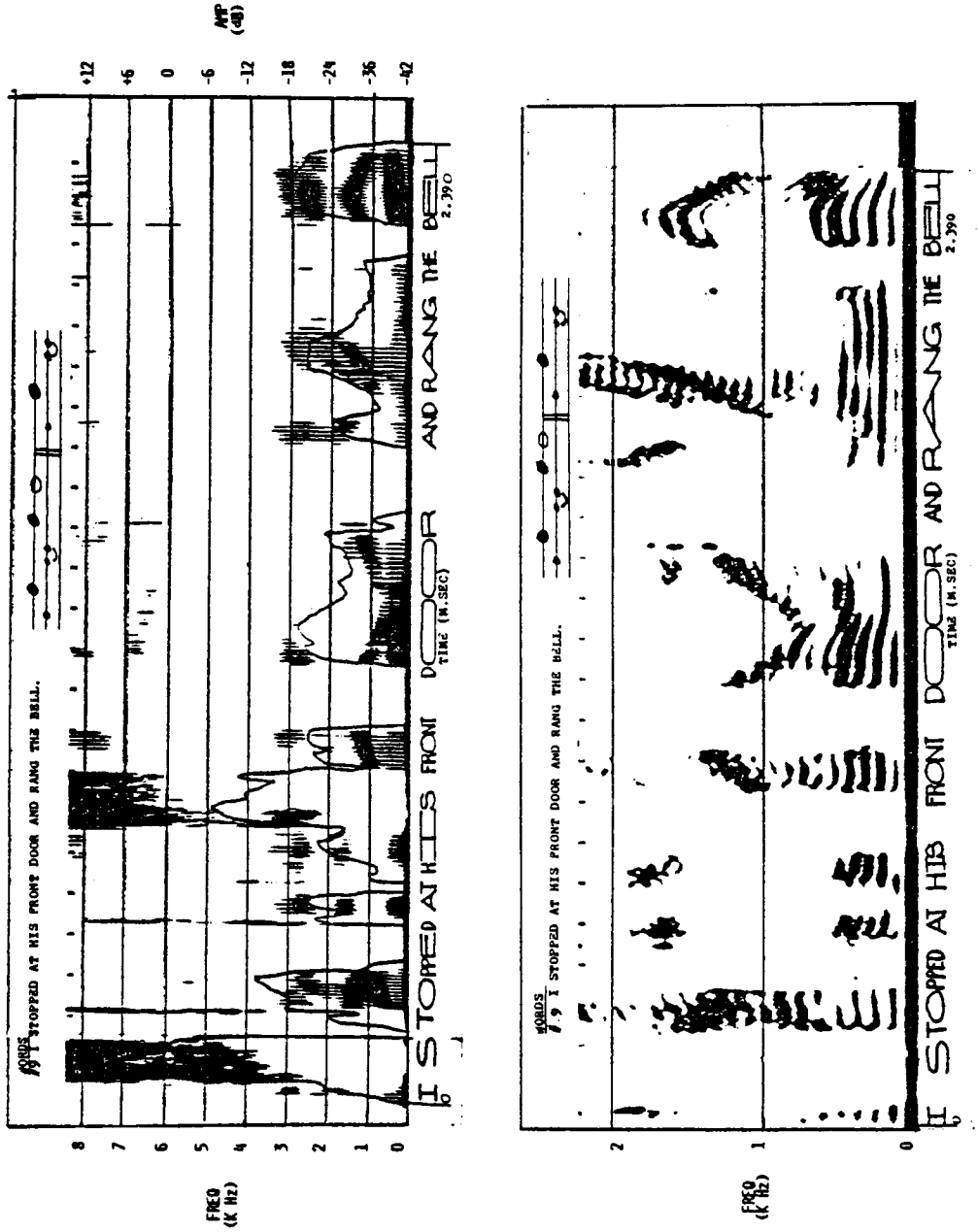

Ma Ma Ma
#6 THE CAT IS BEHIND THE DESK.
AMP (dB)
+12
+6
0
-6
-12
-18
-24
-36
-42
FREQ (K Hz)
8
7
6
5
4
3
2
1
0
0
1.310
TIME (M.SEC)
Ma Ma Ma
#6 THE CAT IS BEHIND THE DESK.
FREQ (K Hz)
2
1
0
0
1.310
TIME (M.SEC)

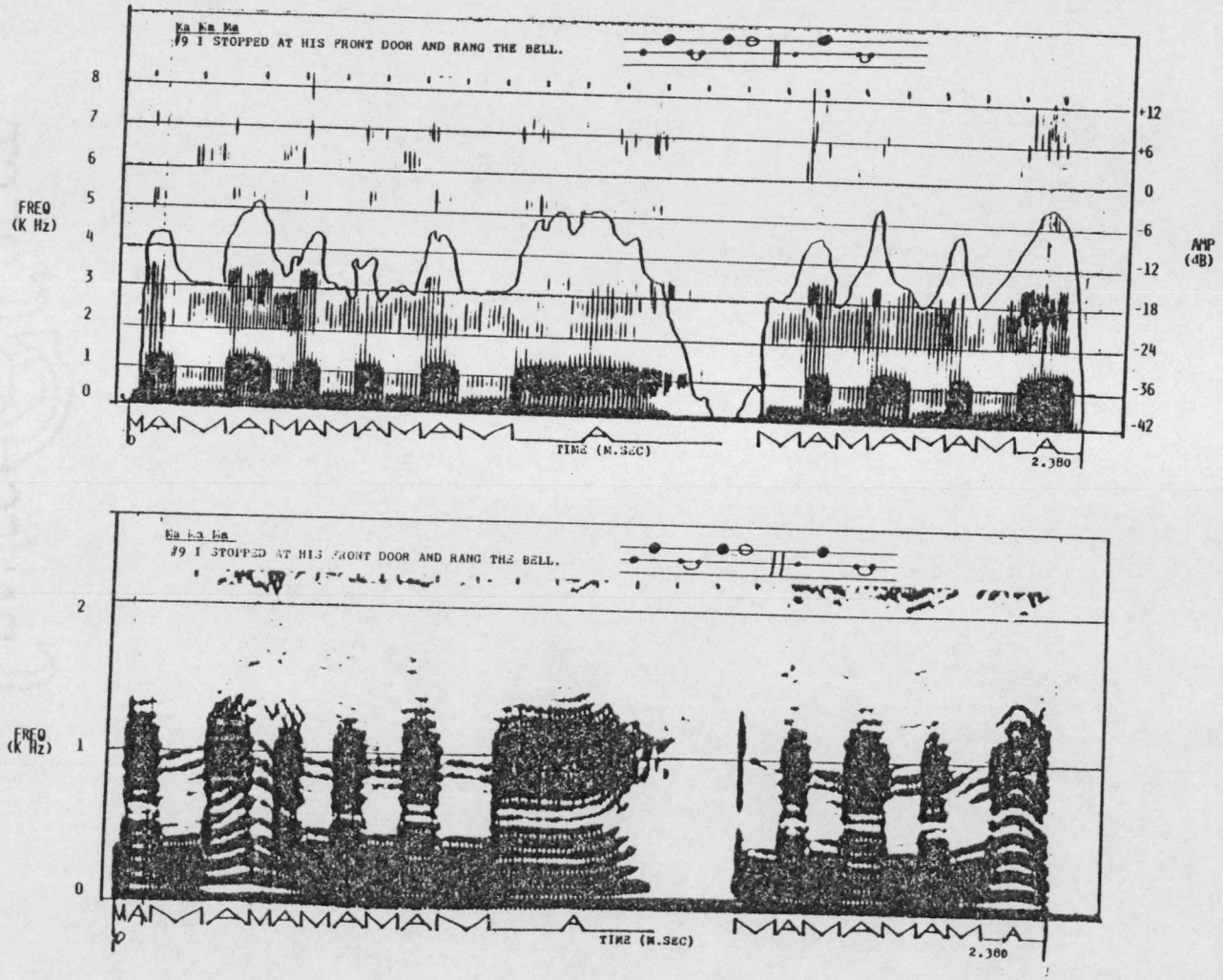

WORDS
#7 IF IT RAINS, WE WON'T GO TO THE BEACH.
FREQ (K Hz)
8
7
6
5
4
3
2
1
0
+12
+6
0
-6
-12
-18
-24
-36
-42
AMP (dB)
IF IT RAINS WE WONT GO TO THE BEACH
0
TIME (M.SEC)
2.100
WORDS
#7 IF IT RAINS, WE WON'T GO TO THE BEACH.
FREQ (K Hz)
2
1
0
IF IT RAINS WE WONT GO TO THE BEACH
0
TIME (M.SEC)
2.100

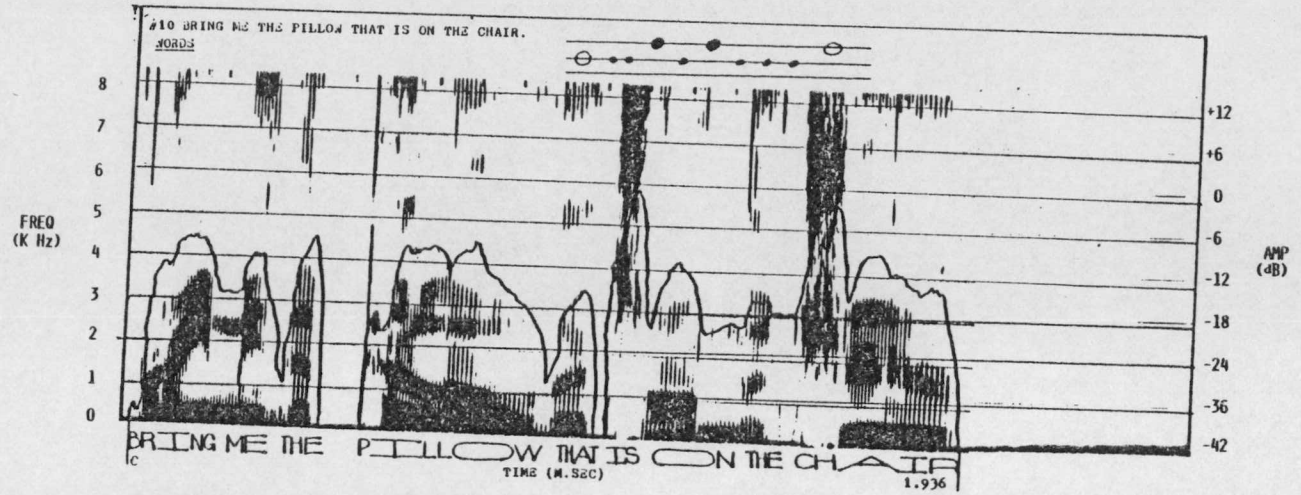

Ma Ma Ma
IF IT RAINS, WE WON'T GO TO THE BEACH.
MAMAMAMA
MAMAMAMA
TIME (M.SEC)
2.140
FREQ (K Hz)
AMP (dB)
+12
+6
0
-6
-12
-18
-24
-36
-42

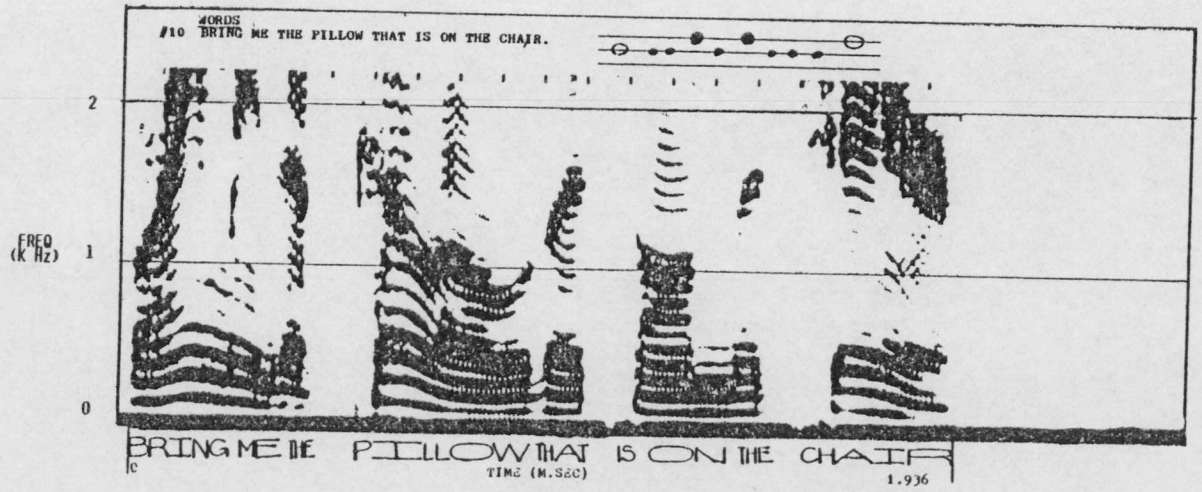

#6 MOTHER TOLD ME TO PLAY IN THE HOUSE.
WORDS
AMP (dB)
+12
+6
0
-6
-12
-18
-24
-36
-42
FREQ (K Hz)
8
7
6
5
4
3
2
1
0
MOTHER TOLD ME TO PLAY IN THE HOUSE
TIME (M.SEC)
1.360
#6 MOTHER TOLD ME TO PLAY IN THE HOUSE.
WORDS
FREQ (K Hz)
2
1
0
MOTHER TOLD ME TO PLAY IN THE HOUSE
TIME (M.SEC)
1.360

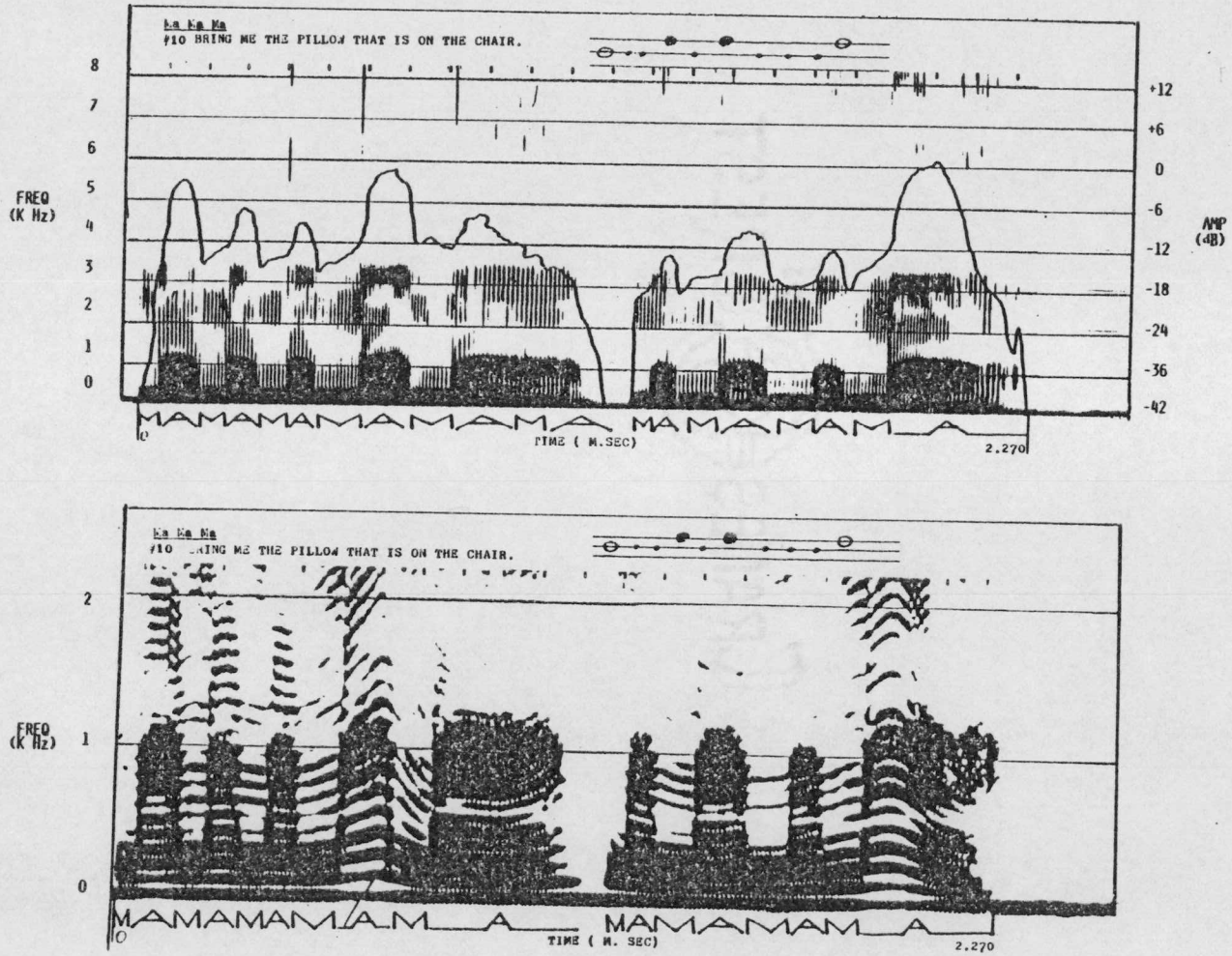

FREQ (K Hz)
AMP (dB)
+12
+6
0
-6
-12
-18
-24
-36
-42
MAMAMAMAMAMA
1.770
TIME (K.SEC)
#8 MOTHER TOLD ME TO PLAY IN THE HOUSE.


WORDS
I, I STOPPED AT HIS FRONT DOOR AND RANG THE BELL.
AMP (dB)
+12
+6
0
-6
-12
-18
-24
-36
-42
FREQ (K Hz)
8
7
6
5
4
3
2
1
0
I STOPPED AT HIS FRONT DOOR AND RANG THE BELL
TIME (M.SEC)
2.390


Ka Ka Ka
#9 I STOPPED AT HIS FRONT DOOR AND RANG THE BELL.
FREQ (K Hz)
AMP (dB)
TIME (M.SEC)
2.380
Ka Ka Ka
#9 I STOPPED AT HIS FRONT DOOR AND RANG THE BELL.
FREQ (K Hz)
TIME (M.SEC)
2.380


#10 BRING ME THE PILLOW THAT IS ON THE CHAIR.
WORDS
FREQ (K Hz)
8
7
6
5
4
3
2
1
0
+12
+6
0
-6
-12
-18
-24
-36
-42
AMP (dB)
BRING ME THE PILLOW THAT IS ON THE CHAIR
TIME (M.SEC)
1.936


WORDS
#10 BRING ME THE PILLOW THAT IS ON THE CHAIR.
FREQ (K Hz)
2
1
0
BRING ME THE PILLOW THAT IS ON THE CHAIR
TIME (M.SEC)
1.936


Ma Ma Ma
#10 BRING ME THE PILLOW THAT IS ON THE CHAIR.
FREQ (K Hz)
8
7
6
5
4
3
2
1
0
+12
+6
0
-6
-12
-18
-24
-36
-42
AMP (dB)
MAMAMAMAMAMA MAMAMAM A
0
TIME ( M.SEC)
2.270
Ma Ma Ma
#10 BRING ME THE PILLOW THAT IS ON THE CHAIR.
FREQ (K Hz)
2
1
0
MAMAMAMAM A MAMAMAM A
0
TIME ( M. SEC)
2.270

# VITA

Virginia Ellen Erkert was born in Chicago, Illinois in 1956. She graduated from West Senior High School in Rockford, Illinois in 1974. In 1978, she received a Bachelor of Science degree in Speech Pathology from Southern Methodist University in Dallas, Texas. In the Fall of 1978, she entered the University of Tennessee, Knoxville where she received a Master of Arts degree in Speech Pathology in March 1980.