DOCUMENT RESUME

ED 105 413 CS 001 739

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TITLE Comprehension of a Narrative Passage by Elementary School Children as a Function of Listening Rate, Retention Period, and IQ. IMRID Papers and Reports, Volume V, No. 2.
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 23p.

EDRS PRICE MF-$0.76 HC-$1.58 PLUS POSTAGE
DESCRIPTORS Aural Learning; *Educational Research; Elementary Education; *Intelligence; *Listening Comprehension; Listening Skills; *Speech Compression

ABSTRACT

The purpose of this study was to evaluate differences in comprehension among elementary school children who listened to a narrative passage presented at different rates of expansion or compression. Subjects were drawn from three populations with respect to intelligence. The three levels of intelligence were low (IQs ranging from 74 to 98), average (90 to 110), and high (102 to 121). The subjects were randomly assigned to nine treatment groups containing six subjects each. These groups listened at rates of 78, 128, 178, 228, 278, 328, 378, and 428 words per minute (wpm). A comparison group was administered the tests covering passage content without having listened to the passages. The materials used in the study were the three Standardized Listening Passages and associated tests prepared by Clark and Woodcock (1967). Immediate and one-week retention data were gathered on each subject. The results indicated that listening rates of 228 to 328 wpm were 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 most efficient rates for higher IQ subjects, and performance curves displayed a secondary peak just prior to the final drop in performance at very high listening rates. (WR)

IMRID Papers and Reports--Volume V, No. 2--1968

COMPREHENSION OF A NARRATIVE PASSAGE BY ELEMENTARY SCHOOL CHILDREN AS A FUNCTION OF LISTENING RATE, RETENTION PERIOD, AND IQ[1]

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Primary avenues of learning in school are reading and listening. For many years an extensive number of studies has been conducted on reading. Only recently, however, has attention been focused on the problems involved in learning through listening; in fact, Taylor (1964) reports that 90 percent of the investigations on listening have been conducted since 1952. On any count, listening skills have received far less attention from researchers than reading skills, even though more than 50 percent of the time spent by students in school learning situations is devoted to listening (Wilt, 1966; Markgraf 1966).

Teachers frequently complain that even bright children learn little by listening. Apparently the attainment of information through listening at normal speaking rates of 125 to 175 words per minute tends to be a tedious process for some children. Yet all children are expected to spend much of their school learning time in this manner. Nichols (1957) describes the inefficiency of learning through listening as a problem in which the brain of many listeners, capable of processing message at rates much faster than it receives them from the normal speaking rate, fills in time between messages with other thoughts. If this is the case, two

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

advantages may accrue to many learners when they are presented spoken information at higher than normal speech rates: (1) the obvious advantage of more information transmitted per unit of time; and (2) the side effect of increased attention to the information as a result of its being presented at a rate nearer to the learner's processing capability. For slow children, perhaps the normal rates of 150 to 175 words per minute are so fast that they are not able to comprehend the material. Thus, it is suggested that different speeds of presentation may be needed by children of different abilities.

The technology of "time compressed and expanded recording" makes possible the reproduction of recorded materials at faster and slower rates of recording 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 also be obtained. The time compression, or expansion, of recorded materials requires laboratory equipment which is available in very few locations in the United States, however, the technology has advanced to the point where applications to education are now feasible and worthy of further exploration.

Before specific applications can be proposed and developed, more research needs to be 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 their diversity of materials and procedures, and to their limited scope. Comprehensive studies are needed to investigate the school child's performance across a wide range

of listening rates, both expanded and compressed. These studies need to provide data regarding the effectiveness of this method of auditory learning by children at various age and intelligence levels. Furthermore, retention as well as immediate recall of materials learned through the medium of compressed speech needs to be evaluated. As the results of such studies become available, they will provide a basis upon which educators can make decisions regarding practical applications of compressed and expanded speech to school learning.

Purpose

The purpose of this study was to evaluate differences in comprehension among elementary school children who listened to a narrative passage presented at different rates 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 retention time and IQ differences. Figure 1 portrays the design of the study.

Figure 1 about here

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 one-week retention scores would be lower than immediate retention scores, and that retention would not be a function of IQ when the experimental groups (sixth grade children with "low" IQ, fifth grade children with

"average" IQ, and third grade children with "high" IQ) had comparable mental ages. The null hypothesis of no interactions among rate, retention period, or intelligence was predicted. The immediate and one-week retention measures were obtained from two alternate forms of a 28-item multiple choice test covering the contents of the narrative passage.

Method

Subjects

Subjects were drawn from three populations with respect to intelligence. A sample of 54 students having IQs ranging from 74-98 were selected from several sixth grade classes of the Metropolitan Nashville Schools in the spring of 1967. This sample comprised the "Low IQ" group in this study. A sample of 54 "High IQ" subjects, with IQs ranging from 102-121, was drawn from third grade classes at the same time. The sample of 54 students having "Average IQs" (90-110) was drawn from fifth grade classes during the fall of 1967. All three of the samples were of comparable mental age, with all subjects falling within a range of 9 years 4 months (9-4) to 11 years 3 months (11-3) as measured by the Peabody Picture Vocabulary Test (PPVT) (Dunn, 1959). The subjects from each of the three IQ levels were randomly assigned into nine treatment groups containing six subjects each. These groups listened at rates of 78, 128, 178, 228, 278, 328, 378, and 428 words per minute (wpm). A comparison group was administered the tests over the passage contents without having listened to the passages. None of the 162 subjects had previous experience with expanded or compressed speech.

Materials and Apparatus

The materials used in this study were the three Standardized Listening Passages (SLP) 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 criterion data.

The "Marco Polo" passage is 1,053 words in length with a listening time of 6.0 minutes at the original recorded rate of 178 wpm. "Dick Whittington and His Cat" is 1,470 words in length and requires 7.9 minutes of listening time at the 178 wpm rate. The "Roland" passage is 2,807 words in length and requires 15.0 minutes of listening time at the 178 wpm rate. Upon re-recording, at expanded or compressed rates, the listening times of the passages were changed proportionately. Multiple choice tests covering the passage contents were used in this study. For the two training passages, each test was ten items in length. Two alternate forms of a 28-item test were used with the "Roland" passage.

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 wpm 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 did not listen to the passages, 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 an SLP tape is the only portion which is compressed or expanded.

Procedure

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

1. Pupils enrolled in the third, fifth, and sixth grade classes in several elementary schools were administered Form B of the PPVT. The standardized procedure for administering this test was modified in order to allow group administration.

2. The pupils meeting the mental age range criterion were randomly assigned into the nine treatment groups at each IQ level.

3. On the following day, subjects were brought, in groups of four or eight, to the library of their school where the experimental apparatus had been arranged. A 1' x 2' Masonite screen was placed between each pair of subjects sitting face-to-face to minimize the opportunity to copy during the testing portion of the procedure. The subjects were told they would listen to a story through the earphones. They were shown their volume controls and instructed to put on the earphones. From this time to the end of each session, all instructions to the subjects were contained on the tape.

4. The 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 earphones. The subjects returned to their classrooms. The entire listening time, from putting on earphones to taking off earphones, was approximately eight minutes more than the listening time for the passage. Thus, in the first training session, the total listening time ranged from 10.5 to 21.5 minutes.

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

6. 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.

7. 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.

8. 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 three 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 three IQ levels should be approximately the same. Table 2 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 three IQ levels cannot be accepted. An examination of the data indicates that this difference is primarily accounted for by a mean mental age which is five months lower for the "High IQ" group than for the other two levels. Some caution is thus indicated in interpreting the results of this study with respect to comparing performances across the three IQ levels.

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Table 1 here

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Table 2 here

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Table 3 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 4 presents the results of this analysis. Significant differences were found which are attributable to rate ($p<.001$) and to retention period ($p<.001$). There was also a significant rate by retention period interaction ($p<.001$). 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 IQ level, nor to the other interactions.

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Table 3

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Figure 2

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Figure 3

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Table 4

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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 levels, 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, except with "High 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 levels. 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 levels. This characteristic may be attributable to the fact that the lower IQ subjects are in higher grades, 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 all three IQ levels tend to be highest at the rates of 78 and 128 wpm 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 5 presents Learning Efficiency Indexes for immediate and one-week criterion data. The means for the "Test Only" groups were obtained from all available data rather than limited to the six subjects used in the analysis of variance. Figure 4 portrays the Learning Efficiency Indexes for the one-week retention data.

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 to 328 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 sixty-two elementary school children, from three 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 to 328 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 most efficient 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

27 Treatment Groups

Rate in WPM	"High" IQ			"Average" IQ			"Low" IQ		
	CA	MA	IQ	CA	MA	IQ	CA	MA	IQ
78	105	118	108	126	128	104	148	122	88
128	105	119	108	127	125	102	145	126	90
178	103	118	110	125	125	102	151	124	86
228	108	122	110	127	128	98	142	127	92
278	105	122	113	130	125	97	144	125	90
328	106	118	106	124	125	99	145	127	91
378	106	122	110	124	124	103	147	121	87
428	107	122	110	128	122	93	142	129	94
Test Only	106	118	108	124	124	100	150	124	87
Total	106	120	109	126	125	100	146	125	89

Table 2

Analysis of Variance: Mental Ages

of the Treatment Groups

Source	df	MS	F	p
IQ Level (A)	2	471.932	15.559	< 0.001
Rate (B)	8	22.696		
AB	16	29.321		
Subjects/AB	135	30.331		
Total	161	35.337		

Table 3

Mean Immediate and One-week Retention T-Scores

by IQ Level and Rate of Presentation

Rate in WPM	High IQ		Average IQ		Low IQ	
	Immediate	One-week	Immediate	One-week	Immediate	One-week
78	48.0	43.8	54.8	50.2	52.5	50.7
128	51.5	45.5	48.8	44.5	51.5	44.5
178	48.0	43.0	51.3	43.0	46.2	40.5
228	43.8	43.0	46.3	45.0	48.0	46.2
278	38.0	38.2	46.3	41.2	46.8	44.0
328	40.3	40.8	41.8	41.2	41.3	40.5
378	39.7	39.5	37.5	38.8	38.7	40.7
428	35.7	35.5	36.2	37.3	36.7	39.7
Test Only	36.5	37.7	36.0	35.8	37.5	38.3

Table 4

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

Source	df	MS	F	p
IQ Level (B)	2	116.753	1.790	0.169
Pate (C)	8	789.866	12.112	<0.001
BC	16	44.076		
Subjects/BC	135	65.212		
Retention (A)	1	287.114	21.051	<0.001
AB	2	6.827		
AC	8	74.482	5.461	<0.001
ABC	16	6.414		
A x Subjects/BC	135	13.639		
Total	323	58.519		

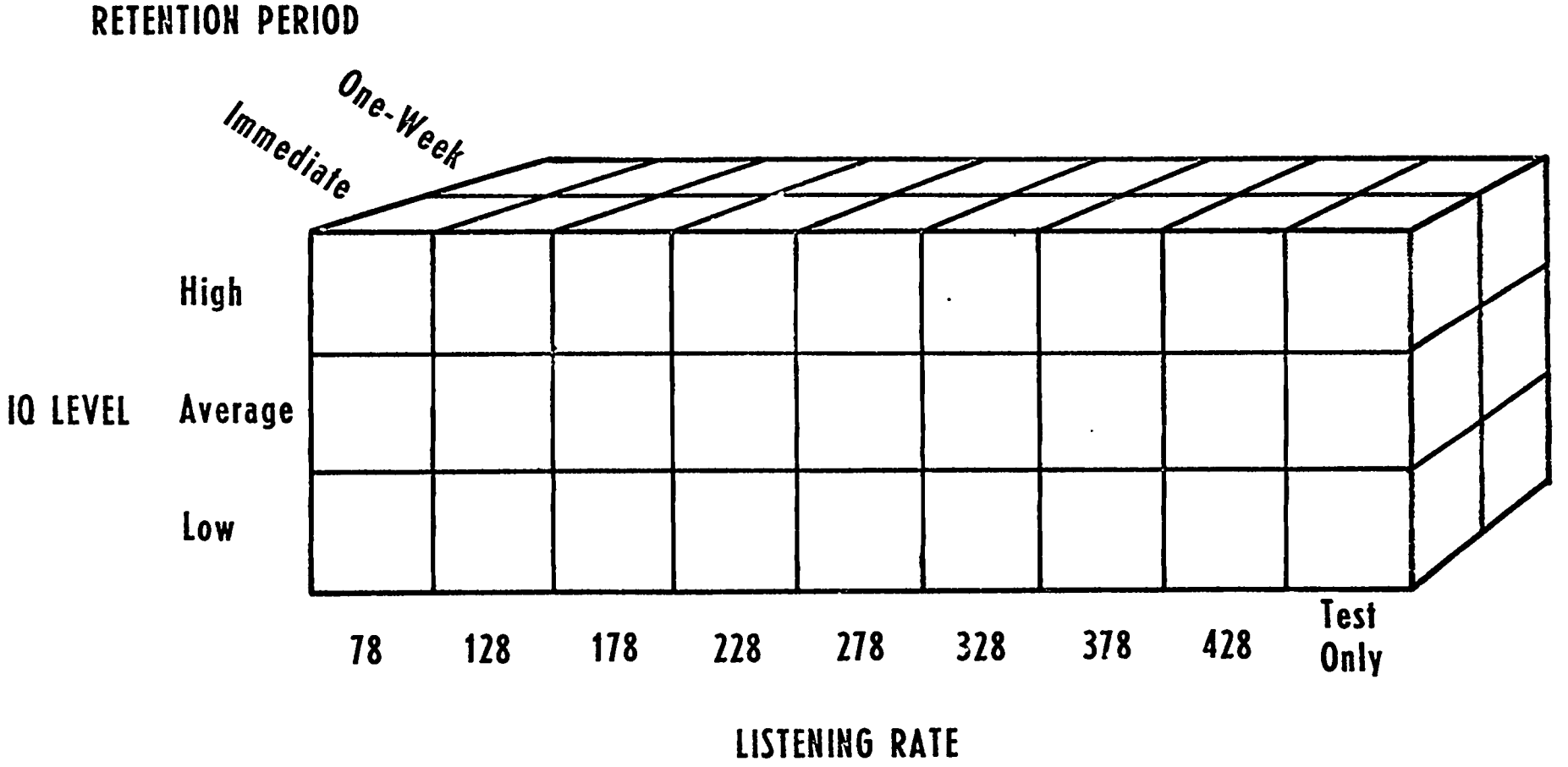

Figure 1. Design of the Study

Table 5

Efficiency Indexes: Immediate and One-week

Retention T-Scores by IQ Level and

Rate of Presentation

Rate in WPM	Listening Time in Minutes	High IQ		Average IQ		Low IQ	
		Immediate	One-week	Immediate	One-week	Immediate	One-week
78	34.2	.33	.22	.49	.37	.46	.40
128	20.9	.71	.44	.52	.33	.71	.35
178	15.0	.76	.45	.89	.36	.63	.23
228	11.7	.62	.57	.71	.63	.97	.78
278	9.6	.15	.20	.86	.38	1.05	.72
328	8.1	.46	.56	.47	.44	.57	.42
378	7.1	.44	.45	-.07	.17	.28	.51
428	6.2	-.15	-.13	-.29	-.05	.00	.42
Test Only	0.0	.00[1]	.00[2]	.00[3]	.00[4]	.00[5]	.00[6]

[1] $\overline{X}$ = 36.6, n = 9 [2] $\overline{X}$ = 36.3, n = 9 [3] $\overline{X}$ = 38.0, n = 14

[4] $\overline{X}$ = 37.6, n = 14 [5] $\overline{X}$ = 36.7, n = 10 [6] $\overline{X}$ = 37.1, n = 10

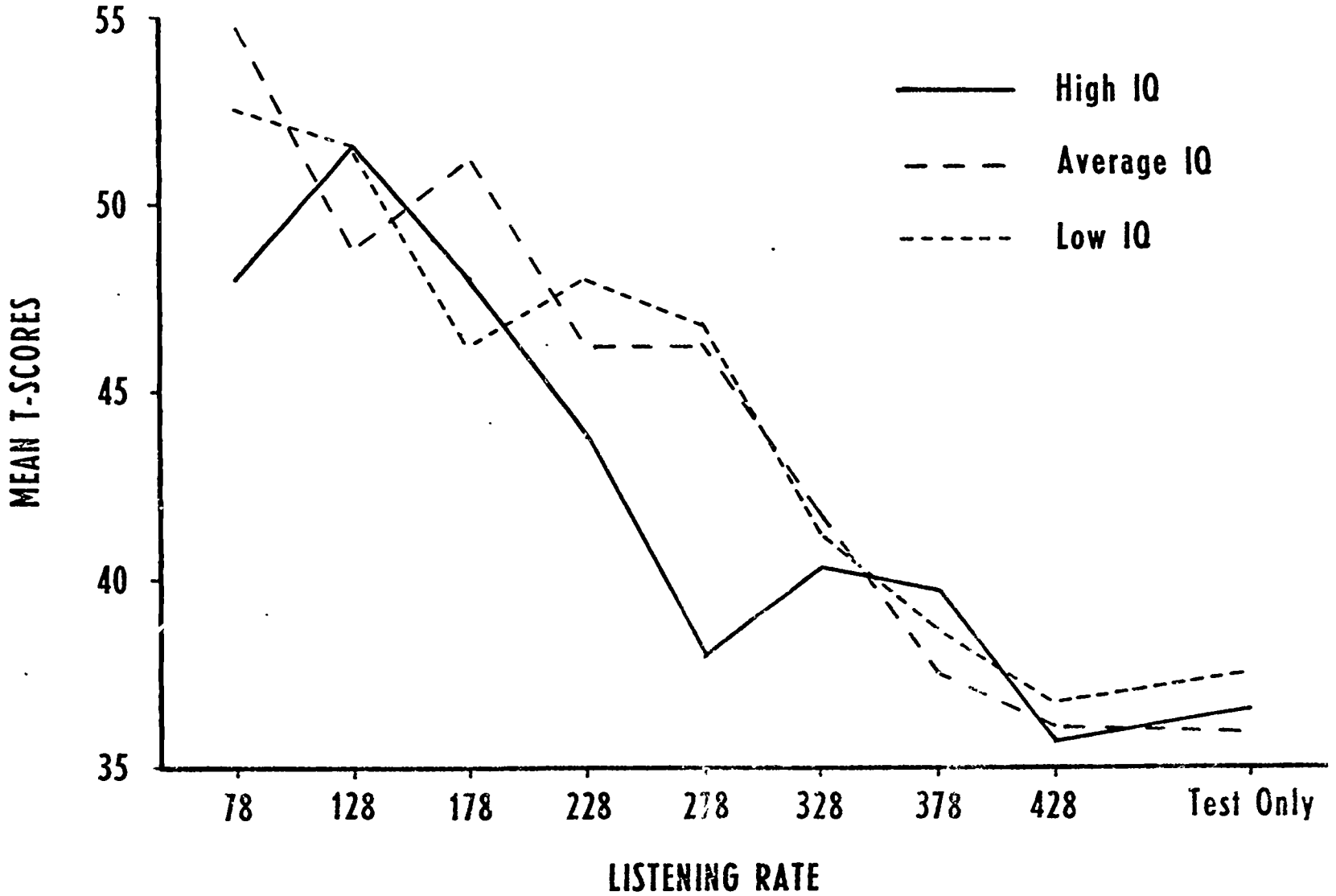

Figure 2. Immediate Retention T-Scores for the Three IQ Levels

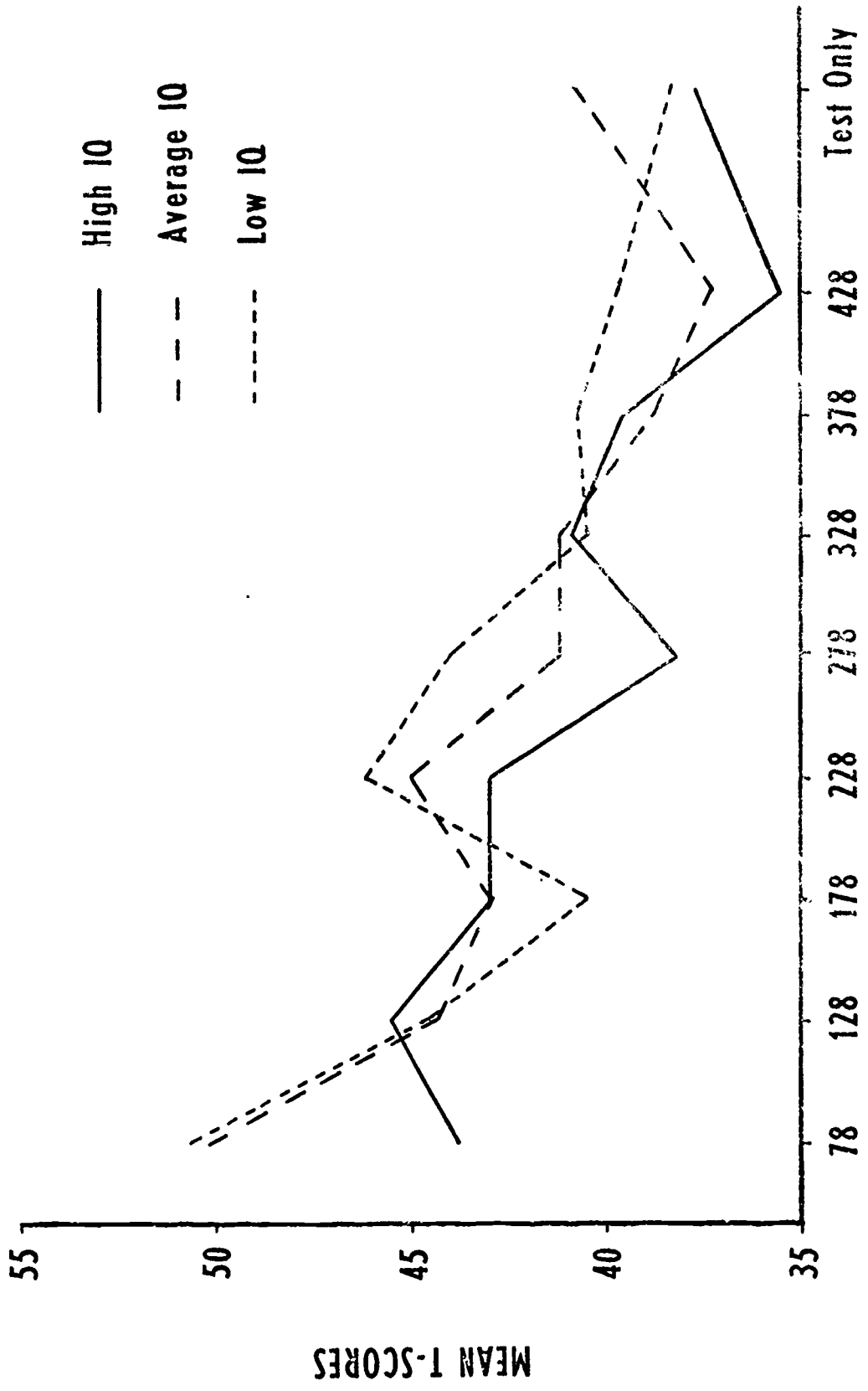

Figure 3. One-week Retention T-Scores for the Three IQ Levels

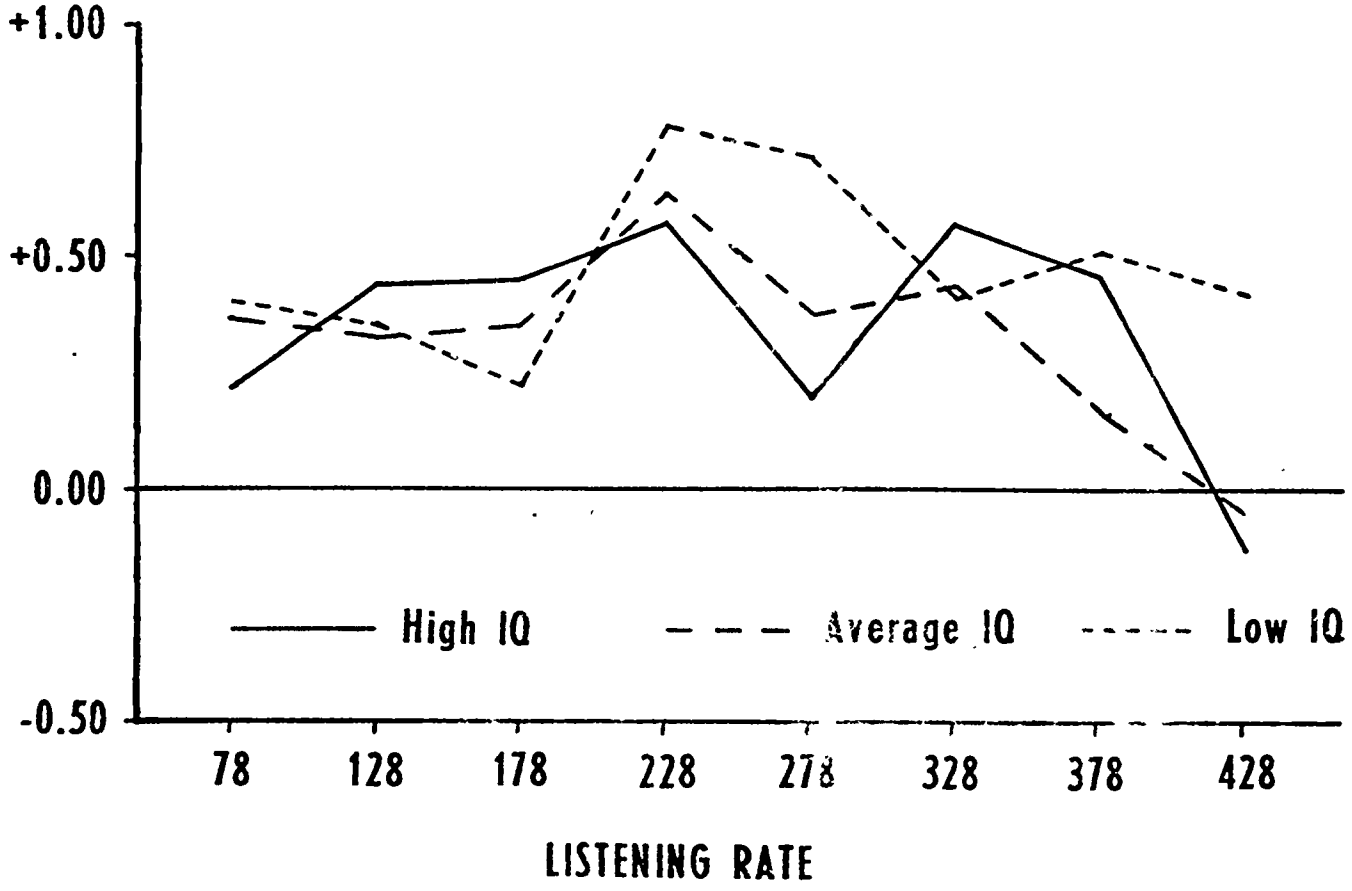

Figure 4. One-week Retention Efficiency Indexes for the Three IQ Levels

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