

## TEMPORAL PATTERNS OF SPEECH RATE ALTERATIONS

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An aspect of speech rate which, until recently, has received little attention from researchers is that of rate alterations. Despite the previous research (Johnson 1938; Minifie 1963; Gilbert and Burk, 1969; O'Halloran 1969; Hinkle 1969; Lass and Noll 1970), several basic issues have not as yet been satisfactorily resolved. The present investigation was undertaken to explore one such issue. The purpose of this study was to determine if there exists a typical temporal pattern, or set of patterns, which speakers employ in their attempts to alter their normal oral reading rate.

## 1. METHOD

1. *Subjects.* — Subjects had normal voice, articulation, and rate characteristics and hearing within normal limits. They ranged in age from 22 to 42 years, with a median age of 23 years. A total of 12 individuals, eight females and four males, participated in the study.

2. *Procedure.* — Seven sessions were required of each subject: one screening and six experimental sessions. The screening session included procedures for the evaluation of voice, articulation, and rate characteristics as well as the hearing status of each potential subject. Individuals who were found to have defects in any of these characteristics were excluded from the study. The first three experimental sessions were used to obtain each subject's average reading rate. The subject was asked to read the first paragraph of Fairbanks' (1960) "The Rainbow Passage" at his normal rate for a total of 10 times in each of the three sessions. This is referred to as the STANDARD READING TASK. The last three experimental sessions consisted of rate alteration tasks. In session #4, the subject read at a rate which he considered to be one-half as fast as his normal reading rate. This is referred to as the FRACTIONATION READING TASK. Session #5 involved reading at a rate which he considered to be twice as fast as his normal rate. This is referred to as the MULTIPLICATION READING TASK. The sixth session consisted of a combination of fractionation and multiplication tasks.

3. *Data Analysis.* — The recorded readings were analyzed by means of a Bruel

and Kjaer model 2305 high-speed power level recorder. The power level tracings were measured in millimeters and later converted to seconds. Since the paper speed of the recorder was 30 mm per second, each millimeter corresponded to .033 second.

4. *Temporal Measures.* — For each of the 24 standard, 12 fractionation, and 12 multiplication readings of each subject, the following temporal measures were obtained: (1) overall rate (in words per second); (2) total time (in seconds); (3) speech time (in seconds); (4) intra-sentence pause time (in seconds); (5) inter-sentence pause time (in seconds); (6) number of intra-sentence pauses; (7) number of inter-sentence pauses; (8) speech-time ratio; and (9) pause-time ratio. A minimum pause in this study was defined as one which measured at least one millimeter in length; i.e., 330 msec. in duration.

## 2. RESULTS

1. *Speech Time vs. Pause Time.* — Figure 1 displays the mean speech-time and pause-time ratios of each of the 12 subjects for the standard, fractionation, and

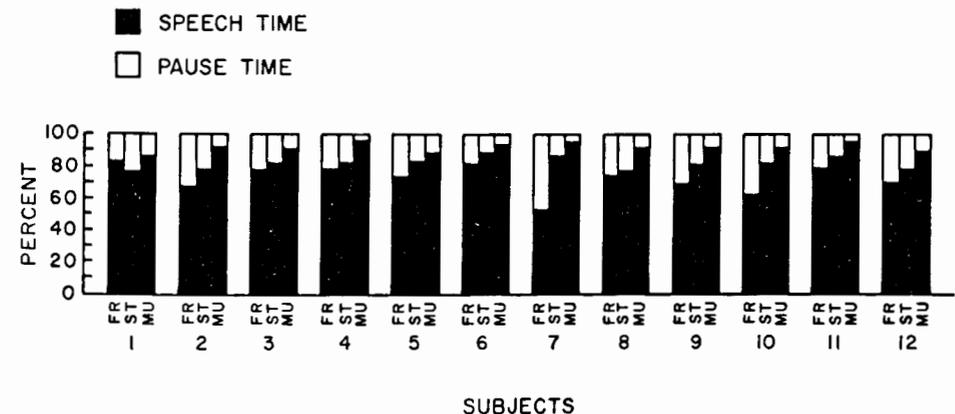


Fig. 1. Mean speech-time and pause-time ratios (in percentage) for each subject's 24 standard (ST), 12 fractionation (FR), and 12 multiplication (MU) readings.

multiplication tasks. The figure indicates that a regular pattern is evident: (1) for 11 of the 12 subjects, pause time increased, and consequently speech time decreased, from their standard readings when they attempted to read at one-half their normal rate; and (2) when attempting to read at twice as fast as their normal rate, pause time decreased and speech time increased. One subject, subject 1, did not exhibit an increase in pause time in his attempts to reduce his reading rate. He appears to have relied more heavily on increasing speech time rather than on decreasing pause time in the fractionation task.

For the multiplication task, all 12 subjects manifested decreases in pause time from their standard readings, i.e., they reduced pause time in an attempt to decrease total

time and thus increase overall reading rate. It is interesting to note that for both the fractionation and multiplication reading tasks, all subjects showed a greater percent change in pause time than in speech time in relation to their standard readings. Another interesting finding is that in none of the three reading tasks did the mean speech-time ratio of any subject drop below .50, although subject 7 exhibited a mean speech-time ratio of .52 for his fractionation readings. That is, he spent almost one-half of the total time for his readings in pausing.

2. *Intra-Sentence vs. Inter-Sentence Pause Time.* — Figure 2 presents a comparison of mean intra- and inter-sentence pause times of each of the 12 subjects for the three

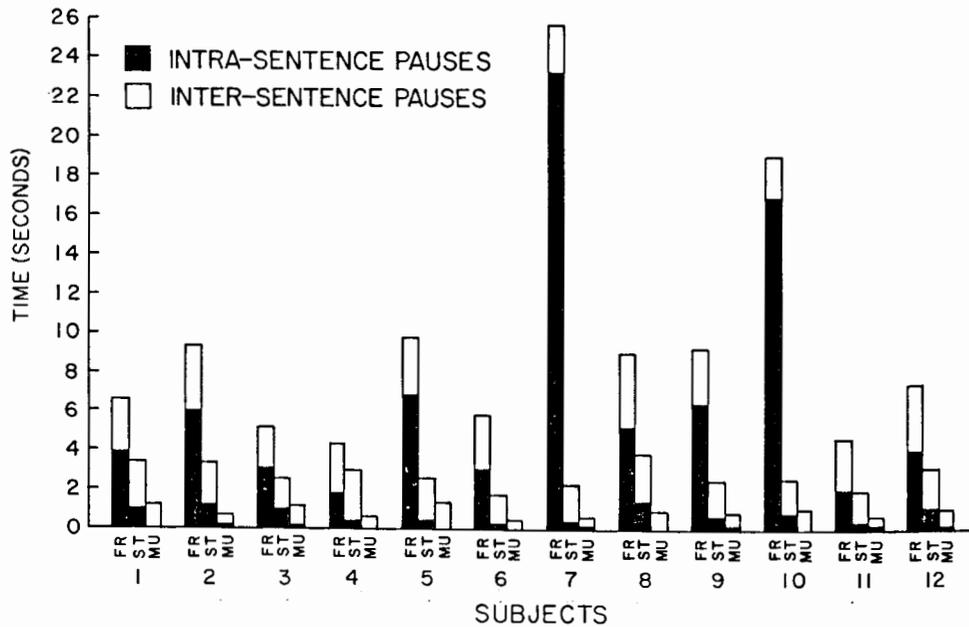


Fig. 2. Mean intra-sentence and inter-sentence pause times (in seconds) for each subject's 24 standard (ST), 12 fractionation (FR), and 12 multiplication (MU) meanings.

reading tasks. It shows that for all subjects, in the standard reading task, mean inter-sentence pause time was greater in duration than mean intra-sentence pause time. However, in the fractionation task, ten of the 12 subjects manifested a greater duration for intra- than for inter-sentence pausing. Furthermore, for the two subjects (4 and 11) who still showed a greater inter-sentence pause time, the difference between the two pause types was less than one second. In terms of percent change from their standard readings, all subjects showed a much greater change in intra- than inter-sentence pause times when attempting to decrease reading rate. One possible explanation for this finding is this: there were only three inter-sentence pauses available in the analyzed portion of the reading passage, while the number of possible intra-sentence pauses was 72. That is, a subject could conceivably pause between each word as well as between

each syllable in a word in each of the four sentences in the passage. In fact, it appears that some subjects relied almost exclusively on such intra-sentence pausing. This is evident in the fractionation bars of subjects 7 and 10. They showed an increase in intra-sentence pause time of 22.9 and 16.1 seconds, respectively, from their standard readings, while altering inter-sentence pause time by only 0.29 and 0.74 seconds, respectively. In the multiplication reading task, all subjects manifested greater inter-sentence than intra-sentence pause times. In fact, six subjects (1,4,5,6,8, and 10) used no intra-sentence pauses at all in their attempts to reduce total time, and thus increase overall reading rate. They paused only between sentences, and the inter-sentence pauses which they used were shorter in duration than those employed in the standard reading task. In relation to their standard readings, all subjects displayed a greater change for intra- than for inter-sentence pause times for both the fractionation and multiplication tasks. It is also interesting to note that total pause time (i.e. intra-sentence plus inter-sentence pause times), which is represented by the height of the bars in the figure, was greatest for all subjects when attempting to reduce reading rate, and smallest when attempting to increase rate.

3. *Number of Intra-Sentence vs. Number of Inter-Sentence Pauses.* — Figure 3 displays a comparison of the mean number of intra- and inter-sentence pauses employed by each of the 12 subjects for the three reading tasks. It indicates that for the standard task, ten of the 12 subjects used a greater number of inter- than intra-sentence pauses. However, for the fractionation task, all 12 subjects manifested a greater

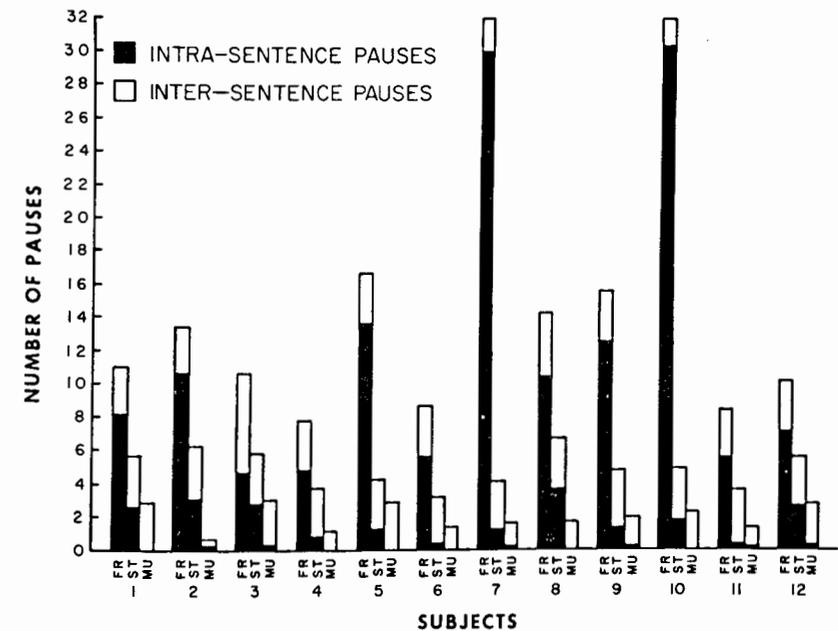


Fig. 3. Mean number of intra-sentence and inter-sentence pauses for each subject's 24 standard (ST), 12 fractionation (FR), and 12 multiplication (MU) readings.

number of intra- than inter-sentence pauses. In the multiplication task, all subjects showed a greater number of inter-sentence than intra-sentence pauses. In fact, six subjects (1,4,5,6,8, and 10) used no intra-sentence pauses at all in attempting to reduce total time and thus increase reading rate. In relation to their standard readings, all subjects displayed a greater percent change for number of intra-sentence than number of inter-sentence pauses for both the fractionation and multiplication tasks.

4. *Overall Reading Rate.* — Figure 4 presents each subject's mean overall reading rate (in words per second) for each of the three reading tasks. A definite pattern is

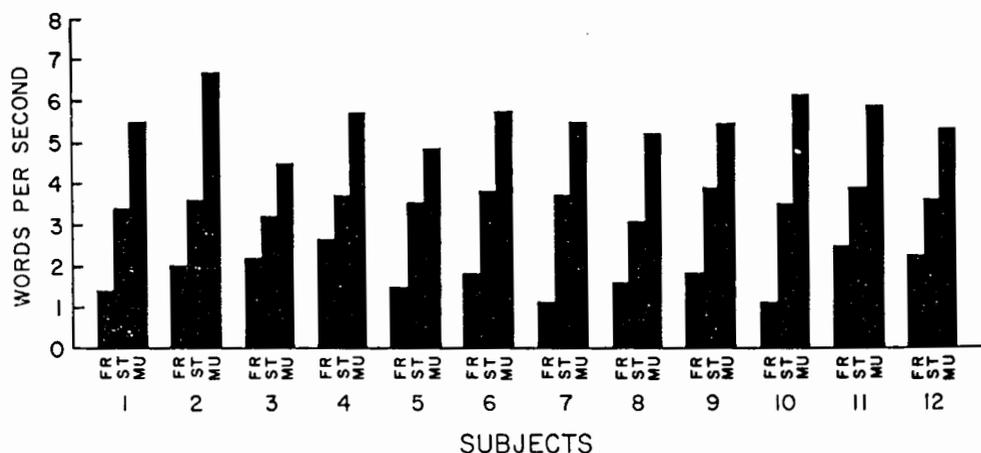


Fig. 4. Mean overall reading rate (in words per seconds) for each subject's 24 standard (ST), 12 fractionation (FR), and 12 multiplication (MU) readings.

evident here: in relation to their standard readings, all subjects showed a decrease in overall rate for the fractionation task, and an increase in overall rate for the multiplication task. Eight subjects (1,2,3,4,6,8,11, and 12) manifested a greater change from their standard readings when attempting to increase reading rate, while four subjects (5,7,9, and 10) showed a greater change in their attempts to reduce reading rate.

### 3. DISCUSSION

The results of this study indicate that there are more similarities than differences between subjects in their attempts to increase as well as decrease normal reading rate. There emerges a definite set of temporal patterns which they employed in altering rate. In attempting to reduce reading rate, the following pattern was evident in 11 of the 12 subjects: (a) an increase in total time and thus a decrease in overall reading rate; (b) an increase in speech time and pause time, with a greater change evident in pause time; (c) an increase in intra- and inter-sentence pause times, with a greater change in intra-sentence pause time; (d) an increase in number of intra- and inter-

sentence pauses, with a greater change in number of intra-sentence pauses. One subject exhibited the same pattern as just described, with one exception: he did not show an increase in pause time from his standard reading; instead, he increased speech time in his attempt to reduce overall rate.

Moreover, all subjects exhibited the same pattern in increasing rate as they did in decreasing rate. The difference, of course, lies in the direction of the changes; i.e., when attempting to increase rate, all temporal measures (except overall rate and speech-time ratio) were decreased. And, when attempting to decrease rate, all temporal measures (except overall rate and speech-time ratio) were increased. The differences that were found to exist between subjects pertained not to the temporal PATTERNS employed in the rate alteration tasks, but rather to the AMOUNT of change in temporal measures from their standard readings which they exhibited when performing the rate alteration tasks.

The importance of pauses in the subjects' attempts to alter normal oral reading rate was quite apparent in this study. The subjects, as a group, manifested the greatest change from their standard readings in intra-sentence pause time and number of intra-sentence pauses, when attempting to increase as well as decrease reading rate. This finding corroborates Minifie's (1963) statement in an earlier investigation that, "the changes in reading rate are more a function of the compression and expansion of silence intervals than a variation in speech intervals".

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## DISCUSSION

GERBER (Santa Barbara, Calif.)

1. How well did the speakers accomplish the rate change in words or syllables per minute?
2. The literature suggests that the ratio of syllable duration to utterance duration remains constant at any rate. Did you also observe this?

LASS

1. Only four of the subjects achieved a rate which was physically equal to, or greater than, one-half the rate of their standard readings, while none of the subjects in the study reached a rate which was physically equal to twice as fast as his standard reading rate. This finding is not unexpected, since it has been shown (Lass and Noll, *Cleft Palate Journal* [1970], and Gilbert and Burk, *Language and Speech* [1969]) that there is no one-to-one relationship between the physical measure of rate in words per minute and the subjective perception of rate. That is to say, if one's standard (average) reading rate is 100 wpm, we would not expect his attempt to use a rate which is twice as fast as his standard rate, to be 200 wpm.

2. We did not look at the ratio of syllable duration to utterance duration but it would be interesting to see if this ratio remains the same for the standard, fractionation, and multiplication reading tasks.