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ABSTRACT

A total of 72 motorically or nonmotorically impaired, learning disabled, elementary grade children were given tasks of auditory synthesis and analysis to determine possible differences. Ss were asked to either separate sounds of a word (analysis) or blend sounds into a word (synthesis). Results indicated that nonmotorically impaired children were significantly more able to analyze words, that no significant difference existed between motorically and nonmotorically impaired children in the ability to synthesize words, and that synthesis skills were significantly superior to analysis skills in both groups of Ss. (DB)

# AUDITORY VOCAL ANALYSIS & SYNTHESIS SKILLS OF LEARNING DISABLED CHILDREN

by
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Auditory Vocal Analysis & Synthesis Skills
of
Learning Disabled Children

The phrase "auditory processing" attempts to consolidate the processes, or tasks, occurring in auditions that are developmentally necessary for learning. Recently an attempt to design a complete model of "auditory processing" was presented by Falck

His model includes numerous tasks, but those of particular interest to this experimenter are the skills of: auditory analysis and auditory synthesis. These skills have been defined by Van Riper as the ability to break down and recombine sound sequences.

Van Riper further states that vocal phonic ability, is probably learned and increases with age. Chomsky, Myklebust and Sabatino suggest that analysis and synthesis skills should be present in the child of six or seven years of age and should reach maximum development by nine years of age.

Wepman, Johnson and Myklebust have been the leaders in the field in respect to emphasis upon auditory handicaps and their influence upon competency in speaking, reading, spelling and writing. These authorities report a substantial proportion of children in early elementary grades may manifest inadequate auditory skills.

The present emphasis of sound or phonics teaching of reading would appear to be the most logical method for children having difficulty in the auditory modality, as it might help remediate this area of weakness.

It would seem that for a child to be successful with the above programs he must be able to cope with the auditory elements of reading. A phonic approach to reading relies heavily upon sequential memory and the discrimination of letters. This is supported by Flynn and Byrne who showed in a study of the relationship between reading and selected auditory abilities that advanced readers scored higher on blending of phonemes and syllables than did poorer readers. In essence they concluded that the auditory tasks of discrimination, memory and blending are essential for good reading. In reading diagnostic work the consensus among reading specialists appears to be that the disabled reader scores significantly lower than the normal reader on auditory verbal tasks, and that the deficits occur at the integrational level of automatic and sequential memory aspects of communication.

In reviewing the literature for studies on auditory vocal analysis and synthesis it was apparent that both are an outgrowth of concern over auditory memory and sequencing abilities. Orton was convinced that speech and reading problems are the result of inability to recall sounds in proper temporal sequence. Aten and Davis evaluated both normal and learning disabled children and found that the latter group were significantly deficient in

performance on the following backward digit span, serial noun span, multisyllabic word repetition, scrambled sentence arrangement and oral sequential accuracy. More recently a study by Huffman and McReynolds states "sequential behavior is necessary for the acquisition of language skills." Ability to analyze and synthesize words requires sequencing skills, memory skills, discrimination skills.

Several test have been developed and distributed to educators to measure synthesis abilities in an effort to improve the task analysis of language deficits. Probably the best known is the Sound Blending sub-test of the ITPA. Others include the Roswell-Chall Auditory Blending Test, the Auditory Test 2 from the Marion Monroe Reading Aptitude Test and the Body Parts Test of Phonemic Synthesis. Only one Auditory Analysis test was found in the literature. Upon examination the AAT was found to be similar to the Auditory Closure sub-test of the ITPA, rather than a true test of auditory analysis.

The purpose of this investigation was to study the degree of development of auditory vocal analysis and synthesis skills in two groups of learning disabled children. More specifically the problems to be investigated in this study were:

1. Do motorically and non-motorically involved learning disabled children have significant differences in their ability to analyze and synthesize words presented through the auditory-vocal channel?

2. Do motorically and non-motorically involved learning disabled children have significant differences in their ability to analyze and synthesize words presented through the auditory-vocal channel among successive age levels?

Two public elementary schools for the learning disabled were utilized as the source of subjects for the study. One of the two schools was specifically for the motorically impaired learning disabled child. The total enrollment of both schools was 142.

SLIDE I ON

The selection criteria for each subject were a chronological age within one of the groups listed in the slide, no hearing loss greater than 20 decibels in both ears at the same frequency, an intelligence quotient of 90 or above on either scale of the Wechsler Intelligence Scale for Children, and a Caucasian. A total of 72 children met the criteria and were used as subjects for the study. The subjects were grouped as illustrated in the slide.

SLIDE OFF

The test utilized to assess vocal phonic analysis and synthesis was designed and standardized by Gray (1963). The auditory vocal ability test was constructed on the following basis:

1. The tests of vocal phonics are tests of auditory perception. Words or nonsense syllables could be used for this purpose because the concept of "meaning" is not related to the direct issue of this study; which is, the individual's ability in analyzing

a series of speech sounds presented orally into a "whole." Words, rather than nonsense syllables, were decided upon for this experiment for two reasons: it appeared to be much easier to give examples of what is expected of the subject with words and the interest of the subject was thought to be better maintained with the use of words. This tends to be supported by a study conducted by Cole involving the perception of syllables and remembering phonemes, which indicated that when a subject was asked to reproduce a series of consonant/vowel syllables, he was more likely to recall those syllables which were also English words. This forming of a word association to a syllable aids recall of both the phonemes in the syllable. Other such imitation studies on the developmental decoding - encoding strategies of speech perception have been conducted by Menyuk, Scholes, Shriner and Daniloff, Slovin and Welsh which suppor Cole's results.

2. Again, although "meaning" is not a direct issue in this study, familiar words were chosen over unfamiliar words to control any possible hesitancy on the part of the subject. It is conceivable that an unfamiliar word might be an intervening variable which could alter the results. With this in mind, a group of nouns were selected from Horn's 1003 most frequently used words by kindergarten children.

3. Oral responses by the subject are necessary on both vocal phonic tests. The synthesis test calls for the subject to synthesize isolated phonemes into a word and the word is given to the examiner orally. The analysis test calls for the

subject to analyze a word presented by the examiner into its isolated phonemes presented orally. Because of this oral method of presentation by the subject, the words used on the test should be chosen for ease of articulation. This provision should eliminate for most of the subjects, the necessity of having to produce difficult combinations of sounds orally which might have an effect of their willingness to synthesize the phonemes or analyze the words. The words chosen for the synthesis and analysis tests contained only those phonemes which would be correctly articulated by four year old children, according to the norms established by Templin.

4. The tests were constructed so that they would increase in difficulty every five words. That is, each test was comprised of five-phoneme words, thus totaling 30 words for each of the two vocal phonic tests. The range from two through seven phonemes was decided so that the tests would be more discriminating than if the range were more narrow.

SLIDE 2 ON

The administration was face to face with examiner's mouth screened to eliminate visual cues. The instructions were set forth in the test and were as follows:

Analysis. I'm going to say a word and then I want you to tell me all the sounds that you hear in the word. For example, if I were to say the word "no" then you should tell me that you hear "no---o" because those are the sounds in the word "no."

Synthesis. I'm going to make some sounds and, if you listen carefully and put them together, you will hear a word. Then you tell me what the word is.

Each test contained five pre-test words and a subject had to be able to analyze and synthesize at least one of these pre-test words before the actual tests were administered. The presentation of the tests was rotated with every other subject to prevent one test from influencing the other. A correct response on the first trial by the subject received a score of two. A correct response on the second trial by the subject received a score of one. The total raw scores on each test could range from 0 to 60 points.

SLIDE OFF

The first two questions that required answering were (1) whether or not there was a difference in the auditory vocal abilities (analysis and synthesis scores combined) of motorically versus non-motorically impaired learning disabled children and (2) whether or not there was a difference in auditory vocal abilities (analysis and synthesis scores combined) of motorically versus non-motorically impaired learning disabled children among successive age levels.

SLIDE 3 ON

An F ratio of 9.19 was statistically significant at the .01 level indicating that there is a significant main effect for motor impairment. Likewise it can be seen that there is a significant main effect for age, with an F ratio of 8.86 being statistically significant at the .01 level. With an increase in age of the subjects there was an increase in their performance when both auditory tests (analysis and synthesis) were combined. Other significant results noted are the analysis versus synthesis scores with a F ratio of 280.47 being significant

at the .01 level. There were also significant interactions between motor versus non-motor and analysis versus synthesis as illustrated in the slide.

SLIDE OFF

The second general area investigated was the evaluation of the significance of age to determine if there was a developmental aspect of auditory vocal analysis and synthesis ability with the learning disabled. As illustrated in the previous slide there was a significant developmental trend when the two tests were combined. The next step was to compare the two groups on auditory vocal analysis and synthesis separately.

SLIDE 4 ON

When testing the mean difference of analysis scores for both groups a t-score of 2.58 was found to be statistically significant at the .01 level. It may be noted from the slide that the non-motor group skill in analysis was increasing with age even through this increase was not statistically significant between successive age groups. Likewise you will note that the motor group was making little or no improvement with an increase in age. Raw scores for both groups did not approach ceiling. However the analysis mean for group III of the non-motor subjects were almost identical to mean scores of non-lip children aged 8-8-5.

SLIDE OFF

SLIDE 5 ON

When testing the mean difference of synthesis scores between groups a t-score of 1.64 was found not to be statistically significant at the .05 level. It may be noted that with both groups that mean scores approached ceiling in the two upper age levels. It is also interesting to note the rapid development between age group one and two with the motor group. The mean score for non-L.D. children at 8-8-5 was 42.50 which is between the means for group I subjects.

SLIDE OFF

When testing the mean difference between analysis and synthesis scores for the motorically impaired groups a t-score of 4.18 was found to be statistically significant at the .01 level. Fianlly when testing the mean difference between analysis and synthesis scores for the non-motorically impaired group a t-score of 6.07 was found to be statistically significant at the .01 level.

The most consistent results from this portion of the study are the findings regarding the difference in auditory vocal analysis and synthesis skills both within and between groups. Without exception auditory vocal synthesis skills were superior to analysis skills.

This portion of the study did not clearly show developmental trends in both auditory vocal analysis and synthesis skills of learning disabled children even though research by Chomsky, Myklebust, Sabatino and Van Riper would suggest that such a trend should exist. One possible reason why the present study did not show expected developmental trends could be due to the compacted age span of the subjects. Finally, it should be remembered that the subjects

were learning disabled and may have reached a plateau in the development of auditory vocal analysis and synthesis skills. This appears to be true especially with the motor impaired subjects.

It is the contention of this investigator that both auditory vocal analysis and synthesis tests might be useful as predictive measures for reading, spelling and writing achievement. This premise is supported by Wedell who concluded after a study of perceptual-motor factors of learning that the predictive value of measures of perceptual-motor skills increases as the tasks measured become more similar to the actual tasks involved in reading, writing, and spelling. Actual classroom activities in both analysis and synthesis would increase total language skills as illustrated by Sabatino and Hayden who concluded that more concentrated classroom and resource work must be applied directly to perceptual skills. They also concluded that auditory perception as a decoding system has a direct relationship to the amount and kind of central language concepts learned.

Conclusions

On the basis of the results obtained in this study, the following conclusions can be stated:

1. There is a significant difference between motorically and non-motorically impaired learning disabled children in ability to analyze words presented through the auditory vocal channel with the non-motorically impaired being superior.

2. There is no significant difference between motorically and non-motorically impaired learning disabled children in ability to synthesize words presented th[illegible] auditory vocal channel.

3. There is a significant difference in analysis and synthesis skills of both motorically and non-motorically impaired learning disabled children with synthesis skills being superior.

TABLE I
Subjects

| Age in Months | Non/Motor | Motor | N = 72 |
|---|---|---|---|
| 108-125 | 12 | 12 | 24 |
| 126-143 | 12 | 12 | 24 |
| 144-161 | 12 | 12 | 24 |

# PHONIC ABILITY TEST
(Gray)

| Synthesis | | 2 pts. | 1 pt. |
|---|---|---|---|
| 1. | boy | | |
| 2. | cow | | |
| 3. | ice | | |
| 4. | knee | | |
| 5. | toe | | |
| 6. | neck | | |
| 7. | fish | | |
| 8. | boat | | |
| 9. | dog | | |
| 10. | suit | | |
| 11. | glass | | |
| 12. | smoke | | |
| 13. | penny | | |
| 14. | dress | | |
| 15. | floor | | |
| 16. | parade | | |
| 17. | Sunday | | |
| 18. | rabbit | | |
| 19. | cracker | | |
| 20. | window | | |
| 21. | fifteen | | |
| 22. | potato | | |
| 23. | napkin | | |
| 24. | fireman | | |
| 25. | airplane | | |
| 26. | elephant | | |
| 27. | animals | | |
| 28. | woodpecker | | |
| 29. | pumpkin | | |
| 30. | children | | |

| Analysis | | 2 pts. | 1 pt. |
|---|---|---|---|
| 1. | pie | | |
| 2. | bee | | |
| 3. | tie | | |
| 4. | egg | | |
| 5. | ear | | |
| 6. | church | | |
| 7. | pig | | |
| 8. | cat | | |
| 9. | game | | |
| 10. | feet | | |
| 11. | paper | | |
| 12. | flag | | |
| 13. | paint | | |
| 14. | ladder | | |
| 15. | truck | | |
| 16. | plant | | |
| 17. | candy | | |
| 18. | circus | | |
| 19. | woman | | |
| 20. | lettuce | | |
| 21. | banana | | |
| 22. | soldiers | | |
| 23. | ice cream | | |
| 24. | reindeer | | |
| 25. | bluebird | | |
| 26. | umbrella | | |
| 27. | butterfly | | |
| 28. | telephone | | |
| 29. | yesterday | | |
| 30. | Christmas | | |

(Lindquist, 1953)

Duncan's Multiple Range Test (Edwards, 1960)
t-test for mean differences

ANALYSIS OF VARIANCE

| Source | df | ss | ms | F |
|---|---|---|---|---|
| Between-Subjects | 71 | 14,535.438 | | |
| Age | 2 | 2,722.667 | 1,361.333 | 8.86** |
| Motor | 1 | 1,412.507 | 1,412.507 | 9.19** |
| Age X Motor | 2 | 260.389 | 130.194 | .85 |
| Error | 66 | 10,139.875 | 153.634 | |
| Within-Subjects | 72 | 18,341.500 | | |
| Analysis/ Synthesis | 1 | 14,062.007 | 14,062.007 | 280.47** |
| Age X Test | 2 | 212.722 | 106.361 | 2.12 |
| Motor X Test | 1 | 333.062 | 333.062 | 6.64* |
| Interaction | 2 | 424.667 | 212.333 | 4.24* |
| Error | 66 | 3,309.042 | 50.137 | |
| Total | 143 | 32,876.938 | | |

*Statistically significant at the .05 level.
**Statistically significant at or beyond the .01 level.

Figure 3: Mean Scores for auditory analysis. (n = 72)

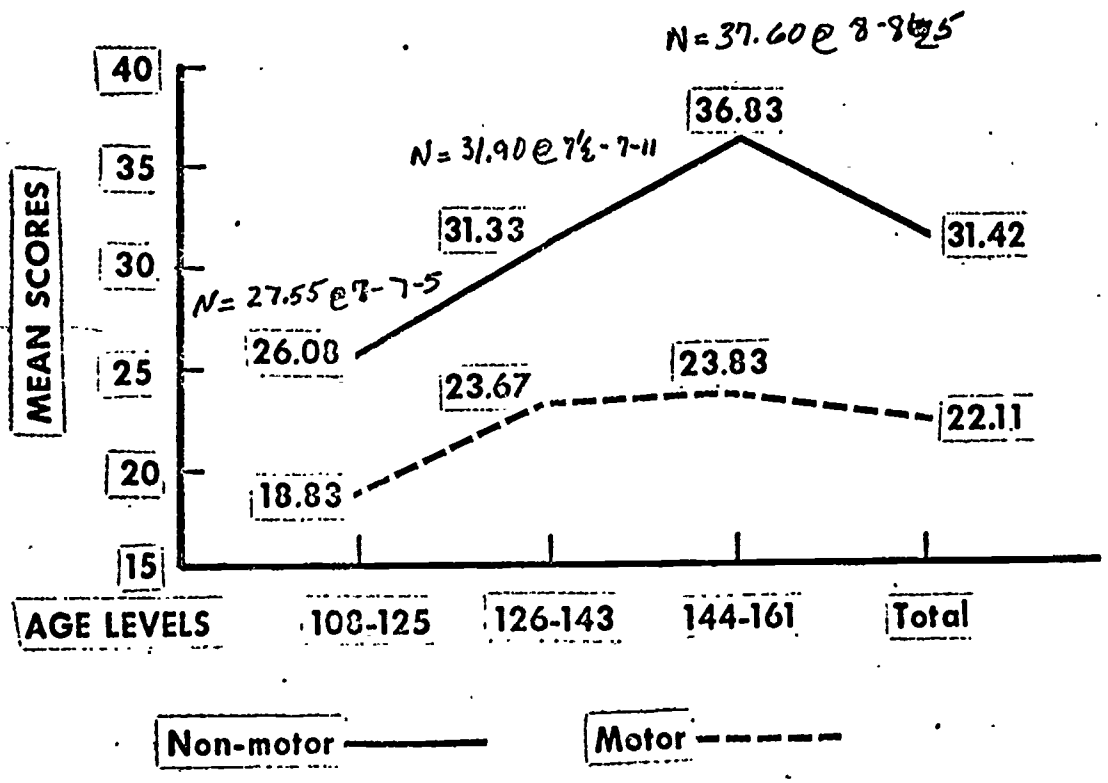
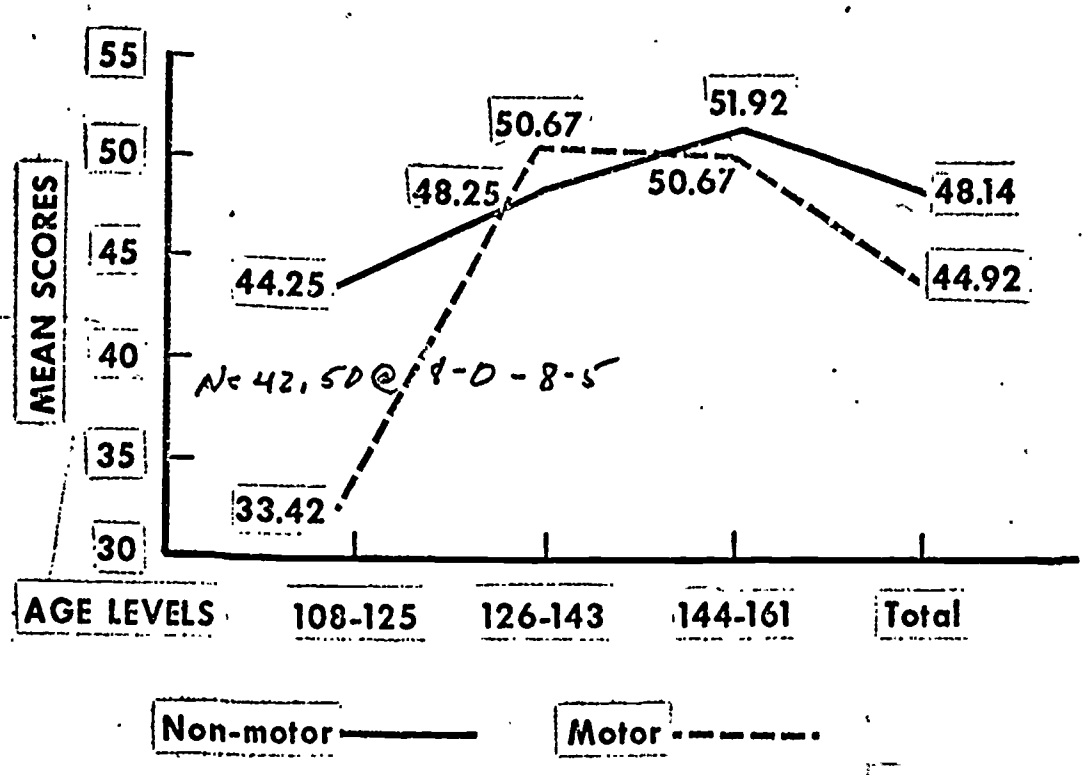


Figure 4: Mean Scores for auditory synthesis. (n = 72)



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SLIDE 3 ON

An F ratio of 9.19 was statistically significant at the .01 level indicating that there is a significant main effect for motor impairment. Likewise it can be seen that there is a significant main effect for age, with an F ratio of 8.86 being statistically significant at the .01 level. With an increase in age of the subjects there was an increase in their performance when both auditory tests (analysis and synthesis) were combined. Other significant results noted are the analysis versus synthesis scores with a F ratio of 280.47 being significant

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SLIDE 4 ON

When testing the mean difference of analysis scores for both groups a t-score of 2.58 was found to be statistically significant at the .01 level. It may be noted from the slide that the non-motor group skill in analysis was increasing with age even through this increase was not statistically significant between successive age groups. Likewise you will note that the motor group was making little or no improvement with an increase in age. Raw scores for both groups did not approach ceiling. However the analysis mean for group III of the non-motor subjects were almost identical to mean scores of non-lip children aged 8-8-5.

SLIDE OFF

SLIDE 5 ON

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TABLE I
Subjects

| Age in Months | Non/Motor | Motor | N = 72 |
|---|---|---|---|
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| 126–143 | 12 | 12 | 24 |
| 144–161 | 12 | 12 | 24 |

# PHONIC ABILITY TEST
(Gray)

| Synthesis | | 2 pts. | 1 pt. |
|---|---|---|---|
| 1. | boy | | |
| 2. | cow | | |
| 3. | ice | | |
| 4. | knee | | |
| 5. | toe | | |
| 6. | neck | | |
| 7. | fish | | |
| 8. | boat | | |
| 9. | dog | | |
| 10. | suit | | |
| 11. | glass | | |
| 12. | smoke | | |
| 13. | penny | | |
| 14. | dress | | |
| 15. | floor | | |
| 16. | parade | | |
| 17. | Sunday | | |
| 18. | rabbit | | |
| 19. | cracker | | |
| 20. | window | | |
| 21. | fifteen | | |
| 22. | potato | | |
| 23. | napkin | | |
| 24. | fireman | | |
| 25. | airplane | | |
| 26. | elephant | | |
| 27. | animals | | |
| 28. | woodpecker | | |
| 29. | pumpkin | | |
| 30. | children | | |

| Analysis | | 2 pts. | 1 pt. |
|---|---|---|---|
| 1. | pie | | |
| 2. | bee | | |
| 3. | tie | | |
| 4. | egg | | |
| 5. | ear | | |
| 6. | church | | |
| 7. | pig | | |
| 8. | cat | | |
| 9. | game | | |
| 10. | feet | | |
| 11. | paper | | |
| 12. | flag | | |
| 13. | paint | | |
| 14. | ladder | | |
| 15. | truck | | |
| 16. | plant | | |
| 17. | candy | | |
| 18. | circus | | |
| 19. | woman | | |
| 20. | lettuce | | |
| 21. | banana | | |
| 22. | soldiers | | |
| 23. | ice cream | | |
| 24. | reindeer | | |
| 25. | bluebird | | |
| 26. | umbrella | | |
| 27. | butterfly | | |
| 28. | telephone | | |
| 29. | yesterday | | |
| 30. | Christmas | | |

.Chi-square, 1953)

Duncan's Multiple Range Test (Edwards, 1960)
t-test for mean differences

ANALYSIS OF VARIANCE

| Source | df | ss | ms | F |
|---|---|---|---|---|
| Between-Subjects | 71 | 14,535.438 | | |
| Age | 2 | 2,722.667 | 1,361.333 | 8.86** |
| Motor | 1 | 1,412.507 | 1,412.507 | 9.19** |
| Age X Motor | 2 | 260.389 | 130.194 | .85 |
| Error | 66 | 10,139.875 | 153.634 | |
| Within-Subjects | 72 | 18,341.500 | | |
| Analysis/ Synthesis | 1 | 14,062.007 | 14,062.007 | 280.47** |
| Age X Test | 2 | 212.722 | 106.361 | 2.12 |
| Motor X Test | 1 | 333.062 | 333.062 | 6.64* |
| Interaction | 2 | 424.667 | 212.333 | 4.24* |
| Error | 66 | 3,309.042 | 50.137 | |
| Total | 143 | 32,876.938 | | |

*Statistically significant at the .05 level.
**Statistically significant at or beyond the .01 level.

Figure 3: Mean Scores for auditory analysis. (n = 72)

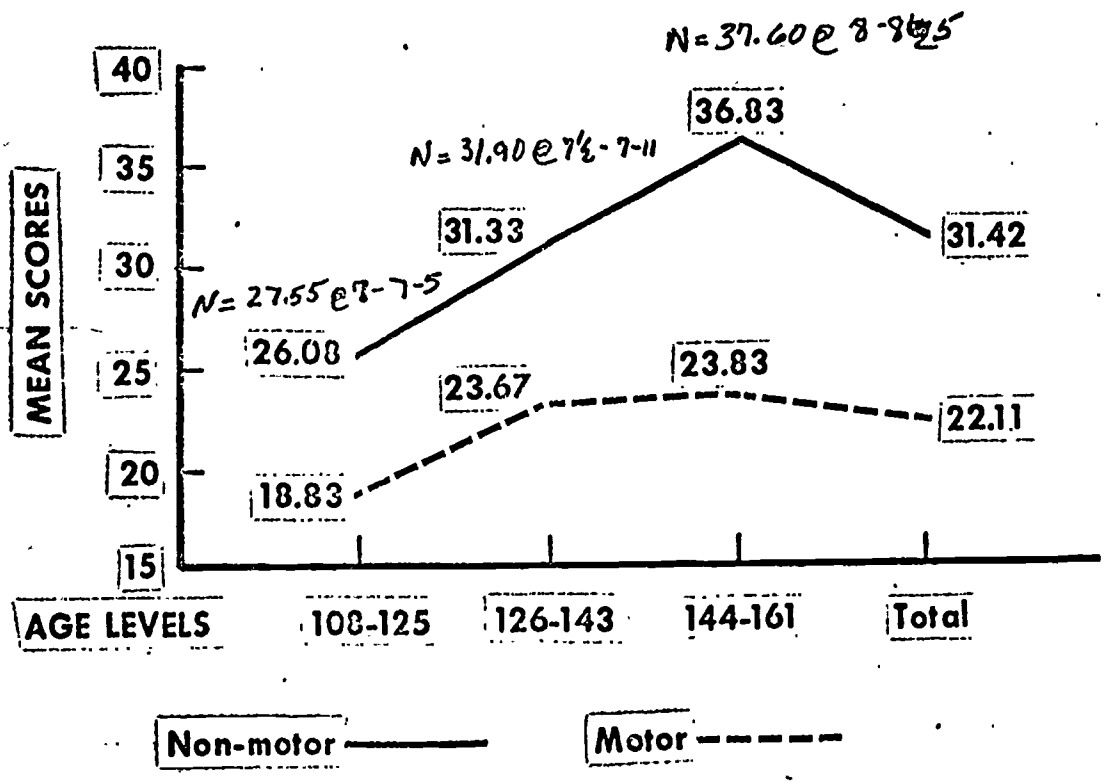

Figure 4: Mean Scores for auditory synthesis. (n = 72)