

A Comparative Study of Rate Characteristics in Cleft Palate and Noncleft Palate Speakers

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In general, researchers in the speech field have concerned themselves with three different aspects of speech rate: impromptu speaking rate, oral reading rate, and perceptual judgments of reading rate. Kelly and Steer (8) introduced a revised concept of speaking rate, that of sentence or phrasal rate. They found that extemporaneous speech is extremely variable, ranging on the average from 125 to 328 words per minute, and that sentence-by-sentence measures of rate are more meaningful than measures of overall rate in analyzing extemporaneous speech.

Speech rate has also been investigated in oral reading situations. In a normative study of oral reading rate, Darley (1) constructed three 300-word passages, each with a different syllabic content, and established normative data on oral reading rate for all three passages.

Another aspect of speech rate is that of perceptual judgments of oral reading rate. Johnson (7) had his subjects read a narrative passage at what they considered to be slow, medium, and rapid rates. His results indicated that the means were 151, 170, and 216 words per minute for the three reading rates, respectively. Franke (4) conducted an experiment to determine if a speaker's word per minute rate was related to the perception of rapidity or slowness by observers. She found a very high correlation (+.93) between the measures of rate in words per minute and the judgments of oral reading rate. In a study of rate alterations in oral reading, Gilbert (5) noted that significant alterations occurred in the reading rates of his subjects when they were asked to make the prescribed changes in their reading rates; however, in no case did the observed differences equal the requested differences.

The majority of studies on speech rate have been concerned with the normal population. Rate has never been investigated in any systematic manner for the cleft palate population. It is not currently known whether the speech rate of cleft palate speakers differs from that of non-cleft palate speakers in oral reading and impromptu speaking tasks; nor

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is it known whether the performance of cleft palate individuals differs from that of noncleft palate individuals in tasks involving perceptual judgments of reading rate. It was the purpose of the present investigation to compare the rate characteristics of cleft palate and noncleft palate adult speakers in oral reading, impromptu speaking, and rate alteration tasks.

Procedure

SUBJECTS. The noncleft palate (control) group and the cleft palate (experimental) group consisted of 40 subjects, 20 in each group. All subjects were male, between 18 and 26 years of age, had hearing thresholds of 40 dB or better bilaterally from 250 through 4000 Hz (re: ISO Standard, 1964), and had normal or above normal intelligence. The mean age of the control subjects was 18 years, 4 months; 21 years, 8 months was the mean age of the experimental subjects. All of the cleft palate subjects had a surgically repaired congenital cleft of the lip and palate or of the palate only. None was currently enrolled in speech therapy.

Five-point equal-appearing intervals scales were used by 10 graduate students in the Purdue University Department of Audiology and Speech Sciences to assess severity of nasality and articulation defectiveness demonstrated by the cleft palate subjects. On the scales, the value *one* indicated mild severity and the value *five* indicated extreme severity. The cleft palate subjects were found to exhibit a mild degree of both articulatory defectiveness (group mean rating of 1.66) and hypernasality (group mean rating of 2.30).

The control subjects had no clefts of the lip and palate, no known pathologies of the larynx, and no evidence of gross deviations in speaking rate. They had normal voice and articulation, but no extensive experience in debate, public speaking, or acting.

RECORDING PROCEDURE. All speech samples were recorded on magnetic tape at a tape speed of 7½ inches per second. The recording equipment, chosen for its portability and high-quality recording characteristics, consisted of two Nagra III tape recorders (model B6 1984) and an Electro-Voice model 664 dynamic cardioid microphone.

A separate recording session, which lasted approximately 85 minutes, was held for each subject (both experimental and control) in the study. Each session consisted of two parts which were separated by a 10-minute interval.

Part One. The first portion of the session consisted of the following tasks in the following order: (a) six oral readings of a factual prose passage, (b) two minutes of impromptu speaking based on the content of a stimulus picture, and (c) six additional readings of the same prose passage. This portion of the recording session lasted approximately 30 minutes.

The reading passage employed in the current study was "The Rainbow Passage" (3). This passage was selected to allow for comparisons with

existent data on speech rate. The stimulus picture employed in the current study was selected from the Peabody Language Development Kits (2). For a detailed description of the procedure employed, the reader is referred to the original dissertation (9).

10-Minute Interval. The 10-minute interval between the completion of the first portion of the recording session and the initiation of the second portion allowed the investigator to determine the reading which best represented the subject's average reading rate. The mean total reading time in seconds for the 10 recorded readings of "The Rainbow Passage" was calculated from the values obtained with a stopwatch. The recording which came closest to the mean value and which contained no reading errors was selected for use as the subject's "Standard".

Part Two. The second portion of the recording session consisted of the following tasks in the order shown: (a) rate alteration tasks; (b) oral reading of 28 articulation testing sentences; (c) an intelligence screening evaluation; and (d) a hearing screening evaluation. This portion lasted approximately 45 minutes.

The rate alteration tasks involved the reading of "The Rainbow Passage" at one-half as fast as the subject's Standard (fractionation) and twice as fast as his Standard (multiplication). The investigator played the subject's Standard and asked him to repeat aloud with the recording. After playing the Standard, the investigator indicated to the subject at which rate he was to attempt to read the passage. A total of four readings at one-half the Standard rate and four at twice as fast as the Standard rate were made by each subject. The eight readings were counter-balanced so that each subject performed the task in a different order. All readings were recorded.

The articulation testing sentences were obtained from the Templin-Darley Tests of Articulation (11). The intelligence screening evaluation was made by means of the Vocabulary and Picture Completion subtests of the Wechsler Adult Intelligence Scale (12).

DATA ANALYSIS. All rate analyses on the Standards and rate alteration tasks involved the middle four sentence (55 words) of the first paragraph of "The Rainbow Passage". The first and last sentences were deleted from analysis to avoid possible effects of initiating and terminating reading (6).

All recordings were analyzed by means of a Bruel and Kjaer model 2304 high-speed power level recorder. The paper speed of the recorder was 30 mm per second, with a writing speed of 140 mm per second and a potentiometer setting of 50 dB. A detailed description of the analysis procedure is provided elsewhere (9).

RATE MEASURES. For the Standard and rate alteration tasks, the following rate measures were calculated: (a) overall rate in syllables per second; (b) overall rate in words per minute; (c) mean sentence rate in syllables per second; (d) mean sentence rate in words per minute. In an attempt to describe how rate alterations were accomplished, the fol-

lowing measures were also obtained: (e) duration of speech time in seconds; (f) duration of intra-sentence pause time in seconds; (g) duration of inter-sentence pause time in seconds; and (h) number of intra-sentence pauses.

Overall rate in syllables per second was determined by dividing the total time for completion of the reading into the total number of syllables spoken. Mean sentence rate in syllables per second was determined by dividing the elapsed time for each sentence into the number of syllables spoken in the sentence. After this was done for the middle four sentences in "The Rainbow Passage", the four values were averaged to yield the mean sentence rate. Overall rate in words per minute was determined by multiplying the number of words in the middle four sentences of the passage by 60 and dividing by the time (in seconds) which elapsed for the reading of all four sentences. Mean sentence rate in words per minute was obtained by multiplying the number of words in each sentence by 60 and dividing by the time (in seconds) which elapsed for the reading of that sentence. After this was done for all four sentences of the passage, the four values were averaged to yield the mean sentence rate. Inter-sentence pause time was obtained by subtracting the time (in seconds) spent to read each sentence (excluding inter-sentence pausing) from the time which elapsed for the reading of all four sentences (including inter-sentence pausing). Duration of speech time, duration of intra-sentence pause time, and number of intra-sentence pauses were obtained directly from the power level tracings. A minimum pause was defined in the current study as one which measured one millimeter in distance (300 milliseconds in duration).

Due to the contextual variation which existed between the impromptu speeches of the subjects, mean sentence rate in syllables per second was the only rate measure calculated for the impromptu speech of each subject.

An estimate of the reliability of the investigator's measurements was made by re-measurement of 10 randomly selected samples, five from the cleft palate group and five from the noncleft palate group. The resulting median difference between the first and second measurements for all 10 subjects was only .01 syllables per second and .01 intra-sentence pauses.

Results

Descriptive analysis of the data included the presentation of means, standard deviations, and range values for the dependent variables under study in each of four parts: (a) Standards; (b) Fractionation Task; (c) Multiplication Task; and (d) Impromptu Speeches. Inferential treatment of the data was accomplished by use of two-factor analyses of variance (ANOV) with repeated measures on one of the factors. In addition, Newman-Keuls tests were used to probe for significance.

DESCRIPTIVE ANALYSIS. *Standards.* The mean, standard deviation, and range values for overall reading rate in syllables per second and words

per minute, intra-sentence speech time (in seconds), intra-sentence pause time (in seconds), number of intra-sentence pauses, and inter-sentence pause time (in seconds) are presented in Tables 1, 2, 3, and 4.

The tables indicate that: (a) the noncleft group exhibited a faster reading rate than the cleft group; (b) the cleft group showed longer intra-sentence speech and pause times, more intra-sentence pauses, and a longer inter-sentence pause time than the noncleft group; and (c) for most of the dependent variables under study, the cleft group exhibited a

TABLE 1. Mean, standard deviation, and range values for mean over-all rate for the cleft palate and noncleft palate groups under standard, fractionation, and multiplication tasks. Entries are in syllables per second (sps) and words per minute (wpm).

<i>group</i>	<i>standard</i>		<i>fractionation</i>		<i>multiplication</i>	
	<i>sps</i>	<i>wpm</i>	<i>sps</i>	<i>wpm</i>	<i>sps</i>	<i>wpm</i>
<i>cleft</i>						
M.	4.35	188.72	3.51	152.62	5.91	256.72
SD.	0.51	21.97	0.74	31.33	0.92	40.21
range. . . .	3.52-5.18	153.01-224.99	1.84-4.71	80.03-205.34	4.55-7.94	197.76-344.13
<i>noncleft</i>						
M.	4.98	217.21	3.83	166.53	6.89	299.37
SD.	0.46	18.25	0.49	21.38	0.78	33.75
range. . . .	4.06-5.85	190.02-253.85	2.90-5.15	125.91-223.96	5.07-8.40	220.25-365.49

TABLE 2. Mean, standard deviation, and range values of mean sentence rate for the cleft palate and noncleft palate groups under standard, fractionation, multiplication, and impromptu speech tasks.

<i>group</i>	<i>standard</i>		<i>fractionation</i>		<i>multiplication</i>		<i>imp. speech</i>
	<i>sps</i>	<i>wpm</i>	<i>sps</i>	<i>wpm</i>	<i>sps</i>	<i>wpm</i>	<i>syll. per sec.</i>
<i>cleft</i>							
M.	5.00	217.69	4.04	175.79	6.53	284.86	4.50
SD.	0.60	27.06	0.85	36.60	0.94	42.10	0.72
range. . . .	3.98-6.32	171.78- 280.73	1.99-5.29	88.64- 229.97	5.06-8.72	219.24- 382.78	3.05-5.97
<i>noncleft</i>							
M.	5.71	247.82	4.45	193.60	7.49	324.44	4.90
SD.	0.44	18.69	0.55	23.77	0.78	32.85	0.85
range. . . .	4.97-6.57	215.54- 284.07	3.35-5.95	145.50- 258.11	5.56-8.96	241.98- 378.98	3.28-7.19

TABLE 3. Mean, standard deviation, and range values for mean intra-sentence speech time (in seconds), mean intra-sentence pause time (in seconds), and average number of intra-sentence pauses for the cleft palate and noncleft palate groups under standard, fractionation, and multiplication tasks.

<i>group</i>	<i>standard</i>			<i>fractionation</i>			<i>multiplication</i>		
	<i>speech time</i>	<i>pause time</i>	<i>No.</i>	<i>speech time</i>	<i>pause time</i>	<i>No.</i>	<i>speech time</i>	<i>pause time</i>	<i>No.</i>
<i>cleft</i>									
M.	14.85	1.14	8.45	17.63	3.12	15.92	11.69	0.48	5.39
SD.	1.67	0.81	6.89	3.91	2.65	10.51	1.58	0.44	4.38
range.	11.60–18.07	0.07–2.80	2–25	14.03–28.67	0.69–10.20	8–43	8.96–14.42	0.00–1.62	0–18
<i>noncleft</i>									
M.	12.96	0.69	8.10	15.80	2.05	13.51	10.22	0.15	3.32
SD.	1.02	0.28	3.63	1.67	0.88	5.18	1.13	0.11	2.16
range.	11.00–15.00	0.27–1.13	2–13	11.71–19.75	0.85–3.96	4.75–22.25	8.54–13.52	0.03–0.50	1.25–9.75

TABLE 4. Mean, standard deviation, and range values of mean inter-sentence pause time (in seconds) for the cleft palate and noncleft palate groups under standard, fractionation, and multiplication tasks.

<i>group</i>	<i>standard</i>	<i>fractionation</i>	<i>multiplication</i>
<i>cleft</i>			
M.	1.72	2.31	1.01
SD.	0.39	0.62	0.39
range.	0.70–2.23	1.11–3.31	0.49–1.62
<i>noncleft</i>			
M.	1.64	2.34	0.81
SD.	0.42	0.42	0.30
range.	0.90–2.57	1.55–3.12	0.32–1.28

larger amount of variability and wider range of performance between members than did the noncleft group.

Fractionation Task. The measures of central tendency and dispersion for the dependent variables under study in the fractionation task are presented in Tables 1, 2, 3, and 4. The fractionation task in the current study was one in which the subject was asked to read at a rate which he considered to be one-half as fast as his Standard rate.

On the fractionation task, it appears that the noncleft group achieved a rate which was slower in relation to its Standard than did the cleft palate group. In an attempt to decrease their reading rate, both groups

exhibited a similar pattern of change from their performance on the Standard task. For both groups, the largest change was in the increase of number of intra-sentence pauses employed. The second largest change came in the increase of duration of intra-sentence speech time. The next largest change appears to be an increase in duration of intra-sentence pause time, and the smallest change for both groups was in the increase of inter-sentence pausing. Thus, in an attempt to decrease their reading rate, both the cleft palate and noncleft palate groups exhibited a similar pattern of change in the dependent variables under study, with the noncleft group showing a larger over-all change (slower rate) than did the cleft palate group.

Multiplication Task. The means, standard deviations, and range measures for the dependent variables under study in the multiplication task are presented in Tables 1, 2, 3, and 4.

On the multiplication task, in which the subject was asked to read at what he considered to be twice as fast as his Standard rate, it appears that the noncleft group achieved a faster reading rate in relation to its Standard rate than did the cleft palate group. In an attempt to increase their reading rate, there appears to be some difference between the two groups. For the cleft palate group, the largest change from its performance on the Standard task was in the decrease of intra-sentence speech time, followed by number of intra-sentence pauses, inter-sentence pause time, and finally intra-sentence pause time. For the noncleft group, the area of largest change was in decreasing the number of intra-sentence pauses, followed by intra-sentence speech time, inter-sentence pause time, and intra-sentence pause time. For both groups, the areas of largest change were number of intra-sentence pauses and intra-sentence speech time; the areas of least change were intra- and inter-sentence pause times.

Impromptu Speeches. Table 2 contains the mean and variability measures of mean sentence speaking rate for the two groups in syllables per second. The noncleft group exhibited a faster speaking rate than did the cleft palate group. In addition, in comparing the speaking rates of the two groups with their reading rates for their Standards, both groups show a faster reading rate.

INFERENTIAL ANALYSIS. Inferential analysis of the data consisted of a series of two-factor analyses of variance (ANOV) with repeated measures on one of the factors (13). Groups (cleft and noncleft) served as one factor and speech conditions (standard, fractionation, multiplication, and impromptu speech tasks) served as the second factor. Repeated measures were made on the speech conditions factor. A separate analysis of variance was performed for each of the following dependent variables: (a) mean overall rate; (b) mean sentence rate; (c) mean intra-sentence speech time; (d) mean intra-sentence pause time; (e) average number of intra-sentence pauses; and (f) mean inter-sentence pause time. When

significant *F* ratios were obtained, Newman-Keuls tests were employed to locate the significance. The purpose of inferential treatment of the data was to determine if observed differences between the two groups were significant differences.

The following is a summary of the results of inferential treatment of the data:

(a) For mean over-all rate (at the .01 level), mean sentence rate (at the .01 level), mean intra-sentence speech time (at the .01 level), and mean intra-sentence pause time (at the .05 level), the differences between the cleft palate and noncleft palate groups were significant across all speech conditions involved.

(b) For mean inter-sentence pause time and average number of intra-sentence pauses, the differences between the two groups were not significant across the speech conditions studied.

(c) For all dependent variables studied (mean over-all rate, mean sentence rate, mean intra-sentence speech time, mean intra-sentence pause time, average number of intra-sentence pauses, and mean inter-sentence pause time) it was found that all speech conditions involved differed significantly from each other at the .01 level.

Discussion

In comparing the performance of the cleft palate and noncleft palate groups in the current study to the performance of Gilbert's (5) group of female college students, one outstanding difference is observed. Gilbert noted that "...in productions requiring multiplication of their Standards, subjects increased by smaller amounts than when asked to fractionate their Standards ..." (p. 35).

However, in the current investigation, the directly opposite trend was observed: both the cleft palate and noncleft palate groups showed larger changes from their Standards when asked to perform the multiplication task (38.6% change for the noncleft group and 36% change for the cleft group) than when asked to perform the fractionation task (23.3% change for the noncleft group and 19.1% change for the cleft group).

In comparing the two groups' reading and speaking rates, both groups were found to exhibit faster rates for reading than for speaking. This finding is in agreement with the previous research comparing rates of reading and speaking (10). However, despite the statistically significant differences between the cleft palate and noncleft palate groups in their reading and speaking rates, both groups exhibited rates which were within normal limits.

Summary

The purpose of the present investigation was to compare the rate performances of cleft palate and noncleft palate speakers on oral reading, impromptu speaking, and rate alteration tasks. Recorded speech samples

were obtained from 40 individuals, 20 cleft palate and 20 noncleft palate male, college-age speakers. The recordings for each subject contained the following: (a) the subject's "Standard", his reading of "The Rainbow Passage" which came closest to the mean overall reading rate (in seconds) for 10 oral readings of the passage; (b) a two-minute impromptu speech based on the content of a stimulus picture; and (c) the subject's performance on two rate alteration tasks. Analysis of the recordings was made by means of a high-speed power level recorder. From the power level tracings of each subject, eight measures of rate and duration were obtained for the Standard and rate alteration tasks. For the impromptu speaking task, one rate measure was calculated. Descriptive and inferential analyses were performed on each of the dependent variables. Analyses of variance indicated that the cleft palate and noncleft palate groups differed significantly on all but two of the dependent variables (inter-sentence pause time and number of intra-sentence pauses) for all rate tasks. It is concluded that cleft palate and noncleft palate speakers differ in their oral reading and impromptu speaking rates as well as in their performance on rate alteration tasks.

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