III. THE QUANTITATIVE DIFFERENTIATION OF SAMPLES OF WRITTEN LANGUAGE

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I. INTRODUCTION

This study is part of a previously described program of research concerned with the general problem of language behavior (16).

The present investigation is concerned primarily with the objective of developing reliable and differentiating measures of language behavior, and, to a limited extent, with determining the intercorrelation of the measures, their relation to other pertinent variables, and with indicating the normal characteristics of language behavior as contrasted with disorder in such behavior.

The scientific study of language behavior has been carried on by many investigators, among them Piaget (18), Cameron (5), Thorndike (22), Horn (13), Zipf (25), Carroll (10), Skinner (20), Jersild and Ritzman (14), Balken and Masserman (2), and Fairbanks (12), to mention only a few.[2]

None of the previous investigators has been precisely concerned with the particular issues around which the present study is centered. In the first place, the present study is strictly quantitative, and this fact serves to differentiate it from a considerable proportion of previous investigations of language. Secondly, this study is concerned with the language behavior of specified individuals, a fact which differentiates it from practically all of the word-frequency studies such as those of Thorndike and Horn, in which large samples of language drawn from a variety of sources were studied but with no attention given to the characteristics of the language of individuals. Thirdly, some of the measures used in the present study, particularly the type-token ratios, have not been employed, as they are here used, in any previous studies, with the exception of the one by Fairbanks (12) which may be regarded as a companion study to this one.

What was desired, for purposes of this particular study, was a sampling of the language of persons who could be regarded definitely as psychopathological, but who could nevertheless produce written language, and a sampling of the language of persons who could be regarded as definitely superior in verbal ability, but who might not be regarded as 'verbal specialists', such as outstanding novelists, scientific writers, etc. The study is concerned, first of all, with the specific problem of whether and in what respects 'adequate' and 'inadequate' language might be differentiated *quantitatively*. The problem of ascertaining the particular factors responsible for any demonstrated differences between the adequate and inadequate language is secondary to the main investigation, but it has been considered in some degree.

[1] This study was done in the Department of Psychology at the State University of Iowa as a dissertation in partial fulfillment of the requirements for the degree of Doctor of Philosophy. The study was directed by Wendell Johnson, and is part of a program of research on language behavior. The writer is grateful to Dr. Andrew H. Woods, Director, and the staff of the Iowa State Psychopathic Hospital, and Dr. Leonard P. Ristine, Superintendent, and the staff of the Mt. Pleasant State Hospital, for their cooperation in securing subjects for the investigation.

[2] The reader who is interested in the study of language from the standpoint of vocabulary and word lists will find an excellent summary in Fries, Charles C. and Traver, A. Aileen, *English Word Lists*, American Council on Education, Washington, D.C., 1940, pp. 109.

Adults schizophrenic patients were selected as the subjects from whom samples of 'inadequate' language were to be obtained. Other specific types of subjects might have been chosen; subjects might have been selected, for example, solely on the basis of educational level, or of intelligence test scores. Aphasics might have been used in order to obtain 'inadequate' language. Aphasics, however, might be expected to produce language 'inadequate' in some relatively rare sense. And schizophrenics were preferred to persons mainly characterized by low-grade test-intelligence, or by low scholastic achievement, because insofar as their language is 'inadequate' it would appear to be so in a peculiarly significant sense from the standpoint of social adjustment. Thus, in the case of schizophrenics, neuro-linguistic inadequacy, insofar as it may exist, may reasonably be judged to have a significance beyond that of the neuro-linguistic inadequacy involved in 'simple' low-grade 'intelligence'.

Having selected the subjects from whom the 'inadequate' language samples were to be obtained, the problem of selecting a contrasting group of subjects presented itself. This problem was essentially that of selecting subjects from whom relatively high-grade language behavior might be expected, but who could be counted upon not to produce language that was highly 'adequate' in some relatively exceptional respect. Superior 'literary' language, for example, was to be avoided. After due consideration, the decision was made to select subjects who were not noted as being talented in some exceptional linguistic respect, who were behaviorally and socially normal in the sense, at least, that they could function as freshmen in a large university, and who were neuro-linguistically superior in the sense that they scored relatively very high on a battery of largely verbal tests administered to them on the occasion of their entering the university which they were attending.

The question might be raised as to the advisability of selecting 'normal' subjects matched with the psychotic patients with respect to such factors as 'intelligence', educational status, etc. The most important consideration in this connection is simply that such a procedure would probably have militated against the main purpose of the study, in that it would have made less likely the obtaining of two definitely differing samples of language. It was a primary consideration that two such samples be obtained if the problem of the quantitative differentiation of language samples was to be fruitfully investigated. A determination of the respects in which language samples of the type were utilized might be quantitatively differentiated would appear to be basic to any study of the relation of specific factors, such as 'intelligence', for example, to measurable aspects of language behavior.[3]

The language obtained from the psychotic subjects used in this investigation definitely constitutes a sample of the

[3] The question as to whether the language of schizophrenics differs, insofar as it does, from the language of superior university freshmen, because the schizophrenics are less "intelligent," raises an extremely complicated issue. It is not to be ligthtly dismissed, for example, that the phrase "highly intelligent schizophrenic" may be in a basic sense self-contradictory. The fact that an "intelligence test" shows a schizophrenic to be superior mentally probably tells, from one point of view, as much about the test as it does about the patient. The schizophrenic offers a means of validating the test quite as definitely as the test offers a means of evaluating the patient. A particularly pertinent answer to the test on which a schizophrenic scores a high "intelligence quotient" is that, when all is said, the schizophrenic is in custody. The issue is not a simple one by any means; further discussion of it, however, is hardly relevant to the present purposes.

language of schizophrenics, but whether its differentiating characteristics are due to 'schizophrenia' is a question, not without interest, but not of primary concern in this study. Of course, insofar as the differentiating characteristics of the schizophrenics' language cannot be attributed to something else, it would appear reasonable to regard them as due to, or as involved in, whatever may be designated by the term 'schizophrenia'. The relation of test-intelligence and educational level, at least, as well as that of sex, to the quantitatively expressible aspects of the schizophrenics' language has been ascertained to some extent in the present investigation. It is to be clearly understood that one is to be cautious, though not to the point of impotence, in drawing from this study any generalizations concerning 'the language of schizophrenia', since the study is designed primarily to yield generalizations with respect to another problem, namely that concerning the quantitative differentiation of samples of written language.

II. STATEMENT OF THE PROBLEM

This study is concerned with the following specific problem: the quantitative differentiation of samples of presumably adequate and inadequate written language, as obtained from superior university freshmen and schizophrenic patients, respectively, in terms of the following specific measures:

(1) The ratio of types (different words) to tokens (total words used).
(2) The relative frequency of usage of certain grammatical categories.
(3) The ratios of the frequency of occurrence of adjectives to verbs, adjectives to nouns, and adverbs to verbs, respectively.
(4) The relative frequency of specific types, expressed as percentage of tokens.

III. PROCEDURE

Two groups of adults served as subjects in this investigation: (1) twenty-four psychotic patients diagnosed as schizophrenic were selected to represent a group presenting psychopathological or inadequate language; (2) twenty-four superior university freshmen were selected to represent a group presenting relatively adequate language. A summary of the main characteristics of these two groups follows.

At the time the data were secured the patients were all confined in the Mt. Pleasant State Hospital at Mt. Pleasant, Iowa. Thirteen of the twenty-four had been previously examined at Iowa State Psychopathic Hospital, Iowa City, and the diagnosis of schizophrenia made by the psychiatrists at the Iowa State Psychopathic Hospital had been confirmed by the staff at the Mt. Pleasant State Hospital. These particular schizophrenic patients were selected because of the relatively maximum certainty of the diagnosis, and the possibility of securing their cooperation in the proposed writing situation. The patients, twelve male and twelve female, ranged in age from sixteen to forty-nine years, with an average age of thirty-two years; four (one male and three females) have been married. The average duration of present confinement in the Mt. Pleasant State Hospital prior to their service as subjects for this investigation was three years and three months, the range being from one year to eight years. The average duration of the illness, taken from the time of the first psychotic symptoms, as shown in the patient's hospital record,[4] was five and one-half years, ranging

[4] This must be considered as only an indication of duration of illness since it is difficult if not impossible in many cases to determine when the illness began. In the case of the disease

from one year to eleven years. Prior to their commitment in the hospital the patients had been engaged in the following occupations: laborer, accountant, farm laborer, high school student, college student, university law student, button cutter, pharmacy clerk, school teacher, telephone operator, hospital maid, and housewife. The level of educational attainment ranged from grade eight to college graduate; sixteen of the twenty-four were high school graduates and ten of those sixteen had some college training. Of the fifteen patients for whom intelligence ratings were available, the range in I.Q. points was from 78 to 138, the mean I.Q. being 99. It should be pointed out that mere I.Q. scores on these patients have little meaning, and care must be exercised in interpreting such scores. Where it was possible to do so, a vocabulary[5] score, or a verbal scale I.Q., and a performance scale I.Q. have been given. The intelligence tests were all administered by the hospital psychometrist and judgments as to probable classification are those of the psychometrist. Of the tests used, two were Wechsler-Bellevue Adult Scale; ten were Revised Stanford-Binet, Form L; one was Revised Stanford-Binet, Form M; and two were the 1916 Stanford Revision of the Binet-Simon Test.

Within the diagnosis of schizophrenia, twelve patients had been further classified as hebephrenic, three as simplex, seven as paranoid, and two as catatonic. The following abstracts present data concerning the individual patients. The information contained in these abstracts was taken from the hospital records for each patient.

Case 1. Diagnosis: Schizophrenia, hebephrenic type. A married female, thirty-eight years of age; completed college education and taught school one year after graduation before being married. First psychotic symptoms in 1931, present commitment to Mt. Pleasant State Hospital began in 1932, having previously been institutionalized in private sanitariums on two occasions. Scored Intelligence Quotient of 107 on Wechsler-Bellevue Adult Scale, Verbal Scale I.Q. 112, and Performance Scale I.Q. 100. Classification by psychometrist: Above Average; some inefficiency.

Case 2. Diagnosis: Schizophrenia, hebephrenic type. A single male, thirty years of age; educated through tenth grade in high school; occupation before committed to hospital, none. First psychotic symptoms one year before commitment to Mt. Pleasant State Hospital in 1936. No previous commitments. No intelligence test results available.

Case 3. Diagnosis: Schizophrenia, catatonic type. A single male, thirty years of age; educated through high school; previous occupations, working in restaurant and drug store. First psychotic symptoms in 1929, present commitment to Mt. Pleasant State Hospital began in 1936, having been committed previously for short periods in 1929 and again in 1931. No intelligence test results available.

Case 4. Diagnosis: Schizophrenia, paranoid type. A single female, aged twenty-seven years, educated through two years of college. First mental symptoms in 1930, present episode began in 1938, hos-

schizophrenia the onset is insidious, often extending over a period of several years before definite psychotic symptoms appear and are diagnosed. Furthermore, it is frequently difficult to ascertain from hospital records who first considered the behavior abnormal and diagnosed it as psychotic.

[5] According to Babcock (1) vocabulary is the best measure of the original intellectual level of the psychotic individual.

pitalized at Iowa State Psychopathic in 1939, then committed to Mt. Pleasant State Hospital and confined there since. Scored Intelligence Quotient of 138 on Revised Stanford-Binet, Form L, passing vocabulary at Superior Adult III level. Psychometrist commented that intellectual level was "very superior".

Case 5. Diagnosis: Schizophrenia, hebephrenic type. A single female, forty-eight years of age, graduated from high school and attended a teachers college one summer. Taught school three years before first attack which was in 1916 lasting for approximately one year, then did housework at home. Second and present attack began in 1938 when she was committed to Mt. Pleasant State Hospital. Scored Intelligence Quotient of 91 on Wechsler-Bellevue Adult Intelligence Scale, Verbal Scale I.Q. 106, Performance Scale I.Q. 78. Psychometrist's statement: "The patient's intellectual development is average."

Case 6. Diagnosis: Schizophrenia, paranoid type. A single male, thirty-two years of age, graduated from high school. Worked as a laborer prior to commitment to Mt. Pleasant State Hospital in 1938. The onset of the present episode was gradual, believed to have begun six or seven years before time of commitment. Scored Intelligence Quotient of 111 on Revised Stanford-Binet, Form L; vocabulary score, high average. Psychometrist's statement: "There is nothing remarkable about his performance. It was consistently good and warrants a classification of High Average Adult."

Case 7. Diagnosis: Schizophrenia, simple type. Single female, twenty-nine years of age, graduated from high school and worked successfully as a telephone operator for six years. First psychotic symptoms manifested in 1934, committed to Mt. Pleasant State Hospital in 1937 and confined there continuously since. Scored Intelligence Quotient of 78 on 1916 Revision of Stanford-Binet Test. Believed by psychometrist to reveal marked deterioration from an average intellectual development.

Case 8. Diagnosis: Schizophrenia, paranoid type. A single male, thirty-two years of age, educated through tenth grade at fifteen years, worked as a laborer prior to commitment in Mt. Pleasant State Hospital in 1939. First psychotic symptoms twelve to eighteen months before commitment and had spent six weeks in a private sanitarium. Scored Intelligence Quotient of 101 on the Revised Stanford-Binet, Form L, passed vocabulary test at Average Adult level. Classification by psychometrist: Average.

Case 9. Diagnosis: Schizophrenia, hebephrenic. A single female, eighteen years of age; present mental episode occurred during senior year of high school; confined to Mt. Pleasant State Hospital in 1939. Scored Intelligence Quotient of 108 on Revised Stanford-Binet, Form M. In this she showed a superior vocabulary. Classification: Average.

Case 10. Diagnosis: Schizophrenia, catatonic type. A single male, thirty-two years of age. Graduated from high school and attended college two and one-half years; confined to Mt. Pleasant State Hospital in 1932. Scored Intelligence Quotient of 101 on Revised Stanford-Binet, Form L. Classification: Average.

Case 11. Diagnosis: Schizophrenia, paranoid type. A married male, aged thirty-three years; educated through high school and two and one-half years of college; occupation, accountant. First symptoms in 1934, confined to Mt. Pleasant State Hospital since early in 1939. Scored Intelligence Quotient of 108 on

1916 Stanford Revision of the Binet-Simon Test. Classification: Average.

Case 12. Diagnosis: Schizophrenia, hebephrenic type. A single female, twenty-three years of age; educated through high school, and one semester of college. First psychotic symptoms in 1935, confined to Mt. Pleasant State Hospital continuously since June, 1938. Record of a Stanford-Binet Test given in 1927 with a C.A. of 11 indicated an I.Q. of 136; Stanford Revision of the Binet-Simon Test, Form L, administered in 1938 yielded an I.Q. of 97, vocabulary, 84. Psychometrist commented: "Vocabulary indicates a previous very superior level."

Case 13. Diagnosis: Schizophrenia, hebephrenic type. A single male, sixteen years of age. Psychotic symptoms began while he was in the ninth grade in high school. Committed to Mt. Pleasant State Hospital in 1939. Test results: Wechsler-Bellevue Adult Intelligence Scale, I.Q. 77, Verbal Scale I.Q. 65, Performance Scale I.Q. 95; Revised Stanford-Binet, Form L, I.Q. 84, vocabulary Average Adult. Classification: Formerly average—low average—poor school achievement.

Case 14. Diagnosis: Schizophrenia, hebephrenic type. A single female, aged thirty-six years; educated through high school and two years of college. First psychotic 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 originally been "at least high average".

Case 15. Diagnosis: Schizophrenia, simple type. A single male, twenty-five years of age, educated through eighth grade. Worked as a farm laborer. First psychotic symptoms appeared one month before commitment to Mt. Pleasant State Hospital in 1939. No intelligence test results available.

Case 16. Diagnosis: Schizophrenia, simple type. A single male, twenty-seven years of age; educated through high school and two years of junior college, then entered University Law School, where he was a good average student. First symptoms in 1934, at which time he was examined at Iowa State Psychopathic Hospital. Confined at Mt. Pleasant State Hospital since 1938. Results of the Revised Stanford-Binet Test, Form L, given in 1938, show an Intelligence Quotient of 87, vocabulary test high. Classification: Average. Shows deterioration from a probably superior intellectual development.

Case 17. Diagnosis: Schizophrenia, paranoid type. A single male, forty-nine years of age; educated through eighth grade. Occupation had been button cutter. First psychotic symptoms in 1930 when he was committed in Mt. Pleasant State Hospital for a short time, released, and then re-committed in 1936. No intelligence test results available.

Case 18. Diagnosis: Schizophrenia, hebephrenic type. A married female, thirty-eight years of age, educated through high school and two summer sessions at college. Taught school before and after marriage. First psychotic symptoms four months before commitment to Mt. Pleasant State Hospital in 1935. No intelligence test results available.

Case 19. Diagnosis: Schizophrenia, hebephrenic type. A single male, twenty-one years of age, educated through high school. Worked as a laborer before committed to hospital. Examined at Iowa State Psychopathic Hospital and hospitalized for seven months in 1936. Committed to Mt. Pleasant State Hospital in 1939. Scored Intelligence Quotient of

101 on Revised Stanford-Binet Test, Form L. Classification: Average.

Case 20. Diagnosis: Schizophrenia, hebephrenic type. A single female, forty-one years of age, educated through high school and two years at junior college. First psychotic symptoms in 1930, confined to Mt. Pleasant State Hospital for eight months. Re-entered the same hospital in 1934 and confined there continuously since that time. No intelligence test results available.

Case 21. Diagnosis: schizophrenia, paranoid type. A single male, thirty-five years of age, educated through high school and occupied as a pharmacy clerk. First psychotic symptoms in 1938, committed to Mt. Pleasant State Hospital in 1939. No intelligence test results available.

Case 22. Diagnosis: Schizophrenia, paranoid type. A married female, aged thirty-two years, educated through eleventh grade at seventeen, worked as a telephone operator until her marriage. First psychotic symptoms in 1938; spent two months in a private sanitarium early in 1939, and committed to Mt. Pleasant State Hospital in May, 1939. Scored Intelligence Quotient of 86 on Revised Stanford-Binet, Form L, vocabulary Average Adult. Classification: Dull Normal.

Case 23. Diagnosis: Schizophrenia, hebephrenic type. A single female, aged thirty-five years, educated through high school and spent several years in a convent; had also been occupied as a maid in a hospital. Admitted to Mt. Pleasant State Hospital for the first time in 1922 and discharged in 1932, re-admitted in 1936 and has remained there continuously since that time. No intelligence test results available.

Case 24. Diagnosis: Schizophrenia, hebephrenic type. A single female, forty-two years of age, educated through eighth grade. First psychotic symptoms in 1931, committed to Mt. Pleasant State Hospital in 1934. No intelligence test results available.

The individuals comprising the second group were freshmen students at the State University of Iowa selected on the basis of their scores on the Iowa Qualifying and Placement Examinations given in September, 1939.[6] They all ranked from the 90th to the 99th percentile on the Composite Score of the examinations, the percentiles being based on the scores made by the freshmen students taking the examinations that year. An unpublished study by Mitchell (17) indicated a correlation of .76 between the Intelligence Quotients of sixty-six freshmen, as scored on the Revised Stanford-Binet, Form L, and the Composite Scores on the Iowa Qualifying and Placement Examination, the average Intelligence Quotient being 122. The freshmen used in the present study may be regarded as generally comparable, although somewhat superior in terms of the test scores in question, to Mitchell's freshmen students.

Of the twenty-four freshmen, twelve were male and twelve were female; they ranged in age from seventeen years, five months to twenty-three years, one month. They came from homes in which the following occupations were represented by the wage-earners in the families: farmer, railroad engineer, jeweler, life insurance agent, plumber, piano tuner, attorney, professor of physiology, switchman, banker, shoe clerk, assistant postmaster, school teacher, real estate salesman,

[6] Three of the twenty-four freshman subjects were taken from the entering class of September, 1938, and one from the entering class of September, 1940. In each case the subject wrote while he was a freshman.

cashier of bank, electrician, and clerical worker.

Written language samples of 2800 words in length were obtained from all of the subjects in the following manner. These instructions were read to the subject: "You are to write a story of your life. Start at the beginning and write it just as you remember things. Any words will do. Even things that may seem unimportant to you should be written and especially things that have made a difference in your life. No one else will see what you have written." Then a copy of the instructions was given to the subject so that he could refer to them again. Each subject was told that his story should be at least 2800 words in length. When a subject did not write enough or asked further questions, instructions were continued in the above terms, or neutral comments were made. With most of the subjects more than one sitting was necessary in order for them to write samples of the length required.

In order to secure the written language samples, the patients were taken into a room off the ward in the hospital, and the freshmen were asked to come to a conference room in one of the university buildings. The writer secured the data from all subjects except the male patients, from whom the language samples were obtained by a male attendant in the hospital. Consistently undisturbing conditions were maintained insofar as was possible, and to a practically sufficient degree, while the samples were being written. Not more than six subjects were writing at the same time in a large-sized room, and the average total time required of the patients to write the sample of the required length was approximately eight hours, while the freshmen averaged approximately five hours. All subjects were cooperative for the most part, although the patients as a group were slower in beginning to write and less consistent in keeping at it, and therefore required more attention and encouragement. In no case, however, were topics suggested to the subjects or 'coaching' resorted to in order to obtain the requisite length of sample. The total time elapsed during the securing of the samples was approximately two weeks for the patients and approximately one month for the freshmen (with the exception of the four freshmen mentioned in the previous footnote).

The 2800-word samples were typed exactly as they were written. Each sample was then divided into twenty-eight successive one-hundred-word segments by counting the first one hundred words, placing a mark, and then counting the second hundred words, etc. Each word was then tabulated on sheets so designed that each one-hundred-word segment could be tabulated separately.[7] The procedure followed in tabulating the data was as follows.

After a sample had been typed, double-spaced, one of a pair of workers (much of the time one worker performed these tasks alone) placed numbers, one to one hundred, over the first one hundred words. These numbers, one over each word, were written very small. After the one hundredth word a small number one was written and encircled—to indicate the *limit* of the *first* one hundred words. The other worker, meantime, had written a letter of the alphabet in the upper-left hand corner of each of several tabulation sheets. The first word of the first one hundred words was noted and worker No. 1 looked all through the

[7] A copy of the tabulation sheet is in the appendix of the manuscript copy of this report which is on file in the State University of Iowa Library.

one-hundred-word sample, counting the number of times the word appeared. Worker No. 2 wrote this word, followed (in parenthesis) by the part of speech it represented in the "Word" column on the tabulation form that carried the letter of the alphabet under which the word would be classified alphabetically. The number of times the word appeared in the first hundred words was noted in the column headed "1" on the tabulation form. A small check was placed over the number, which had previously been placed over the word, as each word was counted.

After the first one hundred words had all been counted and tabulated, worker No. 1 counted off the next hundred words, numbering them from one to one hundred and placing an encircled 2 just after the last word of this second one-hundred-word section. Worker No. 2 totaled the frequencies noted in the column headed "1" on all of the tabulation forms used in order to check that the total was one hundred. The frequencies of the second one hundred words were noted in the column headed "2". Only the words appearing in this second one-hundred-word segment that did not appear in the first one hundred were written in the "word" column. This procedure was continued throughout the 2800-word sample.

The following rules were used 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 James *A.* Brown (three words), or a neologism coined by a subject.
2. Any number was counted as one word; for example, 125 was tabulated as one word.
3. A hyphenated word was counted as one word, Webster's New International Unabridged Dictionary (23) being used as the authority as to whether or not a word should be hyphenated.
4. 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.
5. Common nouns and proper nouns having identical spellings were thrown together. For examples, the two words *Storm Lake* were tabulated under the common nouns *storm* and *lake.*
6. Contractions were divided into two words, for example, *didn't* was changed to *did not* and tabulated as two words.
7. Abbreviations which stood for only one word were written out and tabulated as the complete word. Abbreviations which consisted of more than one unit, as for example *M.D.* and *Ph.D.,* were tabulated as one word.
8. Misspellings, when it was apparent that they were misspellings and not neologisms were corrected and tabulated as corrected.

The part of speech was placed after a word as it was tabulated. Following is a list of the rules which were used in determining the part of speech represented by any given word. To be classified as:

Nouns—all regularly known common and proper nouns and gerunds which the dictionary[8] recognizes as nouns.

Pronouns—all personal and indefinite pronoun forms, including pronominal adjective forms, such as *my, our, your, their,* etc. Also all demonstrative, relative, and interrogative pronouns such as *this, those, who, whom, where,* etc.

Verbals—simple verbs, participles plus auxiliaries, gerunds and participles unless the dictionary recognizes them as nouns and adjectives, as the case may be.

Adjectives—regular classification, and any verb form (i.e. participle) which the dictionary recognizes as an adjective.

Adverbs—regular classification.

Prepositions—regular classification.

Conjunctions—regular classification.

Interjections—exclamatory expressions, and

[8] Webster's New International Unabridged Dictionary (23).

slang expressions used interjectionally. Articles—*a, an* and *the.*

The data on the tabulation sheets were then analyzed and will be presented in three different sections: (1) Type-Token Ratios (TTR's), including both segmental TTR's and overall TTR's; (2) Grammatical Analysis; and (3) Type Frequencies.

The Type-Token Ratio

The type-token ratio[9] is a quantitative measure of language to which most attention has been given in the present study. The number of types in a given language sample is the number of *different* words occurring in the sample, and the number of tokens is the *total* number of words in the sample. The type-token ratio, then, is computed by dividing the number of different words by the total number of words in the sample. Since it may be assumed, from the work of Carroll (10), that the percentage of different words decreases as successive increments are added to a language sample, 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 the computations of the TTR's have been (1) the overall TTR as computed for the entire sample of 2800 words, and (2) the mean segmental TTR. As was stated previously, in this study each 2,800-word sample was divided into twenty-eight successive one-hundred-word segments. To secure the mean segmental TTR's the TTR was computed for each one-hundred-word segment independently and these segmental TTR's were averaged for each sample. This procedure makes it possible to compare samples of different magnitudes since such segmental TTR's are directly comparable as long as they represent segments of equal size, and the means of such segmental TTR's and mean segmental TTR's from the present study can be compared with those from any other study involving one-hundred-word segments, regardless of the number of such segments in a given sample.

Consideration of the TTR Scale

The limits of the TTR are mathematically defined as greater than zero and equal to or less than one. As to the nature of the cumulative TTR curve, it may safely be stated that D (the number of different words, or types) is a complex function of N (the total number of words, or tokens, in the sample). The greater the base on which the TTR is computed the smaller the absolute value of the TTR will be for any one sample of any one individual.[10]

The question may arise as to the relative value of the TTR unit at any given position on the scale from zero to one. This question is more obvious when it is considered whether the difference of one TTR unit at one point on the scale is equal to a difference of one TTR unit at any other point on the scale. First of all, the operational character of the TTR unit is clear. The question here raised would appear to be significant, if ever, whenever interpretations might be drawn as to the relation of the TTR to some other variable. It is to be pointed out that in any segment of the TTR scale where the variability of the TTR's for any given group of language samples is relatively large, a correspondingly larger absolute difference between any

[9] This term was introduced by Johnson (15) and the ratio has been discussed by him.

[10] The problems implied by these statements are treated in greater detail by Chotlos (11).

two TTR's would be required to satisfy the criteria of statistical significance, than would be required in any segment of the scale where the variability of TTR's is relatively less. In this sense, then, the question becomes one of the relative difference with regard to variability of TTR's at different points along the scale, and insofar as there are differences in such variability, it is to be expected that there will be corresponding differences in the relative significance statistically to be ascribed to differences of the same absolute magnitude, depending upon the segment of the scale which they involve. However, safeguards against misinterpretations that might conceivably result from this fact are to be found in the statistical procedures to be used in treating the data that are to be interpreted; it is not the similarity of two differences with regard to their absolute magnitude but the similarity with regard to their relative magnitude as shown in their degree of statistical significance, that would govern any interpretation regarding them. A logical consideration of the TTR scale would indicate that a mean TTR value at either the upper or lower end of the scale should imply a lower degree of variability among the individual TTR's of which it is the mean than would a mean TTR value in the middle range of the scale. This is true because variation from the mean in the direction of zero, in the case of a low mean TTR value, would obviously be limited in extent, and any relatively large variations from the mean in the opposite direction would tend to raise the mean; the same type of consideration would hold with regard to a relatively high mean TTR value. It is obvious, on the other hand, that a mean TTR value approximating .50, for example, does not necessarily imply any such limited range of deviations of the individual TTR's from the mean.

In order to make a partial investigation of the question under discussion Pearson product-moment correlations were run between the mean segmental TTR's and the standard deviations, separately for the psychotic subjects and for the freshmen. This correlation for the psychotic subjects was −.09, and for the freshmen it was −.12. Neither of these values deviates significantly from zero. This may be interpreted to mean that for each of the groups the TTR's fell within a segment of the scale within which there would appear to be no appreciable relation between the absolute magnitude of the TTR and its variability. However, the trend is in the direction indicated by the above logical considerations, and it may be assumed that the low correlations obtained are to be accounted for in part, at least, by the fact that TTR's for each group fell within a relatively narrow range.

In order to ascertain the degree of relation between the absolute value of the mean segmental TTR's and their variability when a larger number of measures and a larger range of the scale were involved, a Pearson product-moment correlation was run between the mean segmental TTR's and the standard deviations for all subjects. The correlation obtained was −.58. The fact that this correlation coefficient is higher than either of the corresponding coefficients for the separate groups tends further to substantiate the above logical considerations.

It is to be emphasized again, however, that the relationship implied by these coefficients of correlation and by the logical analysis of the scale are of no particular significance so far as the inter-

pretation of differences in TTR values is concerned, since the differences are to be interpreted with reference to their relative rather than their absolute magnitude. Misinterpretation would occur only if the indicated relationships were ignored; they are, of course, taken into account in the statistical procedures on the basis of which the significance of the differences between the TTR values is estimated.

Grammatical Analysis

The grammatical analysis is concerned with ascertaining the proportion of the entire language sample, for each subject and for each group of subjects, that is represented by each of the parts of speech. Relationships between certain parts of speech have been computed in terms of ratios.

Type Frequencies

The section on type frequencies is concerned with an objective language measure which expresses relative frequency of occurrence of each different word, or type. Of particular interest are those type frequencies which differentiate the written language of schizophrenic patients from that of freshmen. In order to select such types, if they exist, the one hundred most frequently used types were found for each group and comparisons of these were made. Particular attention was also given to certain types such as self-reference words and 'allness' terms, such as *never, always, all,* etc.

Also, the proportionate vocabularies of the two groups were compared. The proportionate vocabulary is found by determining the number of types making up a certain proportion of the tokens in a given language sample. Finally, a word list was compiled which presents each type separately and shows the number of subjects in each group who used the word, and the type frequency for each of the two groups.[11]

IV. RESULTS

Introduction to Results

In order to facilitate the discussion of the results the following system of symbols has been devised. The reader is asked to refer to this list for definitions of the symbols in terms of the operations to be performed in deriving the statistics which they represent.

The data were analyzed to determine the characteristics of the type-token ratios for one-hundred-word segments. The following symbols will be used in discussing the results of this section of the analysis.

Let $\text{TTR}=R=\frac{D}{N}$ where D is the number of different words (types) in a segment and N is the total number of words (tokens) in that segment.

Let R_p = segmental TTR where p is the subscript for any given one-hundred-word segment.

Let $R_1, R_2, R_3, \cdots R_p, \cdots R_{28}$ refer to segmental TTR's for each one-hundred-word segment, one through twenty-eight.

$$R_1=\frac{D_1}{N_1},\quad R_2=\frac{D_2}{N_2},\cdots\quad R_p=\frac{D_p}{N_p},\cdots R_{28}=\frac{D_{28}}{N_{28}}$$

where $D_1, D_2, \cdots D_p, \cdots D_{28}$ are independently computed, the number of different words in any one segment not being influenced by any words in any other segment, and $N_1=N_2=\cdots N_p=\cdots N_{28}=100$.

Let R_i represent the mean of $R_1, R_2, \cdots R_p \cdots R_{28}$ for each individual subject.

$$R_i=R_1+R_2+\cdots+R_p+\cdots+R_{28}=\frac{\Sigma R_p}{28}.$$

Let s_i represent the standard deviation of the $R_1, R_2, \cdots R_p, \cdots R_{28}$ for each individual subject.

$$s_i=\sqrt{\frac{\Sigma(R_p-R_i)^2}{28}}.$$

[11] This complete word list is contained in the appendix of the manuscript copy of this report on file in the State University of Iowa Library.

The data were analyzed in order to determine the characteristics of the segmental TTR for the group. The following symbols will be used in the discussion of the results of this part of the analysis.

Let R_m represent the segmental TTR for the group

$R_m=\frac{\Sigma R_i}{n}$ where R_i is the mean TTR per subject summed over all the group and n is the number of subjects in the group

Let s_m represent the standard deviation of the distribution of mean segmental TTR's (R_i's) for the group.

$$s_m=\sqrt{\frac{\Sigma(R_i-R_m)^2}{n}}.$$

Let S.E.$_m$ represent the standard error of the group mean segmental TTR(R_m).

$$\text{Let S.E.}_m=\sqrt{\frac{\Sigma(R_i-R_m)^2}{n(n-1)}}=\frac{\Sigma s_m}{\sqrt{n-1}}.$$

Let M_{si} represent the mean of the standard deviations for each of the n subjects in a group.

$$M_{si}=\frac{\Sigma s_i}{n}.$$

Let σ^2_{si} represent the estimated variance of the standard deviations for the group

$$\text{est. }\sigma^2_{si}=\frac{\Sigma(s_i-M_{si})}{n-1}.$$

The data were analyzed to determine the characteristics of the TTR when it is computed by considering the entire sample as a whole. This TTR is called the overall TTR and the following symbols will be used in discussing the results of this section of the analysis.

Let R′ represent overall TTR

$R'=\frac{D'}{N'}$ where D′ is the number of different words (types) and N′ is the total number of words (tokens) in the entire sample. Computed independently for each subject.

Let R'_m represent the mean overall TRR for the group.

$R'_m=\frac{\Sigma R'}{n}$ where n is the number of subjects in the group.

Let s'_m represent the standard deviation of the overall TRR's for the group.

$$s'_m=\sqrt{\frac{\Sigma(R'-R'_m)^2}{n}}.$$

Let $\overline{S.E.'_m}$ represent the standard error of the group mean overall TRR.

$$\overline{S.E.'_m}=\sqrt{\frac{\Sigma(R'-R'_m)^2}{n(n-1)}}.$$

Let σ^{12}_m represent the estimated variance of the overall TRR's for the group.

$$\sigma^{12}_m=\frac{\Sigma R'-R'_m}{n-1}.$$

I. TYPE-TOKEN RATIO

Internal Consistency of Segmental TTR's

It was felt that it would be desirable to secure some measure or indication of the internal consistency (i.e. how well a random half of the sample measures what the whole sample measures) of the 2800-word samples for each subject. This was obtained by splitting the R_1, R_2, . . . R_p, . . . R_{28} for each subject at random into two sets of R's. The mean for each random half was computed and the *t*-test for related measures was applied.[12] It would be expected from such a test that if the internal consistency of the samples was high, the value of *t* so derived would fail to be statistically significant. When this test was applied to the random sets of R's for the patients the value of *t* was 1.82, and when applied to the random sets of R's for the freshmen

[12] See Lindquist, E. F., *Statistical Analysis in Educational Research*, Houghton Mifflin Company, Boston, 1940, p. 58. The procedure is that of finding the difference for each pair of R's and for this distribution of differences, determining whether or not the mean difference differs significantly from zero.

the value of t was .411. The values in both cases fall short of significance at the five per cent level of confidence with twenty-three degrees of freedom (d.f.).

Variability in Segmental TTR's

We were interested in determining whether the schizophrenic patients were more variable than the freshmen, not only from subject to subject, but whether they also showed more variability from segement to segment than did the freshmen. In order to determine this the s_i for each subject and Ms_i for each group were computed. The F ratio[13] when computed as a ratio of the variance of the distribution of s_i's for schizophrenic patients to the variance of the distribution of s_i's for freshmen resulted in a value of F of 10.35 which, with twenty-three and twenty-three d.f., is significant at the one per cent point.

TABLE 1

TTR's for each subject ranked in descending order within each group

Mean-Segmental TTR's		Overall TTR's	
Patients	Freshmen	Patients	Freshmen
.7450	.7357	.3932	.4079
.7404	.7354	.3854	.3907
.7386	.7339	.3618	.3607
.7164	.7307	.3596	.3471
.7007	.7293	.3407	.3457
.6975	.7286	.3154	.3454
.6846	.7279	.3150	.3450
.6757	.7261	.2961	.3439
.6700	.7236	.2946	.3411
.6700	.7236	.2821	.3375
.6700	.7200	.2789	.3307
.6668	.7196	.2779	.3293
.6657	.7143	.2746	.3289
.6618	.7118	.2725	.3250
.6607	.7104	.2639	.3229
.6582	.7082	.2575	.3218
.6482	.7057	.2464	.3104
.6436	.7054	.2371	.3089
.6389	.6975	.2371	.3086
.6264	.6946	.2279	.3014
.5993	.6943	.2121	.2971
.5700	.6932	.2121	.2921
.5346	.6836	.1943	.2879
.4600	.6708	.1850	.2689

In order to determine whether or not there was a difference in variability from segment to segment between the sexes, the F ratio was computed as a ratio of the variance of the distribution of s_i's for the female subjects to the variance of the distribution of s_i's for the male subjects. The value of F so obtained for the patients was 4.49 which with eleven and eleven d.f. is significant at the one per cent point, the male patients showing more variability than the female patients. The value of F so obtained for the freshmen was 1.47 which with eleven and eleven d.f. fails to be significant at the five per cent point, the value of F required for significance at that point being 2.82.

Means and Distributions of Mean Segmental TTR'S and Overall TTR's

The R_1, R_2, . . . R_p, . . . R_{28} for each subject were averaged and a mean segmental R (R_i) obtained for each individual.[14] An overall R (R') was also obtained for each subject by considering the 2800-word sample as a unit and dividing the number of types in the entire sample by 2800. The R_i's and R''s for each group are ranked in descending order in Table 1. An examination of this table reveals that there is some overlapping between the two groups on both the R_i's and R''s. The R_i's for three patients were higher than the highest R_i among the freshmen; and the R_i's for eight patients were higher than the lowest R_i among the freshmen. The lowest R'

[13] See Lindquist, *op. cit.*, p. 60. F, the variance ratio, is defined as $\frac{\sigma_1^2}{\sigma_2^2}$ in which σ_1^2 and σ_2^2 are estimates of the true variances of the populations sampled.

[14] Table 1 in Appendix A of the manuscript copy of this report on file in the State University of Iowa Library presents the twenty-eight R's for each subject.

TABLE 2

Group means, standard error of means, and standard deviation for mean-segmental TTR's and overall TTR's

	Mean-Segmental TTR			Overall TRR		
	R_m	S.E.$_m$	S_m	R'_m	S.E.$'_m$	S'_m
All Patients	.6559	.01322	.06404	.2801	.01180	.05625
Female	.6468	.02138	.06134	.2782	.01550	.05180
Male	.6651	.01608	.05385	.2819	.01855	.06078
All Freshmen	.7135	.00358	.01753	.3291	.00636	.03072
Female	.7179	.00392	.01254	.3350	.01060	.03548
Male	7091	.00590	.01776	.3232	.00710	.02365

among the freshmen was higher than the R''s for ten patients. Only one R′ among the freshmen was higher than all R''s among the patients.

Table 2 presents the mean of the R_i's for the group (R_m) and the mean of the R''s for the group (R'_m) with the standard deviations (s_m for the R_i distribution and s'_m for the R′ distribution) and the standard error of the means (S.E.$_m$ for R_m, and S.E.$'_m$ for R'_m) for each group for all patients, female patients, male patients, all freshmen, female freshmen, and male freshmen.

The curves drawn from the frequency distributions of the twenty-four mean

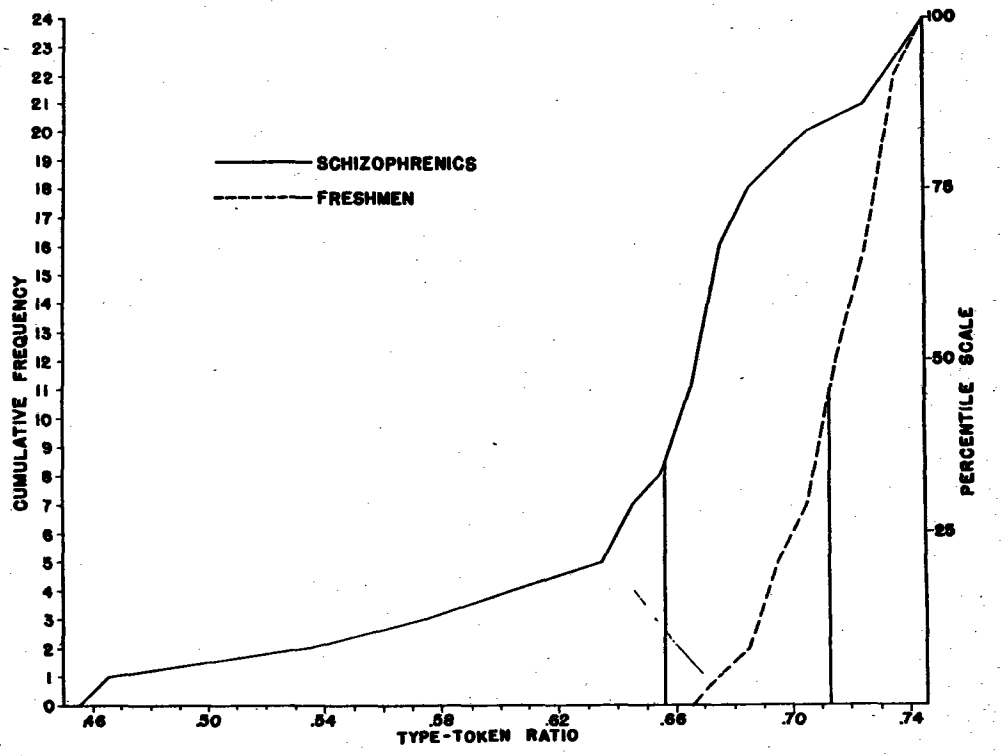

FIG. 1. Cumulative frequency curves of mean segmental TTR's for 24 schizophrenics and 24 freshmen. Means are shown by vertical lines.

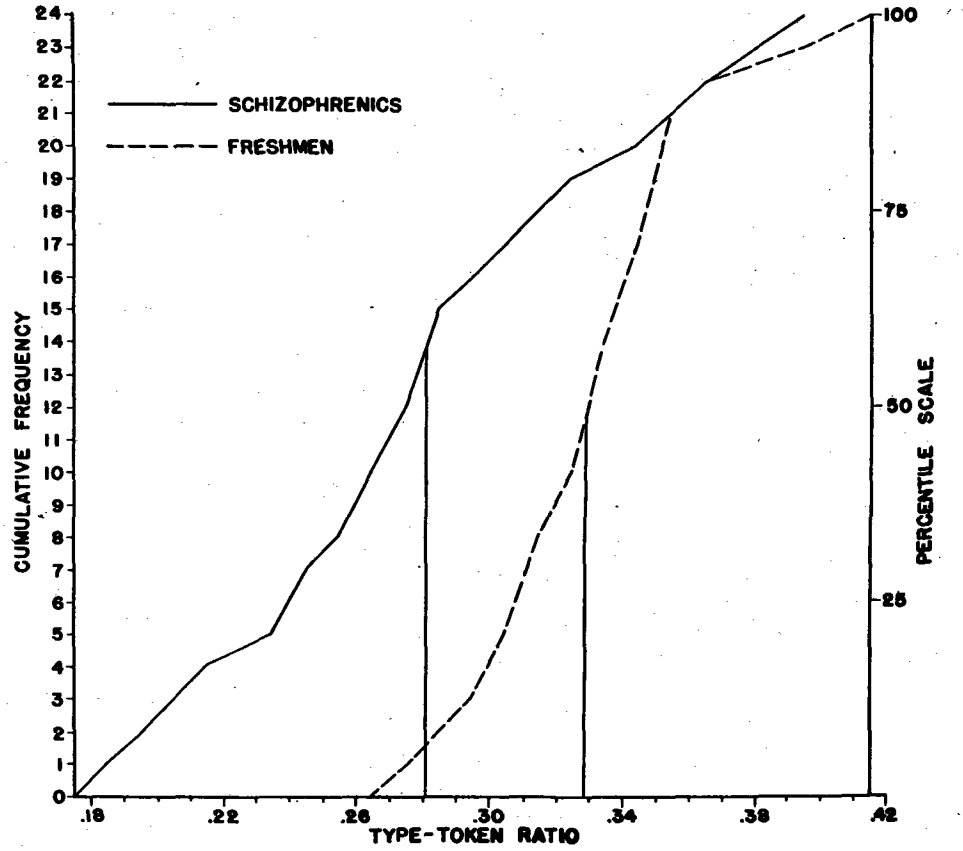

FIG. 2. Cumulative frequency curves of overall TTR's for 24 schizophrenics and 24 freshmen. Means are shown by vertical lines

segmental TTR's (R_i's) of the schizophrenic patients and those of the freshmen are shown in Fig. 1, and the curves drawn from the distributions of the overall TTR's (R''s) for both groups are shown in Fig. 2. It is apparent from the curves in Fig. 1 that the range of R_i's for the patients is greater than that for the freshmen, the range for the patients being .4600 to .7450 while that for the freshmen is .6708 to .7357, indicating more variability among the patients. The range of the R''s was also somewhat greater for the patients than for the freshmen, the values ranging from .1850 to .3932 for the patients, and from .2689 to .4079 for the freshmen. The R_m for the patients was .6559 while that for the freshmen was .7135; the R'_m for the patients was .2801 and that for the freshmen was .3291.

Mean Segmental TTR's: Group Differences

The *t*-test was applied to test the significance of the difference between R_m for the patients and R_m for the freshmen.[15] The value obtained for *t* was 4.204 which, with forty-six d.f., is significant at the one per cent level of confidence. Therefore, we would feel justified in rejecting the hypothesis that these samples were drawn from populations whose means are equal.

However, since one of the assumptions

[15] See Lindquist, *op. cit.*, p. 56-58.

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 one sample must be equal (or approximately equal) to the true variance of the other sample, a test of the significance of the difference in variability was applied.

The F ratio when computed as the ratio of the variance of the distribution of R_i's for patients to the variance of the distribution of R_i's for the freshmen resulted in a value of F of 13.34. which with twenty-three and twenty-three d.f. is significant at the one per cent point. The results of this test indicate that the variability of the patients as a group exceeds the variability of the freshmen as a group to an extent which cannot be attributed to chance fluctuations in random sampling. Another way of stating this is that we are 'practically certain' that the samples are drawn from different populations and that our 'best estimate' of the true variance of the population from which the sample of schizophrenic patients was drawn is considerably greater than the corresponding 'best estimate' of the true variance of the population from which the sample of freshmen was drawn.

Although we have no way of knowing the *true* variance of the populations which have been sampled, there is some question as to the validity of applying *t* to test the significance of the difference in means in view of the difference in variability of the two groups. Therefore, the analysis of the data was extended to get a further indication of the significance of the difference between the means for the two groups which would not rest upon the assumption of homogeneity of variance. This was accomplished by using *t* to establish 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. At the one per cent level of confidence the limiting values of the true mean for the patients were .6188-.6930, and for the freshmen they were .7034-.7236. Since there is no overlap in these 'confidence intervals' we may be practically certain that the difference between the R_m's for the patients and for the freshmen indicates a real difference between the two groups.

The critical ratio of the difference between the R_m's for patients and for freshmen was 4.204. The probability that a C.R. of this magnitude for independently drawn samples from these two populations will be exceeded solely through errors in random sampling is .0001. This value of the critical ratio is larger than the criterion usually required for statistical significance.

The Effect of Certain Variables on TTR

In an attempt to determine how certain variables, particularly within the schizophrenic group, influence the TTR, the schizophrenics were sub-divided into groups and the average TTR's for these sub-groups compared. The fifteen patients for whom intelligence test results were available were split into two groups on the basis of I.Q., an I.Q. of 100 representing the dividing line. Seven patients had I.Q. scores below 100, ranging from 78 to 97, with an average of 87; eight patients had I.Q. scores above 100, ranging from 101 to 138, the average being 109. The mean segmental TTR's for the individuals within each group were averaged, resulting in an average mean segmental TTR of .6800 for the "above average I.Q." group and .6586 for the "below average I.Q." group. The *t*-test of the significance of this difference in the average mean segmental TTR's for

these groups resulted in a t value of .51 which with thirteen d.f. is not statistically significant.

Level of educational attainment would appear to be a variable among the patients which might influence the TTR's. To get an indication of how this factor affects the TTR, the patients were subdivided into three groups on the basis of level of educational attainment: ten patients who had college training; six patients who had graduated from high school but who had had no college training; and eight patients who had not graduated from high school. The average mean segmental TTR for each group was computed and a simple analysis of variance technique was used to determine whether the differences in means for the three groups are significant of real differences, or may be explained away in terms of chance fluctuations in random sampling. The mean segmental TTR's were .6462 for college graduates, .6876 for high school graduates, and .6395 for the lowest educational group, or non-high school graduates. The ratio (F) of the estimate of the populations variance, based on the variance of the group means, to the estimate of the population variance, based on variance within groups, resulted in an F value less than unity which obviously is not significant.

Duration of illness might conceivably be an important variable influencing the TTR's for the patients. Since duration of illness can at best be only roughly estimated, it was felt that the effect of duration of confinement in the hospital could be more reliably ascertained. Since the average length of confinement in the hospital was three years, the patients were sub-divided with this average as a criterion. The thirteen patients who had been confined in the hospital for a shorter period than three years had an average mean segmental TTR of .6579, while the patients who had been confined in the hospital three years or longer had an average TTR of .6536. The t-test of the significance of the difference between these means is not statistically significant.

Comparison of TTR's Computed from Written and Spoken Language

A study by Fairbanks (12) in which she compared mean segmental TTR's, using one hundred tokens as the size of the segment, for spoken language samples from schizophrenic patients and superior freshmen, yielded results comparable to those obtained in this investigation. These studies are highly similar in that the subjects used in both were drawn from the same populations and the procedures followed in tabulating and analyzing the data were essentially the same, but there is one point of difference which warrants some consideration. In her study Fairbanks employed an interview situation, involving the use of fourteen proverbs, the interview being recorded by means of an electric dictaphone technique without the subject's knowledge, and with instructions to the subjects to continue talking about anything that they wished to after finishing the proverbs. In the present study the instructions to the subjects were to write "the story of your life". It is doubtful that much importance should be attached to this difference in methods of securing the data, inasmuch as the samples of language obtained were probably of sufficient length to compensate for such differences.

In general, the main findings of Fairbanks as to the differences between the spoken language of schizophrenic patients and freshmen students were in the

same direction as those reported here for written language, the patients showing more variability as a group than the freshmen, and the difference between the mean segmental TTR's for the two groups being statistically significant.

Of particular interest is the comparison between spoken language and written language as indicated by these two studies. Table 3 presents the average mean segmental TTR's for each group and the range values, taken from the mean segmental TTR's for the individuals in each group, for written and spoken language of schizophrenic patients and freshman students. It may be readily observed from this table that the mean TTR for both types of subjects runs considerably higher for written language than for spoken language. This difference might have been anticipated because of the fact that in producing written material the individual has opportunity and ample time to alter and rearrange the words that he writes, which in many cases amounts to striving for variety or 'diversity' in the words used. Thus, this premeditated aspect of written language tends to obliterate the spontaneity which is more characteristic of spoken language.

It is interesting to note that the spoken language of freshmen is characterized by approximately the same mean segmental TTR value as is the written language of schizophrenics.

Overall TTR's

In determining the differences in overall TTR's between the groups the steps in the analysis followed those presented for the differences in segmental TTR's for the groups.

The R'_m for the patients as a group was .2801 while that for the freshmen was .3291. The *t*-test applied to test the significance of the difference between these R'm's resulted in $t = 3.65$, which with forty-six d.f. is significant at the one per cent level of confidence. The results of this test indicate that the difference in R'_m's for the patients and for the freshmen is a real difference.

The F test of the significance of the difference between the variances of the distdribution of R''s for the two groups yielded a value of 3.35. The value required for significance at the one per cent point with twenty-three and twenty-three d.f. is 2.70. While the obtained value of F is greater than that required for significance at the one per cent point, it is not much greater.

The further test, which has been discussed previously, of using *t* to set limiting values of the true mean of each group was applied to the R'_m's of patients and of freshmen. The limiting values of the true mean for the patients at the one per cent level of confidence were .2370-.3132 while the limiting values of the true mean for the freshmen were .3113-.3469. There is a slight over-

TABLE 3

The average mean segmental TTR's (R_m) for each group and the range values within each group for written and spoken language of schizophrenic patients and freshmen students. The data for spoken language are from Fairbanks (12)

	Written Language		Spoken Language	
	R_m	Range	R_m	Range
Schizophrenic Patients	.6559	.4600–.7450	.5681	.4933–.6193
Freshmen Students	.7135	.6708–.7357	.6416	.6137–.6650

lap in the intervals for the patients and the freshmen at the one per cent level of confidence, the upper limit for the patients extending .0019 above the lower limit for the freshmen. The limiting values of the true mean for the patients at the two per cent level of confidence were .2506-.3096 while those for the freshmen were .3132-.3450. Thus we are able to say that at the two per cent level of confidence there is a true difference between R'_m's for the patients and the freshmen.

The critical ratio of the difference between the R'_m's for patients and for freshmen resulted in a value of 3.654. The probability that a C.R. of this magnitude for independently drawn samples from these two populations will be exceeded solely through errors in random sampling is .0003. This test again indicates that the difference in R'_m's for the two groups is statistically significant.

Sex Differences

Since each group of twenty-four patients and twenty-four freshmen consisted of twelve male and twelve female subjects, the data were analyzed to determine whether there were significant differences between the sexes within each group for the R_m's and R'_m's.

The F ratio when computed as the ratio of the variance of the distribution of R_i's for the female patients to the variance of the distribution of R_i's for male patients gave an F value of 1.729 which, with eleven and eleven d.f., would be exceeded by chance in more than five per cent of similarly selected random samples. The results of this test give us no adequate basis for rejecting the hypothesis that these samples were drawn from equally variable populations. Likewise, the *t*-test of the significance of the difference between the R_m's for the female patients and the male patients resulted in a value of *t* of .683 which, with twenty-two d.f., is clearly not significant, since a value of this magnitude can be expected to occure by chance more than fifty per cent of the time in similarly selected random samples.

The F ratio when computed as the ratio of the variance of the distribution of R_i's for female freshmen to the variance of the distribution of R_i's for male freshmen gave an F value of 2.661 which, with eleven and eleven d.f., is not statistically significant. This value can be accounted for by chance fluctuations in random sampling and we are therefore not justified in rejecting the hypothesis that the samples were drawn from equally variable populations. Similarly, the *t*-test of the significance of the difference between R_m's for female freshmen and male freshmen resulted in a $t = 1.24$ which, with twenty-two d.f., is not statistically significant since a value of *t* of this magnitude can be expected to occur by chance between twenty and thirty per cent of the time. The results of this analysis give us no adequate basis for assuming any difference in R_m's between male and female patients or between male and female freshmen.

The ratio F when computed as a ratio of the variance of the distribution of R''s for female patients and the variance of the distribution of R''s for male patients resulted in an F of 1.431 which, with eleven and eleven d.f., would occur by chance more than five per cent of the time in similarly selected random samples. The *t*-test when applied to the difference in R'_m's for female and male patients resulted in $t = .153$ which, with the twenty-two d.f., would occur by chance more than eighty per cent of the time. The same tests when applied to the distributions of R''s for female and male

freshmen resulted in values of $F = 2.231$ which, with eleven and eleven d.f., is not statistically significant, and when applied to the difference in R'_m's for female and male freshmen the resulting $t = .922$ which, with twenty-two d.f., would be expected to occur by chance between thirty and forty per cent of the time in such samples. Our conclusion again is that the differences in R′'s between the sexes for the two groups are not statistically significant and we are not justified in rejecting the hypothesis that the samples consisting of females and males, respectively, in each group were drawn from the same populations.

Correlation Between Mean Segmental and Overall TTR's

The Pearson product-moment correlation coefficient between the R_m and R'_m was .62 for patients and .62 for freshmen. For all forty-eight subjects $r = .71$. The fact that the r for all subjects is greater than the r for either the patient or the freshmen group may be due to the bimodality of the distribution for all subjects, or to the discrepancy in variability between patients and freshmen, or to an interaction of these two factors.

2. Grammatical Analysis

Distributions and Group Differences

The data were analyzed to determine the relative frequency of usage of each of the eight conventional parts of speech, plus articles (which were treated separately from other adjectives). Table 4 presents these frequencies, expressed as percentages of the total number of words (67,200) used by each group, separately for schizophrenic patients and for freshmen. The standard deviations of the distributions of the five main categories, and range values for each category taken from individual samples are also included in the table.

TABLE 4

Relative frequency of usage of different parts of speech expressed as percentage of the total number of words used by the group (67,200), with standard deviations of the distributions of five main categories. The range values are from individual samples*

	Schizophrenic Patients			Freshmen Students		
	Percentages	S.D.	Range Values	Percentages	S.D.	Range Values
Nouns	24.27	3.98	17.43–33.68	22.15	2.26	17.86–25.57
Pronouns	13.12	3.78	4.79–20.25	14.57	1.50	11.68–17.07
Verbs	19.82	2.30	15.86–23.93	18.71	1.60	16.18–22.36
Adverbs	7.70	1.71	3.68–10.57	8.34	1.05	6.00–10.79
Adjectives	8.33	2.56	4.68–16.00	9.45	1.17	6.89–10.96
Conjunctions	7.23		3.75– 9.46	6.55		4.32– 8.29
Prepositions	12.33		7.75–16.57	12.35		10.46–14.43
Interjections	0.07		0.04– 0.86	0.05		0.00– 0.21
Articles	7.15		4.96–11.00	7.83		5.21–10.11

* Table 1 in Appendix B of the manuscript copy of this report on file at the State University of Iowa Library contains the percentage of usage of each part of speech for each individual.

The statistical significance of the difference between the groups was tested for adjectives, adverbs, nouns, pronouns, and verbs. Of particular interest were the differences in percentages of the total number of words represented by each of these grammatical categories, and differences in variability of usage of these parts of speech.

The t-test was applied to test the significance of the difference between patients and freshmen in percentages for certain parts of speech. The values of t

TABLE 5

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

	Values of t	Values of F
Adjectives	1.88	4.78
Adverbs	1.54	2.68
Nouns	2.22	3.11
Pronouns	1.77	6.38
Verbs	1.86	2.07

$n = 24$

With forty-six d.f. the values of t required for significance are: at the one per cent level of confidence $t = 2.69$; at the five per cent level of confidence $t = 2.01$. With twenty-three and twenty-three d.f. the values of F required for significance are: at the one per cent point $F = 2.72$; at the five per cent point $F = 2.01$

obtained for the categories tested are presented in Table 5. The only t value which might possibly be regarded as statistically significant is that obtained for the difference in percentage of nouns. This t is significant at the five per cent level of confidence. The differences between schizophrenic patients and freshmen in percentages for adjectives, adverbs, pronouns, and verbs may, therefore, be attributed to chance fluctuations in random sampling.

The F ratio when computed as the ratio of the variance of the distribution of percentages (based on total words per sample) for each grammatical category, used by the patients, to the variance of the distribution of percentages of the same category used by the freshmen, resulted in the values of F presented in Table 5. Each F value was statistically significant, the F values obtained for adjectives, nouns, and pronouns being significant at the one per cent point while those for adverbs and verbs were significant at the five per cent point. We may conclude that the variability of the patients as a group exceeded that of the freshmen as a group in relative frequency of usage of five grammatical categories, by an amount which cannot be attributed to chance fluctuations in random sampling.

Sex Differences

Table 6 presents the relative frequency of usage of different parts of speech expressed as percentage of the total number of words used by each sex (33,600) in each group, with the standard deviations of the distributions of the five main categories.

The t-test was used to test the significance of the differences between males and females in each group in relative

TABLE 6

Relative frequency of usage of different parts of speech expressed as percentage of the total number of words used by each sex (33,600), with standard deviations of the five main categories

	Schizophrenic Patients				Freshmen Students			
	Female		Male		Female		Male	
	Percentages	S.D.	Percentages	S.D.	Percentages	S.D.	Percentages	S.D.
Nouns	23.73	4.61	24.80	3.20	22.77	2.18	21.53	2.15
Pronouns	13.99	4.39	12.26	2.85	14.27	1.71	14.87	1.81
Verbs	20.22	2.59	19.39	1.99	18.47	1.80	18.95	1.33
Adverbs	7.93	1.87	7.47	1.53	8.09	0.76	8.59	1.30
Adjectives	8.43	2.02	8.24	3.03	9.36	0.86	9.53	1.48
Conjunctions	6.88		7.58		6.99		6.12	
Prepositions	12.00		12.65		12.26		12.44	
Interjections	0.09		0.04		0.05		0.05	
Articles	6.73		7.57		7.74		7.92	

TABLE 7

Values of t and F obtained from testing significance of the difference, in usage of grammatical categories based on percentage of total sample between the sexes within each group

	Schizophrenic Patients		Freshmen Students	
	Values of t	Values of F	Values of t	Values of F
Adjectives	.174	2.24 (Males)*	.333	2.93 (Males)
Adverbs	.638	1.53 (Females)	1.088	2.91 (Males)
Nouns	.633	2.07 (Females)	1.333	1.03 (Females)
Pronouns	1.094	2.37 (Females)	.907	1.73 (Females)
Verbs	.846	1.69 (Females)	.706	1.85 (Females)

With twenty-two d.f. the values of t required for significance are: at the one per cent level of confidence $t = 2.819$; at the five per cent level of confidence $t = 2.074$.

With eleven and eleven d.f. the values of F required for significance are: at the one per cent point $F = 4.46$; at the five per cent point $F = 2.82$.

* The sex which was more variable in each case.

frequency of usage of certain parts of speech. The values of t, presented in Table 7, are not statistically significant for any of the grammatical categories tested either for schizophrenic patients or for freshmen.

The F ratio when computed as the ratio of the variance of the distribution of percentages for each grammatical category (based on total words per sample) for female subjects, to the variance of the distribution of percentages for the same category for male subjects, resulted in values shown in Table 7, for patients and for freshmen. The F values obtained for adjectives and adverbs as between male and female freshmen exceed the value of F required for significance at the five per cent point. In each of these two categories the male freshmen were

TABLE 8

Comparison of the relative frequency of usage of parts of speech in written and in spoken language expressed as percentage of the total number of words used by the groups, 67,200 in the case of written and 30,000 in the case of spoken language. Data for spoken language from Fairbanks (12)

	Schizophrenic Patients			
	Spoken		Written	
	%	Range	%	Range
Nouns	13.04	10.40–16.63	24.27	17.43–33.68
Pronouns	22.68	19.33–24.75	13.12	4.79–20.25
Verbs	26.28	24.27–30.47	19.81	15.86–23.93
Adverbs	11.54	7.00–17.97	7.70	3.68–10.57
Adjectives	5.37	3.77– 7.10	8.33	4.68–16.00
Conjunctions	6.55	4.10– 8.77	7.23	3.75– 9.46
Prepositions	7.48	4.30–10.00	12.33	7.75–16.57
Interjections	2.64	0.53– 4.43	0.07	0.04– 0.86
Articles	4.48	2.53– 6.87	7.15	4.96–11.00
	Freshman Students			
Nouns	15.39	12.67–18.53	22.15	17.86–25.57
Pronouns	17.96	14.40–20.40	14.57	11.68–17.07
Verbs	22.95	20.50–24.47	18.71	16.18–22.36
Adverbs	10.16	8.87–11.20	8.34	6.00–10.79
Adjectives	6.69	5.67– 7.87	9.45	6.89–10.96
Conjunctions	8.83	7.33–11.40	6.55	4.32– 8.29
Prepositions	10.00	8.80–11.00	12.35	10.46–14.43
Interjections	1.26	0.47– 2.00	0.05	0.00– 0.21
Articles	6.79	5.27– 9.07	7.83	5.21–10.11

TABLE 9

Rank order of increase in relative frequency of usage of parts of speech, expressed as percentage of the total number of words used by the group in written over spoken and spoken over written language. Schizophrenic patients and freshmen students. Data for spoken language from Fairbanks (12).

Rank Order of Increase (Written over Spoken)			
Schizophrenic Patients	%	Freshman Students	%
Nouns	86.1	Nouns	43.9
Prepositions	64.8	Adjectives	41.3
Adjectives	55.1	Prepositions	23.5
Articles	59.6	Articles	15.3
Conjunctions	10.4		
Rank Order of Increase (Spoken over Written)			
Schizophrenic Patients	%	Freshman Students	%
Pronouns	72.9	Verbs	27.7
Verbs	32.7	Pronouns	23.3
Adverbs	49.8	Conjunctions	34.8
Interjections	3671.4	Adverbs	21.8
		Interjections	2420.0

more variable than the female freshmen.

Comparison of Written and Spoken Language

Table 8 presents a comparison of the relative frequency of usage of parts of speech in written language with that in spoken language, the latter data being taken from the above mentioned study by Fairbanks (12) concerned with the spoken language of schizophrenic patients and freshman students. This comparison is justified by the fact that the data presented from Fairbanks' study were from samples drawn from the same two general types of subjects and were analyzed in essentially the same manner as were the data presented in this study. This latter consideration is of great importance in view of the fact that results in word count studies and grammatical usage analyses depend to a large extent upon the rules followed in determining what constitutes a word and the rules used in classifying words as to the parts of speech represented by them. An examination of Table 8 reveals several differences in the relative frequency of usage of parts of speech in the spoken and written language of schizophrenic patients and freshman students, respectively. These differences are summarized in Table 9 by showing the rank order of increase in usage of the various parts of speech in written over spoken and spoken over written language for each of the two groups.

There is a marked increase in percentage of nouns, adjectives, prepositions, and articles for both schizophrenics and freshmen, and in conjunctions for schizophrenics, in written language over spoken language. For both groups the amount of increase in written over spoken language is greatest for the nouns, the patients showing 86.1 per cent increase and the freshmen 43.9 per cent increase in nouns used in written over spoken language.

There is an increase in percentage of pronouns, verbs, adverbs, and interjections for both groups, and in conjunctions for the freshmen, in spoken over written language. The largest amount of increase in spoken over written language was 72.9 per cent in the pronouns for the patients and 27.7 per cent increase in verbs for the freshmen. (The increase for interjections, for both groups, was so great as to mean for all practical purposes that interjections are used only in spoken language.) The parts of speech for which there was increase in written over spoken language and increase in spoken over written language were the same for the two groups wtih the exception of conjunctions, which showed a slight increase in written over spoken language for the patients, and an increase in spoken over written language for the freshmen.

Inter-relationships Among Parts of Speech

Of the relationships between certain parts of speech, the adjective-verb quotient (A_{vq}) is of perhaps the greatest interest, since it, or a variation of it, has been used by other investigators. Busemann (4), as reported by Boder (3), recorded in shorthand a number of stories told by children of different ages and found a marked fluctuation of the relationship between 'qualitative' and 'active' (dynamic) expressions. In the category of qualitative expressions he included not only adjectives, but also nouns and participles of verbs, when used as attributes to any other nouns; in the category of active expressions he included all verbs except the auxiliary. By dividing the number of verbs by the number of qualitative expressions he obtained a measure which he called the Action quotient (Aq.) of style. Busemann found that a rhythmical increase and decrease of the Aq. occurs with increase in age, which he believes to correspond to alleged rhythmical changes of emotional stability during childhood, adolescence, and youth. Furthermore, according to Busemann's theory, these rhythmical variations continue throughout the whole lifetime and reflect rhythmical variations of emotional stability and creative power.

Rorschach (19), again as reported by Boder (3), in classifying the interpretations given by subjects to a series of ink blots, calculated the ratio between different types of descriptions made. He found that the predominance of kinaesthetic description (verbs) indicates moderate, sluggish motility, introversion, and little adaptability to reality, while the predominance of color descriptions (qualitatives) reflects the excited, but alert, exact, and rapid motility, extraversion, and better adjustment to reality.

Stimulated by the suggestions made in these studies, Boder (3) set out to find whether there exist gross differences of adjective-verb ratios corresponding to differences in subject matter of various classes of writing. He inverted the procedure of Busemann, however, and took the adjective as the numerator in order to obtain a measure which might (if Busemann is right) correlate positively with desirable traits. The ratio he used indicates the number of adjectives per one hundred verbs and is designated in purely grammatical (as opposed to Busemann's behavioral 'action quotient') terms as the Adjective-Verb Quotient (A_{vq}). He found that for each of the kinds of writings studied, i.e., plays, legal statutes, fiction, and scientific monographs, the distribution of A_{vq}.'s shows sufficiently large differences to prove that as a rule the A_{vq} varies with the subject matter of the text. The Adjective-Verb Quotients reported in the present study are fairly comparable to the quotients reported by Boder, although the special rules followed by him in the word count analyses were somewhat different from the ones followed in the present analysis. The main differences were that in his study only attributive adjectives were counted, i.e., only adjectives placed before the noun; quantitative and ordinal numerals were not counted; no forms of *have* and *be* were counted, nor were *could, should,* and *would.* Inasmuch as the rules followed in the present study differed from those of Boder in such a way as to increase both the number of adjectives and the number of verbs, we might expect the ratios to remain fairly comparable as between the two studies.

Table 10 presents the A_{vq}'s for all scizophrenic patients and all freshman students ranked in descending order.

TABLE 10

Adjective-verb quotients for schizophrenic patients and freshman students for written language, ranked in descending order for each group

Adjective-Verb Quotients	
Schizophrenics	Freshmen
.93	.66
.92	.64
.58	.62
.53	.62
.53	.60
.51	.59
.51	.58
.49	.58
.42	.55
.42	.54
.41	.54
.39	.53
.39	.53
.36	.52
.35	.50
.34	.48
.33	.48
.31	.47
.30	.42
.30	.41
.30	.37
.29	.35
.29	.35
.22	.35

With the exception of two patients whose $A_{vq.}$'s were strikingly high, the $A_{vq.}$'s for six freshmen were higher than those of the patients, and the $A_{vq.}$'s for nine patients were lower than the lowest one for the freshmen. Table 11 presents the mean $A_{vq.}$'s for both groups for written and spoken language, together with the mean quotients for adjectives to nouns, and adverbs to verbs for both groups for written and spoken language. Although the values for both of the latter quotients were larger for the freshmen than for the patients, indicating the use of more adjectives per noun, and more adverbs per verb, these quotients did not appear to be as differentiating as between freshmen students and schizophrenic patients as did the adjective-verb quotients.

The *t*-test was used to test the significance of the difference in mean $A_{vq.}$'s derived from written language for patients and freshmen, resulting in a value of 1.93 which, with forty-six d.f., is almost significant at the five per cent level, the value needed for significance being 1.95.

Table 12 shows the comparison of the mean $A_{vq.}$'s for schizophrenic patients and freshmen students for both written and spoken language, together with the average $A_{vq.}$'s obtained by Boder for each of four different types of style of writing. This table reveals that the mean $A_{vq.}$ for the spoken language of schizophrenic patients falls slightly below that of Boder's 'normative' style, while the mean $A_{vq.}$ for freshman students on spoken

TABLE 11

Relationships between certain parts of speech expressed as ratios for each group. The ratios for spoken language were computed from Fairbanks' data (12)

	Written		Spoken	
	Schizophrenic Patients	Freshmen Students	Schizophrenic Patients	Freshmen Students
$\frac{\text{Adjective}}{\text{Verb}}$ quotient	.43	.51	.20	.29
$\frac{\text{Adjective}}{\text{Noun}}$ quotient	.34	.42	.41	.43
$\frac{\text{Adverb}}{\text{Verb}}$ quotient	.39	.44	.44	.44

TABLE 12

Comparison of the A_{vq}'s obtained from written and spoken language of schizophrenic patients and freshmen students with those obtained by Boder

	Obtained Values of A_{vq}.
Schizophrenics, Written	.43
Freshmen, Written	.51
Schizophrenics, Spoken	.20
Freshmen, Spoken	.29
Boder's Data:	
Conversational (drama)	.11
Normative (legal statutes)	.20
Narrative (fiction)	.35
Descriptive (science)	.76

material falls midway between Boder's 'normative' and 'narrative' styles. The A_{vq}.'s computed from written language samples are considerably higher than those computed from spoken language for both schizophrenic patients and for freshman students. The mean A_{vq}. for schizophrenic patients on written material falls somewhat above that for Boder's 'narrative' type, while the mean A_{vq}. for freshmen on written material falls about midway between the A_{vq}.'s for Boder's 'narrative' and 'descriptive' types. The differences between written as opposed to spoken language for both groups correspond to the findings of Boder. He suggests that this may be explained by the fact that

"the time of writing is under the author's control; so that he can pay more attention to the style and choose the proper expressions. He has the possibility of rereading his material and inserting adjectives where found necessary, thus converting his material into a product of repeated and premeditated activity, lacking the spontaneity and speed which characterize the dialogue."(3)

3. TYPE FREQUENCIES

Table 13 presents a list of the hundred most frequently used words for the schizophrenic patients and the freshmen students, respectively. The list for the freshmen has those words common to both lists arranged in order of frequency, while the list for the schizophrenics has the words corresponding to those of the freshmen arranged in order of sequence regardless of frequency. The seventeen words in each of the two groups not common to both lists are arranged at the bottom of the table in order of frequency. When this list of one hundred most frequently used words in written language of these two groups is compared with that reported by Fairbanks (12) for spoken language, we find that sixty-nine of the hundred are common to both lists for freshmen and sixty-four of the hundred are common to both lists for schizophrenic patients.

Fairbanks reported some striking differences in the frequencies with which certain types occurred in the spoken language of schizophrenics and freshmen. She found, for example, that schizophrenics used *not* almost twice as many times as did the freshmen, and that *no* and *never* occurred in the schizophrenic list while *not* was the only negative word that occurred among the one hundred words most frequently used by the freshmen. An examination of the words in Table 13 shows that these group differences are not found in the written language. Fairbanks also reported that *very* was used three times more often by freshmen than by schizophrenic patients, while in the present study the patients used *very* almost three times more often than did the freshmen.

Table 14 shows the relative frequency of occurrence of first person singular pronouns (*I, my, mine, me, myself*), first person plural pronouns (*we, our, ours, us, ourselves*), second person pronouns, singular and plural (*you, your, yours, yourself, thee, thou*), and third person pronouns, singular and plural (*he, his,*

TABLE 13

List of 100 words most frequently used by schizophrenics and freshmen. The first 83 words common to both lists are arranged in descending rank order according to frequency of usage for freshmen. The remaining 17 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.	3354	the	art.	3052
2.	I	pro.	2778	I	pro.	2662
3.	and	conj.	2350	and	conj.	2950
4.	to	prep.	1805	to	prep.	2093
5.	was	verb	1468	was	verb	1069
6.	my	pro.	1346	my	pro.	859
7.	in	prep.	1328	in	prep.	1054
8.	of	prep.	1162	of	prep.	1641
9.	a	art.	844	a	art.	847
10.	it	pro.	672	it	pro.	507
11.	we	pro.	646	we	pro.	795
12.	had	verb	603	had	verb	646
13.	not	adv.	552	not	adv.	468
14.	that	pro.	442	that	pro.	430
15.	with	prep.	440	with	pro.	457
16.	at	prep.	429	at	prep.	417
17.	for	prep.	428	for	prep.	139
18.	have	verb	421	have	verb	416
19.	on	prep.	400	on	prep.	326
20.	were	verb	399	were	verb	278
21.	but	conj.	395	but	conj.	215
22.	that	conj.	387	that	conj.	170
23.	school (s)	noun	371	school (s)	noun	288
24.	this	pro.	327	this	pro.	236
25.	time	noun	289	time	noun	287
26.	is	verb	269	is	verb	585
27.	which	pro.	269	which	pro.	173
28.	when	conj.	252	when	conj.	297
29.	would	verb	245	would	verb	350
30.	she	pro.	239	she	pro.	180
31.	our	pro.	228	our	pro.	150
32.	did	verb	221	did	verb	184
33.	an	art.	212	an	art.	158
34.	from	prep.	211	from	prep.	264
35.	he	pro.	210	he	pro.	298
36.	her	pro.	198	her	pro.	144
37.	by	prep.	196	by	prep.	192
38.	or	conj.	192	or	conj.	241
39.	year	noun	189	year	noun	111
40.	mother	noun	182	mother	noun	107
41.	as	conj.	181	as	conj.	319
42.	they	pro.	181	they	pro.	243
43.	first	adj.	167	first	adj.	102
44.	one	adj.	165	one	adj.	174
45.	us	pro.	163	us	pro.	122
46.	do	verb	162	do	verb	210
47.	about	prep.	159	about	prep.	169
48.	them	pro.	159	them	pro.	163
49.	so	adv.	156	so	adv.	119
50.	out	adv.	155	out	adv.	194
51.	who	pro.	151	who	pro.	86
52.	his	pro.	149	his	pro.	132
53.	as	adv.	142	as	adv.	153
54.	all	noun	140	all	noun	87
55.	one	pro.	139	one	pro.	111
56.	life	noun	134	life	noun	123
57.	years	noun	134	years	noun	130

TABLE 13 (Continued)

	Freshmen			Schizophrenics		
	Word	Part of Speech	Freq.	Word	Part of Speech	Freq.
58.	two	adj.	131	two	adj.	138
59.	then	adv.	130	then	adv.	186
60.	up	adv.	129	up	adv.	99
61.	could	verb	128	could	verb	111
62.	went	verb	124	went	verb	290
63.	remember	verb	120	remember	verb	118
64.	too	adv.	114	too	adv.	178
65.	other	adj.	113	other	adj.	88
66.	are	verb	112	are	verb	224
67.	some	adj.	112	some	adj.	137
68.	all	adv.	111	all	adv.	87
69.	always	adv.	110	always	adv.	94
70.	good	adj.	103	good	adj.	152
71.	am	verb	100	am	verb	95
72.	so	conj.	100	so	conj.	139
73.	after	prep.	97	after	prep.	110
74.	there	adv.	95	there	adv.	353
75.	day (D)	noun	96	day (D)	noun	126
76.	very	adv.	93	very	adv.	252
77.	what	pro.	93	what	pro.	96
78.	if	conj.	92	if	conj.	109
79.	just	adv.	92	just	adv.	86
80.	go	verb	91	go	verb	159
81.	took	verb	90	took	verb	101
82.	quite	adv.	86	quite	adv.	90
83.	get	verb	85	get	verb	102
84.	home	noun	172	house	noun	181
85.	high (H)	adj.	169	young	adj.	152
86.	little	adj.	104	got	verb	150
87.	never	adv.	97	work	noun	134
88.	teacher	noun	97	also	adv.	128
89.	into	prep.	93	used	verb	126
90.	more	adv.	92	Iowa	noun	125
91.	any	adj.	90	people	noun	120
92.	class	noun	90	can	verb	113
93.	things	noun	90	been	verb	112
94.	only	adv.	85	father	noun	105
95.	still	adv.	85	him	pro.	99
96.	came	verb	84	city (C)	noun	90
97.	made	verb	82	will	verb	93
98.	than	conj.	81	while	conj.	82
99.	town	noun	81	know	verb	82
100.	great	adj.	80	like	verb	81

TABLE 14

Relative frequency of usage of the different personal pronouns in spoken and written language expressed as percentage of the total number of words used by each group, 30,000 for each group on spoken material, and 67,200 for each group on written material. Data for spoken language from Fairbanks (12)

	Spoken		Written	
	Schizophrenics	Freshmen	Schizophrenics	Freshmen
	%	%	%	%
First person singular	10.42	3.69	5.92	7.05
First person plural	.34	1.05	1.59	1.57
Second person singular and plural	1.44	2.14	.16	.06
Third person singular and plural	5.52	6.41	2.81	3.13

him, himself, she, her, hers, herself, it, its, itself, they, their, theirs, them) in the written language of schizophrenic patients and freshman students and Fairbanks' spoken language. It is apparent from this tabulation of the data that her findings in regard to differences between the groups in spoken language were not substantiated with regard to written language.

Proportionate Vocabulary

From her spoken language data Fairbanks found that the schizophrenics used only thirty-three types to make up fifty per cent of the total number of tokens, while the freshman group used forty-six types to arrive at the same percentage. In the present study of written language, the schizophrenics used ninety-five types to make up fifty per cent of the total number of tokens, while the freshman group used ninety-six types to make up the same percentage. For both groups ten types make up slightly over twenty-five per cent of the tokens in the written language. In connection with these comparisons of proportionate vocabulary of written and spoken language it should be pointed out that the number of tokens used by each group for the written language data was 67,200 while for the spoken language data the number of tokens for the schizophrenics was 29,800 and for the freshmen it was 30,000.

By dividing the number of types making up fifty per cent of tokens by the total number of tokens in each case the following percentages were obtained: for written language, .14 for both freshmen and for patients, and for spoken language, .15 and .11 for freshmen and for schizophrenics, respectively.

The patients used fifty-seven words which appeared to be privately coined words or neologisms while the freshmen used only five words which might be considered neologisms.[16]

V. SUMMARY AND CONCLUSIONS

This study is concerned primarily with the specific problem of determining whether and in what respects 'adequate' and 'inadequate' language might be differentiated quantitatively. Twenty-four schizophrenic patients, twelve male and twelve female, were selected to represent a group presenting 'inadequate' language and twenty-four superior university freshmen, twelve male and twelve female, were selected to represent a group presenting relatively 'adequate' language.

A 2800-word written language sample was obtained from each of the subjects under as uniform conditions as possible, the instructions to the subjects being to "write a story of your life." Each sample thus obtained was divided into twenty-eight successive one-hundred-word segments and each word, together with the part of speech it represented, was tabulated on sheets so designed that each one-hundred-word segment was recorded separately. Three types of analysis of the data were made: (1) the type-token ratio which is computed by dividing the number of different words (types) by the total number of words (tokens) in a given sample. In this study the ratio was computed for each one-hundred-word segment and the twenty-eight segmental

[16] Table 1 in Appendix C of the manuscript copy of this report on file at the State University of Iowa Library contains an alphabetical word list showing the number of freshmen and/or schizophrenics who used each word, and the frequency of its occurrence in each group. Words starred in the list are words which were considered neologisms in the generally used sense of that term; that is, they were privately coined by the individuals who used them and are not used by other persons. The starred words of the freshmen are mainly slang terms essentially, although relatively unusual.

TTR's obtained from each sample were averaged to secure a mean segmental TTR for each individual. An overall TTR was also obtained for each individual by considering the 2800-word sample as a unit and dividing the number of different types in the entire sample by 2800. (2) Grammatical Analysis; and (3) Type Frequencies. Statistical treatment of the data resulted in the following findings.

Type-Token Ratios

1. When the twenty-eight segmental TTR's for each subject were split at random into two sets of TTR's, the mean for each random half computed, and the *t*-test for related measures applied, it was found that the difference between the mean segmental TTR's yielded by the two random sets was not statistically significant for the patients nor for the freshmen.

2. The standard deviation of the twenty-eight segmental TTR's for each subject was computed. When the F-test of the significance of the difference in variability was applied it was found that the schizophrenic patients showed significantly more variability in the number of types used per one-hundred-word segment than did the freshmen.

3. When the mean segmental TTR and the overall TTR for each subject were compared it was found that the overall TTR's were consistently lower for all subjects than the mean segmental TTR's, bearing out the assumption that as an individual's verbal output increases the rate of increase in the number of different words he uses tends to decrease. There was some overlapping between the schizophrenic patients and freshmen on both the mean segmental TTR's and the overall TTR's, the range of values for mean segmental TTR's being .4600 to .7450, and .6708 to .7357, and for overall TTR's .1850 to .3932 and .2689 to .4079 for the patients and freshmen, respectively.

4. Group mean segmental TTR's were obtained by averaging the mean segmental TTR's for the individuals within each group. The mean segmental TTR for the schizophrenic group was found to be significantly lower than the mean segmental TTR for the freshmen. The variance of the distribution of mean segmental TTR's for the patients was found to be significantly greater than the variance of the corresponding distribution for the freshmen. When the analysis of the significance of the difference between the group mean segmental TTR's was extended by using *t* to establish limiting values of the true mean for each group, it was found that there was no overlap between these 'confidence intervals' for the two groups at the one per cent level of confidence.

5. Comparisons were made to determine the effect of certain variables, among the schizophrenics, on their mean segmental TTR's. These intra-group comparisons indicated that differences in intelligence test scores, level of educational attainment, and duration of confinement in the hospital had relatively insignificant influence on the TTR's for the patients, and did not adequately account for the differences between the schizophrenic patients as a group and freshman students as a group.

6. Written language samples obtained in this study were compared with spoken language samples obtained by Fairbanks (12) from schizophrenic patients and freshman students. The mean TTR's for both types of subjects run considerably higher for written than for spoken language. This finding may be attributed to the fact that, generally speaking, an individual's written language is a more finished product, permitting more alter-

ing and rearranging of the words used, than is his spoken language.

7. In regard to overall TTR's it was found that the mean overall TTR for the schizophrenic patients was significantly lower than the mean overall TTR for the freshmen, and that the variability in overall TTR's for the patients was significantly greater than the variability in overall TTR's for the freshmen. When t was used to set limiting values of the true mean overall TTR for each group, there was slight overlap in the intervals for the patients and freshmen at the one per cent level of confidence, but there was no overlap in these intervals at the two per cent level of confidence.

8. Differences between the sexes for the two groups in regard to mean segmental TTR's and overall TTR's were not statistically significant, nor was the variability for either sex significantly greater than the variability for the other sex with regard to either of the measures.

9. Correlation between mean segmental and overall TTR's resulted in a Pearson product-moment correlation coefficient of .62 for the patients and .62 for the freshmen. For all subjects the r was .71.

Grammatical Analysis

1. Differences between schizophrenics and freshmen in relative frequency of usage of each of five grammatical classifications (adjectives, adverbs, nouns, pronouns, and verbs), expressed as percentages of the total number of words used, were not statistically significant, with the possible exception of the difference between the groups in relative frequency of usage of nouns, which was significant at the five per cent level of confidence, the patients using more nouns than the freshmen.

2. Differences between males and females within each group in relative frequency of usage of the grammatical categories tested were not statistically significant for schizophrenic patients nor for freshmen.

3. Comparison with Fairbanks' data shows that there is a marked increase in percentage of nouns, adjectives, prepositions, and articles, for both groups, and in conjunctions for schizophrenics, in written over spoken language, and an increase in percentage of pronouns, verbs, adverbs, and interjections, for both groups, and in conjunctions for the freshmen, in spoken over written language.

4. Ratios of adjectives to verbs, adjectives to nouns, and adverbs to verbs were generally higher for the freshmen than for the patients, the difference with regard to the adjective-verb quotient being the greatest; this difference fell very slightly short of significance at the five per cent level.

Type Frequencies

1. Eighty-three words were common to the lists of one hundred most frequently used words for both schizophrenics and freshmen.

2. The number of neologisms, i.e. privately coined words, was fifty-seven for the schizophrenics, and five for the freshmen.

3. When the vocabularies for each group were considered from the point of view of the number of types used to make up a certain per cent of the total number of words, it was found that ten types made up slightly more than twenty-five per cent of the tokens for each group, and that ninety-five types made up fifty per cent of the tokens for the schizophrenics, while ninety-six types made up fifty per cent of the tokens for the freshmen.

4. Differences in the frequencies with which certain types occurred in the

spoken language of schizophrenics and freshmen reported by Fairbanks were not found in the written language of these two groups.

Conclusions

Of the measures used in this study the type-token ratios appear to offer the most fruitful means of differentiating quantitatively written language samples of the type investigated. With the exception of the adjective-verb quotient, and perhaps certain other ratios of parts of speech, the grammatical analysis did not prove useful in this respect. From the results reported by Fairbanks (12) as to the frequency of certain types in spoken language, and from observations of clinical manifestations of ego-centricity, negativism, and frequency of neologisms, the prediction might logically have been made that an investigation of type frequencies would provide a quantitative differentiation of the language of the groups studied. However, the results of the analysis were contrary to this prediction. It is possible that the formality of the writing situation offers a possible explanation of the relative infrequency of self-reference terms, for example, in the written language of schizophrenics. However, the fact still remains that the freshmen students used relatively more first person singular pronouns, while the patients used relatively fewer such pronouns, in written as compared to spoken language. Two other considerations may be mentioned in this respect. It could be postulated that the task assigned the subjects in this study, that of writing a "life story", would tend to increase the frequency of reference to self. This may actually have operated to increase the frequency of self-reference for the freshmen, but for the schizophrenic patients this effect may have been counteracted to a large extent by their tendency to enumerate, and to get 'off the track' in recounting their life histories by describing certain places, events, or things, with little or no reference to their own relation to such places, events, or things. This was particularly noticeable in the writing of some of the patients, one of whom went to great pains to describe how *one* (or *you*) may "bake bread", "can apples", "teach a class in geography", etc., but with almost no reference to *self* involved in such descriptions. It appears obvious from the lack of differentiation between the two groups in terms of the frequency of specific types, that further investigations into this problem will require the formulation of certain other measures designed to offer a means of evaluating the 'adequacy' of the language from a different standpoint.

Insofar as this is a study of 'psychopathological' language on the one hand, and 'normal' language on the other, certain conclusions may be drawn as to the differences between these types of language. The 'normal' subjects investigated in this study appear to have a more highly differentiating language structure in that they use more adjectives per noun, more adverbs per verb, and more adjectives per verb, than do the schizophrenics. This may be interpreted to mean that on the whole they define, modify, and restrict their language in such a way as to make it more accurately representative of the actualities which they are attempting to symbolize. The assumption that 'normal' language structure is more highly differentiated is further substantiated by the fact that the 'normal' subjects have higher type-token ratios indicating that they use more *different* words in producing a given verbal output, than do the schizophrenic patients.

The language of schizophrenics does not appear to be differentiated from 'normal' language in terms of the specific most frequently used words. The vocabu-

laries of the two groups in this study appear to be very similar in that there is an overlap of eighty-three words between the lists of one hundred most frequently used words for each group. The only differentiating feature which a study of the vocabulary pointed to was the relative frequency of neologisms in the language of schizophrenics, as compared to the frequency of their occurrence in the language of freshmen.

As a preliminary investigation this study has provided a quantitative differentiation of language of different types of individuals, and points the way to further research with particular reference to determining the degree of correlation between these measures and other pertinent variables, and to a comprehensive study of language development. Further development and modification of such quantitative measures may provide a means of constructing scaled continua with reference to which any given language sample might be evaluated.

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