II. The Quantitative Differentiation of Samples of Spoken Language[1]

HELEN FAIRBANKS
University of Iowa

I. INTRODUCTION

THE GENERAL PROGRAM of research, of which this study is a part, has been outlined in a previous article by Johnson (9). As the first study to be undertaken within that program, this investigation is concerned primarily with problems of method. It is concerned specifically with a partial exploration of the possibilities of measuring certain aspects of language behavior, and of differentiating samples of spoken language in terms of the measures employed.[2] It is assumed that the first step in a comprehensive language behavior research program lies in the attempt to develop adequate techniques of measurement necessary for the formulation and testing of hypotheses.

In accordance with this point of view, an attempt was made in this study to obtain two groups of language samples which might be assumed to be sufficiently different as to make possible some indication of the sensitivity of the measures to be employed. On the basis of this consideration it was decided to obtain the language samples from hospital patients suffering from schizophrenia, and from university freshmen who were judged to be superior in terms of criteria to be indicated in the section on Procedure. The 'superior' freshmen were chosen with the expectation that they would furnish relatively 'adequate' language, and the schizophrenic patients were used on the assumption that their language would prove to be relatively 'inadequate', and that the contrast might be sufficiently marked to be quantitatively expressed. One of the important clinical manifestations of schizophrenia is to be noted in the language of the patients suffering from the disease (13). As the illness progresses there is a tendency for the language to appear disconnected, illogical, even incomprehensible. Stereotypy in verbal expression is frequently apparent. Thus, there would seem to be reasonable ground for expecting that the language of schizophrenic patients might be demonstrably different, quantitatively, from that of 'superior' normal subjects. Relevant studies have been reported by White (15), Woods (16), and Cameron (2, 3).

It was an incidental consideration that any differences that might be revealed as between these two groups would possibly be of psychiatric and psychological interest. The primary purpose of the investigation is, however, methodological, and any conclusions to be drawn from the findings with regard to the nature of 'schizophrenic language' are to be most carefully evaluated. In this

[1] This study was done in the Department of Phychology at the State University of Iowa as a dissertation in partial fulfillment of the requirements for the degree of Doctor of Philosophy. It is part of a program of research on language behavior and was directed by Wendell Johnson. The writer is grateful to Dr. Andrew H. Woods, Director, and the staff of the Iowa State Psychopathic Hospital [1938-40]; and to Dr. Leonard P. Ristine, Superintendent, and the staff of the Mt. Pleasant State Hospital, for their cooperation in securing subjects for the investigation. Special acknowledgment is made of the assistance of Dr. Frank Robinson, resident psychiatrist at the Iowa State Psychopathic Hospital during 1938-39.

[2] A companion study by Mann [11] is concerned with written language. The specific measures used in that study and this one, as well as several other types of language measures, are discussed in the above mentioned article by Johnson [9].

connection, it is to be emphasized that it was regarded as of first importance to obtain two groups of subjects who might be expected with some assurance to produce demonstrably different language samples. It was for this reason that 'superior' university freshmen were selected. This meant, however, that the possibility of securing schizophrenic patients matched with the freshmen in terms of intelligence and educational background —a difficult undertaking in any case— was deliberately jeopardized. Most of the patients were judged to be of average intelligence or above, as will be indicated later, but the fact remains that any demonstrated language differences between the patients and the students may be due, in part, to differences in intelligence or in scholastic background, and not entirely to schizophrenia, *per se*. It appeared advisable, nevertheless, to establish first, as far as possible, the degree to which the measures used were sensitive or differentiating. Had well matched groups been used and no differences in language found, the basic question of the differentiating value of the measures would have remained unanswered. It could not have been concluded whether there were no differences to be measured, or that the measures used were too crude to reveal them. Therefore, the methodological problem was placed first in importance in designing the study, but schizophrenic patients were used in the hope that, if the measures turned out to be differentiating, some findings of psychiatric and psychological significance might be gained.

II. PROCEDURE

Two groups of adults served as subjects in this study: (1) ten psychotic patients diagnosed as schizophrenic; (2) ten freshmen at the State University of Iowa. The major characteristics of these groups are summarized below.

Of the schizophrenic subjects, four were patients at the Iowa State Psychopathic Hospital, Iowa City, and the other six, three of whom had previously been in the Iowa State Psychopathic Hospital, were committed patients at the Mt. Pleasant State Hospital at Mt. Pleasant, Iowa. These ten patients were chosen on the basis of the certainty of the diagnosis made of them by the psychiatrists and the possibility of securing their co-operation in the proposed interview situation. Data concerning the individual cases are as follows:

Case 1. Diagnosis: schizophrenia, paranoid type. A single male, aged 46 years, 6 months; educated through 9th grade and one year business college; first psychotic episode in 1916, confined to the Mt. Pleasant State Hospital continuously since 1934; scored Intelligence Quotient of 114 on Wechsler-Bellevue Adult Test and 104 on Revised Stanford-Binet Test, Form L, passing the vocabulary test on the latter at the Superior Adult III level; patient inclined to give up easily on tests; psychometrist commented: "intellectual development has been superior."

Case 2. Diagnosis: schizophrenia, hebephrenic type. A single male, aged 31 years; educated through 8th grade; first mental symptoms in 1935, confined in Mt. Pleasant State Hospital since; scored Intelligence Quotient of 24 on Revised Stanford-Binet Test, Form L, but so deteriorated psychometrist felt no estimate of original intellectual level possible.

Case 3. Diagnosis: schizophrenia, catatonic type. A single male, aged 20 years, 8 months; educated through 11th grade; first mental symptoms in 1939, discharged from Iowa State Psychopathic Hospital several months later as much

improved; scored Intelligence Quotient of 62 on Stanford Revision of Binet-Simon Test but excited and distractible; six weeks later when more co-operative scored Intelligence Quotient of 99 on retest and 115 on Revised Stanford-Binet Test, Form L, passing the vocabulary test on the latter at the Superior Adult II level; original level judged by psychometrist to have been "high average to superior."

Case 4. Diagnosis: schizophrenia, paranoid type. A widower, aged 41 years, 9 months; educated through 8th grade; first mental symptoms in 1934, confined in Mt. Pleasant State Hospital since 1938; had an Intelligence Quotient of 76 on Revised Stanford-Binet Test, Form L, scoring slightly below average on vocabulary test; required considerable urging before trying tests; original level estimated by psychometrist to have been "slighty below average."

Case 5. Diagnosis: schizophrenia, paranoid type. A single male, aged 31 years, four months; educated through high school and business college; expressed paranoid ideas in 1930 and 1935 and developed acute symptoms in 1939, discharged after several months from Iowa State Psychopathic Hospital as improved; scored Intelligence Quotient of 87 on Stanford Revision of Binet-Simon Test, passing vocabulary test at high average level; passed vocabulary test on Revised Stanford-Binet, Form L, at Superior Adult I level; original level felt by psychometrist to have been "average intelligence or above."

Case 6. Diagnosis: schizophrenia, hebephrenic type. A single female, aged 36 years, 11 months; educated through high school and two years' college; first mental symptoms in 1932, hospitalized at Iowa State Psychopathic Hospital in 1933, then committed to Mt. Pleasant State Hospital and there since; scored Intelligence Quotient of 83 on Revised Stanford-Binet, Form L, passing vocabulary test at Superior Adult II level; judged by psychometrist to have been originally "at least high average."

Case 7. Diagnosis: schizophrenia, paranoid type. A single female, aged 27 years, 1 month; educated through two years' college; first mental symptoms in 1930, present episode began in 1938, hospitalized at Iowa State Psychopathic Hospital in 1939, then committed to Mt. Pleasant State Hospital and there since; scored Intelligence Quotient of 118 on Stanford Revision of Binet-Simon Test, passing vocabulary test at very superior level, and 138 on Revised Stanford-Binet, Form L, passing vocabulary test at Superior Adult III level; psychometrist commented that intellectual level was "very superior."

Case 8. Diagnosis: schizophrenia, unclassified type. A single female, aged 37 years, 1 month; educated through preparatory school and four years' college, in Biblical seminary at time of first mental symptoms in 1934; hospitalized at Iowa State Psychopathic Hospital, 1939, discharged home after several months as much improved but symptoms gradually returning.

Case 9. Diagnosis: schizophrenia, paranoid type. A married female, aged 45 years, 3 months; educated through 8th grade; first mental symptoms in 1937, hospitalized at Iowa State Psychopathic Hospital, 1939, and discharged several months later as unimproved with advice to commit patient to a state hospital.

Case 10. Diagnosis: schizophrenia, paranoid type. A married female, aged 31 years, 3 months; educated through high school and business school; first mental symptoms in 1939, hospitalized at Iowa State Psychopathic Hospital for several

weeks, then transferred to Independence State Hospital, Independence, Iowa, and there since; scored Intelligence Quotient of 92 on Stanford Revision of Simon-Binet Test, passing vocabulary test at superior level; psychometrist commented: "vocabulary and the quality of her responses indicate superior intelligence".

In summary, the schizophrenic subjects consisted of five males and five females, ranging in age from 20 years, 8 months, to 46 years, 6 months; six had been diagnosed as paranoid, two as hebephrenic, one as catatonic, and one had not been classified. The length of the illness ranged from an acute episode lasting about a month to an illness that began in 1916 and has gradually shown exacerbations since. The educational backgrounds ranged from 8th grade to college graduation; one patient was felt by the psychometrist to be of very superior intelligence, two superior, two high average to superior, one average or above, one slightly below average, and one too deteriorated to permit evaluation of original level. It was not possible to obtain psychometric ratings on the remaining two patients; of these, one graduated from college and one had no training beyond the 8th grade but was considered an excellent business manager by a local attorney.

The freshman students who formed the second group were chosen on the basis of their September, 1938, scores on the Iowa Qualifying and Placement Examinations. All ranked from the 91st to the 99th percentile on Silent Reading, Comprehension, and from the 95th to the 99th percentile in English Training. It can be assumed that the intellectual level of these subjects is probably superior, as a recent unpublished study by Mitchell (12) indicated a correlation of .76 between the Intelligence Quotients of 66 freshmen as scored on the Revised Stanford-Binet, Form L, and their Composite Score on the Iowa Qualifying and Placement Examination, the average Intelligence Quotient being 122. The group of ten freshmen was chosen on the assumption that its members would represent relatively adequate language usage. Six of the freshmen were female and four were male; the age range was from 17 years, 5 months, to 19 years, 1 month. They came from homes in which the following occupations were represented by the wage earners: bank receiver, jeweler, theatre owner, coal miner, postmaster, county superintendent of schools, life insurance agent, lumberman, odd jobs and trucking, industrial engineer and sales manager.

A consideration of the methods to be used in treating the data and of the issues with which the study was involved seemed to indicate that a 3,000-word spoken language sample from each subject would be adequate. In formulating the procedure care was taken to secure samples that would be comparable from subject to subject and group to group. Because of the frequent difficulty found in getting schizophrenic patients to talk readily, the following interview situation was prepared, utilizing 14 proverbs whose efficacy as stimuli has been demonstrated in previous studies done at the Iowa State Psychopathic Hospital. The following instructions were given to each subject:

"I want you to talk about some proverbs today. You know what a proverb is. A proverb is a sentence that teaches a lesson. I am going to read some proverbs to you, and I want you to tell me what they mean. I also want you to describe a situation in which each proverb would apply. For example, the proverb 'Let

sleeping dogs lie' means that we should avoid stirring up old troubles or quarrels. An example of a situation in which this proverb would apply would be, for instance, if you and a friend had quarreled over something several months ago, you should forget it and be friends with him again instead of continuing to quarrel with him each time that you see him. Do you understand what I mean? Now you tell me what this proverb means, 'The early bird catches the worm.'

"Now give me an example illustrating that."

This procedure was continued with each of the following proverbs:

"He who laughs last laughs best."

"A chain is as strong as its weakest link."

"The devil finds work for idle hands."

"Tell me the company you keep and I'll tell you what you are."

"Deeds are males and words are females."

"Like father, like son."

"What you sow you will reap."

"Barking dogs never bite."

"You can't touch pitch without being tarred."

"A crow is known by the company he keeps."

"A fair face may hide a foul heart."

"A prophet is without honor in his own country."

"It is always darkest just before the dawn."

The subjects were asked to continue talking about anything that they wished to after finishing the proverbs. It was difficult to keep the interview situation as simple for the schizophrenics as for the freshmen, as would be expected with psychotic individuals who show so little response to their environment, and it was necessary to stimulate them more frequently with such questions as why they were in the hospital and what they were doing, in order to get the requisite 3,000 words from each. Two patients had to be interviewed a second time in order to get enough words, the second interview continuing where the first had left off. In one of these cases the total number of words still did not approximate 3,000, and as the patient was removed from the hospital by relatives before a third interview could be arranged, his language sample consists of only 2,800 words. The patients were interviewed by a resident psychiatrist at the Iowa State Psychopathic Hospital, while the experimenter interviewed the freshman subjects. All interviews were completely recorded by means of an electrical dictaphone apparatus, consisting of a microphone, amplifier, and two dictaphones. All recordings were continuous. As the microphone was concealed among books and papers on the interview desk, the subjects were not aware of the fact that their speech was being recorded except in the case of one freshman who happened to uncover the microphone. However, it was the opinion of the interviewer that even in this case speech was not disturbed.

The dictaphone records were then transcribed by the experimenter, following the conventional forms of word division and spelling as closely as possible. The neologisms or coined words occasionally introduced by the schizophrenics were spelled as they sounded phonetically. As would be expected, the intelligibility of the records varied in accordance with the amount of intensity and the clearness of articulation used by the various subjects. Each record was played over until the experimenter was reasonably sure of the transcription. All words and sections which were doubtful were omitted.

A study by Betts (1) has indicated that fewer than one per cent of the words of normal speakers recorded by the electrical dictaphone technique are unintelligible. However, the percentage of such words is probably higher in the present study due to occasional mumbling by the patients, but it cannot be stated definitely just how much. As stated before, the experimenter played the records over until reasonably certain of the transcription, omitting all words or phrases that were doubtful.

The language sample of each subject was divided into 30 consecutive segments consisting of 100 words each. A word count was then made for each protocol by placing a tally mark for each different word on tabulation sheets so organized that each 100-word segment could be tabulated individually. The part of speech for each word was designated as it was tabulated. The following rules were followed in determining what constituted a word:

1. Each group of letters separated by spaces on both sides from adjacent groups of letters was counted as a word, even though it might be part of a place name, as in *Des Moines* (two words), an initial, as in *John D. Rockefeller, Jr.* (four words), and abbreviation of a word previously used, as *coop.* for *cooperative,* a spelling of a word previously pronounced, as *p-a-r-d* for *pard* (one word), or a neologism coined by a schizophrenic patient, as *tombody.*

2. Random letters given consecutively by schizophrenic patients, such as *d-t, were* considered as spellings and counted as one word.

3. Any number was counted as one word; for example, *125* was tabulated as one word.

4. A hyphenated word was counted as one word, Webster's New International Unabridged Dictionary (14) being used as the authority as to whether or not a word should be hyphenated.

5. Sounds like *uh* and *er* uttered by subjects during pauses were not considered as words. However, in one case *uh* and *er* were cited by a subject as examples, in which instance they were regarded as words. The sounds *huh, uh huh,* and *hunh uh* were also regarded as words, being tabulated under *what, yes,* and *no* respectively.

6. Each time a word was used as a different part of speech it was counted as a different word. For example, *mine* as a noun and *mine* as a pronoun were tabulated as two different words.

7. Different tenses of a verb having identical spellings were counted as different words. For example, *read,* present tense, and *read,* past tense, were tabulated as two different words.

8. Common nouns and proper nouns having identical spellings were thrown together. For example, the two words, *Death Valley,* were tabulated under the common nouns, *death* and *valley.*

The data taken from these tabulation sheets were organized into three different sections of results: (1) the type-token ratios, (2) grammatical analysis, (3) word frequencies (8, 9).

III. RESULTS

1. *Type-token ratio.* This measure is computed by dividing the number of different words (types) by the total number of running words (tokens). Since the number of different words decreases as successive increments are added to a language sample (4), the number of tokens used in computing the type-token ratio must be kept constant in order to determine any variations within any given language sample, or in order to make the ratio comparable from one sample

to another. In this study 100 was used as the standard number of tokens, each language sample having been divided up into 30 consecutive 100-word segments. The TTR for each of these 100-word segments was then computed.

To determine, first, the internal consistency (i.e., how well a random half of the sample measures what the whole sample measures) of the 3,000-word sample for each subject, the *t*-test for related measures (10) was used. This was computed by dividing at random the 30 TTR's[3] for each subject into two sets and finding the group mean for each half. From this procedure there resulted two sets of ten means each for each group of subjects. Each set of ten means was averaged, giving two mean values for each group of subjects. The difference between these two mean values was evaluated. The value of *t* for the difference between the two means thus obtained for the schizophrenic patients was .219, and that for the freshmen was .430. As neither of these values of *t*, with nine degrees of freedom, is significant at the 5 per cent level of confidence it would appear that there is no reliable difference between the two means for each group, or that the internal consistency of the language samples is high.

A test of the hypothesis that there is no difference between the variances of the distributions of the SD's of individual samples of the schizophrenic patients and of the freshmen is afforded by the *F* test (10). It will be recalled that each individual sample is made up of 30 segments, for each of which a TTR was computed. When *F* was computed as the ratio of the variance of the distribution of the SD's for the schizophrenic patients to that for the freshmen, the value obtained was 2.2. Since the value of *F*, with nine and nine degrees of freedom, needed for significance at the 5 per cent point is 3.18, the hypothesis of no significant difference is tenable. That is to say, the TTR's of the schizophrenic patients did not vary more from segment to segment than did those of the freshmen.

Table 1 gives the distribution of the mean segmental TTR's for the individual freshmen and schizophrenics; each individual mean represents the average of the 30 segmental TTR's computed for each sample. This table indicates a tendency for the mean TTR to be generally lower in the case of the schizophrenics, only one freshman having a lower ratio than the patients with the highest ratios. It is to be noted, also, that the range for the schizophrenic group is much greater than for the freshman group, extending from .49 to .62 for the former, and from .61 to .67 for the latter.

The group mean TTR for the schizophrenics was .57, with a standard error of .0124, and that for the freshmen was .64, with a standard error of .0043. In order to test the significance of the difference between these two means the *t*-test (10) was applied. The value obtained for *t* was 5.61, which, with 18 degrees of freedom, is significant at the 1 per cent level of confidence. Therefore, the hypothesis that these two samples were drawn from populations whose means are equal may be rejected.

However, one of the assumptions underlying the *t*-test when used to test the significance of the difference between means of independent small samples is that the true variance of the population from which one sample is drawn must be equal (or approximately equal) to the

[3] As the language sample of one schizophrenic patient consisted of only 2,800 words, because he was withdrawn from the hospital before 3,000 words could be obtained, only 28 TTR's were obtained in his case.

TABLE 1
Mean TTR's for the individual subjects ranked in descending order

Schizophrenic patients			Freshman subjects		
Mean TTR	S.D.	C.V.	Mean TTR	S.D.	C.V.
			.67	.056	8.36
			.66	.037	5.61
			.66	.035	5.30
			.64	.040	6.25
			.64	.057	8.91
			.64	.057	8.91
			.64	.053	8.28
			.63	.053	8.41
			.63	.042	6.67
.62	.048	7.74			
			.61	.057	9.34
.61	.044	7.21			
.60	.048	8.00			
.58	.050	8.62			
.57	.071	12.46			
.56	.030	8.93			
.56	.056	10.00			
.55	.064	11.64			
.53	.071	13.40			
.49	.066	13.47			

true variance of the population from which the other sample is drawn. In order to discover whether or not this assumption is valid in these samples the F test was applied. When F was computed as the ratio of the variance of the distribution of the mean TTR's for the schizophrenics to that of the freshmen, the value obtained was 8.36, which, with nine and nine degrees of freedom, is significant at the 1 per cent point. It might be possible to interpret this as invalidating the above use of the t-test with these data. There is doubt on this point, and while some statisticians might accept the t-test as here applied, it was thought best to treat the data in another and somewhat different way. Consequently, as a further check on the reliability of the difference between the two group means, t was used to set limiting values for each group outside of which any exact hypothesis as to the value of the true mean may be rejected with a given degree of confidence (10). At the 1 per cent level of confidence the limiting values of the true mean for the patients were .6085-5277, and for the freshmen they were .6556-.6276. Since there is no overlap in these confidence intervals, we may be practically certain that the difference between the group mean TTR for the schizophrenics and that for the freshmen indicates a real difference between the two groups.

In general it may be concluded that the schizophrenic patients tended to have lower mean segmental TTR's than did the freshmen. In other words, the schizophrenic patients employed smaller vocabularies than did the freshmen.

Interpretation of these differences in regard to the TTR's of the schizophrenic patients and the freshmen must necessarily be made with caution because of several variables in the two groups, especially within the schizophrenic group, such as age, time of onset of illness, intellectual level and educational advantages, which the experimenter was not able to control rigidly within the limitations of this study. However, two possible relationships may be pointed out, namely, that existing between the intel-

lectual level and the TTR and that existing between certain clinical pictures presented by the patients and the TTR.

From a preliminary study by Zipf (17) in which he used a measure similar in some respects to the TTR, it may be inferred, although it cannot be stated conclusively, that the TTR probably correlates positively with mental age. When the schizophrenic patients are ranked according to their mean TTR and what estimates could be obtained of their original intellectual level, it would appear that a positive correlation would result.

Schizophrenics		*Mean TTR*	*Estimates of Intelligence or Education*
Case	*Type*		
7	paranoid	.62	"Very superior"
3	catatonic	.61	"High ave. to sup."
9	paranoid	.60	Eighth grade edu.
1	paranoid	.58	"Superior"
10	paranoid	.57	"Superior"
8	unclassified	.56	College grad.
6	hebephrenic	.56	"At least high ave."
5	paranoid	.55	"Ave. or above"
4	paranoid	.53	"Slightly below ave."
2	hebephrenic	.49	"Too deteriorated to estimate." Eighth grade education

Certainly the highest mean TTR was made by the schizophrenic with the highest intelligence, while the three lowest TTR's were made by the three patients with probably the lowest intelligence. Five other patients with probably high average to superior intelligence ranked in between.

No statements characterizing the various types of schizophrenia in terms of the TTR would be justified by the above tabulation.

Despite the probability that a positive correlation exists between the TTR and the intellectual level, the fact still remains that there were differences between the mean TTR's for the schizophrenics who ranked highest intellectually and most of the freshmen. As the TTR represents the relationship between the number of different words and the total number of words, the lower TTR's of the schizophrenics would obviously indicate a smaller number of different words used, hence more repetitions of the same words. Clinically, schizophrenic patients present a tendency to repetition of behavior known as stereotypy which may be of attitude, movement, or speech. When the same word, phrase or sentence is repeated the stereotypy is known as verbigeration (13). It is possible, then, that the lower mean TTR's for the patients represent to some degree in a quantitative manner this clinical picture of stereotypy.

2. *Gramatical analysis.* For this part of the study eight conventional parts of speech were used, namely, nouns, pronouns, verbs, adjectives, adverbs, prepositions, conjunctions and interjections. The articles were tabulated separately and then considered both alone and in conjunction with the adjectives. For the classification of words on this basis, the following rules were followed:

1. A noun used as an adjective was tabulated as an adjective only if the dictionary (14) gave the adjectival use as possible. For example, *family* in the combination *family prayers* was considered as an adjective as the dictionary gives this usage. However, the word *football* in the combination *football championship* was tabulated as a noun as no

TABLE 2

Relative frequency of usage of the different parts of speech expressed as percentage of the total number of words used by the two groups, 29,800 in the case of the schizophrenic patients, and 30,000 in the case of the freshman subjects. The range values are from the individual samples

	Schizophrenic patients		Freshman subjects	
	%	Range	%	Range
Nouns	13.04	10.40–16.63	15.39	12.67–18.53
Pronouns	22.68	19.33–24.73	17.96	14.40–20.40
Verbs	26.28	24.27–30.47	22.95	20.50–24.47
Adverbs	11.54	7.00–17.97	10.16	8.87–11.20
Conjunctions	6.53	4.10– 8.77	8.83	7.33–11.40
Prepositions	7.48	4.30–10.00	10.00	8.80–11.00
Interjections	2.64	.53– 4.43	1.26	.47– 2.00
Adjectives	5.37	3.77– 7.10	6.69	5.67– 7.87
Articles	4.48	2.53– 6.87	6.79	5.27– 9.07
Adjs. and Arts.	9.85	8.60–12.40	13.48	11.43–16.40

adjectival use is mentioned in the dictionary.

2. Participles were classes as adjectives and gerunds as nouns only when this was indicated as permissible by the dictionary. Otherwise, they were classed with the verbs.

3. All pronouns were classified under pronouns whether modifying nouns or not.

4. The neologisms or coined words of the patients were interpreted according to the parts of speech that they seemed functionally to assume in the sentence; if in isolation, they were considered as nouns.

TABLE 3

Values of t and F obtained from testing significance of the difference in usage of certain grammatical categories, based on percentages of total sample, between schizophrenic patients and freshmen

	Values of t	Values of F
Adjectives	3.22	2.61
Adverbs	1.44	10.10
Nouns	2.50	1.53
Pronouns	5.30	1.42
Verbs	3.92	2.19
Adjs. and Articles	5.34	1.58
Articles	4.20	1.12
Prepositions	5.04	4.50
Conjunctions	3.43	1.44
Interjections	2.98	6.72

With 18 degrees of freedom, the values of t required for significance are: at the 1% level of confidence $t=2.88$; at the 5% level of confidence $t=2.10$.

With 9 and 9 degrees of freedom, the values of F required for significance are: at the 1% point $F=5.35$; at the 5% point $F=3.18$.

Table 2 gives the results of this grammatical analysis for the schizophrenics and freshmen, respectively. The t-test was applied to test the significance of the differences between the various percentages for the two groups, and the values of t obtained are given in Table 3. As can be seen, all of the t values thus obtained are significant at the 1 per cent level, except that for nouns which is significant at the 5 per cent level, and that for adverbs, which is not significant at that level. From this we may conclude that the schizophrenic patients used significantly fewer nouns, conjunctions, prepositions, adjectives, and articles than did the freshmen, and significantly more pronouns, verbs, and interjections.

The F ratio, involving the variances of the distributions of percentages (based on total words per sample) for each grammatical category for the two groups, resulted in the values of F also given in Table 3. Here the only significant results were with respect to the adverbs and interjections, which were significant at the 1 per cent point, and the prepositions

which was significant at the 5 per cent point. This would indicate that only in the use of adverbs, prepositions, and interjections did the schizophrenic patients show significantly greater variability than did the freshmen.

The ranges shown in Table 2 represent the highest and lowest percentage for each part of speech in the individual language sample for each subject, the total number of words being 3,000 in each instance, except for the one patient who had only 2,800. It will be noted that the schizophrenic patients showed a greater range for all parts of speech except the pronouns and the adjectives and articles combined, where the freshmen had a slightly greater range.

TABLE 4

Relative frequency of use of the different parts of speech expressed as percentage of the total number of words used by the two groups, 29,800 for the schizophrenic patients and 30,000 for the freshman subjects, compared with data from French, Carter, and Koenig (6) on telephone conversation.

	Tele phone Conv.	Schizo- phrenics	Fresh- men
Nouns	15.91	13.04	15.39
Pronouns	18.22	22.68	17.96
Verbs	22.39	26.28	22.95
Adjs. and advs.	10.06	16.91	16.85
Preps. and conjs.	12.62	14.01	18.83
Articles	5.60	4.48	6.79
Interjections	8.08	2.64	1.26

Table 4 shows the group percentages for each part of speech for the schizophrenics and for the freshmen, as compared with percentages computed from data given by French, Carter, and Koenig (6), in a study of telephone conversations. The data taken from this study were reorganized, wherever given in such form as to make it possible, in order to make them more nearly comparable to those of the present study. However, there were some differences in the French, Carter, and Koenig material that could not be changed so as to make it accord with that of the present study. For example, they classified all forms of *yes* and *no* under interjections, while such words were classed as adverbs in the present study, and they also classified laughter as an interjection, while it was ignored in this study. In addition, they grouped letters and numbers together under a separate heading, not classifying them as representing a part of speech, while letters were usually called nouns and cardinal numbers, adjectives, in this study. Therefore, this group of items, representing 5.05 per cent of the total number of words in their study, was ignored in the comparisons. These differences in procedure explain to some extent why the percentages of adjectives and of adverbs in the French, Carter, and Koenig data are considerably smaller than those for either of the two groups considered by the present experimenter, and why the percentage of interjections is considerably larger. However, it is interesting to note that the percentages for nouns, pronouns, and verbs in the French, Carter, and Koenig study approximate very closely the corresponding percentages for the freshman group used in this study, and hence are lower for pronouns and verbs than are those of the schizophrenic group, while the percentage of nouns is higher. In regard to prepositions and conjunctions the French, Carter, and Koenig percentage is lower than that for both the schizophrenic and freshman groups, but it more closely approximates that for the schizophrenic group. The percentage of articles in telephone conversation lies almost exactly half way between the percentage of articles for the schizophrenics and that for the freshmen.

Table 5 presents data from Horn (7)

TABLE 5

Relative frequency of use of the different parts of speech expressed as percentage of the total number of words used by the two groups, 29,800 for the schizophrenic patients and 30,000 for the freshman subjects, compared with data from Horn (7) on children

	Children		Schizophrenics		Freshmen	
	Mean	Range	Mean	Range	Mean	Range
Nouns	50.65	42.2–59.1	13.04	10.40–16.63	15.39	12.67–18.53
Pronouns	2.25	.9– 3.6	22.68	19.33–24.73	17.96	14.40–20.40
Verbs	27.75	16.9–38.6	26.28	24.27–30.47	22.95	20.50–24.47
Adverbs	5.65	2.5– 8.8	11.54	7.00–17.97	10.16	8.87–11.20
Conjunctions	1.5	.3– 2.7	6.53	4.10– 8.77	8.83	7.33–11.40
Prepositions	1.1	.6– 1.6	7.48	4.30–10.00	10.00	8.80–11.10
Interjections	.6	0 – 1.2	2.64	.53– 4.43	1.26	.47– 2.00
Adjectives	13.45	10.1–16.	9.85	8.60–12.40	13.48	11.43–16.40

showing the range of percentages on parts of speech that 11 investigators have found in children's language, as compared to the percentages for the schizophrenics and freshmen found in this study. For case of comparison the experimenter averaged these ranges, each study having been done on only one child. Here we immediately note some striking differences. The children used approximately three to four times as many nouns as either the schizophrenics or freshmen. They used eight to ten times fewer pronouns, about half as many adverbs, four to six times fewer conjunctions, seven to ten times fewer prepositions, two to four times fewer exclamations, about the same number of adjectives as did the freshmen (hence more than the schizophrenics), and about the same number of verbs as did the schizophrenics (hence fewer than did the freshmen). Again no conclusive comparisons can be made because of the probably varying procedures used in making the grammatical analyses.

If reference is made also to the French, Carter, and Koenig data, one might conclude that while the relative proportions of the various parts of speech change greatly from childhood to the adult level, the differences among various samples of adults are much smaller. Certainly there is no apparent tendency for the schizophrenic patients to regress toward the childhood level with respect to the general grammatical construction of their language, unless it might be in regard to more frequent use of verbs.

3. *Word frequencies.* Table 6 gives a list of the 100 most frequently used words for the schizophrenic patients and the freshmen, respectively, the list for the latter having those words which are common to both lists arranged in order of frequency, while the list for the schizophrenic patients has the words corresponding to those of the freshmen arranged in order of sequence regardless of frequency. The 21 words in each of the two groups not common to both lists are arranged at the bottom of the table in order of frequency. Several interesting differences between the list for the schizophrenic patients and that for the freshmen can be noted in regard to the frequencies for various words. For example, the schizophrenics used *not* almost twice as many times as did the freshmen. In addition, *no* and *never* occur in the list for the schizophrenics, while no other clearly negative words occur in the first 100 words for the freshmen. Hence, we have the schizophrenics using these negative words 1,087 times to 484 times for the freshmen, the former

TABLE 6

List of 100 words most frequently used by schizophrenics and freshmen. The first 79 words common to both lists are arranged in descending rank order according to frequency of usage by freshmen. The remaining 21 words not common to both lists are arranged in order of frequency for the two groups at the end of the table

	Freshmen			Schizophrenics		
	Word	Part of Speech	Freq.	Word	Part of Speech	Freq.
1.	the	art.	1140	the	art.	735
2.	and	conj.	1113	and	conj.	785
3.	I	pron.	924	I	pron.	2501
4.	a	art.	788	a	art.	356
5.	to	prep.	779	to	prep.	635
6.	is	verb	629	is	verb	580
7.	it	pron.	623	it	pron.	729
8.	of	prep.	612	of	prep.	416
9.	that	pron.	599	that	pron.	633
10.	you	pron.	562	you	pron.	392
11.	not	adv.	484	not	adv.	942
12.	in	prep.	396	in	prep.	266
13.	he (He)	pron.	347	he (He)	pron.	244
14.	that	conj.	327	that	conj.	172
15.	have	verb.	305	have	verb	339
16.	do	verb.	304	do	verb	638
17.	they	pron.	276	they	pron.	321
18.	well	interj.	271	well	interj.	565
19.	was	verb	270	was	verb	412
20.	are	verb	238	are	verb	136
21.	if	conj.	234	if	conj.	164
22.	she	pron.	220	she	pron.	127
23.	we	pron.	218	we	pron.	79
24.	but	conj.	211	but	conj.	173
25.	or	conj.	204	or	conj.	150
26.	just	adv.	177	just	adv.	190
27.	for	prep.	175	for	prep.	128
28.	there	adv.	168	there	adv.	163
29.	with	prep.	165	with	prep.	98
30.	would	verb.	164	would	verb	226
31.	had	verb	159	had	verb	212
32.	what (uh?)	pron.	155	what (uh?)	pron.	297
33.	very	adv.	154	very	adv.	46
34.	think	verb	147	think	verb	131
35.	oh	interj.	143	oh	interj.	125
36.	about	prep.	141	about	prep.	133
37.	know	verb	139	know	verb	496
38.	on	prep.	138	on	prep.	109
39.	get	verb	125	get	verb	120
40.	at	prep.	117	at	prep.	73
41.	out	adv.	115	out	adv.	95
42.	will	verb	113	will	verb	52
43.	people	noun	111	people	noun	74
44.	something	noun	108	something	noun	86
45.	them	pron.	108	them	pron.	66
46.	this	pron.	100	this	pron.	85
47.	one	pron.	99	one	pron.	72
48.	me	pron.	96	me	pron.	272
49.	up	adv.	93	up	adv.	71
50.	when	conj.	93	when	conj.	114
51.	might	verb	89	might	verb	47
52.	then	adv.	85	then	adv.	100
53.	as	conj.	84	as	conj.	46
54.	things	noun	84	things	noun	80
55.	time	noun	83	time	noun	61
56.	because	conj.	82	because	conj.	149
57.	can	verb	78	can	verb	75

TABLE 6 (Continued)

	Freshmen			Schizophrenics		
	Word	Part of Speech	Freq.	Word	Part of Speech	Freq.
58.	were	verb	76	were	verb	58
59.	say	verb	75	say	verb	104
60.	good	adj.	75	good	adj.	47
61.	him (Him)	pron.	74	him (Him)	pron.	57
62.	go	verb	71	go	verb	56
63.	my	pron.	71	my	pron.	286
64.	cannot	verb	70	cannot	verb	93
65.	did	verb	70	did	verb	158
66.	like	prep.	69	like	prep.	82
67.	all	adj.	68	all	adj.	53
68.	so	adv.	62	so	adv.	75
69.	see	verb	62	see	verb	47
70.	am	verb	61	am	verb	167
71.	one	adj.	59	one	adj.	64
72.	some	adj.	59	some	adj.	54
73.	anything	pron.	59	anything	pron.	110
74.	could	verb	58	could	verb	121
75.	got	verb	56	got	verb	72
76.	want	verb	52	want	verb	62
77.	been	verb	52	been	verb	67
78.	way	noun	48	way	noun	58
79.	means	verb	48	means	verb	93
80.	his (His)	pron.	121	yes (uh huh)	adv.	173
81.	person	noun	118	be	verb	145
82.	an	art.	103	said	verb	109
83.	has	verb	102	no (hunh uh)	adv.	96
84.	who	pron.	102	why	interj.	89
85.	her	pron.	76	suppose	verb	85
86.	so	conj.	74	now	adv.	82
87.	by	prep.	71	guess	verb	73
88.	let	noun	65	here	adv.	73
89.	from	prep.	65	any	adj.	71
90.	other	adj.	63	thought	verb	70
91.	example	noun	63	mean	verb	66
92.	going	verb	62	sir	noun	65
93.	quite	adv.	61	thing	noun	56
94.	your	pron.	58	too	adv.	56
95.	which	pron.	57	all	noun	53
96.	does	verb	54	never	adv.	49
97.	always	adv.	54	understand	verb	49
98.	us	pron.	50	little	adj.	47
99.	then	conj.	49	right	adj.	45
100.	course	noun	48	tell	verb	43

group using them about two and one-half times more than the freshmen, when only the 100 most frequently used words are considered. Instead of the *never* used by the schizophrenics ,the freshmen used *always* about an equal number of times. Another interesting item is that the freshmen used *very* over three times as often as did the schizophrenics. When the verbs among these 100 most frequently used words for the group were considered, it was found that the schizophrenic patients used eight past tense verbs a total of 1158 times while the freshmen used six such verbs only 683 times. It is interesting to note, also, that two verbs carrying the connotation of indecision, *suppose* and *guess*, occur among the 100 most frequently used words of the schizophrenics for a total of 158 times, while no such words occur in the comparable list for the freshmen.

A more detailed comparison of frequencies for various words used by the schizophrenic group and by the freshman group possibly would show several interesting and differential facts. A consideration of the qualitative aspects of some of the words used by the two groups would also provide interesting material.

Because of the tendency shown in the TTR analysis for the schizophrenic patients to repeat words more frequently than do the freshmen, Fig. 1 is presented to show what proportion the 100 most frequently used words constituted of the total number of words for the two groups. We may refer to this as proportional vocabulary. The frequencies for each consecutive five words, starting with the most frequently used word, were added cumulatively for each group, and these successive cumulative frequencies were expressed as fractions of the total number of words. The curves show that the patients consistently use a smaller number of different words to represent any given percentage of the total number of words. For example, the schizophrenic group use only 33 words to make up 50 per cent of the total number of words, while the freshman group use 46 words to arrive at the same percentage. The entire 100 most frequent words constitute 68.32 per cent of the total number of words for the schizophrenics as a group, and 62.91 per cent for the freshmen. Superimposed on these curves is a similar curve taken from the French, Carter, and Koenig (6) study, indicating that the 100 most frequently used words in the telephone conversations analyzed formed 75 per cent of the total number of words. The curve on written material was also given by French, Carter, and Koenig, and was taken by them from Dewey (5). According to it, the 100 most frequently used words in written material form only 56 per cent of the total number of words used. A consideration of all four curves shows that the telephone conversation and written English represent the extremes in this factor of repetition, or number of types constituting a given percentage of the total number of tokens, the telephone conversation being the most repetitious and the written English the least. This might be expected from the stereotyped, truncated nature of telephone conversation as compared to the reflective style of written English in which a premium is placed on variety. That the curves for the two groups considered in this study should fall in between these extremes, that for the schizophrenic group more nearly approximating that for the telephone conversation and the curve for the freshman group being closer to the one for the written English, might also be expected, considering the repetitious nature of the schizophrenic speech. The freshmen appear to have been more successful in introducing variety and flexibility into their spoken language. The lower end

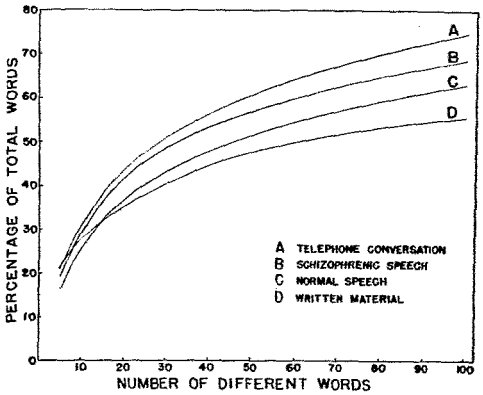

FIG. I. Curves showing the cumulative percentages of the total words for the 100 most frequently used words. A, telephone conversation (0); B, schizophrenic subjects; C, freshman subjects; D, written material (5).

of the curves indicates the interesting fact that the curve for written English overlaps the other three and is higher for the first five words or so. This might be explained as being due to the completeness of written English as compared to conversations, the articles and the conjunctions and prepositions being used by writers probably more than by speakers. An examination of Dewey's list shows that the five most frequently used words in the written English samples were *the, of, and, to,* and *a.*

Another analysis that suggests itself, because of the schizophrenic's self-preoccupation and his tendency to ignore his environment, is the relative frequency of referrals to self and of referrals to others found in the language of the two groups. This analysis was made by computing the percentage of the total number of words represented by the different personal pronouns. Table 7 shows the results of this computation. The most striking fact in this table is that references to self, using some form of the first person singular pronoun (*I, my, mine, me, myself*), make up 10.42 per cent of the total number of words for the schizophrenic group, while they represent only 3.69 of the total for the freshmen. On the other hand the freshmen use the first person plural pronoun in its various forms (*we, our, ours, us, ourselves*) three times as often as do the schizophrenics; the second person pronoun, plural and singular (*you, your, yours, yourself, thee, thou*), almost twice as frequently as do the schizophrenics; and the third person pronoun, singular and plural (*he, his, him, himself, she, her hers, herself, it, its, itself, they, their, theirs, them*), almost 20 per cent more often.

TABLE 7

Relative frequency of use of the different personal pronouns expressed as percentage of the total number of words for the two groups, 29,800 for the schizophrenic patients and 30,000 for the freshmen

	Schizophrenics		Freshmen	
	N	%	N	%
1st person sing.	3104	10.42	1107	3.69
1st person plural	102	.32	315	1.05
2nd person sing. and plural	429	1.44	643	2.14
3rd person sing. and plural	1645	5.52	1923	6.41

The schizophrenic patients used a total of 14 neologisms, or coined words. These words are *banoon, d-s, d-t, dokey, g-m, g-o-d-t, okey-dokey, oke, pard, p-a-r-d, recognization, strob, striked, woozy, adjects.* Neologisms were not found in the freshmen samples.

IV. SUMMARY AND CONCLUSIONS

Three-thousand-word language samples were obtained from each of ten schizophrenic patients, five males and five females, and ten University of Iowa freshmen, four males and six females, the latter ranking above the 90th percentile on the Composite Score of the Iowa Qualifying and Placement Examinations. An interview situation was employed, involving the interpretation of 14 proverbs, the interviews being recorded by an electric dictaphone technique without the subjects' knowledge.

A word count was then made for each language sample, each word being tabu-

lated according to its frequency in consecutive 100-word segments and according to its grammatical usage. Three types of analysis were made: (1) the type-token ratio, computed by dividing the number of different words in each 100-word segment by the total 100 words; (2) grammatical analysis; and (3) word frequencies.

1. When the *t*-test for related measures was applied to the language samples for both groups by dividing at random the 30 TTR's for each subject into two sets and finding the group mean for each half, it was found there was no significant difference between the two means either for the schizophrenics or for the freshmen.

2. When the ratio of the variance of the distribution of the standard deviations of the segmental TTR's for the schizophrenic patients to that of the freshmen was computed, the resulting *F* value was not significant, indicating that the schizophrenic patients did not vary more from segment to segment than did the freshmen.

3. The mean TTR's of the schizophrenic patients were generally lower than were those of the freshmen, and the range for the patients was much greater.

4. The group mean TTR of the schizophrenic patients was found to be significantly lower than the group mean TTR for the freshmen.

5. It is probable that a positive correlation exists between the TTR and the intellectual level, according to previously reported findings, and judging by the indicated relationship between the TTR's of the patients and their probable intellectual levels when both were ranked in descending order. However, there were differences between the mean TTR's for the schizophrenic patients who ranked highest intellectually and most of the freshmen.

6. When the *t*-test was applied to test the difference between the two groups in terms of the relative frequency of usage of the eight grammatical categories, expressed as percentages of the total number of words used, it was found that the schizophrenic patients used significantly fewer nouns, conjunctions, prepositions, adjectives, and articles than did the freshmen, and significantly more pronouns, verbs, and interjections.

7. The *F* ratio, involving the variances of the distributions of percentages (based on total words per sample) for each grammatical category for the two groups revealed that the schizophrenic patients showed significantly greater variability than did the freshmen in the use of adverbs, prepositions, and interjections.

8. Comparison of the relative proportions of the various parts of speech found in this study with those given in another study on telephone conversation, for presumably normal adults, indicates a very close approximation between the percentages of nouns, pronouns, and verbs used in telephone conversation and those used by the freshman group. The procedure used in the former study for classifying these three parts of speech was quite similar to that used in the present study. The procedures for classifying the prepositions and conjunctions, and the articles also apparently were similar, but the percentage for the former was considerably lower for the telephone conversation than for the freshman language, and the percentage of articles was slightly lower. The percentages of adjectives and adverbs were also considerably lower for the telephone conversation than for either the schizophrenic or freshman samples, and the

percentage of interjections was a great deal higher, but the procedures for the classification of these two groups of words differed considerably in the two studies.

The most definite differences between the schizophrenic patients and the normal adults in this and the other study lie in the fact that the patients used proportionately more pronouns and verbs, and proportionately fewer nouns and articles.

9. A general comparison with similar data on children under six and one-half years of age showed several marked differences between the percentages on the parts of speech for the children and those for the two groups in this study. The children used many more nouns and many fewer pronouns, adverbs, conjunctions, prepositions and interjections than either the schizophrenic or freshman group. In the percentage of verbs the children more closely resembled the schizophrenic group, and their percentages of adjectives was nearly the same as for the freshman group.

10. Assuming that the probably different procedures in the grammatical analyses of the three studies permit general comparisons, it would appear that while the relative proportions of the various parts of speech change greatly from childhood to the adult level, the differences among various samples of adults are much smaller. There was little evidence from this analysis that schizophrenia constitutes a regressive tendency, except for the more frequent use of verbs, the other findings for the children and schizophrenics, respectively, being decidedly different.

11. When a list of the 100 words most frequently used by the schizophrenics and by the freshmen was made, it was found each list had 21 words not common to the other.

12. The total frequencies for these 100 most frequently used words constituted 68.32 per cent of the total number of words used by the schizophrenics and 62.91 per cent of those used by the freshmen, the schizophrenics consistently using a smaller number of different words to make up any given percentage of the total up to this figure. For the schizophrenics 33 different words (types) constituted 50 per cent of their total sample of 29,800 words (tokens); for the normals 46 types constituted 50 per cent of their 30,000 tokens.

13. A comparison of the relative proportion of referrals to self and referrals to others, as indicated by the use of personal pronouns by the two groups, shows that the schizophrenics used more first person singular pronouns, and fewer first person plural, second person plural and singular, and third person plural and singular pronouns than did the freshmen. *I, my, mine, me,* and *myself* represented 10.42 per cent of the total number of words for the schizophrenics, and only 3.69 per cent of the total words for the freshmen.

14. Several interesting differences in the frequencies of occurrence of specific words among these 100 most frequently used words were noted, such as the fact that negative words (*not, no,* and *never*) have a frequency two and one-half times larger in the schizophrenic list than in the freshman list, and that verbs in the past tense had a frequency a little less than twice as large in the schizophrenic list as in the freshman list.

The conclusion can be stated that the measures used do make possible the quantitative expression of certain differences among samples of spoken lan-

guage. Statistically significant differences between schizophrenic language and the language of superior university freshmen, as these types of language were here sampled, were indicated by the measures of vocabulary extent and 'flexibility', and of grammatical structure. The measures of word frequency were also suggestive of some possibly important differences between the two groups.

These findings are to be evaluated with clear awareness that they may not be due entirely to the schizophrenia, since, as was explained in the Introduction, there were necessarily differences between the two groups with regard, particularly, to intelligence and scholastic training, and the relevance of these differences cannot, at this stage of investigation, be clearly judged. The degree to which such 'intellectual' factors are related to the language measures employed is not yet known; and the problem of measuring the intelligence of psychopathological individuals is by no means simple. Insofar as any conclusions may be drawn about 'schizophrenic language' on the basis of this study, they would appear to suggest the possibility that such language differs from the language of 'normal' persons in being (a) less highly differentiated in structure—the ratio of different words (types) to total words (tokens) is lower, as shown by the analyses in terms of type-token ratio and proportional vocabulary; (b) more negatively toned; (c) indicative of preoccupation with the past, as shown by relatively more past tense verbs; (d) indicative of more self-reference, as shown by more frequent occurrence of self-reference terms in the first person singular pronoun class; (e) characterized by a slight tendency toward the use of neologisms; (f) featured by a probable peculiarity of grammatical structure, represented by relatively more pronouns and verbs and fewer nouns and articles, which might possibly be suggestive of excessive self-preoccupation and 'instability'. Moreover, such comparison as could be made of the 'schizophrenic language' and that of children (7) provided little ground for the view that schizophrenia constitutes a regression to childhood behavior patterns, in that the language of the schizophrenics, as measured, bore no striking resemblance to that of the children, except possibly in the proportionate number of verbs.

Again, it is to be emphasized that this study was designed primarily to explore the possibilities of language measurement. From this point of view, its results may be regarded as definitely promising. Any conclusions concerning the nature of 'schizophrenic language' are advanced only for their suggestive value.

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