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HEMISPHERIC LATERALIZATION FOR SPEECH PERCEPTION IN STUTTERERS[1]

M. F. Dorman and R. J. Porter, Jr.

(Haskins Laboratories, New Haven, and Lehman College of the City University of New York, and Department of Psychology, University of New Orleans, and Kresge Hearing Research Laboratory of the South, Louisiana State University Medical Center)

Some authors have suggested that stutterers suffer from incomplete cerebral lateralization for speech (Orton, 1928; Travis, 1931; Beech and Fransella, 1968). In this view, often called the Orton-Travis theory, an absence of normal cerebral dominance is thought to result in an incoordination of cortical areas underlying speech production and perception. Early attempts to test this possibility (Bryngelson, 1935, 1940; Heltman, 1940) were inconclusive, perhaps due to the inherently low reliability of the measures of cerebral lateralization employed (e.g., handedness). Renewed interest in testing the theory has developed, however, because of a new, and possibly more reliable, behavioral measure of cerebral lateralization of auditory function introduced by Kimura (1961a, 1961b).

Several varieties of Kimura's task now exist (Berlin and McNeil, 1975). However, all share a common component. Subjects are asked to identify and/or recall contrasting pairs of speech sounds, each member of the pair being presented to a different ear. Under such dichotic competition, subjects tend to report the right-ear stimuli more accurately than the left-ear stimuli. This right-ear advantage (REA) can be interpreted as reflecting the left-hemisphere's specialization for speech and language processing (Kimura, 1961b; Studdert-Kennedy and Shankweiler, 1970; Berlin, Lowe-Bell, Cullen, Thompson and Loovis, 1973).

Several investigators have attempted to test the Orton-Travis theory by administering dichotic listening tasks to stutterers and nonstuttering control subjects. The results have been contradictory. Curry and Gregory (1969) found support for the Orton-Travis theory when a majority of the stutterers they tested evidenced better left- than right-ear report on a dichotic word task. In another test, Jones (1966), using the Wada intracarotid sodium amytal test (Wada and Rasmussen, 1960), found bilateral speech representation in four stutterers who underwent surgery for brain injury. Quinn (1972), however,

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has reported no differences between adult stutterers and controls on a dichotic listening task, and Slorach and Noehr (1973) have obtained similarly negative results with six-to nine-year-old stutterers and controls. This discrepancy in dichotic results may be due, in part, to the fairly large variability in REAs obtained with some dichotic tasks (Porter, 1975) and to the difficulty of obtaining samples of stutterers' homogeneous in handedness, degree of speech impairment, etc.

In the present study, adult, right-handed, moderate-to-severe stutterers and normal-speaking subjects were presented a highly reliable dichotic nonsense-syllable task in order to probe further the possible relationship between hemispheric lateralization for speech and stuttering.

Material and Method

Subjects

The subjects were 16 right-handed adult stutterers (12 males, 4 females) and 20 nonstutterers (10 males, 10 females). The stutterers were drawn from therapy programs at the Institute for Behavioral Research (Summer 1969) and the University of Connecticut (1970). All were moderate-to-severe stutterers with at least a 10-year history of stuttering. The nonstutterers, students at the University of Connecticut, were given class credit for partecipation. All subjects had normal hearing (by self report) and were native speakers of American English.

Apparatus

Synthetic signals appropriate for consonant-vowel syllables [ba, da, ga, pa, ta, ka] were generated with the aid of the Haskins Laboratories' speech synthesizer. Under computer control these six stimuli were combined into the 15 possible contrasting pairs and were recorded dichotically in a fully counterbalanced, random order onto magnetic tape. The resulting tape contained 60 stimulus pairs with each member of a pair occurring twice on each channel. The interpair interval was 4 sec. The stimuli were reproduced on an Ampex AG 500 or a General Radio tape recorder and presented via matched TDH-39 headphones. The outputs of the tape channels were equated (within 1 db) and monitored by voltmeter. The signal level was 75 db SPL.

Procedure

In order to familiarize the subjects with the stimuli, and to discover any gross hearing deficits, the subjects were first presented two monaural syllable identification tests (one to each ear). (All subjects performed at virtually 100% on these monaural tasks). Before dichotic testing the subjects were told they would hear two syllables simultaneously and were instructed to write the identity of both syllables, in order of clarity, on an answer sheet. The subjects were given three dichotic practice trials followed by two presentations of the 60-item dichotic test. The subjects' headphones were reversed for the second 60-item test in order to counterbalance any channel imbalances.

RESULTS

The mean number of dichotic syllables correctly reported (maximum of 120 for each ear) from the right and left ears for both stutterers and controls, subcategorized by sex, is shown in Table I. Significant REAs were found for

TABLE I

Mean Number of Syllables Correctly Reported from Each Ear

Group		N	Left	Right	t
Stutterers	M	12	20.25	27.04	2.21*
	F	4	17.51	29.62	2.16
Controls	M	10	19.80	26.15	2.92*
	F	10	15.52	34.71	5.91**

* $p < .05$
** $p < .01$

both male stutterers and male controls. The magnitude of the REAs did not differ between these groups ($t_{20} = 0.147$, $p > .05$). A significant REA was also found for the female controls. Three of the four female stutterers evidenced large REAs ($S_1 = 38\%$; $S_2 = 52\%$; $S_3 = 13\%$; $S_4 = 0\%$), but the REA was not significant. Because of the small number of female stutterers, the statistical analysis of these data and a comparison with controls must be made with some caution. The female stutterers' results do, however, fall within the range of the control results, and there appears to be no reason to classify them as abnormal.

Within the control population, females evidenced a significantly larger REA than males ($t_9 = 3.55$, $p < .01$). The mean scores for male and female stutterers bear the same relation as those for male and female controls.

A summary of the findings in terms of the metric $\frac{R-L}{R+L} \times 100$, where R (or L) is the number of syllables correctly reported from the right (or left) ear, is shown in Table II.

TABLE II

Mean Ear Advantage (%) in Terms of $\frac{R-L}{R+L} \times 100$

	Stutterers	Controls
Males	14.78 N = 12	13.81 N = 10
Females	26.65 N = 4	38.20 N = 10

Discussion

Both male and female stutterers identified syllables presented to the right ear better than syllables presented to the left ear. Furthermore, the magnitude of the REA for the stutterers as a group was very similar to that of the controls as a group. Clearly, these data fail to lend support to the theory that stutterers suffer abnormalities in speech lateralization.

Although the absolute magnitude of the female stutterers' REA was smaller than that of the female controls' REA, all stutterers' REAs were well within the range of REAs found in normal populations (Studdert-Kennedy and Shankweiler, 1972). In fact, if any group performance approaches the extremes of the normal population, it is that of the female control group.

In summary, the present data, those of Quinn (1972), and those of Slorach and Noehr (1973) indicate that stutterers fall well within the normal range of lateralization for speech as indicated by a dichotic test. Since it has also been demonstrated that individuals with bilateral speech representation (as determined by the Wada test) may have normal speech ability (Milner, Branch, and Rasmussen, 1964) it would appear that factors other than abnormalities in cortical lateralization underlie stuttering.

Summary

Sixteen adult, right-handed, moderate-to-severe stutterers (12 males, 4 females) and 20 nonstuttering controls (10 males, 10 females) were given a dichotic nonsense-syllable test to determine hemispheric lateralization for speech. Both male and female stutterers evidenced right-ear advantages in syllable identification similar in magnitude to those found for normals. These data confirm other reports of no difference in cerebral speech lateralization for stutterers and nonstutterers and, therefore, lend no support to theories that relate stuttering to abnormalities in cerebral lateralization.

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M. F. Dorman, 270 Crown Street, New Haven, Conn. 06510, U.S.A.
R. J. Porter, Department of Psychology, University of New Orleans, Lakefront, Louisiana, U.S.A.