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ABSTRACT

Forty-eight sixth-grade students were studied to determine their response to selected compressions of the narration of an instructional sound motion picture. A 4:10 color film with a 158 wpm recorded narration was shown at 25, 33-1/3 and 50 percent compression rates; performance time and quality were measured immediately and after 12-day intervals. It was found that compression of up to 50 percent did not significantly effect performance quality, but had a significantly negative effect on performance time in female students and those of low perceptual speed. Both sex and level of perceptual speed ability were held to be patent predictors of poorer quality and slower work in instruction via compressed sound motion pictures. A compression rate of 25 percent was held least effective for females and most effective for males; a 33-1/3 percent rate, least effective for those of low perceptual ability and most effective for those of high perceptual ability. (SK)

Psychomotor Performance Effects Upon Elementary School Children by Sex and Perceptual Speed Ability of Three Compressions of an Instructional Sound Motion Picture

(short title)

Effects of Motion Picture Compression on Psychomotor Performance

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Introduction

Interest in increasing the efficiency of instruction by reducing time-to-solution in learning tasks is of long standing. One promising technique of continued interest for reducing both stimulus and response time without a significant reduction in acquisition is compressed speech. Defined as a message in which the word rate has been increased without distortion in vocal pitch, speech compressions of up to 50 percent have been shown to result in no significant decrease in student's ability to comprehend (Nelson, 1948; Harwood, 1955; Fairbanks, Guttman and Micron, 1957).

It has been reported that visuals such as print, pictures or slides used in conjunction with compressed speech increased comprehension (Woodcock and Clark, 1968 and 1969; Watts, 1969; Bruland, 1970; Parker, 1970; Benz, 1971); however, in many cases the difference was not significant when compared with a normal speech presentation rate (Jester, 1966; Loper, 1967; Anderton, 1969; Boyle, 1969).

Loper (1967) studied the effect of time compression upon comprehension and retention of a iconographically augmented televised lecture. Loper reported that comprehension was an inverse function, but only when the message was presented without visual augmentation.

Woodcock (1969) summarized a series of studies conducted at the Institute of Mental Retardation and Intellectual Development at George Peabody College and concluded with six recommendations concerning the application of compressed speech in the classroom: among them that listening plus viewing slides is a more effective and efficient medium for learning than listening alone.

Anderton (1969), Perry (1970) and Benz (1971) all studied the effect of tape-slide upon presentations at differing rates of speed. The results revealed no significant difference in comprehension at the higher rates of speed. However, in Benz' study the one-half compression aural-visual version was nearly as effective as the normal rate aural-only presentation.

Parker's (1970) and Bruland's (1970) studies found that a printed page accompanying an aural presentation was superior to listening only at compressed rates.

Baker (1971) studied the effects of differing speed of video feedback (normal and slow) and levels of perceptual speed on psychomotor performance. Results indicated that students scoring high on a perceptual speed test performed significantly better than students with low scores. No significant difference was found between the video treatments.

Parker (1971) investigated the degree to which college students could recall information presented in uncompressed and compressed (ten percent, 12½ percent and 16 2/3 percent) versions of a 16mm film. Parker concluded that the selected rates of audio and visual compression had little or no effect upon information recalled.

Parker recommended that further studies be conducted concerning the effects of higher rates of sound motion picture compression on affective and psychomotor performance.

Mori and Tadang (1973) studied the effect of abnormal speed motion pictures (high and low speeds) upon children estimating the time of a falling body. The results indicated that the child's estimation of the time did not depend upon the film speed, but upon S's perception of the velocity of natural phenomena in his daily experiences.

Problem

The literature review suggests that 50 percent speech compression is the upper limit which can be comprehended by subjects without prior training and that visually augmented compressions less than 16.5 percent yield no significant differences in performance. Remaining uninvestigated are audio/visual compressions in excess of 16.5 percent. The spread of compressions to be investigated in this study was therefore selected as 0, 25, 33 1/3, and 50 percent.

The literature further suggests two dependent measures of psychomotor performance: quality and time-to-solution and suggests that some differences might be attributable to sex and perceptual speed ability. No measures of attitudinal effects were planned.

Although the investigators originally chose television messages for compression the present state of the art precluded feasible compressions and sound motion picture film was selected as more workable. However, the results of this study might tentatively be generalized to televised instruction.

Hypotheses

1. There are no significant differences among immediate performance-quality scores of Ss exposed to selected compressions of an instructional sound motion picture.

2. There are no significant differences among immediate performance-time scores of Ss exposed to selected compressions of an instructional sound motion picture.

3. There are no significant differences among 12-day delayed performance-quality scores of Ss exposed to selected compressions of an instructional sound motion picture.

4. There are no significant differences among 12-day delayed performance-time scores of Ss exposed to selected compressions of an instructional sound motion picture.

Design

Design was 4 (film compressions: 0, 25, 33 1/3, 50 percent) by 2 (perceptual speed ability) by 2 (sex). Analysis was by three-way ANOVA for each dependent measure of immediate and 12-day delayed performance.

Experimental Task

After exposure to treatment, Ss were asked to build a simple wood boat following film instructions and procedures using materials and tools provided.

Subjects

Forty-eight sixth grade pupils were selected from two classes in an elementary school chosen because of on-site availability of an appropriate wood-working shop, and a curriculum that provided no industrial arts activities at the elementary level.

Materials

A four minute and ten second Super 8mm color film demonstrating tools, materials and procedures for producing a simple wood boat was produced and edited to synchronize with a 158 word per minute recorded narration. The master audio tape was compressed to rates of 25, 33 1/3, and 50 percent at the Center for Rate Controlled Recordings, University of Louisville. By varying the ratio of projector to camera speed, comparable compressions of the film were made by rephotography from a rear screen. Uncompressed film was then rephotographed to

insure uniform film quality across all treatments. Sound and picture were synced during presentation by a parallel line switch linking player and projector.

Procedures

French's Identical Picture, P-3 was administered to all members of the two sixth grade classes and middle scoring Ss delted. The remainder were grouped by sex and perceptual speed ability for random assignment to treatment. Ss reported to the viewing room in groups of 4 where stimulus was administered via a rear screen projector with individually volume controlled earphones from a tape player. A brief introductory film clip corresponding to the treatment film was shown to the group to reduce confusion (Ss in a pilot study thought the compressed treatment was a technical malfunction) and allow adjustments in earphones. After treatment, Ss were guided to the workshop, assigned a station isolated from other Ss by a partition and set to work. Raters recorded performance quality on an illustrated check sheet corresponding to the film's procedural content and recorded time-to-solution in minutes and seconds. After finishing, each S was praised for his effort, asked not to discuss it with his peers, told he could pick up his boat after school and returned to his classroom to resume normal activity.

Results

Three-way ANOVA was computed for immediate and 12-day delayed scores on both dependent measures: performance-quality and performance-time.

No significant main effects were detected for immediate measures of performance-quality (Table 1). Hypothesis 1 was therefore accepted.

Significant differences (.05) were recorded for immediate performance-time scores by compression (A), perceptual speed ability (B), and sex (C): (Table 2). Hypothesis 2 was therefore rejected.

Duncan's New Multiple Range Test (Table 3) isolated the 50 percent compression as the significant source of variance among treatments.

Differences in performance-time by perceptual speed ability (Figure 1) favored Ss of high perceptual speed ability. At 50 percent compression, performance-time for all Ss increased; for Ss of high perceptual speed ability however, the increase only slightly exceeds the scores for the zero compression treatment.

Highly significant (.01) differences in 12-day delayed scores by perceptual speed ability (B) and sex (C) for both dependent measures are reported in Tables 4 and 5. Hypotheses 3 and 4 were therefore rejected.

As can be seen from Figures 2, 3, 4, 5 and 6, differences on both delayed dependent measures generally favored male Ss and Ss of high perceptual speed ability.

No significant differences in mean performance-quality or performance-time by compression (A) were identified for either delayed dependent measure.

Three significant (.01, .05, .05 respectively) interactions were identified as compression (A) x perceptual speed ability (B), perceptual speed ability (B) x sex (C), and A x B x C for delayed measures of performance-quality (Table 4).

Examined graphically, the A x B interaction (Figure 2) is characterized by a reversal of performance-quality of Ss of high and low perceptual speed ability. Ss of low perceptual speed ability outperformed high perceptual speed ability Ss at the zero compression level, fell markedly lower at the 25 and 33 1/3 percent compression level and recovered at the 50 percent level. Performance of high perceptual speed ability Ss was in marked opposition.

The B x C interaction (Figure 3) displays a somewhat similar pattern. Male Ss performance was best at the 25 percent compression while female Ss was poorest. In contrast, male Ss performance was weakest at the 33 1/3 compression level while female Ss was strongest.

The A x B x C interaction is better understood when previous figures are compared to a display of male and female performance-quality by perceptual speed ability (Figure 6). The dominance of male Ss and Ss of high perceptual level is clearly seen. A study of all relevant figures reveals the vigor of all three independent variables and hence the interaction affecting delayed performance-quality.

Discussion

Significant differences in mean performance-quality and performance-time scores generally favored males and Ss of high perceptual speed ability. Such a finding might have been predicted from implications in the literature reviewed. What is noteworthy here is the overall consistency of the differences and their potency as demonstrated by the 12-day delayed measures.

The significant negative effect of 50 percent compression of film on immediate performance-time could, in isolation, suggest that such a high compression rate had no instructional utility. However, the lack of significant differences attributable to compression aft[illegible] 12-day delay suggests that a 50 percent compression of instructional motio[illegible]ctures could have practical instructional applications. Certainly, these data cannot be taken as establishing the upper limit for practical instructional film compression.

The data presented in Figure 1 suggests to these investigators that Ss may have been attempting to model their work rate after the rate of film presentation. Thus immediate performance-time tends to reduce as instructional time reduces from 0 through 33 1/3 percent. This pattern does not persist after the 12-day delay suggesting that after the initial attempt, learners return on succeeding attempts to a work rate based upon individual habit. This hypothesis could be tested directly once base line work rates were established for a population.

An extension of this hypothesis would suggest that the differences observed in this experiment could be attributed more to the effects of artificially induced work rates than to the ability of Ss to comprehend the instructional message. A design in which cognitive measures were taken in conjunction with measures of psychomotor performance might answer that question.

The loss in treatment effect vigor at the 50 percent compression over time can possibly be explained by the tendency for learners who are unsuccessful in a task to covertly rehearse and replicate for some time after the experience. Although Ss did not know a delayed measure was scheduled they were ready when the time came. Thus while all Ss reduced their performance-time, those at the 50 percent compression group reduced overall time by half (Figures 1 and 4).

In contrast, performance-quality among the 50 percent group remained substantially the same while quality among the 25 and 33 1/3 group improved.

This contradiction suggests a potential hazard in the use of compressed motion pictures for instruction: learners may infer that when instruction is presented at an unusually rapid rate the major criterion for evaluation will be performance-time rather than performance-quality. Thus, although it should have been possible for low scoring Ss under the 50 percent condition to improve the quality of their work via covert rehearsal and replication, they chose instead to improve their rate of work. This hypothesis has important implications for instructional presentations in all modalities and deserves further study.

Conclusions

1. Instructional sound motion pictures can be compressed at rates not in excess of 50 percent without significantly affecting performance-quality in a psychomotor task.

2. Instructional sound motion pictures compressed at a rate of 50 percent have a significantly negative effect upon performance-time in a psychomotor task attempted immediately following treatment and exert a greater effect upon females than males and Ss of low perceptual speed than high perceptual speed.

3. The negative treatment effect of 50 percent compressions on performance-time is not significantly maintained after a 12-day delay.

4. Both sex and level of perceptual speed ability are potent predictors of immediate and delayed performance in a psychomotor task attempted following instruction via compressed sound motion pictures; females and Ss of low perceptual speed ability reliably perform poorer quality and slower work than males and Ss of high perceptual speed ability.

5. An instructional sound motion picture compressed at the rate of 25 percent appears to be the least effective compression among those tested for maintaining performance-quality among females and the most effective for males. All other compressions tested seem equally effective.

6. An instructional sound motion picture compressed at the rate of 33 1/3 percent appears to be the least effective compression among those tested for maintaining performance-quality among Ss of low perceptual speed ability and the most effective for Ss of high perceptual speed ability. All other compressions tested seem equally effective.

TABLE 1

SUMMARY ANOVA

IMMEDIATE PERFORMANCE-QUALITY

Source	SS	df	MS	F
A Compression	17.73	3	5.91	1.27
B Perception Level	2.52	1	2.52	.54
C Sex	.18	1	.18	.04
A x B	7.56	3	2.52	.54
A x C	1.57	3	.52	.11
B x C	2.53	1	2.53	.54
A x B x C	4.58	3	1.52	.32
S/ABC	149.33	32	4.67	
Total	185.98	47		

Critical Values	.05	.01
1 & 32 df	4.16	7.53
3 & 32 df	2.90	4.47

TABLE 2

SUMMARY ANOVA

IMMEDIATE PERFORMANCE TIME

Source	SS	df	MS	F
A Compressions	28.60	3	9.53	2.90 *
B Perceptual Level	13.79	1	13.79	4.18 *
C Sex	17.69	I	17.73	5.37 *
A x B	6.84	3	2.28	.69
A x C	10.09	3	3.35	1.02
B x C	1.86	1	1.82	.55
A x B x C	.97	3	.32	.10
S/ABC	105.46	32	3.30	
Total	185.30	47		

Critical Values	.05 *	.01
1 & 32 df	4.16	7.53
3 & 32 df	2.90	4.47

TABLE 3

DUNCAN'S NEW MULTIPLE RANGE TEST
DIFFERENCES AMONG TREATMENT GROUP
MEAN PERFORMANCE-TIME

	$\bar{x}_2$	$\bar{x}_3$	$\bar{x}_1$	$\bar{x}_4$
25% $\bar{x}_2$ 3.40	--	.04	.38	1.89*
25% $\bar{x}_3$ 3.44		--	.34	1.85*
0% $\bar{x}_1$ 3.78			--	1.51*
50% $\bar{x}_4$ 5.29				--

* significant at the .05 level

TABLE 4

SUMMARY ANOVA

12-DAY DELAYED PERFORMANCE-QUALITY

Source	SS	df	MS	F
A Compression	10.40	3	3.47	1.556
B Perceptual Level	17.52	1	17.52	7.856**
C Sex	22.69	1	22.69	10.175**
A x B	33.89	3	11.30	5.067**
A x C	15.72	3	5.24	2.350
B x C	9.19	1	9.19	4.121*
A x B x C	20.24	3	6.75	3.027*
S/ABC	71.33	32	2.23	
Total	200.98	47		

Critical Values	.05 *	.01 **
1 & 32 df	4.16	7.53
3 & 32 df	2.90	4.47

TABLE 5

SUMMARY ANOVA

12-DAY DELAYED PERFORMANCE-TIME

Source	SS	df	M	F
A Compression	2.76	3	.92	1.87
B Perceptual Level	7.23	1	7.23	14.76**
C Sex	11.62	1	11.62	23.71**
A x B	2.07	3	.69	1.41
A x C	.83	3	.28	.57
B x C	.05	1	.05	.10
A x B x C	2.63	3	.88	1.80
S/ABC	15.74	32	.49	
Total	42.93	47		

Critical Values	.05	.01 **
1 & 32 df	4.16	7.53
3 & 32 df	2.09	4.47

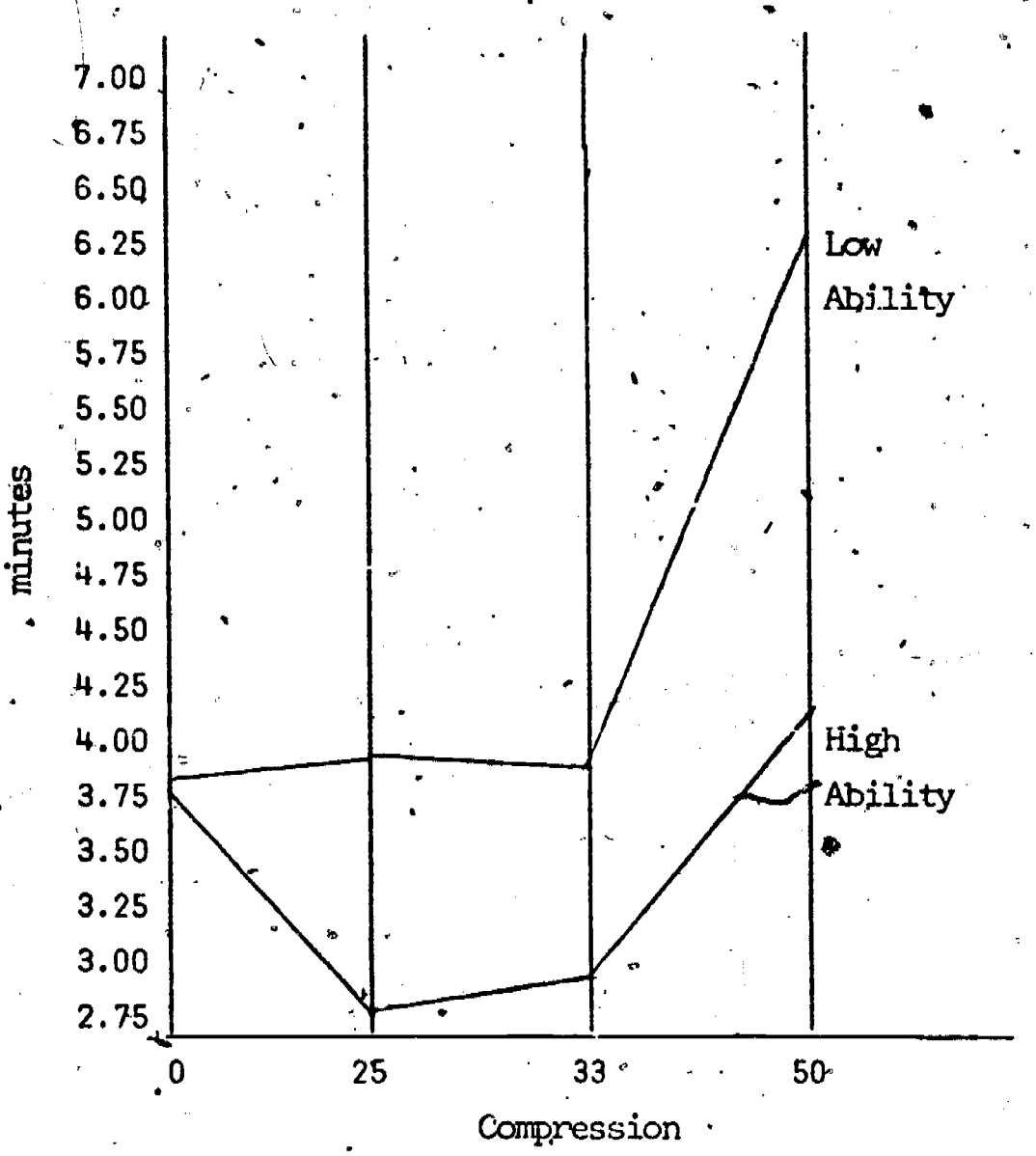

Figure 1. Immediate Performance Time by Compression and Perceptual Speed Ability

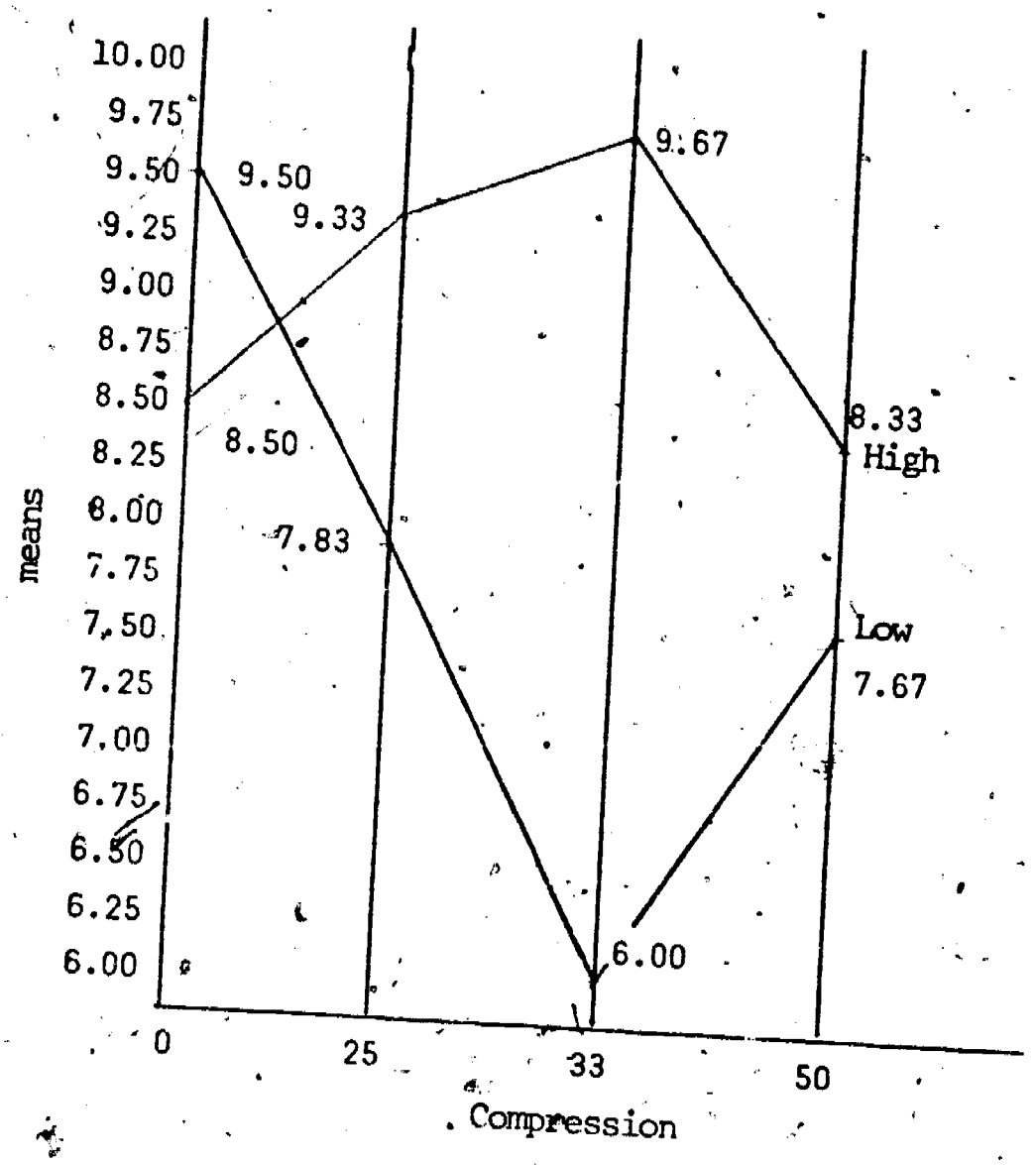

Figure 2. 12-Day Delayed Performance Quality by Compression and Perceptual Speed Ability

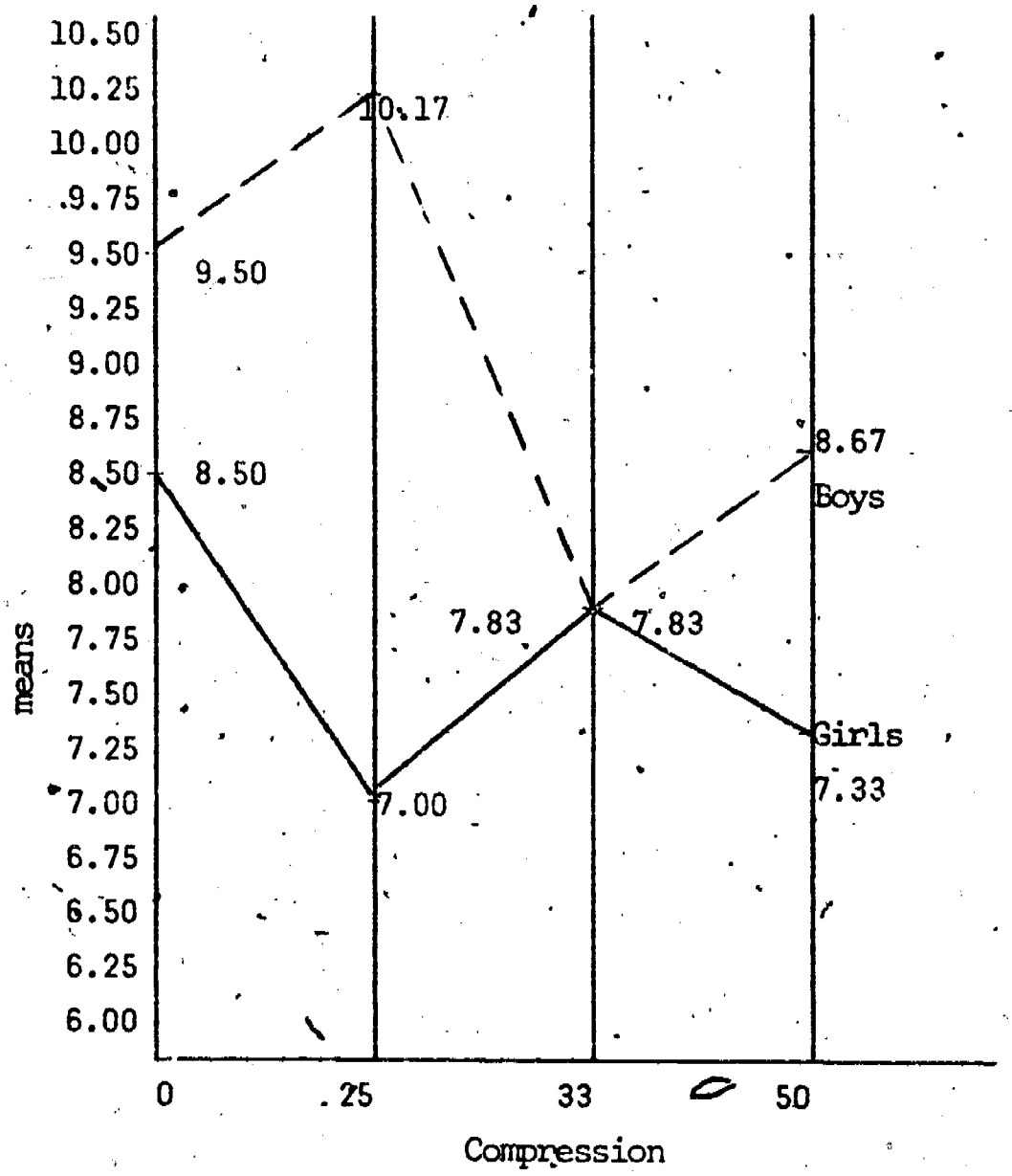

Figure 3. 12-Day Delayed Performance Quality by Compression and Sex.

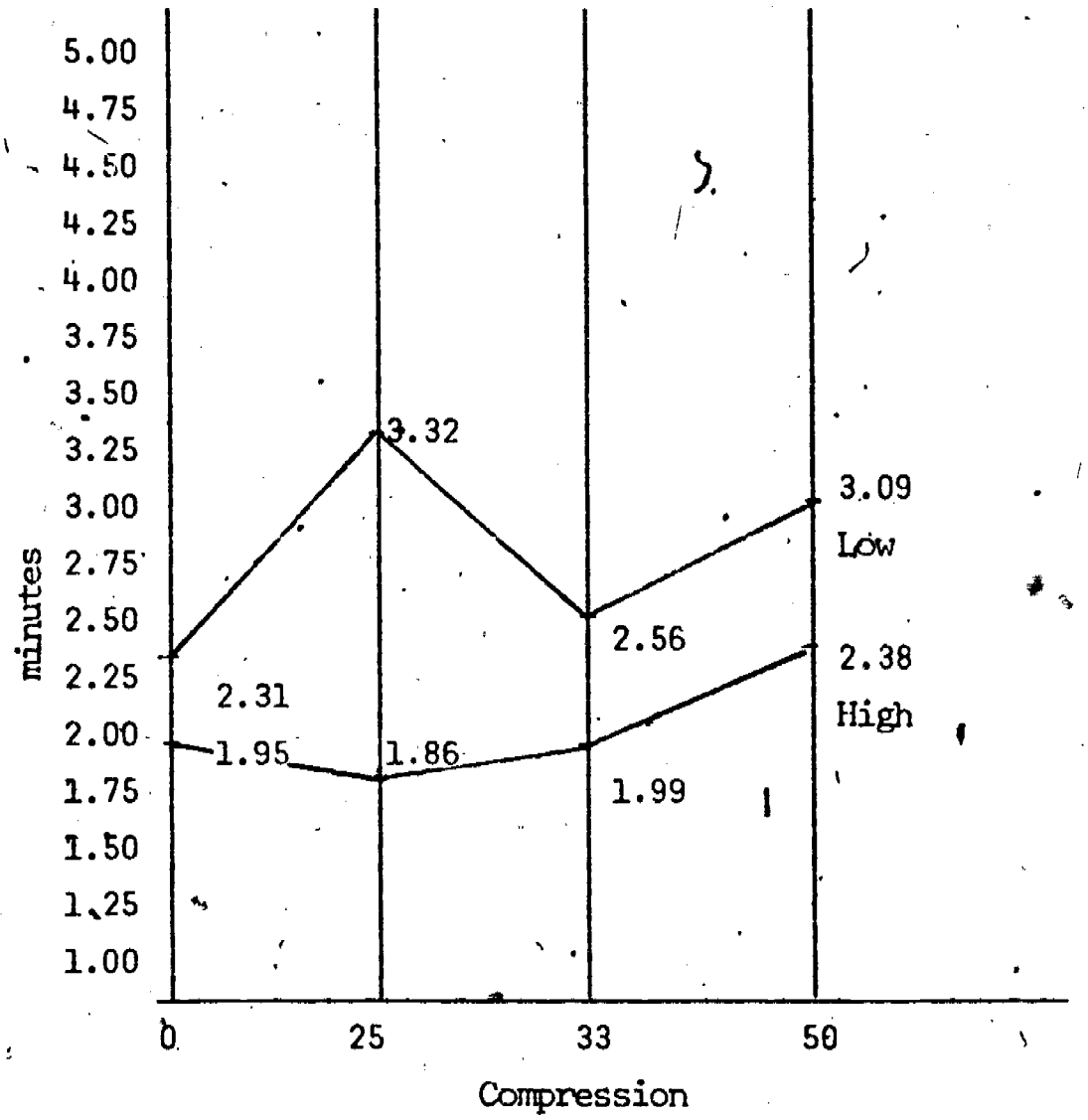

Figure 4. 12-Day Delayed Performance Time by Compression and Perceptual Speed Ability.

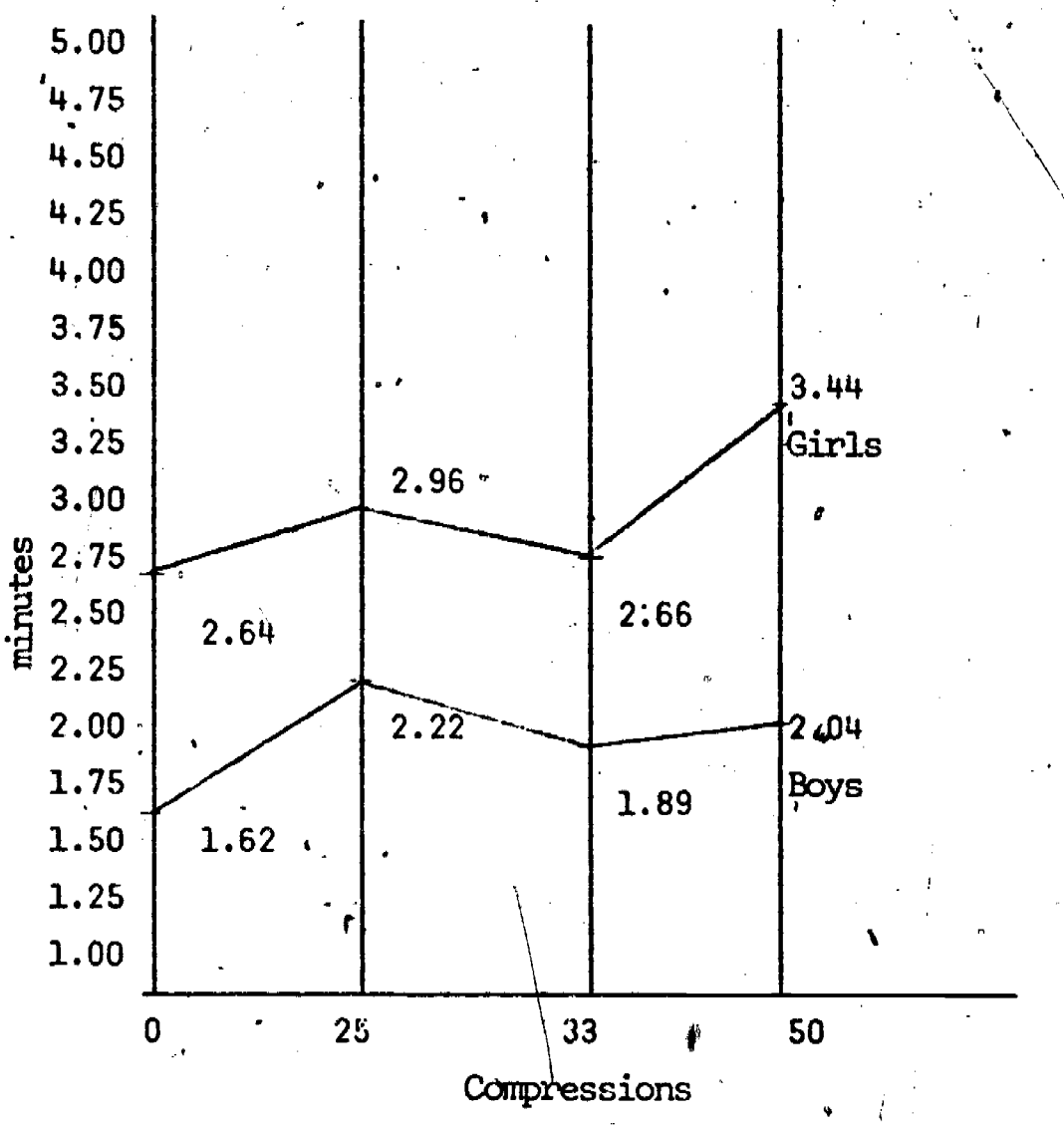

Figure 5. 12-Day Delayed Performance-Time by Compression and Sex.

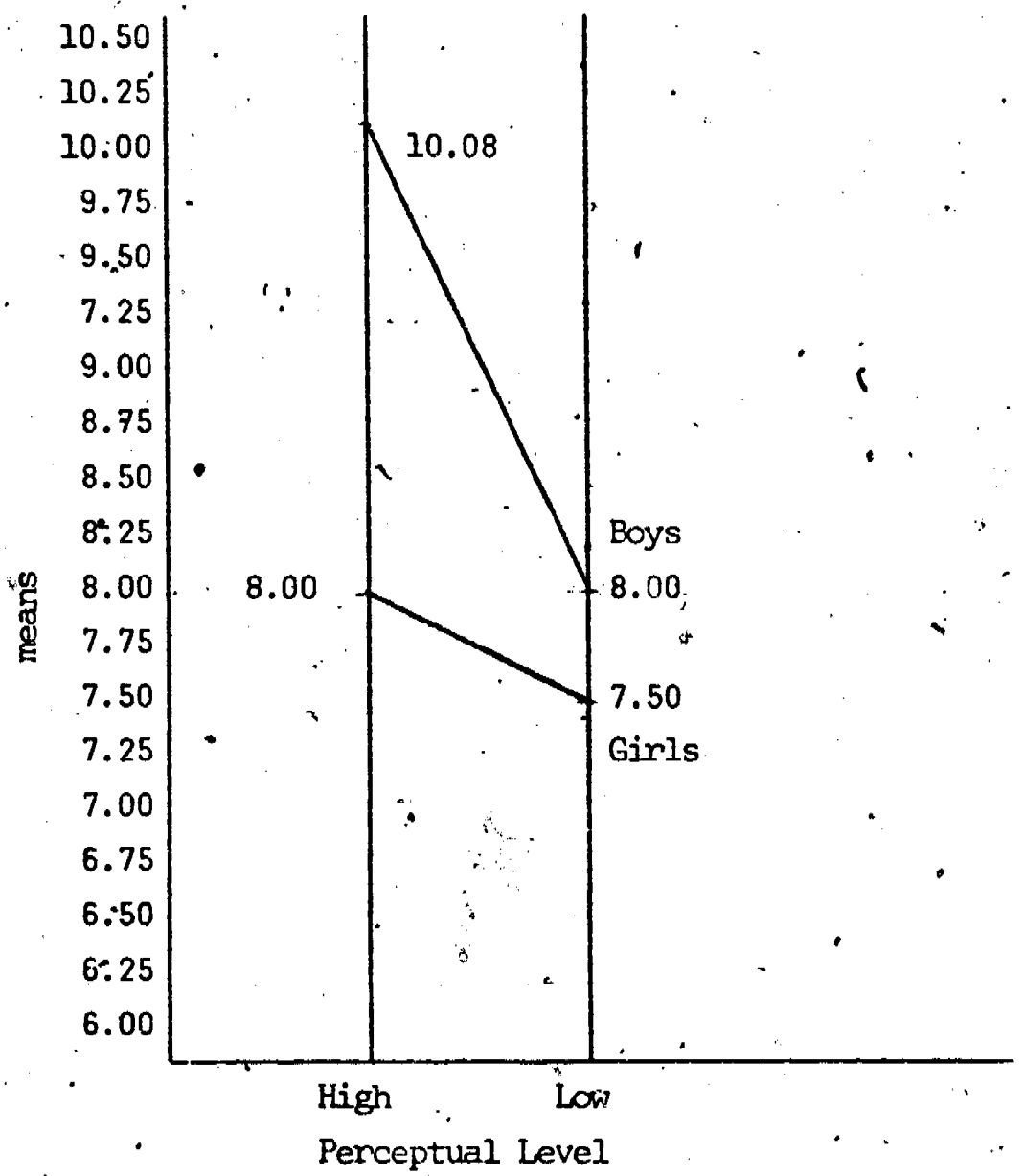

Figure 6. 12-Day Delayed Performance-Quality by Perceptual Speed Ability and Sex.

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