

1931

Common factors in reading and speech disabilities

George A. Kelly
University of Iowa

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<https://doi.org/10.17077/etd.eo5aqznp>

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COMMON FACTORS IN READING
AND SPEECH DISABILITIES

by

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Geo. A. Kelly

A thesis submitted in partial fulfillment of the
requirements for the degree of Doctor of
Philosophy, in the Department of
Psychology, in the Graduate
College of the State
University
of
Iowa.
June, 1931

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ACKNOWLEDGEMENT

To Dean C. E. Seashore for
the suggestion of the problem and
to Professor L. E. Travis for many
helpful suggestions the writer is
deeply indebted.

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HISTORICAL

The deep-seated and diffuse nature of the stutterer's defect has been emphasized by Travis (19). He has shown numerous motor disturbances to be existant during the activities of the stutterer which are apparently unrelated to his speech. The explanation offered is that in the stutterer there is a tendency toward decentralized neural control resulting primarily from a lack of inherent bias for cerebral dominance or from lesions which reduce the ascendancy of the higher motor centers. The result of this decentralized control is dysintegration of the nervous system, manifest, in the case of stuttering, in speech. The present study is an investigation of this and other factors which may be common to reading and speech disabilities.

Fessler (6) has shown that the breathing of the stutterer during overt speech is dysintegrated from the standpoint of effectively producing normal speech. Murray (13), following

Fossler, has shown that similar dysintegrations occur in the breathing of stutterers during silent reading and reasoning. He has also pointed out the tendency toward a silent reading disability among stutterers.

Orton (14) reports that about 2% of the school population have reading defects of the "word-blindness" type. He attributes this type of manifest defect to a difficulty in the building of associations between the visual and auditory spheres at the third functional level, the lowest level on which cerebral dominance plays any significant part. The natural inconsistency between visual and auditory stimuli is, according to him, normally eradicated at this level, but, due to a lack of inherent bias toward cerebral dominance or to lesions, is in this type of reading defective the cause of "congenital word blindness" (strephosymbolia). On this associational level the memory images of the two visual cortices are mirrored counterparts of each other; thus

a lack of dominance of one cortex over the other confuses the visual memory images and prevents normal images.

It is generally maintained that Wernike's center ("auditory speech center") is directly involved in the production of overt speech. Cases have been recorded of bilateral lesion of this area producing loss of hearing and loss of speech, the motor centers being unaffected. This is called Wernike's sensory aphasia. Mott (12) reports a clear-cut case of this sort. This direct connection with overt speech is not evident to the same extent in the case of the visual cortices of the occipital lobe. While lesions of the visual centers have been frequently observed they are not known to be entirely responsible for the loss of overt speech.

Bartley and Perkins (1) in comparing action currents obtained from the different areas of the dog's brain under varying circum-

stances found that the activity tended to be focalized in not less than two of the following areas, auditory, visual, motor. At one time the activity might be focalized in the auditory and visual areas with comparative quiescence in the motor area; at another time the activity might be focalized in the auditory and motor areas with comparative quiescence in the visual area; at another time the activity might be focalized in the visual and motor areas with comparative quiescence in the auditory area. Never was activity in focalized in one area only.

Bluemel (3) at one time expressed the thesis that "The stammerer's difficulty is transient auditory amnesia." At that time he emphasized the contention that the stammerer was an "audito-moteur" type and his stammering was due to a loss of the memory-image of the sound which should follow that on which he stammers. More recently, however, he has expanded his conception of this

transitory phenomenon. His recent thesis is that the stammerer is confronted with a discontinuity in the whole of his consciousness.

Ranschburg (15) attributes reading defects among children to lack of development of the carotid arteries with corresponding reduction of the oxygen supply. Starr (17) reports low vital capacity and insufficient ventilation in stutterers. He has also found a high carbon-dioxide content and a low calcium concentration associated with stutterers. For certain types of stutterers ("psychopathic") he has found low hydrogen ion concentrations; for others, "normals" he reports extremely high hydrogen ion concentrations.

Studies of imagery habits, mostly based upon introspection technique, have had perennial revivals since Galton(7) made his classic study of "types". A review of the literature on these studies would be a dissertation in itself. One study of particular significance in the present connection is that reported by

Golla and Antonovitch (9). A box plethysmograph, said by the authors to be unusually sensitive, was used in connection with a smoked-drum kymograph for the recording of subjects' breathing over a long period of time. Of 67 cases whose rest breathing was recorded over a considerable period of time, 34 were classed as "regular" breathers, 33 of which were "visual" types, and 1 was an "auditory" type. Of the 32 "irregular" breathers 28 were "auditory" types and 4 were "visual" types (1 case rejected). When given a problem to solve which required the employment of visual imagery 25 of the 30 "irregular" breathers breathed regularly and the remaining 5 abandoned attempts to solve the problem. The breathing of the "regular" breathers remained unchanged during the solution of the problem.

Such a striking conclusion as this appears to be, if verified, would have far-reaching significance in psychology and education. In the present investigation a check was made upon

this finding and showed it not to be without partial substantiation, as will be shown later.

Most of the experimental work with breathing curves, exclusive of studies of speech production, has attempted to link breathing rhythm with changes of attention or with emotional states. Skaggs (16) reports shallow and more rapid breathing during silent reasoning and somewhat deeper, though rapid, breathing during emotional states. One of the first studies in the field was made in Wundt's laboratory by Joneff and Meumann (10) and revealed changes in breathing rhythm with fluctuations of attention.

Probably one of the most significant investigations from the standpoint of the present study is that recently reported by Bills (2). In studying the decrements of work curves for homogeneous serial tasks he has observed certain periodicities in production efficiency which occur in rhythmic succession at the rate of about three a minute. The periods of efficiency were separated by periods of blocking when the tasks were performed slowly and imperfectly. Furthermore, the moments of maximum efficiency tended to be separated by just

half a phase-length from the moments of minimum efficiency, thus indicating a truly cyclical phenomenon.

At about the same time Knight (11) observed periodicities in the occurrence of errors made by sixth grade children in solving multiplication problems involving several places in the multiplier. Errors occurred most frequently at the end of the problem and least frequently at the beginning. The rhythm of efficiency and inefficiency tended to adjust itself to changes in the tasks, that is, efficiency was partly restored at the beginning of each new problem. A finding of this nature is of primary importance in the field of educational method.

In 1927 Farnsworth, Seashore, and Tinker (5) published the results of a study which showed a correlation of as high as $+.53$ between certain serial reaction times and Army Alpha intelligence scores. The correlation was considerably lower between serial reaction times and scores made on those intelligence tests which place less emphasis

upon the speed factor. The correlation of simple reaction times with intelligence scores was insignificant. Gaskill (8) reports a relationship between simple reaction times and the phase of breathing, the shortest reaction times occurring when the stimulus was given during the period between the phases of breathing, that is, when breathing movements were momentarily suspended.

METHOD

The first hypothesis taken into consideration by the present investigation was that those individuals who are defective in silent reading would exhibit dysintegrations in breathing during silent reading similar to those of the stutterer during silent reading. Accordingly six groups of subjects were chosen from the men of the 1930-31 freshman class of the State University of Iowa. They were chosen on the basis of the entrance tests given to all freshmen who enter the University and on the basis of scores on the Iowa Silent Reading Comprehension Tests which were administered to nearly all freshmen as a part of a survey made by the Department of Speech. The groups were selected in the following manner:

In one group were eight subjects whose percentile ranks in the Iowa Silent Reading Comprehension Test were not only low, but considerably lower than their percentile ranks in the General Qualifying Examination, a test highly correlated with intelligence tests. In another group were eight subjects matched with these on the basis of percentile ranks in the General Qualifying Examination but whose percentile ranks in the reading test were approximately the same as their ranks in the General Qualifying Examination. In another group were eight subjects matched with the subjects in the other two groups on the basis of percentile ranks in the General Qualifying Examination but whose percentile ranks on the reading test were relatively high. Similarly, there were four (it being impossible match one score) subjects whose percentile ranks in the reading test were high but whose percentile ranks in the General Qualifying Examination were higher, five matched on the basis of the percentile ranks in the General Qualifying Examination but with reading ranks approximately equivalent, and five matched on the basis of the percentile ranks in the General Qualifying Examination but with reading ranks relatively high.

The subjects were called into the laboratory singly. Each subject was seated in a chair facing a table on which were placed the materials which he used during the experiment. His breathing was recorded by means of two Boulitte pneumographs, one placed over the thorax on the level of the arm-pits and the other over the diaphragm about one inch inferior to the xiphoid process. The record was made with black Skrip ink on white paper with a Renshaw polygraph. The pulse from the left carotid artery was recorded similarly by means of a very sensitive tambour. A Boulitte laryngeograph was used to record laryngeal movements simultaneously with the pulse and breathing movements. The polygraph was placed behind the subject. The experimenter sat at the right and slightly back of him.

The experimental series consisted of the following items, many of which are identical with those used by Murray (13) in his study of the breathing of stutterers during silent reading.

1. A period of adjustment for the subject during which he conversed freely with the experimenter and became accustomed to the hum of the polygraph.

2. A five-minute period of rest-breathing during which the subject sat without moving or speaking while listening to the ticking of a Jaquet chronometer. He was instructed not to think about anything too intently and to bring his attention to the ticking if he found any other subject absorbing his interest.

3. Two minutes silent reading of fairly difficult prose.

4. Answering in writing multiple-choice questions, visually presented, over the material he had just read.

5. Two minutes silent reading of poetry.

6. Questions.

7. Two minutes silent reading of light prose.

8. Questions.

9. One minute rest.

10. Solving and writing the answers to mental arithmetic problems auditorily presented by the experimenter.

11. Visualizing the face of a clock. In this part of the experiment the subject was given a series of problems such as this: "Suppose it were twenty-three minutes past seven; what time would it be if the positions of the two hands of the clock were exchanged? Write your answer."

12. Silent reasoning. The subject was presented with a proposition such as this: "A falsehood is justifiable if to one's knowledge it will save the reputation of a friend." He was then told to make a decision as to the truth or falsity of the statement and to formulate three reasons for his answer. After the subject had indicated that his answer and reasons were ready he was asked to dictate them into an Ediphone. Five of these propositions were presented.

13. Memorizing from a visual stimulus. The subject was given a typewritten selection of an abstract nature and told that he would be given five minutes to memorize it.

14. Solving Golla's "visual imagery" problem. The exact procedure was as follows: The experimenter said, "Now imagine a number of blocks like the

ones you used to play with when you were a child. Imagine you have built of them a cube, three blocks on a side; that is, a perfect cube, three blocks high, three blocks long and three blocks wide. Now imagine that you have painted it red all over and taken it apart. How many of the little blocks will have three sides red, -- how many will have two sides red, -- and how many will have one side red? Lift your hand when you have the right answer. The cube was three blocks on a side."

15. Memorizing from auditory stimulus. The experimenter repeated four times a short selection similar to the one memorized from visual stimulus.

16. Visual aphasia test. In this test the presentations were made by means of a band of white paper stretched between the drums of a small kymograph. For the length of the band a black line appeared. Alternately above and below this line appeared pairs of digits about 8 mm. high. A cardboard shield containing a window 22 mm. wide was placed around one of the kymograph drums so that when the kymograph was set in motion the pairs of digits were exposed successively. Following each pair of digits above the line appeared a pair of digits below the line, one of which had appeared

in the previous pair and one of which was unlike either of the digits in the preceding pair. The subject was asked to pick out and write down the unrepeated digit in each pair of digits appearing below the line. Presentations were made at about two-second intervals and were forty-five in number. A short practice period preceded the test.

17. Auditory aphasia test. In this test the presentations were made by means of an Ediphone record. Each presentation consisted of a three-place number spoken as follows: "Three hundred and twenty-nine!" The subject was asked to write the number with the positions of the first two digits exchanged, that is, in the above illustration he would write, "2 3 9". Presentations were made at three-second intervals and were forty in number.

During the whole experiment, which usually consumed from an hour and a half to two hours, the polygraph was kept running and a continuous record of breathing, pulse, and laryngeal movements was made. (The exact experimental procedure may be followed through in the experi-

menter's manuscript and accessory materials given in Appendix A.)

As criteria of breathing irregularity Murray (13) used the coefficients of variation of the following four variables: (a) duration of expiration, (b) duration of inspiration, (c) amplitude of expiration, (d) amplitude of inspiration. This involved making four measurements of each breathing curve and if carried out in the present study would have entailed measuring with a millimeter scale some 600,000 curves. Accordingly another method was devised (although for the breathing curves during silent reading individual measurements were made and coefficients of variation computed). Durations of expiration and of inspiration during the five minutes of rest breathing were measured, the means and standard deviations computed, and the normal range of values found, assuming a normal distribution to extend three standard deviations on either side of the mean. Thus a value of each of the two variables, duration of inspiration and duration of expiration, was found, values below which would fall outside the normal probable distribution. Likewise another value was found, values above which would fall outside the

normal probable distribution. Thus with rest breathing as a standard, irregularity of breathing during the different tasks of the series could quickly be observed. Three measures of breathing irregularity were used, (a) the number of inspirations whose durations fell outside the normal distribution of inspiration durations for rest breathing, divided by the time in seconds; (b) the number of expirations whose durations fell outside the normal distribution of expiration durations for rest breathing, divided by the time in seconds; (c) defining any expiration or inspiration whose duration was greater than the normal duration in rest breathing as a "block", the total duration of all blocks in seconds divided by the total time in seconds. Measure "c" might be designated as the ratio of blocking time to total time.

DATA AND DISCUSSION

Breathing irregularities of reading disability cases: Table 1 shows the average for each group of subjects on each type of task in terms of each of the three criteria of breathing irregularity. A superficial glance at Table 1 will indicate that there is no consistent relation be-

Table 1.

Irregularity of Breathing as Measured by the Mean Number of Abnormal Expiration Durations per Second (X/T), the Mean Number of Abnormal Inspiration Durations per Second (I/T), and the Ratio of Blocking Time to Total Time (B/T) for Each of the Six Groups of Subjects While Performing Each of the Eight Kinds of Tasks in the Experimental Series.

Task	Measure of Irregularity	GROUPS					
		Intelligence Low			Intelligence High		
		Reading Lower	Reading Same	Reading Higher	Reading Lower	Reading Same	Reading Higher
Silent Reading	X/T	.0089	.0095	.0126	.0041	.0348	.0089
	I/T	.0043	.0049	.0037	.0034	.0257	.0085
	B/T	.0208	.0534	.0214	.0124	.0345	.0529
Questions	X/T	.0301	.0103	.0127	.0065	.0642	.0106
	I/T	.0114	.0089	.0145	.0054	.0438	.0055
	B/T	.0591	.0584	.0307	.0266	.0244	.0452
Arithmetic	X/T	.0328	.0128	.0260	.0280	.0791	.0105
	I/T	.0328	.0127	.0366	.0019	.0521	.0129
	B/T	.0626	.0585	.0379	.0579	.0323	.0370
Clock Problems	X/T	.0207	.0162	.0236	.0161	.0956	.0241
	I/T	.0253	.0067	.0380	.0106	.0476	.0109
	B/T	.0712	.0753	.0509	.0496	.0528	.1214

Table 1 (concl.)

Task	Measure of Irregu- larity	GROUPS					
		Intelligence Low			Intelligence High		
		Reading Lower	Reading Same	Reading Higher	Reading Lower	Reading Same	Reading Higher
Reason- ing	X/T	.0418	.0172	.0266	.0114	.0635	.0243
	I/T	.0349	.0115	.0363	.0175	.0494	.0173
	B/T	.1202	.0663	.0648	.0554	.0475	.1241
Memorizing from							
Visual Stim- ulus	X/T	.0733	.0188	.0541	.0149	.0311	.0478
	I/T	.0779	.0102	.0625	.0036	.0525	.0711
	B/T	.2151	.1036	.1673	.0604	.1174	.2140
Memorizing from							
Auditory Stim- ulus	X/T	.0395	.0105	.0400	.0040	.0454	.0279
	I/T	.0486	.0082	.0485	.0069	.0475	.0100
	B/T	.1002	.0535	.1125	.0374	.0873	.1392
Golla's "Visual" Problem	X/T	.0435	.0066	.0468	.0148	.0681	.0266
	I/T	.0418	.0096	.0476	.0018	.0541	.0294
	B/T	.1234	.0415	.1338	.0436	.0517	.1345

tween breathing dysintegration and reading disability either with or without intelligence taken into consideration.

Table 2 shows coefficients of variation based on individual measurements of each curve. Again no consistent difference between the groups is apparent.

The findings with respect to the hypothesis that reading defectives would show breathing irregularities during silent reading as do stutterers are essentially negative. They are consistent, however, with the findings reported elsewhere in this study.

General relation of reading and speech defects:

The next question to be answered is whether or not there is any relation between speech and reading defects. Murray (13) reports that "Stutterers appear to be approximately one grade below normal in rate of reading. The disparity is emphasized further at least one-half grade when their reading achievement is considered in relation to their true intelligence." The question remaining to be answered is whether or not the converse is true;

Table 2

Mean Coefficients of Variation of Durations
of Thoracic Inspiration and Expiration for the
Six Groups of Subjects During Silent Reading

GROUPS					
Intelligence Low			Intelligence High		
Reading Lower	Reading Same	Reading Higher	Reading Lower	Reading Same	Reading Higher
Expiration					
17.6	18.6	18.1	17.1	21.2	22.3
Inspiration					
18.4	19.5	18.5	15.6	28.2	19.9

are reading defectives defective speakers? It is to be remembered in this connection that stuttering is only a very specialized kind of speech disability while in the present connection no distinction between kinds of reading disability has been made.

Analysis of the speech of reading disability cases: In the present investigation an analysis was made of the speech of the thirty-one subjects who made records under item 12 in the procedure described above. Five different criteria of speaking ability were used; (a) the number of words spoken a second under the conditions of the experiment; (b) counting each hesitation of one second or less at a place where the thought content did not require a pause as a block of one second, the ratio of hesitation or blocking time to total time of speaking; (c) the ratio of repeated vowel sounds, excluding completed words, to the total number of words spoken; (d) the ratio of repeated words to the total number of words spoken; (e) the ratio of slurred words to the total number of words spoken. (Slurred words were defined as those indistinctly spoken, either because of too short a phonation

time or omission of one or more syllables.)

The results of this analysis are shown in Table 3. It is evident from this table that there is quite a definite relation between silent reading ability and speaking ability with intelligence held constant. Especially in the rate of speaking is the relationship brought out. These averages are computed on the basis of about two hundred spoken words for each individual.

Analysis of silent reading scores of general speech disability cases: As a further check on the coincidence of reading and speech defects an analysis was made of the data obtained by the Department of Speech in the University of Iowa in its general survey of speech abilities among the members of the 1930-31 freshman class. During the first semester of the year each freshman was given a general effectiveness rating on his speech by a committee chosen from the staff of the Department of Speech. For the 101 (approximately the lowest decile) who were indicated as being defective speakers the mean percentile rank on the Iowa Silent Reading Test was 44.8, or very nearly at the median. Since

Table 3

Analysis of Speech Records in Relation to
Silent Reading And Intelligence

Cases	Number of Words per sec.	Block	Repeated	Repeated	Slurred	
		time	vowels	words	words	
		<u>Total</u>	<u>Total</u>	<u>Total</u>	<u>Total</u>	
		Time	Words	Words	Words	
Reading ability and intelligence both relatively low. Groups matched in intelligence.						

Reading Ability Relatively Lower	7	1.66	.46	.23	.06	.05
Reading Ability Relatively Same	7	1.94	.34	.06	.03	.05
Reading Ability Relatively Higher	7	2.24	.36	.04	.01	.04

Table 3 (concl.)

	Number of Cases	Words per sec.	Block time <u>Total</u> Time	Repeated vowels <u>Total</u> Words	Repeated words <u>Total</u> Words	Slurred words <u>Total</u> Words
Reading ability and intelligence both relatively high. Groups matched in intelligence.						

Reading Ability Relatively Lower	3	1.97	.44	.13	.06	.12
Reading Ability Relatively Same	4	2.20	.18	.03	.02	.04
Reading Ability Relatively Higher	3	2.63	.30	.10	.04	.04

general intelligence was operative both in determining the speech rating and the reading test rank it can scarcely be maintained on the basis of this finding alone that any other factor was responsible for the slightly low reading average.

By subtracting the percentile rank of each freshman on the reading test from his percentile rank on the General Qualifying Examination a measure of the discrepancy between the two could be obtained. For those freshmen rated as speech defectives (the same group described in the previous paragraph) the mean of these percentile differences was only + 1.1, indicating quite definitely that here there was no relation between speech and reading disability other than perhaps a low general intelligence.

At this point it became apparent that if there were a relationship between reading disability and speech disability it must be of a particular rather than of a general nature.

Analysis of the relation of different aspects of the speech survey to silent reading disability:
In rating each freshman's general effectiveness in

speech the committee in charge of the survey scored on a scale of 1 to 10 each individual's ability in each of the following aspects of speech: Articulation, Voice, Organization of Materials, and Symbolic Formulation and Expression. The intercorrelations between these scores and the raw scores on the silent reading tests are shown in Table 4. From this table it can be seen that except for "halo" effects between scores on certain of the aspects of the speech rating the general inter-relationship is insignificant. (Coefficients were computed on the basis of random samples of 250 cases.)

Analysis of the relation of different aspects of the silent reading test to speech disability: Since organization of materials was taken into consideration in rating each freshman's general effectiveness in speech it was thought that inability to organize might comprise a common element in speech and reading defects. For the 113 freshmen rated as deficient in speech organization the mean percentile rank in sentence organization as measured by the Iowa Silent Reading Comprehension Test was 46.36, or nearly at the median. Similarly, for the same group the mean percentile rank in paragraph organization as measured by the Iowa Silent Reading Com-

Table 4

Intercorrelations Between Aspects of the
Speech Ratings and Scores of the Iowa Silent
Reading Test

Reading	Articula- tion	Voice	Speech Organi- zation	Symbolic Formulation and Expression
Read- ing	.080	.035	.090	.110
Articu- lation		.338	.219	.300
Voice			.260	.230
Speech Organ- ization				.549
Symbolic Formulation and Expression				

prehension Test was 46.77, again nearly at the median. Apparently there is little relation between speech organization and sentence or paragraph organization during silent reading.

Relation between speech comprehension and silent reading comprehension: If general intelligence or general ability to comprehend language represented the only common element in speech and reading ability one would expect to find scores in silent reading comprehension and speech comprehension very highly correlated. However, such was not found to be the case. In connection with the same survey of speech abilities in the freshman class as was mentioned above, the Travis-Barnes Speech Comprehension Test was given. In giving this test the tester reads aloud a selection, after which the testee selects from four printed selections the one which he believes to be identical with the one read. Fifty selections are read in the entire test and the testee's score is the number which he is able correctly to identify on the printed page.

A coefficient of correlation of $+.575 \pm .030$ was obtained between this test and the Iowa Silent Read-

ing Comprehension Test. This coefficient is far below that which would be expected if intelligence or general ability to comprehend language were the only factor involved. Scores on an auditory acuity test made in the general speech survey revealed no consistency with the scores on the Travis-Barnes Speech Comprehension Test. Thus it becomes evident that some factor other than general intelligence or even than general language comprehension is operative in one or the other or both of these tests.

Relation of speech rhythm defects to silent reading disability: One aspect of the speech survey did appear to be definitely related to silent reading disability. For the 67 cases who were diagnosed as being defective in the rhythm of their speech the mean percentile ranking on the General Qualifying Examination was 45.25 and the mean percentile ranking on the Iowa Silent Reading Test was 40.87, a discrepancy of 4.39. In this connection it should be borne in mind that silent reading comprehension is a very considerable element in any written examination and that therefore the above numerical difference is probably too small.

This finding checks with the analysis made of the records of the 31 cases who recorded their speech on the Ediphone. All the measures used in that analysis were essentially measures of speech rhythm. (See Table 3). Thus on the basis of two studies defective speech rhythm was found to be related to reading disability. This points toward a common element in speech and reading defects which is essentially transient in nature.

Relation of silent reading disability to cerebral dominance as manifest in ambidexterity and sinistrality: For a further explanation of this essentially transient element the present investigation followed the lead of Orton (14) who emphasized the importance of "word blindness" or strephosymbolia in reading disability. It is true that Orton limits this defect to about 2% of the school population, but it is conceivable that the defect is present to some extent in everyone. With strephosymbolia and stuttering (essentially a defect in speech rhythm) both being attributable to lack of cerebral dominance it becomes a matter of prime importance to study the reading disabilities of those whose cerebral dominance is somewhat doubtful, that is,

left-handed and ambidexterous individuals.

Of 28 individuals who reported left-handedness or ambidexterity in the speech survey 22 or 79% had a lower percentile ranking in silent reading comprehension than in the General Qualifying Examination. The mean percentile ranking for this group on the Iowa Silent Reading Comprehension Test was 41.0 and the mean percentile ranking on the General Qualifying Examination was 47.6, a discrepancy of 6.6 percentiles. Again it should be pointed out that any silent reading disability would tend to influence unfavorably scores on the General Qualifying Examination.

In the speech survey 22 individuals reported having been changed from the left to the right hand at some time in their lives. Silent reading ranks were available for only 16 of these individuals; however, for this small group the mean reading percentile was 43.7 and the mean qualifying percentile was 47.9. It is interesting to note in passing that 4 of these individuals were stutterers.

Relation of transient sensory aphasia to silent reading disabilities: It is evident from the fore-

going paragraphs that although there is a common element, essentially transient in nature, in reading and speech rhythm defect, there is still some discrepancy and the presence of one type of defect in an individual does not insure the presence of the other type of defect. An analysis of the two tests for transient aphasia will throw some light on this discrepancy. Table 5 shows the results. From this table it can be seen that the percentage of errors made on the visual aphasia test (described under item 16 in the experimental series) is a fair measure of the silent reading ability with the intelligence held constant. The auditory aphasia test (described under item 17 in the experimental series) does not appear to be as closely related to silent reading ability.

Relation of transient sensory aphasia to defective speech rhythm: After examining the results shown in Table 5 the question arises whether or not the auditory test might be more closely related to speech rhythm defects. In order to test this hypothesis a much longer auditory aphasia test and a much longer visual aphasia test were constructed. The natures of the tests and the methods of presentation were retained but the number of

Table 5

Percentages of Errors in the Transient Aphasia Tests According to Groups Selected on the Basis of the Discrepancy Between Silent Reading Percentile Ranks and Percentile Ranks in Intelligence as Measured on the Iowa General Qualifying Examination

GROUPS					
Intelligence Low			Intelligence High		
Reading Lower	Reading Same	Reading Higher	Reading Lower	Reading Same	Reading Higher
Transient Visual Aphasia Test					
20.0 %	11.9 %	5.9 %	1.0 %	3.7 %	2.7 %
(7cases)	(7cases)	(7cases)	(3cases)	(5cases)	(3cases)
Transient Auditory Aphasia Test					
42.2 %	28.2 %	28.2 %	15.0 %	17.5 %	21.8 %
(7cases)	(7cases)	(7cases)	(3cases)	(5cases)	(3cases)

presentations was increased to 133 in the auditory test and to 197 in the visual test. Time intervals between presentations remained unchanged in each case.

For the experiment 12 stutterers and an equivalent number of normal speakers were matched on the basis of age and advancement in school. All the individuals were either undergraduate or graduate students in the university. Table 6 shows the results of this experiment. The differences are striking; here both visual aphasia and auditory aphasia tests appear to be closely related to stuttering. However, it can be seen that those individuals who made a high percentage of errors on one test did not necessarily make a high percentage of errors on the other.

Preliminary generalizations: At this point it is possible to generalize from the foregoing results to some extent. In the first place the connection of reading disability to defective speech rhythm independent of general intelligence indi-

Table 6

Stutterers and Normals Compared on Basis of
Percentage of Errors Made on Aphasia Tests

Case	Normals Auditory Aphasia Test	Visual Aphasia Test	Case	Stutterers Auditory Aphasia Test	Visual Aphasia Test
Gr.	.75 %	0 %	Ba.	28.80 %	7.61 %
Ha.	7.51	7.61	Be.	61.60	34.50
Ke.	.75	3.55	Fr.	68.40	11.16
Ly.	0	0	Gr.	54.90	19.30
Ma.	36.80	9.14	He.	67.60	3.04
Na.	5.26	1.52	Ho.	19.53	10.64
Pa.	17.30	3.05	Ja.	7.50	13.20
Pr.	28.60	8.01	Jo.	6.76	10.15
Ti.	21.80	0	Ma.	100.00	100.00
Wa.	6.01	1.52	Sc.	24.80	8.10
Wh.	3.76	0	Sw.	43.60	17.76
Wi.	<u>6.76</u>	<u>1.01</u>	Va.	<u>42.10</u>	<u>12.70</u>
Means:	11.28 %	2.95 %		43.80 %	20.68 %

cates a common element of a transient nature. In the second place the connection of reading disability to lack of cerebral dominance indicates the presence in reading disability cases the same sort of neurological condition as that involved in stuttering. In the third place the more particular connection of transient aphasia in the visual test to reading disability and the more particular connection of transient aphasia in the auditory test to stuttering indicates a certain amount of differentiation between the sensory fields involved in this neurological condition. It would appear, then, that "neural blocking" due to lack of cerebral dominance results in a transient sensory aphasia which may or may not be apparent in both visual and auditory fields, although there is a general tendency for both fields to be involved. To the extent that both fields are involved, speech and reading defects have, independently of low intelligence, a common element.

Introspective evidence: Two interesting incidents in the giving of the tests for visual and auditory aphasia lend weight to this conclusion. One subject was having considerable difficulty with

the test for auditory aphasia and as the test went on his difficulty increased, as was common with subjects taking this test. At the 97th presentation he had missed 29 of the numbers. Suddenly he announced that he would miss no more, and from that point on appeared to make the responses with a minimum of difficulty. The remaining responses were all correctly made. When asked to explain his "trick" he said that while before he had tried to recall the sounds of the numbers, in the latter part of the test he visualized the numbers as they were presented to him and simply "copied" from the visual image. This indicates that the transient aphasia of this subject involved his auditory imagery more particularly than his visual imagery.

Another subject, a stutterer, reported that he could "feel" the transient auditory aphasic states "coming on". He reported having at these times the same kinaesthetic sensations in his chest as he was accustomed to have at the onset of stuttering.

Relation of auditory imagery to control of breathing during non-speaking intervals: The close relationship between transient auditory aphasia and dis-

orders of speech rhythm opens the question of the extent to which auditory imagery is related to control of the speech organs, particularly those involved in breathing, during non-speaking intervals. Golla's and Antonovitch's (9) claim that rest breathing variability is very closely associated with auditory-motor types is not entirely substantiated by the present investigation. Table 7 shows a comparison between the 6 subjects of the first experiment who reported habitual use of auditory imagery and the 6 subjects who most definitely reported visual imagery. Of the latter group, however, Subject Sa reported ability to recall very definite kinaesthetic images of such activities as playing golf, walking down the street, etc. It will be noticed that his breathing more nearly resembles that of the auditory group than that of the visual group into which the definiteness of his reported visual imagery required that he be placed.

The coefficients of variability for the durations of diaphragmatic expiration during rest breathing are only slightly larger in the case of the auditory group and there is considerable over-lapping. Golla

Table 7

Auditory and Visual Types of Individuals Compared on the Basis of Ratios of Expiration Duration to Inspiration Duration and Variability of Breathing During Rest, Silent Reading, Memorizing from a Visual Stimulus, and Solving Golla's "Visual" Problem

Auditory Types	Ratio of Expiration Duration to Inspiration Duration		Coefficient of Variation of Expiration Durations During Rest Breathing	Ratio of Blocking Time to Total Time	
	Rest	Silent Reading		Memorizing from Visual Stimulus	Solving Golla's Visual Problem
Al.	2.12	2.19	19.9	.6580	.1766
Br.	2.27	1.86	13.1	.2622	.1486
Da.	1.85	1.78	15.2	.1882	.4960
Ge.	1.71	2.08	24.5	.4200	.0667
Nu.	2.00	2.13	25.5	.6930	.0318
Su.	2.26	2.36	25.1	.0373	.0895
Means:	2.03	2.07	20.5	.3764	.1682

Table 7 (Concl.)

Visual Types	Ratio of Expiration Duration to Inspiration Duration		Coefficient of Variation of Expiration Durations During Rest Breathing	Ratio of Blocking Time to Total Time	
	Rest	Silent Reading		Memorizing from Visual Stimulus	Solving Golla's Visual Problem
Ba.	1.85	1.40	13.3	.0866	0
Ca.	1.25	1.49	18.6	.1800	.2850
De.	1.46	1.49	22.0	.0138	0
Fl.	1.58	1.32	13.6	.0165	.0495
Kn.	1.32	1.48	14.4	0	.0375
Sa. (Visual-kinaesthetic type)	1.98	1.88	10.4	.1272	0
Means:	1.57	1.51	15.4	.0707	.0620

and Antonovitch only report a 7.5% discrepancy between irregular breathing and auditory imagery.

Much more significant in rest breathing is the difference between the two groups in the ratios of diaphragmatic expiration durations to diaphragmatic inspiration durations. The relatively long expirations and short inspirations of the auditory types suggest breathing during overt speech. Continual employment of verbalization during silent reasoning and studying probably implants a speech-like pattern of breathing in the individual. The fact that the subjects were supposedly directing their attention to the ticking of a chronometer when these records were being made indicates that this type of breathing persists whether or not the individual is verbalizing at the time.

The ratio of expiration duration to inspiration duration during the silent reading periods is also shown in Table 7. About the same difference between the two groups as in rest-breathing is indicated.

The most striking difference between the two groups appears in their breathing during a period

of memorizing from a visual stimulus (described under item 13 in the experimental series). The measure here used is the ratio of blocking time to total time, or the ratio of the time during which the individual was making unusually long expirations or inspirations to the total time. Here the auditory types, due to their employment of verbalization in memorizing the passage made relatively long expirations.

It was Golla's and Antonovitch's (9) claim that auditory types showed regular breathing patterns while solving a problem in which they were forced to employ visual imagery. The same problem (see item 14 in the experimental series) which these investigators used was employed in the present investigation, but with different results (see Plate Three). In no case did the breathing become more regular and in most cases the problem was solved before a fair sample of breathing curves could be obtained. In Table 7 the ratios of blocking times to total times for visual and auditory types are shown. The auditory group is shown to be much more irregular in breathing than the visual group. That this irregularity

was largely due to a tendency to verbalize on this "visual" problem could easily be observed by the experimenter.

In passing it seems not inappropriate to remark that while Titchener (18) and other authorities generally agree that about 75% of the population-at-large are visual types the authors of the preceding study found 29 auditory types in a group of 67 cases. The present study revealed only 6 clear-cut auditory types out of 38 cases.

Synchronization of breathing with mental processes: The foregoing data indicate a relatively close relationship between auditory imagery and the habitual pattern of respiration. It is not to be assumed that there is not also a relation between the breathing rhythm and visual imagery, although that relation is not nearly as marked as in the case of auditory imagery. During both visual and auditory tests the breathing of all subjects tended to be synchronized with the presentations on the tests (see Plate Four). Four general types of synchronization were employed by the subjects. In most cases the individual would

employ one of these types consistently throughout the test. The most common form of synchronization was to regulate the breathing so that each presentation occurred during an expiration. Usually the breathing was regulated so that presentations came on successive expirations. A variation of this form of synchronization occurred in the cases of some of the auditory types of subjects; it was to regulate each expiration so as to include two presentations (see D, Plate Four). This enabled the subject to breathe more slowly and more nearly at his normal rate. Another method of synchronization employed by some subjects was to allow the presentation to occur at the change of breathing phase when the respiration movements were momentarily suspended. In some cases this tended to occur during the change from expiration to inspiration and in others it tended to occur during the change from inspiration to expiration. A variation of this method was to allow the presentation to occur at every third change of phase. The individuals who used this method would regulate their breathing so that one presentation would occur during the change from expiration to inspiration and the following pre-

sentation would occur during a change from inspiration to expiration, either one or three phase-lengths later. The synchronization of the breathing with the presentations of the aphasia tests was particularly marked with the auditory types of subjects and with all subjects while taking the auditory aphasia test (see Plate Four).

Location of breathing dysintegrations: Suspension or blocking of the respiration, when it occurred during the experimental series, usually did so at the beginning of a task, either just before the task was undertaken or just after it was undertaken (see Plate One). However, with some individuals prolonged expirations or inspirations occurred periodically throughout the performance of a task.

Relation of pulse rate to breathing dysintegration: Since the pulse from the right carotid artery was recorded on the same record as the breathing it was possible to observe changes in pulse rate in relation to breathing irregularities. With all individuals the pulse rate tended to be markedly increased at the same instant that a pro-

longed expiration or inspiration was begun (see Plate Two). Since the increase in pulse rate occurred in some cases even before the breathing phase had reached a state of prolongation it would appear that the phenomenon cannot be entirely attributed to carbon dioxide stimulation in the lungs. A more likely explanation is that an underlying neural disturbance interferes with the rhythm of both heart pulse and respiration.

As a measure of the variability of the pulse rate in individual cases the number of pulsations during every third five-second period throughout the six minutes of silent reading in the experimental series was recorded. The mean difference between successive measurements was used as a measure of the heart pulse. The coefficient of correlation between variability of heart pulse as measured in this manner and the variability of breathing as measured by the coefficient of variation of thoracic inspiration duration was $+ .63 \pm .07$.

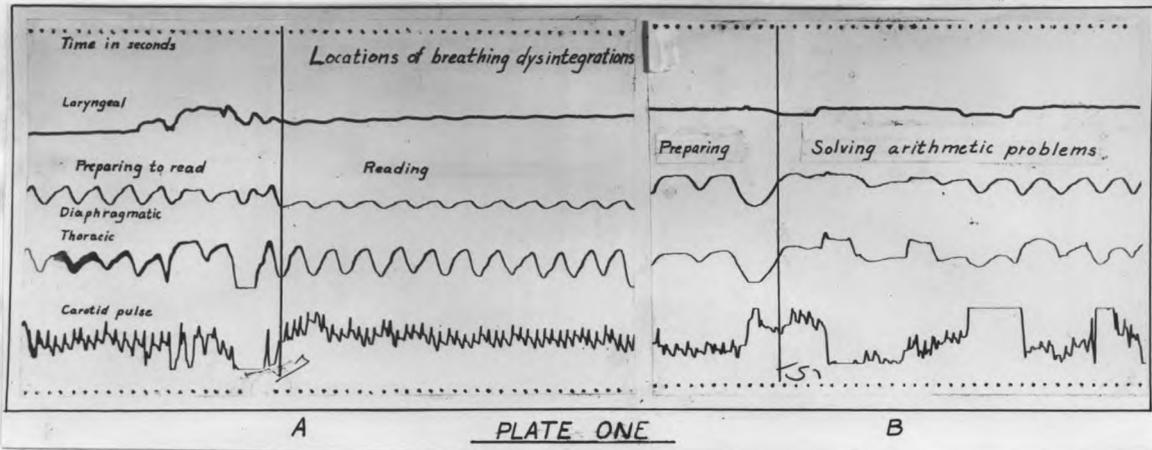
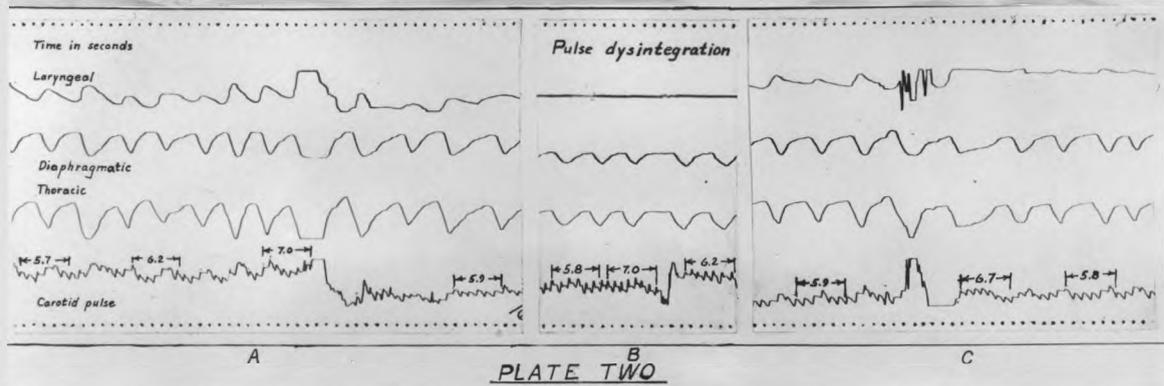


PLATE ONE

In the experimental series irregular breathing usually occurred at the beginning of a task. Plate One shows two examples of the location of irregular breathing. In case A the irregularity occurred just before the task was begun; in case B it occurred somewhat after the task was begun. The solid line reaching vertically across the entire record indicates the point at which the signal to start was given. Curves of both thoracic and diaphragmatic breathing are indicated. The top line is the record of laryngeal movements.



Irregularity in breathing was accompanied in almost every instance with a simultaneous increase in the heart pulse rate. Plate Two shows three examples. Measurements of the number of beats in some of the five-second intervals are indicated. In case A there were 5.7 beats in the first five-second interval indicated while in the third five-second interval, which was coincident with an irregularity in the breathing, there were 7.0 beats. The same sort of increase in pulse rate occurring over a very short interval of time is shown in case B. Case C is another example of the same sort of thing. As in Plate One the top line is the record of laryngeal movements, the second of diaphragmatic breathing, the third of thoracic breathing, and the bottom line a record of the heart pulse taken from the right carotid artery.

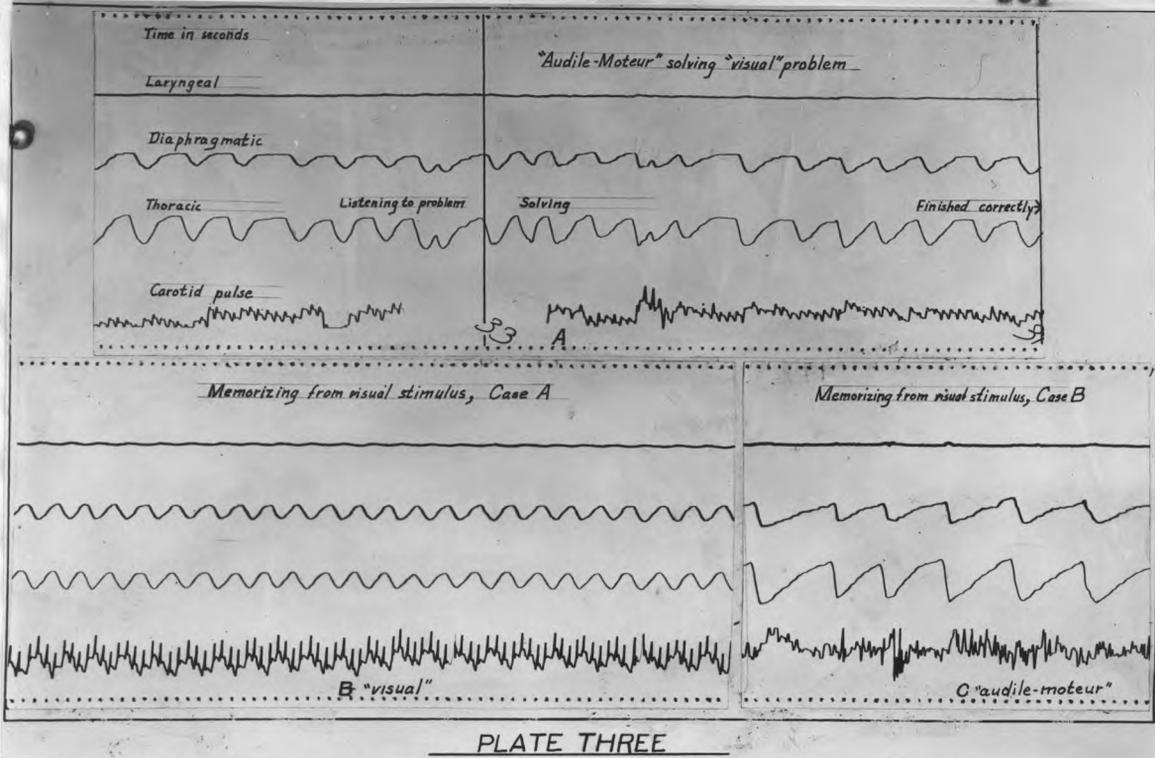


PLATE THREE

Golla and Antonovitch (9) report that auditory types of individuals are irregular breathers during rest periods but that when given a "visual" problem to solve their breathing becomes regular. A in Plate Three shows the breathing of a typical auditory type of individual before and during the solution of the same "visual" problem upon which these investigators based their conclusion. Three points in refutation of their findings are illustrated. In the first place, breathing was not more regular during the period in which the problem was solved; secondly, the problem was solved correctly before

a fair sample of breathing curves could be obtained; and thirdly, the last seven curves suggest verbalization or use of auditory-kinaesthetic imagery. The findings of the this study with regard to the difference between visual and auditory types are illustrated in B and C. The most marked differences occurred during a period of memorizing a typewritten selection. Case A is the record of a visual type of individual while memorizing the selection and Case B is the record of an auditory type of individual while memorizing the same selection. The latter individual was simply verbalizing or making use of auditory-kinaesthetic imagery. A similar, though much less marked, difference in the breathing curves of the two types of individuals was observed during rest breathing.

In each record the top line indicates the laryngeal movements, the second diaphragmatic breathing, the third thoracic breathing, and the bottom line the pulse of the carotid artery. Movements of these muscles of the neck involved in breathing and in verbalization naturally affected the record of the carotid pulse.

PLATE FOUR

Breathing of all types of individuals tended to be synchronized with the presentations in the aphasia tests. In A, Plate Four the vertical dotted lines indicate the point at which each presentation in the auditory aphasia test began. The record shows how the individual in nearly every instance adjusted his breathing so that the presentation would occur during his inspiration and the response would be made during his expiration. In B, the record of an auditory type of individual is shown. In the same test this individual regulated his breathing so that each presentation occurred in the midst of an expiration.

In C, the vertical dotted lines indicate the end of each presentation in the visual aphasia test. The record of a visual type of individual is shown. The breathing is shown to be regulated so that a change of phase occurs at the end of each presentation. There seems to be little consistency as to whether the change is from inspiration to expiration or from expiration to inspiration. In D, the record of an auditory type of individual is shown. In this instance the breathing is regulated so that two presentations occurred on the same expiration.

Hydrogen ion concentration in the mixed saliva of stutterers: The hydrogen ion concentration in the mixed saliva of nine of the stutterers after they had taken the visual and auditory aphasia tests was determined. A sample of the saliva was collected from each stutterer and kept under 2 cc. of oil in a 15 cc. vial. Determinations were made by the electrometric method. Following are the pH values for the nine stutterers:

Case	pH
Ma.	7.05
Va.	5.75
Ho.	5.25
Ba.	6.90
Sc.	5.00
Fr.	5.60
Gr.	6.00
Sw.	6.30
Ja.	6.10

All but two of the pH values are considerably below the normal range of pH values for normal individuals under ordinary conditions of mental work. Accepting the interpretation of Starr (17) this would mean the presence of a considerable amount of carbon-

dioxide in the blood, due to inefficient breathing. That the inefficient breathing, in turn is due to dysintegration in the functioning of the nervous system is reasonable to suppose, since the accompanying aphasic condition is related to a peculiar neural situation.

SUMMARY OF RESULTS

1. Individuals representing cases of silent reading disability were found to be as regular in their breathing during silent reading and associated mental processes as were normal readers.

2. Individuals representing cases of silent reading ability inconsistent with their general intelligence were found to be as regular in their breathing during silent reading and associated mental processes as were individuals whose reading ability was consistent with their intelligence.

3. Individuals whose silent reading ability was low in relation to their general intelligence were most deficient in the rhythm of their speech; individuals whose silent reading ability was high in relation to their general intelligence were least deficient in the rhythm of their speech; and individuals whose silent reading ability was consistent with their intelligence were midway between the other two groups in the rhythm of their speech.

4. Individuals who were diagnosed as deficient

in the rhythm of their speech were found to be not only low in silent reading ability but low in proportion to their intelligence.

5. Silent reading comprehension and speech comprehension were not found to be highly correlated.

6. Individuals who were diagnosed as speech defectives, as a group, did not show any significant silent reading disability.

7. Individuals who were diagnosed as deficient in ability to organize a speech were deficient in neither sentence organization nor paragraph organization in silent reading.

8. None of the following aspects of speech were significantly correlated with silent reading ability: Articulation, Voice, Organization of Materials in a Speech, Symbolic Formulation and Expression.

9. Left-handed and ambidexterous individuals were found to be not only low in silent reading ability but low in proportion to their intelligence.

10. Transient visual aphasia was found to be associated with silent reading disability independently of intelligence.

11. Transient auditory aphasia was found to be associated with stuttering.

12. The rest-breathing of auditory-motor types of individuals was found to be nearly as regular as the rest breathing of visual types of individuals.

13. The duration of expiration among auditory types at all times, but especially when memorizing from a visual stimulus, was relatively long as compared with the duration of inspiration.

14. Breathing of both visual and auditory types of individuals was found to be synchronized with successive presentations of visual or of auditory stimuli in the aphasia tests.

15. Suspension or blocking of breathing, when it occurred, was most apt to occur at the beginning of a task.

16. Heart-pulse rate was found to increase momentarily during prolonged expirations or inspirations.

17. Variability in heart-pulse rate was highly correlated with variability in breathing rhythm.

18. Hydrogen ion concentration in stutterers after taking the aphasia tests was generally high.

MAJOR CONCLUSIONS

1. The connection of reading disability to defective speech rhythm and of defective speech rhythm to reading disability independent of general intelligence indicates a common element of an essentially transient nature in speech and reading defects.

2. The connection of speech rhythm defects, such as stuttering, to lack of cerebral dominance (according to Travis (19)) and the connection of reading disabilities independent of intelligence to lack of cerebral dominance indicates the same sort of neurological condition underlying each type of defect.

3. The more particular connection of transient visual aphasia to reading disability and of transient auditory aphasia to stuttering indicates a certain amount of differentiation between the sensory fields affected by the underlying neural situation.

4. Neural blocking, due to a lack of cerebral

dominance, results in a transient sensory aphasia which may or may not involve both visual and auditory sensations.

5. To the extent that transient aphasia involves both visual and auditory sensations, speech and reading defects have, independently of low intelligence, a common element.

MINOR CONCLUSIONS

6. A pattern of breathing resembling that necessary for the production of overt speech implants itself upon those individuals who customarily employ auditory-kinaesthetic imagery in the mechanism of their thought.

7. The rhythm of breathing tends to be synchronous with the rhythm of thought or fluctuations of attention over short-time intervals.

8. The rhythm of breathing is closely associated with the rhythm of the vaso-motor system and interruptions in the former alter the rate of the latter.

9. Most stutters have a high hydrogen ion concentration.

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APPENDIX A

EXPERIMENTER'S MANUSCRIPT

AND

ACCESSORY MATERIALS

Adapted from Murray (13).

EXPERIMENTER'S MANUSCRIPT

(Marginal numbers refer to notations made on polygraph record)

Adjust Boullitte flat stype pneumograph on level with armpits and Boullitte flat style pneumograph about one inch inferior to xiphoid process. Seat S. Place simple cardiograph over carotid artery on right side of neck. Say, while adjusting apparatus, "The purpose of this experiment is to discover how you study. I am going to give you several different things to study and some different kinds of problems to solve. Some of the tasks I shall ask you to do will be very difficult, others you may find somewhat easier. Will you try to refrain from talking while the experiment is going on; except when you have an urgent question; in that case be sure to ask it. There will be frequent intervals when you may relax and speak, if you wish. Try to forget the apparatus and concentrate on what I ask you to do."

Start chronometer and say, "Can you hear this ticking behind you quite clearly?"

Connect to polygraph tambours as follows:

cardiograph No. 1

thoracic pneumograph No. 2

diaphragmatic pneumograph No. 3

larvneograph No. 4

Fill pens.

Start motor and check working of apparatus.

See that pneumograph valves are closed.

Say, "Now can you hear the ticking above this hum? Just keep listening to it, but not so intently that you become dizzy. The main thing is to relax and if you find your mind concentrating on something too intently bring your attention back to the ticking."

1

(5 min.)

2

Place Selection 1 before S.

Say, "Here is a selection from a history textbook which I want you to read silently. Be sure that you study it so that you can answer the questions I shall ask you over it. You have only a limited time for study but be sure you understand everything you read. Start!"

3

(2)

4

Say, "Stop!"

Say, "Where were you when I said, "stop"?"

Mark number of words read.

Say, "Could you understand the material you read?"

Say, "Does the writer of this article start out by discussing armies or government?"

Say, "I will give you a few moments to relax before I give you the questions over what you have read."

(30 sec.)

Place questions, pencil, and paper before S.

Say, "Here is a pencil and some paper and here are some questions over the material you have just read. Write the number of the question and after it your choice of an answer or answers on the blank page. Read the directions here. You will have as much time as you need for answering the questions."

5

6

Say, "You have a moment to relax before beginning the next selection."

(30 sec.)

Place Selection 2 before S.

Say, "Here is the next selection. Read it as you did the last one. You have only a limited time. I shall ask you questions over it. Start!"

7

(2)

8

Say, "Stop!"

Say, "Where were you when I called, "stop"?"

Mark the number of words read.

Say, "Could you understand the material you read?"

Say, "Is the author describing a scene or is he calling our attention to something abstract?"

Say, "You have a moment to relax before I give you the questions over what you have read."

(30 sec.)

Place questions before S.

Say, "Here are the questions. Use the same method of indicating your answer as you did on the previous questions. You have as much time as you need."

9

10

Say, "Now relax a moment."

(30 sec.)

Present Selection 3.

Say, "Here is the third and last selection.

Read it as you did the others."

11

12

Say, "Stop!"

Say, "Where were you when I said, "stop"?"

Mark number of words read.

Say, "Could you understand the material you read?"

Say, "Does the author believe that anything more can be done for the prevention of war?"

Say, "Now relax for a moment."

(30 sec.)

Place questions before S.

Say, "Here are the questions."

13

14

Say, "Now relax for a few moments before beginning a new kind of study."

(1)

Say, "Now I want you to work a few mental arithmetic problems for me. Write down the answers in a column here but do not write any part of the problem. Think fast. Are you ready?"

15 Give orally the following problems as fast as S writes answers. State each problem twice.

(1) 66×4

(2) 9×17

(3) $1.4 \times .02$

(4) $10,000 \times 1,000$

(5) $5 \times 5 \times 6$

(6) $5 \times 6 \times 16$

(7) 64×14

- (1) 98 - 89
- (2) 555 - 150
- (3) 3,636 - 1,111
- (4) 1.43 - .44
- (5) 9,000 - 1,333

17

- (1) $\frac{1,664}{8}$
- (2) $\frac{2,225}{5}$
- (3) $\frac{160,000}{20}$
- (4) $\frac{1,000,000}{50}$
- (5) $\frac{6.6}{.3}$

18

Say, "Now relax a moment."

(30 sec.)

Say, "Now I want to see how well you can visualize the face of a clock."

19

(1) Say, "Suppose it is twenty-two minutes past six by the clock, what time would it be if the positions of the two hands were exchanged? Write your answer."

Give problems as fast as S can write answers.

(2) Say, "Suppose it is eighteen minutes past seven, what time would it be if the positions of the two hands were exchanged? Write your answer."

(3) Say, "Suppose it is nine minutes past ten, what time would it be if the positions of the hands were exchanged? Write your answer."

(4) Say, "Suppose it is four minutes past nine, what time would it be if the positions of the hands were exchanged?"

(5) Say, "Suppose it is twenty-two minutes till twelve."

(6) Say, "Suppose it is six minutes till eleven."

20

Say, "Now relax for a moment."

(30 sec.)

Say, "Here are some problems of right and wrong. In each case formulate three reasons for your answer before you say anything. I will read you a statement; you may say it is right or you may say it is wrong, but you must be able to give three reasons before you say anything. When the answers and the reasons are ready, lift your hand to let me know and then I will have you record them on the Ediphone."

How is it clear what we are to do?"

Say, "Here is the first proposition; it would be proper for a boy to steal bread for a starving family. Lift your hand when you think you can state three reasons for or three reasons against it."

21

22

Place Edinphone mouthpiece in S's hand and control meter from switch on machine.

Say, "Hold this mouthpiece against your mouth so that it just touches your cheek. It has been sterilized. State your reasons clearly and distinctly. All right! Start!"

Say, "Here is the next statement. Have your three reasons ready as soon as possible. The Federal Trade Commission should prohibit the use of the radio for advertising tobacco."

23

24

Say, "Hold the mouthpiece against your lips and speak distinctly."

Say, "Now think of three reasons for your answer to this statement; a falsehood is justi-

fiable, if to one's knowledge, it will save the reputation of a friend."

25

26

Say, "Now dictate your answers as before."

Say, "This is the next statement; popular education inevitably lowers scholarship."

27

28

Give S dictaphone mouthpiece.

Say, "This is the next statement; The purchaser of "bootleg" liquer should be punished equally with the party who sells it."

29

30

Give S dictaphone mouthpiece.

Say, "that is all of that kind of problem. Now we will attempt something that will require your very best concentration. Are you ready?"

Present Selection 4.

Say, "I will give you just five minutes to memorize this. You ought to be able to do it; if not, do the best you can. Get ready! Start!"

31

32

Say, "Stop."

Say, "Now how much of it can you repeat?"

Say, "Now imagine a number of blocks like the ones you used to play with when you were a child. Imagine you have built of them a cube, three blocks on a side; that is, a perfect cube three blocks high, three blocks long, and three blocks wide. Now imagine that you have painted it red all over and taken it apart. How many of the blocks will have three sides red, how many will have two sides red, and how many will have one side red? Lift your hand when you have the answer. The cube was three blocks on a side."

33

34

Say, "What is your answer?"

Say, "Now I am going to read through a selection four times for you and when I get through I am going to see how much of it you can repeat. You will have to concentrate just as hard as you did on the other selection. Are you ready?"

35

36

Say, "Now, how much can you repeat?"

Say, "I have another hard task for you."

Say, "On this strip of paper you see a line with numbers above and below it. You will notice that one digit in each number that is below a line is different from either of the digits in the number above the line which is just in front of it. If you look through the window you will see the numbers come past when I set the machine going. Mark down in a column the digits of the bottom numbers which are unlike either of the digits in the top number which preceded it. Be sure to look at the numbers through the window because I have a key line on my side of this shield that will tell me immediately if you don't write your answers as the numbers pass the window. Is everything clear? Here is a practice series."

Run practice series.

Say, "Can you understand all right?"

Say, "Start!"

Run regular series and mark on time line one dot for every exposure.

39

40

Give S ear-piece of reproducing unit of Ediphone and say, "The instructions for your

next test are all on this dictaphone record."

Start Ediphone and set needle on instructions for written answers. When instructions are given stop Ediphone and say, "Do you understand what you are to do?"

Start test.

41

Mark time line at every presentation.

42

Disconnect apparatus and get introspections, age, major, etc.

Reading Selections and Questions Used in the
Experimental Series

SELECTION 1

America and the World War

The American state is taking on new functions and new powers year by year. A generation ago the government was thought of primarily as a police power. Its attitude toward business and social problems was purely negative. Now it is interested, through administrative boards and by copious legislation, in a thousand and one concerns of production and distribution, of industrial regulation, of social betterment, of international cooperation. Aggressive presidents like Roosevelt and Wilson have brought the presidency close to the people. The congresses of other days sat for a few months of the year, and their rather perfunctory acts were scantily noticed by the press and the public. From the entrance of America into the world war the close of the year, 1919, Congress was in session for twenty-eight out of thirty-nine months, and its debates were conducted before a forum of 1,000,000,000 citizens.

The war came like a great searchlight to reveal both the latent powers and the hidden dangers of our new

democracy. Disloyalty and greed, ignorance and violence, have appeared, as well as courage, patriotism, sacrifice, and devotion. We have a serious race problem on our hands in the just treatment of 10,000,000 American negroes. The examining boards found that 25 per cent of the 1,600,000 men between twenty-one and thirty-one years of age could not read or write our language. Every year hundreds of thousands of aliens come to our shores to enjoy the opportunities offered here for making a better living. Merely taking out naturalization papers will not make them Americans. Herded in the slums of our cities or driven in gangs of laborers out to mines and mills, these people can escape the influence of the preachers of disloyalty, lawlessness, and class-hatred only by being taught the basal principles of American democracy -- respect for law, the responsibilities of freedom, and the duty of each citizen to make himself as capable as possible of participating in the common task of securing social justice. The day of the heartless exploitation of human lives for the sake of profits must cease. The little children, "the seed corn of the nation", must not be taken from the school and from the sunlight to toil in the cigar factories, the canning sheds, the

cotton mills, and the coal breakers. We must have healthy parents and happy homes; for the home is the ultimate life cell of our society, conditioning its soundness or its decay.

America has been called the 'land of the dollar', as if we cared for nothing but sordid material gain. The history of the past few years has proved how false that judgement is. When the clear call came for the defence of an ideal against the ruthless assertion of brute force which knew not law, Americans rich and poor, high and low, rallied to the banners of the right with the fervor of the crusaders of old. They poured out their money like water; they gave their lives with joy. Their presence on the battlefields of Europe was an inspiration like the breath of a new morning. "They came because they saw on the other side of the bloody abyss that vision for which they had always fought -- a world without poverty, war, preventable disease, idle rulers, ill-paid workers, ignorance, and hapless toiling millions."

Muzzey, D. S., *An American History*, Pp. 542-3, rev. ed., Ginn & Co., N. Y., 1925.

QUESTIONS ON SELECTION 1

The following are some questions over the material you have just read. Write your answers on a separate sheet of paper which will be provided. Write the number of the question and opposite it the letter or letters which indicate the best of the answers which are written below it. The answers to Questions 5 and 6 are numbers.

1. A generation ago the American Government was thought of as primarily:

- A. an industrial regulator B. an instrument of
~~inter~~international cooperation C. a police power
 D. a legislative agency

(Write "1-A, 1-B" or whatever indicates the best answer.)

2. Which of the following presidents were termed as "aggressive?"

- A. McKinley B. Taft C. Roosevelt D. Lincoln
 E. Washington F. Hoover G. Wilson H. Jackson

3. The acts of congresses of other days were termed:

- A. rather perfunctory B. unusually mercenary
 C. very progressive D. wholly political

4. Which of the following were named as principles of the American democracy?

- A. industrial regulation B. intelligent voting
 C. respect for law D. the responsibility

- C. respect for law D. intelligent voting
- E. equality of opportunity F. child labor
- G. assertion of brute force

5. For how many months was Congress in session between April, 1916 and December, 1919? (Answer with the correct number.)
6. How many men between the ages of 21 and 31 did the army examining boards report upon?
7. What is called the ultimate life cell of our society?

SELECTION 2
Essay on Man
Alexander Pope

Of the Nature and State of Man with Respect
to the Universe

Awake, my St. John, leave all meaner things
To low ambition and the pride of kings.
Let us, since life can little more supply
Than just to look about us and to die,
Expatiate free o'er all this scene of man;
A mighty maze, but not without a plan:
A wild, where weeds and flowers promiscuous
shoot;
Or garden, tempting with forbidden fruit.
Together let us beat this ample field,
Try what the open, what the covert yield;
The latent tracts, the giddy heights explore
Of all who blindly creep or sightless soar;
Eye Nature's walks, shoot folly as it flies,
And catch the manners living as they rise:
Laugh where we must, be candid where we can,
But vindicate the ways of God to man.
I. Say first, of God above or man below,

What can we reason but from what we know?
 Of man what see we but his station here,
 From which to reason, or to which refer?
 Through worlds unnumbered though the God be known,
 'Tis ours to trace him only in our own.
 He, through vast immensity can pierce,
 See worlds on worlds compose one universe,
 Observe how system on system runs,
 What other planets circle other suns,
 What varied beings peopled every star,
 But of this frame, the bearing and the ties,
 The strong connections, nice dependencies,
 Gradations just, had they pervading soul
 Look through? or can a part contain a whole?

Is the great chain, that draws all to agree,
 And drawn supports, upheld by God or thee?
 II. Presumptuous man, the reason wouldst thou find,
 Why formed so weak, so little, and so blind?
 First, if thou canst the harder reason guess,
 Why formed no weaker, blinder, and no less?
 Ask of the mother earth, why oaks are made
 Taller or stronger than the weeds they shade?
 Or ask of yonder argent fields above,

Why Jove's satellites are less than Jove
Of systems possible, if 'tis confessed
That wisdom infinite must form the best,
Where all that rises, rise in due degree;
Then in the scale of reasoning life, 'tis plain
There must be, somewhere, such a rank as man:

- - - - -

QUESTIONS ON SELECTION 2

Answer the following questions in the same manner as you answered the questions over the preceding selection.

1. How is the scene of man characterized?
 - A. a mighty maze
 - B. folly as it flies
 - C. a turmoiled sea
 - D. a vast plain
2. Why is man formed so weak?
 - A. the author does not attempt an answer
 - B. the system of the universe is so vast
 - C. there must be some rank between the strong and the weak
 - D. God is all-pervading
3. When should we be candid?
 - A. in judging nice dependencies
 - B. in the things that blindly creep or sightless soar
 - C. where we can and still vindicate God's ways
 - D. where we must
4. To whom is the poem addressed? (The answer is the name of a person.)
5. From what are we compelled to reason of God?
(Answer in less than five words.)
6. What is the answer which is implied in the question as to who upholds the chain "that draws all to agree, and drawn supports, --" ?
(Answer is less than five words.)

7. To whom or what should "all meaner things" be left?

(Answer in less than six words.)

8. Where and where only can we trace God? (The answer is the name of a place.)

9. Which of the following lines best indicates the stated purpose of the poem?

A. "Together let us beat this ample field, -- "

B. "Let us, -- expiate free o'er all this scene
of man: -- "

C. "-- But vindicate the ways of God to man."

D. Show "That wisdom infinite must form the best,--"

SELECTION 3

The Constructive Attitude toward the War Problem

There can be no more important aim of cooperation than to make war improbable. One need not expect to make it impossible -- for lawlessness exists in the best-governed communities -- but to make it as improbable as burglary or murder by the plain citizen who lives next door. The policy of governments which mix wisdom with their desire for better relations will be to drive directly and practically against this form of national behavior, to drive directly against the institution of war which is still established politically so long as nations continue to prepare for waging war.

To strike successfully at this institution will evidently require more than was in the mind of the American Secretary of State, Mr. Lansing, at Paris in 1919 -- that each nation declare its decision to refrain thereafter from aggression. It will require more than the treaty of 1928, renouncing war as an instrument of national policy, exceedingly important as this is. For the nations that signed and ratified that treaty accepted a new ideal, not only in condemning that way for national purposes, by declaring that they would settle by pacific means all disputes, of whatever nature or origin. Such agreements indicate the great distance traversed and the preparation for still greater advance. But urgent things remain to be done.

Nor can these deeper needs be met merely by defeating the latest nation that happens to be strongest in its naval or military power. Such a nation seems to itself pacific while being reasonably prepared; all others call the nation militaristic or navalistic. But whatever may be true, defeating the nation is no cure. War was not ended in America when the Spaniards were victorious over the Aztecs who were militaristic to the bone; nor in the world generally when Spain's power was broken; nor in Europe by the final overthrow of Napoleon, nor by the defeat of militaristic France in 1871, or of militaristic Germany in 1918. The war against war merely by military methods no longer can seem hopeful. The opening attack on war may come only after the actual fighting is over.

War prevention is a peace-time enterprise and requires, besides the work of the scientist and all the arts of education, certain constructive work in international politics. For we saw that some of the main causes of the trouble were in the peculiar international situation, where no sufficient substitutes for war had been heartily adopted, and where war was still felt to "pay".

A part -- some say the whole -- of this constructive work will be to establish and loyally to use better means

of international justice. There must be some established means of rendering an effective decision when each of two nations believes that its boundary should be where the other knows it should not be; or when they disagree as to the control of certain ports or waterways; or disagree over raw materials, privileges or trade, or the influence which each should exert over some other people.

Stratton, G. M., Social
psychology of international
conduct, Appleton, N.Y.,
1929, pp 332-4

QUESTIONS ON SELECTION 3

Answer the following questions in the same manner as you answered the questions over the preceding selection.

1. What is the most important aim of cooperation according to the author?
 - A. to make war improbable B. to prevent war
 - C. to make war impossible C. to avoid competition
2. What men were specifically mentioned as trying to strike at war?
 - A. Lansing B. Briand C. Napoleon D. Macdonald
3. What steps are mentioned as being inadequate for striking successfully at the institution of war?
 - A. renouncing war as an instrument of international policy
 - B. defeating the largest and strongest nation
 - C. pacifism
 - D. education
 - E. maintenance of an army and navy
4. What was the significance of the Treaty of 1928?
 - A. It guaranteed the enforcement of the Treaty of 1919.
 - B. It stopped preparation for war.
 - C. It renounced war as an institution of national policy.
 - D. It was a step in the direction of pacifism.

5. Why is war against war by military methods unhopeful?
- A. No sufficient substitutes for war have been adopted.
 - B. The attack on war may come only after the actual fighting is over.
 - C. Pacifism has always failed.
 - D. War is too destructive
6. What defeats of militaristic nations were specifically mentioned?
- A. The defeat of the Aztecs by the Spaniards
 - B. the defeat of the Spaniards
 - C. the overthrowing of the Roman Empire
 - D. the defeat of Austria
 - E. the defeat of Athens

Memorizing from Visual Stimulus

SELECTION 4

Johann Friedrich Herbart

(From "A History of Experimental Psychology" by E. G. Boring)

(The following selection was memorized from the typewritten MS)

Psychology is science. This as an explicit contention is something new. Physiology is presumably a science, and we have seen philosophical psychologists citing physiology, and also physiologists (although mostly after Herbart) writing psychology. But to say that psychology is science, as Herbart did, is new. Of course, Herbart was not saying that, as science, psychology is not also philosophy. This distinction comes later, when psychologies like Mach's could begin with 'antimetaphysical' chapters.

Memorizing from Auditory Stimulus

SELECTION 5

Johann Friedrich Herbart

(From "A History of Experimental Psychology" by E. G. Boring)

(The following selection was repeated four times by the experimenter.)

Johann Friedrich Herbart (1776-1841) was a philosopher and is best known as the 'father' of scientific pedagogy, which he founded upon psychology. His psychology is therefore of primary importance when Herbart is considered as an educational theorist, but it also in its own right occupies an important place in the history of psychology. ... -- in spite of his denial of the possibility of psychological experiment, his work had a definite influence upon the later experimental psychology.