DOCUMENT RESUME

ED 105 478 CS 202 006

AUTHOR	Woodcock, Richard W.; Clark, Charlotte R.
TITLE	Comprehension of a Narrative Passage as a Function of Listening Rate, Recall Period, and IQ: Nashville Third and Sixth Grade Study. IMRID Papers and Reports, Volume IV, No. 17.
INSTITUTION	George Peabody Coll. for Teachers, Nashville, Tenn. Inst. on Mental Retardation and Intellectual Development.
SPONS AGENCY	National Inst. of Child Health and Human Development (NIH), Bethesda, Md.
PUB DATE	68
NOTE	20p.
EDRS PRICE	MF-$0.76 HC-$1.58 PLUS POSTAGE
DESCRIPTORS	Educational Research; Elementary Education; Grade 3; Grade 6; *Instructional Programs; *Intelligence Differences; Learning Theories; Listening; *Listening Comprehension; *Listening Skills; Listening Tests; *Time Factors (Learning); Verbal Learning
IDENTIFIERS	*Compressed Speech; Listening Rate

ABSTRACT

This study investigated learning through listening at rates ranging from 78 to 428 words per minute (wpm). The sample consisted of 117 elementary school children, from two levels of intelligence. Immediate and one-week retention data were gathered on each subject. Results of the study indicate that listening rates of 228 and 278 wpm are more efficient for learning and retention than the normal rate of 178 wpm. Subject with lower IQs performed better at rates which were slower than the better rates for higher IQ subjects. It was further observed that the performance curves obtained in this study display a secondary peak just prior to the final drop in performance at very high listening rates. This study provides evidence that high-speed listening can be an efficient learning medium for elementary school children; hence, the utilization of instructional programs, incorporating the medium of compressed speech, may prove to be highly effective. (Author)

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COMPREHENSION OF A NARRATIVE PASSAGE AS A FUNCTION OF LISTENING RATE, RECALL PERIOD, AND IQ: NASHVILLE THIRD AND SIXTH GRADE STUDY

by

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IMRID PAPERS AND REPORTS

Volume IV No. 17

1968

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Introduction

The primary avenues of learning in school are reading and listening. For many years extensive research has been conducted on learning through reading, and on the reading process itself. Only recently, however, has attention been focused on the problems involved in learning through listening. Ninety percent of the research on listening has been conducted since 1952 (Taylor, 1964). Wilt (1966) and Markgraf (1966) have concluded that over 50 percent of the time spent by students in school learning situations is devoted to listening. Yet, reading skills have received far more attention by educators than listening skills.

Perhaps the concentrated concern with children's reading is due to the fact that reading in school is a necessity for accomplishing the goals of education in the upper grades. By the middle grades children have begun to read as fast as the normal speech rate of 125 to 175 words per minute and from this point throughout life it is assumed that reading is a faster method of knowledge acquisition in many fields than is listening. Numerous children and adults have difficulty in reading. For the individual who does not read well, listening may be the primary medium for obtaining certain types of knowledge.

A frequent complaint of teachers is that children do not listen as they should. The attainment of information through listening at normal speaking rates of 125 to 175 words per minute, is a slow and sometimes boring process, yet a child is expected to utilize much of his school learning time in this manner. Nichols (1957) describes the inefficiency of learning through listening as a problem in which the brain, capable of processing messages at rates much faster than it receives them from the normal speaking rate, fills in time between

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*The research reported herein was supported by Grant HD 973 from the National Institute of Child Health and Human Development.

messages with other thoughts. If this is the case, two advantages may accrue to the learner presented spoken information at higher than normal speech rates: first, the obvious advantage of more information transmitted per unit of time; and second, the side effect of increased attention to the information as a result of its being presented at a rate nearer to the processing capability of the learner.

The technology of "time compressed recording" makes possible the reproduction of recorded materials at a faster-than-original rate of recording, but without the usual accompanying audio distortions. Rates on the order of 300 to 400 words per minute can easily be obtained through the process of compression. Rates slower than normal (such as, 75 words per minute) can be obtained through "time expanded recording". The time compression, or expansion, of recorded materials requires laboratory equipment which is available in very few locations in the United States. The technology, however, has arrived at the point where applications to education are feasible and worthy of further exploration.

Before specific applications to education can be proposed, however, there needs to be more research conducted with children. Most of the experimentation to date has been with adults. The few studies reported with children are difficult to compare due to the diversity of materials and procedures. Most of the studies dealing with comprehension, rate and subject differences report findings in terms of percent of comprehension and/or retention at a specific rate of compression or expansion. Foulke, Amster, Nolan, & Bixler (1962), in studying the effects of compressed speech with blind children in grades six through eight, found 90 percent comprehension of a scientific and of a literary passage at a rate of 275 words per minute. Wood (1965) reported that comprehension of short imperative sentences exceeded 90 percent up to a speed of 350 words per minute with average superior and very superior children in grades one, three and five.

Some of the studies report a specific rate as best for comprehension. Spicker (1963) studied normal and educable retarded children with comparable mental ages. He concluded that narrative materials presented at rates of 125 words per minute for the retarded and 175 words per minute for the normal group were better comprehended and retained than materials presented at rates of 225 or 275 words per minute. Fergen (1954) found 130 words per minute the most effective speed for comprehension of narrative passages by children in grades four, five, and six.

Only Spicker found significant differences in retention due to intelligence. The ambiguity in best speeds for good comprehension is possibly due to differences in subjects, materials and methods of compression. Fergen (1954) did her study before the technology of sampling for compression. Wood (1965) used short imperative sentences such as "Rub one of your elbows." and based comprehension on the child's ability to do what he heard. Foulke et al. (1962) used blind subjects whose main learning avenue is through listening. Spicker (1963) found 125 and 175 words per minute to be the best speeds for comprehension and retention of narrative passages in his samplings of retarded children and normal

children. Perhaps results would be more interpretable across studies if the amount of learning per unit of time were reported instead of percent of comprehension at particular speeds or favorable rates for good comprehension. None of the studies used a wide range of rates of compression and expansion. Though Wood used 10 rates ranging from 175 words per minute to 400 words per minute, there were no expanded rates. If the speed of presentation of materials is a primary factor in the comprehension ability of children, as suggested by much of the research, then there is the need for determining the performance curve over a wide range of rates.

Purpose

The purpose of this study was to evaluate differences in comprehension among elementary school children who listened to a narrative passage presented at some rate of expansion or compression ranging from 78 words per minute (in increments of 50 words per minute) to 428 words per minute. The effects of learning through this medium were studied further in respect to immediacy of recall and to IQ differences. It was predicted that learning through listening would be less efficient at the lower and at the higher rates in contrast to listening at the intermediate rates used in this study. It was also predicted that delayed recall scores would be lower than immediate recall scores, and that comprehension and retention would not be functions of IQ when the experimental groups (sixth grade children with low average IQ and third grade children with high average IQ) had comparable mental ages. No interactions among rate, recall period, or intelligence were predicted. The immediate and delayed recall criterion measures were obtained from two alternate forms of a 28-item multiple choice test covering the contents of a narrative passage.

Method

Subjects

Subjects were drawn from two populations in respect to intelligence. Fifty-six students of low average and below average IQs were selected from the sixth grade classes of Glenview and Inglewood Elementary Schools in Nashville. The second sample, containing 61 students, was drawn from a population of high average and above average IQ children in the third grade classes of the same two schools. These two samples were of comparable mental ages with all subjects falling within a range of 9 years and 4 months to 11 years and 3 months as measured by the Peabody Picture Vocabulary Test (PPVT) (Dunn, 1959). The subjects from both IQ levels were randomly assigned into treatment groups. These groups included the experimental groups listening at rates of 78, 128, 178, 228, 278, 328, 378 and 428 words per minute, and a comparison group at each IQ level which was administered the tests over the passage contents without having listened to the passages. Table 1 presents a statistical description of these 18 treatment groups. None of the 117 subjects had had previous experience with expanded or compressed speech.

Table 1 about here

Materials and Apparatus

The materials used in this study were comprised of the three Standardized Listening Passages and associated tests prepared by Clark and Woodcock (1967). The contents of the three passages are concerned with the historical legendary figures of Marco Polo, Dick Whittington, and Roland. The first two passages were used for training and familiarization purposes. The "Roland" passage was used for obtaining the criterion data.

The "Marco Polo" passage is 1,053 words in length and the listening time is 6.0 minutes at the original recorded rate of 178 words per minute. "Dick Whittington and His Cat" is 1,470 words in length and requires 7.9 minutes at the 178 words per minute rate. The "Roland" passage is 2,807 words in length and requires 15.0 minutes of listening time at the 178 words per minute rate. Upon re-recording, at expanded or compressed rates, the listening times of the passages are changed proportionately. Table 2 indicates listening time for the "Roland" passage at each of the eight rates used in this study.

Table 2 about here

Multiple choice tests covering the passage contents are available for each passage and were used in this study. The tests over the two training passages are each ten items in length. Two alternate forms of a 28-item test are available for use with the "Roland" passage. A full description of the Standardized Listening Passages, their development, and the standard procedure followed in their administration is included in the reference cited above.

The text of the Standardized Listening Passages (SLP) and tests were originally recorded in the studios of the American Printing House for the Blind in Louisville, Kentucky. The instructions to the subjects, the passages and the tests were read by Mr. Livingston Gilbert, a professional reader in those studios. The three passages, but not the instructions or tests, were re-recorded at the various rates of expansion and compression by Dr. Emerson Foulke in the Center for Rate Controlled Recordings at the University of Louisville. The compressed and expanded recordings were prepared on the Center's Tempo-Regulator, in its modified state as of May 1967.

The contents of the experimental tapes were assembled in their final

form at the Bill Wilkerson Hearing and Speech Center in Nashville, using high quality Ampex tape equipment. Each SLP tape consists of the following portions:

1. Instructions to the subject regarding the earphones and adjustment of volume to each ear.

2. Instructions regarding the listening task to be presented.

3. The passage at the appropriate words per minute rate.

4. Instructions to the subject for taking the test.

5. The multiple choice test over the contents of the passage.

The SLP tapes used with the comparison groups who were administered "tests only", do not include sections "2" and "3" above. All instructions and tests are presented at the normal speech rate on the SLP tapes--the passage section of a tape is the only portion which is compressed or expanded.

The SLP tapes were played on a Model T-1500 Wollensak tape recorder. The volume control of the tape recorder was set at "7" and the tone control at "Hi Fi". The output of the tape recorder was taken from its external speaker jack and fed by cable into a specially constructed junction box. These junction boxes provide jacks for four sets of earphones and a pair of 50,000 ohm volume controls for each set. Subjects listened through 10,000 ohm padded high-fidelity stereo earphones.

The experimental subjects were seated in groups of four with each group sharing a common junction box. A 1' x 2' Masonite screen was placed between each pair of subjects sitting face-to-face. This was done to minimize the opportunity to copy during the testing portion of the SLP procedure.

Procedure

Figure 1 portrays the design of the study. Eighteen groups of subjects were used in this study, nine groups at each of two levels of intelligence. The "high IQ" subjects were drawn from third grade classes, the "low IQ" subjects were drawn from sixth grade classes. The mental age range of the subjects from both IQ levels was between 9 years and 4 months to 11 years and 3 months inclusive. Criterion data were obtained immediately after listening to the "Roland" passage and again one week later.

Figure 1 about here

The sequence of steps in selecting subjects, conducting the two training sessions and the experimental sessions was as follows:

1. The pupils enrolled in the third and sixth grade classes in two elementary schools were administered Form B of the PPVT. The standardized procedure for administering this test was modified in order to allow group administration. Each subject was given a set of the PPVT plates and a specially prepared answer sheet. The subject was instructed to draw a circle around the number of the picture in each plate which corresponded to the stimulus word given by the examiner. Several plates, beginning with No. 25, were administered for practice purposes. Any needed assistance was given the subjects until all understood the procedure. The examiner then instructed the subjects to turn to Plate No. 50 and all items were administered from Plate No. 50 through Plate No. 120.

2. The answer sheets were scored in the usual manner. All subjects receiving a raw score of 73 to 84 inclusive were used as experimental subjects.

3. The subjects were randomly assigned into the nine treatment groups at each level.

4. On the following day the subjects were brought, in groups of four or eight, to the library of their school where the experimental apparatus had been arranged. The subjects were seated in groups of four and told that they would be coming into the library for two or three days to work with the experimenters. They were told they would listen to a story through the earphones and were shown their volume controls. Subjects were then instructed to put on the earphones. From this time to the end of each training or experimental session, all instructions to the subjects were contained on the SLP tape.

5. The SLP tape for the first training session ("Marco Polo") was played. The listening time ranged from 2.5 to 13.7 minutes, depending upon the rate of compression or expansion. The experimenters distributed a copy of the test and a pencil to each subject during the presentation of instructions for the test. The test items were presented simultaneously on the tape as the subjects followed on their printed test form and selected answers. At the completion of the test, the SLP tape instructed the subjects to remove their phones. The subjects were returned to their classrooms. The entire listening time, from putting on earphones to taking off the earphones, was approximately eight minutes more than the listening time for the passage. Thus, in the first training session, there was a total listening time ranging from approximately 10.5 to 21.5 minutes.

The comparison groups followed the same procedure except their

SLP tape instructions went directly from the adjustment of earphones into the test instructions and the test, bypassing any reference to the listening passage and the passage itself.

6. The same procedure was repeated on the second day, using the "Dick Whittington and His Cat" SLP tapes. The listening time for the passage ranged from 3.2 to 18.0 minutes, depending on the rate. The total time for the session required eight minutes in addition to the listening time for the passage.

7. The same procedure, now well established, was repeated the third day. The subjects listened to the "Roland" passage, but were unaware that this day had any other significance than the two preceding days. The listening time for the "Roland" passage ranged from 6.2 to 34.2 minutes. The total time required for the session was an additional 15 minutes. The additional time was longer for the "Roland" tapes since the test contained 28 rather than 10 items.

8. All subjects were administered Form B of the "Roland" test one week later. The procedure was the same as before, except none of the subjects listened to the passage.

9. The criterion tests were scored by the experimenters. Raw scores were converted into normalized T-scores using the norms provided by Clark and Woodcock (1967).

Results

Table 1 shows the mean CA, MA, and IQ for each of the treatment groups, and for treatment groups combined within each of the two IQ levels. Since the subjects were "matched" on mental age, i.e., selected from populations with mental ages between 9 years 4 months and 11 years 3 months, the mean mental ages for the two IQ levels should be approximately the same. Table 3 presents the results of an analysis of variance of the mental ages of the treatment groups. A statistically significant difference in mental ages was obtained ($p < .001$), thus, the assumption of comparable mental ages for the two IQ levels cannot be accepted. An examination of the data indicates that this difference is accounted for by mean mental ages which run seven months lower for the "High IQ" group than for the other level. Some caution is thus indicated in interpreting the results of this study with respect to comparing performances across the two IQ levels.

Table 3 here

Table 4 presents the immediate and one-week criterion data for each of the treatment groups. The data are reported as mean T-scores for each group. Figure 2 graphically portrays the immediate retention data and Figure 3 portrays the one-week retention data. These criterion data were analyzed by a Lindquist Type III analysis of variance. Table 5 presents the results of this analysis. Significant differences were found which are attributable to IQ level ($p=.016$), to rate ($p .001$) and to retention period ($p .001$). There was also a significant rate by retention period interaction ($p=.003$). This interaction appears due to means at the higher listening rates, both immediate and one-week, being chance scores. At lower wpm rates, these means are higher than chance and the immediate retention mean is always higher than the corresponding one-week retention mean. There were no significant differences at the .05 level due to other interactions.

Table 4

Figure 2

Figure 3

Table 5

Discussion

The results of this study were essentially as predicted, though at first glance the performance curves seem to criss-cross erratically. The clearest picture of the typical curve can be seen by examining the immediate retention curve in Figure 2 for the "High IQ" group. The performance of this group begins relatively low and builds up to a peak at 128 wpm. The curve then drops to a low at 278 wpm. At this point an interesting phenomenon occurs. There is an increase in performance

across the rates of 328 and 378 wpm before the final dropping off at 428 wpm to a level of performance comparable to the "Test Only" group. Similar performance curves are noted at the other IQ level, and for the one-week retention curves. The absence of data in this study for rates lower than 78 wpm obscures the picture somewhat since 78 wpm does not seem to be slow enough to demonstrate a drop in performance with "Low IQ" subjects. (The authors have obtained data in other studies at rates of 53 and 65 wpm and have observed the expected lower performance both with "Average IQ" and mentally retarded subjects.)

Two other observations regarding the performance curves may be significant. First, there is a tendency for these curves to be displaced toward the left (toward slower wpm rates) for the lower IQ level. This suggests that, with the same material, slower rates are more effective for children with lower IQs. Second, there is a tendency for these curves to be displaced upward (higher overall scores) for the lower IQ level. This chara-teristic may be attributable to the fact that the lower IQ subjects are in a higher grade, are older, and thus, have had more experience in learning situations involving materials of this general nature and level of difficulty.

The T-scores for both IQ levels tend to be highest in the 78 to 178 wpm region and move downward to 428 wpm. Such curves, as those in Figures 2 and 3, do not reflect the time spent in learning by groups listening at different rates. From an educational point of view, it is pertinent to evaluate these results with respect to efficiency of learning at the various rates. Such comparisons are possible by calculating Learning Efficiency Indexes based upon the amount of learning per unit of learning time. The formula used in this study for calculating these indexes is as follows:

$$\text{Learning Efficiency Index} = \frac{\text{Treatment Mean} - \text{"Test Only" Mean}}{\text{Listening Time in Minutes}}$$

Table 6 presents Learning Efficiency Indexes for immediate and one-week criterion data. Figure 4 portrays the Learning Efficiency Indexes for the one-week retention data.

Table 6

Figure 4

When the curves in Figure 4 are contrasted with the curves in Figure 3, a different picture emerges. Rather than the lower rates appearing best as they do in Figure 4, rates on the order of 228 and 278 wpm emerge as the more efficient rates at which to present information. Though the normal and expanded rates of presentation (178, 128, and 78 wpm) have higher test scores associated with them, they appear as relatively inefficient listening rates when analyzed in respect to amount of learning per unit of time.

Summary

This study investigated learning through listening at rates ranging from 78 to 428 wpm. One hundred seventeen elementary school children, from two levels of intelligence, comprised the sample. Immediate and one-week retention data were gathered on each subject. Results of the study indicate that listening rates of 228 and 278 wpm are more efficient for learning and retention than the normal rate of 178 wpm. Subjects with lower IQs performed better at rates which were slower than the better rates for higher IQ subjects. It was further observed that the performance curves obtained in this study display a secondary peak just prior to the final drop in performance at very high listening rates. This study provides evidence that high-speed listening can be an efficient learning medium for elementary school children; hence, the utilization of instructional programs, incorporating the medium of compressed speech, may prove to be highly effective.

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Table 1

Mean CA, MA, and IQ for Each

of the 18 Treatment Groups

Rate in WPM	"High" IQ				"Low" IQ			
	n	CA	MA	IQ	n	CA	MA	IQ
78	7	107	119	107	7	147	123	89
128	7	106	118	108	6	145	126	90
178	5	103	118	110	7	149	126	88
228	7	107	123	112	5	142	127	92
278	7	107	121	111	7	143	126	91
328	7	106	117	105	6	145	127	91
378	7	108	121	109	5	147	124	87
428	7	108	121	108	6	142	129	94
Test Only	7	107	117	106	7	150	126	87
Total	61	107	119	108	56	146	126	90

Table 2

Listening Time in Minutes for the Roland Passage at Each Presentation Rate

Rate in WPM:	78	128	178	228	278	328	378	428
Listening Time:	34.2	20.9	15.0	11.7	9.6	8.1	7.1	6.2

Table 3

Analysis of Variance: Mental Ages of the Treatment Group

Source	df	MS	F	P
IQ Level (A)	1	1182.5	34.446	0.001
Rate (B)	8	38.2	1.114	0.360
AB	8	32.2		
Subjects/AB	108	34.3		
Total	125	43.6		

Table 4

Mean Immediate and One-week Retention T-Scores

by IQ Level and Rate of Presentation

Rate in WPM	High IQ		Low IQ	
	Immediate	One-week	Immediate	One-week
78	48.3	43.6	55.6	52.1
128	51.0	45.9	51.6	44.6
178	48.0	43.0	46.4	42.1
228	44.7	43.9	48.0	46.1
278	39.0	38.3	46.9	44.9
328	39.6	40.3	41.3	40.4
378	40.1	39.4	38.7	40.7
428	34.9	35.1	36.7	39.7
Test Only	37.7	35.3	36.4	38.7

Table 5

Analysis of Variance: Immediate and One-week Retention T-Scores

Source	df	MS	F	P
IQ Level (B)	1	359.6	6.020	0.016
Rate (C)	8	628.7	10.526	0.001
BC	8	74.6	1.249	0.278
Subjects/BC	108	59.7		
Retention	1	183.5	12.050	0.001
AB	1	8.0		
AC	8	48.6	3.195	0.003
ABC	8	9.4		
A x Subjects/BC	108	15.2		
Total	251	58.7		

Table 6

Efficiency Indexes: Immediate and One-week Retention T-Scores by IQ Level and Rate of Retention

Rate in WPM	Listening Time in Minutes	High IQ		Low IQ	
		Immediate	One-week	Immediate	One-week
78	34.2	.31	.24	.56	.39
128	20.9	.64	.51	.73	.28
178	15.0	.69	.51	.67	.23
228	11.7	.60	.74	.99	.63
278	9.6	.14	.31	1.09	.65
328	8.1	.23	.62	.60	.21
378	7.1	.34	.58	.32	.28
428	6.2	-.45	-.03	.05	.16
Test Only	0.0	.00	.00	.00	.00

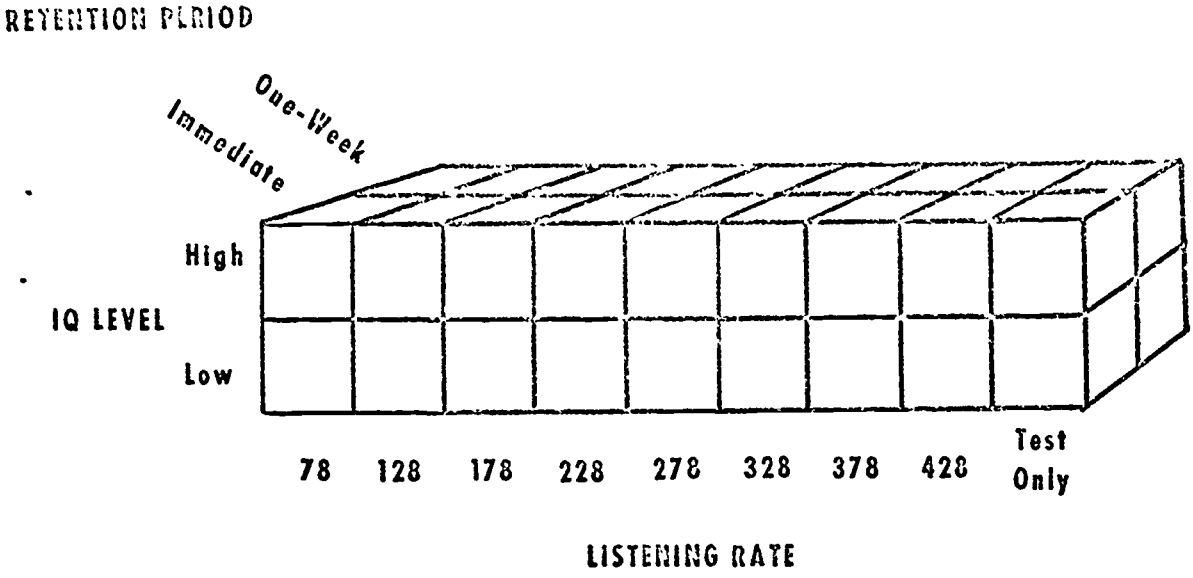

Figure 1. Design of the Study

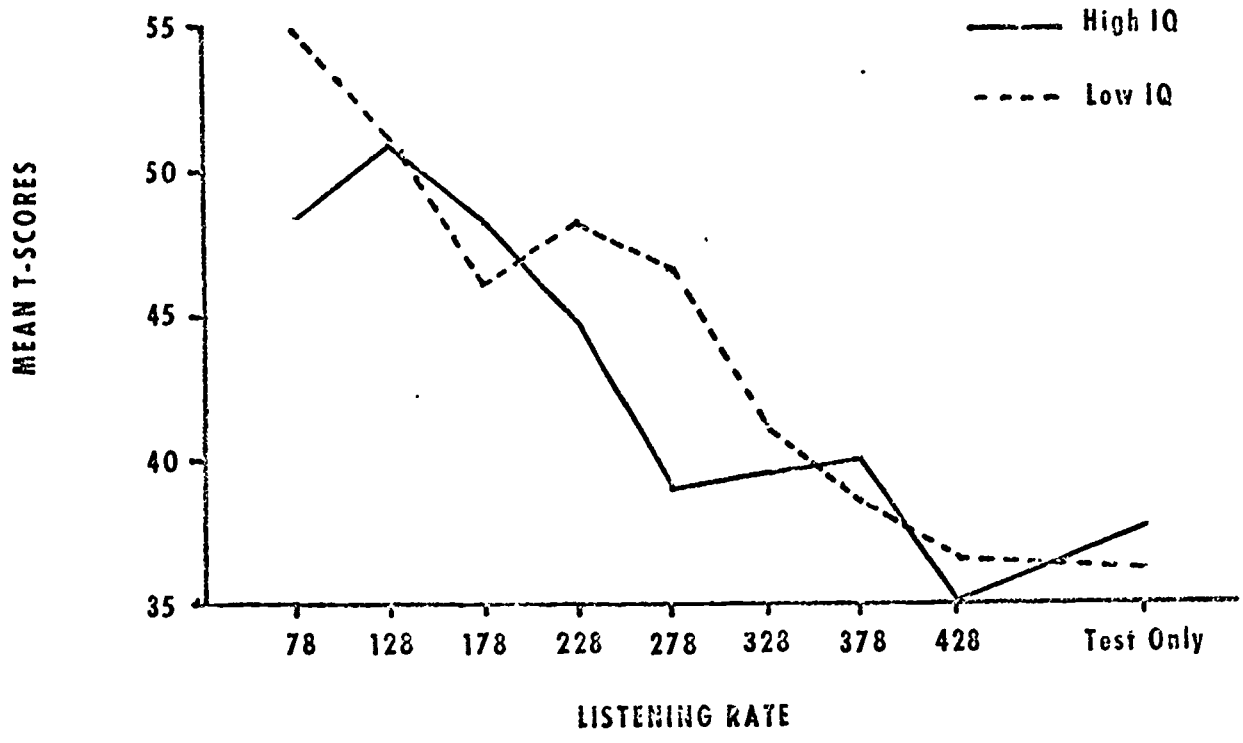

Figure 2. Immediate Retention T-Scores for the Two IQ Levels

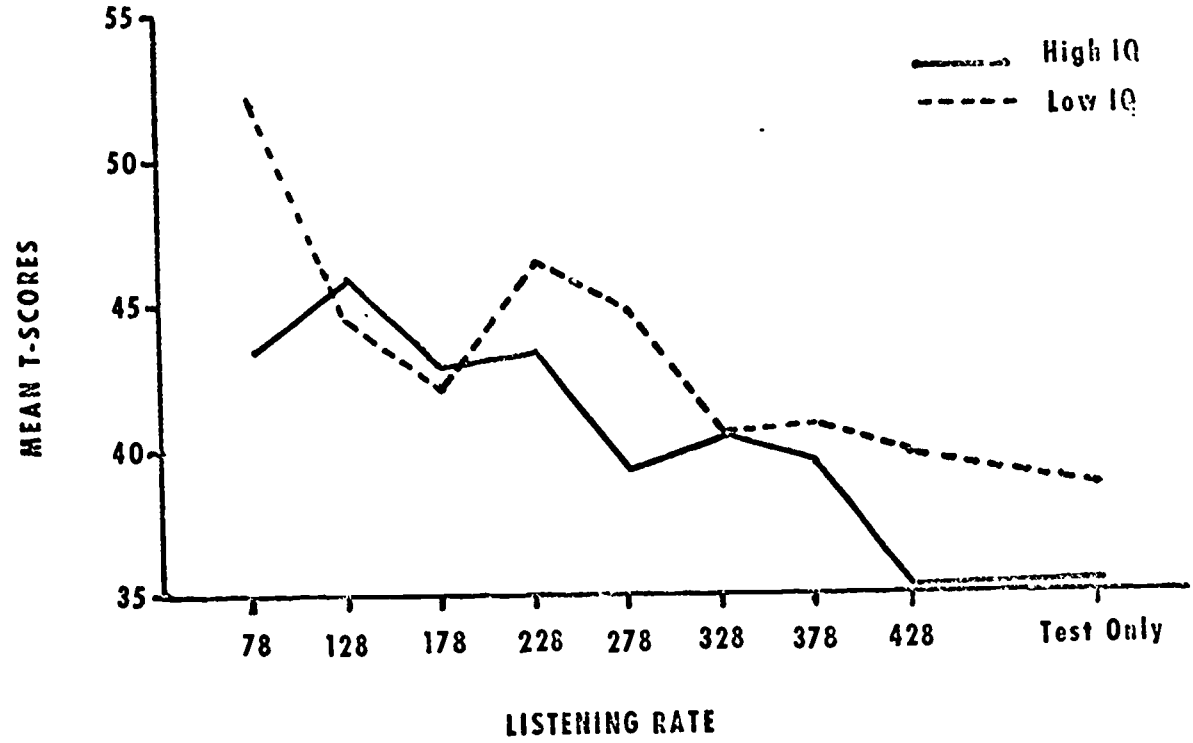

Figure 3. One-week Retention T-Scores for the Two IQ Levels

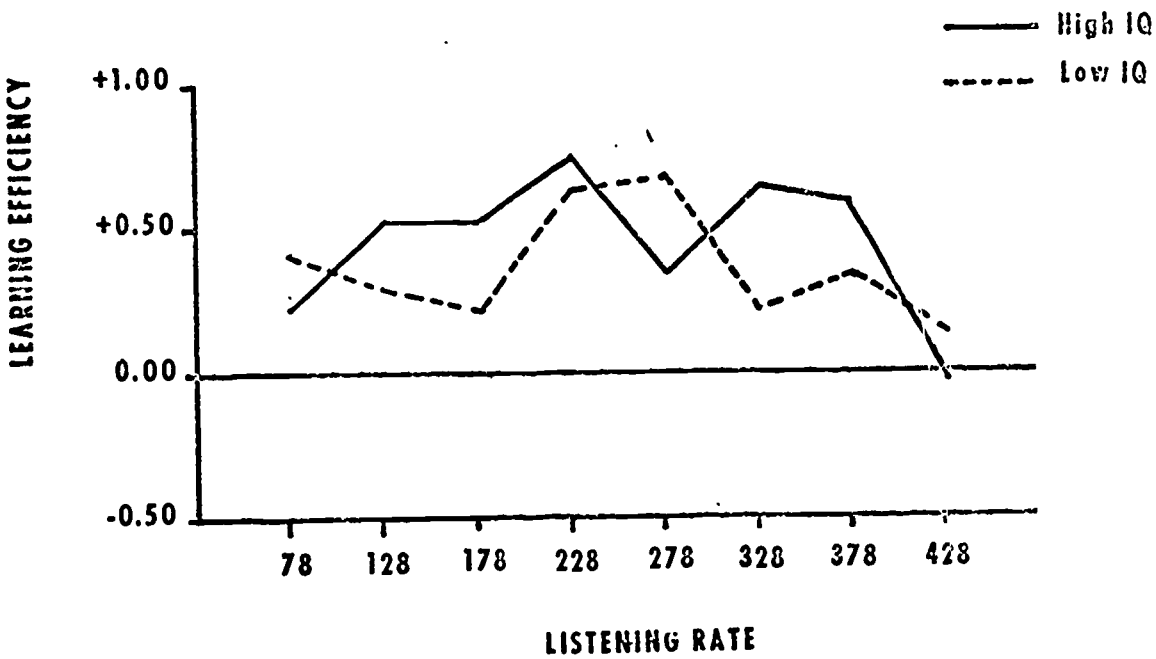

Figure 4. One-week Retention Efficiency Indexes for the Two IQ Levels