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Relationship between RAT Scores and Associative Hierarchy

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RELATIONSHIP BETWEEN RAT SCORES AND ASSOCIATIVE HIERARCHY

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ABSTRACT

The purpose of this study was to investigate the relationship between the Remote Associates Test, which purports to measure creativity, and the shape of the associative hierarchy. Four hypotheses were presented. These were: 1) RAT scores would vary directly with total number of responses; 2) RAT scores would vary inversely with total mean communality scores; 3) RAT scores would vary inversely with rate of responding in the early portions of the sequence; and 4) Associates, in terms of communality, would be negatively correlated with RAT scores only in the later portions of the sequence. These hypotheses were based directly upon Mednick's theory concerning the difference in associative behavior between so-called "high and low creatives".

Seventy-seven subjects were given a continual word association test with a ten-minute limit for associating to each of six stimulus words. At a mean interval of two weeks, all subjects then were given the RAT.

The results revealed no significant relationships between any of the word association variables and the RAT. Further analysis yielded a significant difference between high creatives and low creatives (defined in terms of RAT scores) only in rate of responding, the former being faster thoroughout the associative sequence.

These results were interpreted as providing little evidence for Mednick's predictions. Suggestions for further research and/or explanations for the results were discussed.

RAT SCORES AND THE ASSOCIATIVE HIERARCHY:

AN EMPIRICAL INVESTIGATION OF AN ASSOCIATIVE THEORY OF CREATIVITY

INTRODUCTION

In the last decade there have been many theoretical and research reports published on creativity. Golann (1963) listed those issues which have been apparent in the psychological study of this area. These are: 1) What is creativity? - questions of definition and criteria, 2) How does creativity occur? - questions of the process viewed temporally, and, 3) Under what conditions is creativity manifest? - questions of necessary personal and environmental conditions. The present study is primarily concerned with the first question.

Since the area is one of relatively recent interest to experimental psychologists , the literature is typified by a large variety of approaches that investigators have followed, numerous factors about which suggestions and speculations have been made, and equally varied results that have been obtained. For example, there are those who follow a specific theoretical frame of reference (e.g. Guilford, 1950; Wertheimer, 1945; Mednick, 1962; May, 1959; Schafer, 1958; and Maslow, 1953), while others investigate problems in this area without any traditional theory at all (e.g. Torrance, 1963; Getzels and Jackson, 1962; Barron and Taylor, 1963; and Yamamoto, 1965). There are those who have designed experiments, or used psychological tests, or conducted interviews, or some combination of these approaches (e.g. Terman, 1925; Guilford, 1959: Barron,

1963; Pine and Holt, 1960; Getzels and Jackson, 1962; and Torrance, 1963) while others have speculated about creativity on the basis of biographies they have read or experiences they have had (e.g. Freud, 1908; Adler, 1930; Fromm, 1959; Murphy, 1958; Mead in H. H. Anderson, 1958; May, 1959; and Wenhart, 1960). Insofar as the criterion of who is a creative person is concerned, there are those who selected their subjects on the basis of scores on intelligence tests (Terman, 1925; Thurstone, 1950); others used number of citations or number of lines devoted to a person in histories or biographies of "famous people" (e.g. Cattell, 1903; Galton, 1879; Lehman, 1958); a third group utilized the judgments of professionally qualified people (e.g. Roe, 1951; Stein, 1957); a fourth group concerned itself with people of generally acknowledged "eminence" (e.g. Freud, 1958; Patrick, 1949; Hirsch, 1933; Maslow, 1959); and a fifth group studied persons who were in professions that require creative behavior (e.g. Rosen, 1953; Maier, 1939: Munsterberg and Mussen, 1953; and Cattell and Drevdahl, 1955).

Six distinctly and traditionally different theoretical positions related to creativity emerge from a review of the literature: Psycho-analytic, Gestalt, Existential, Interpersonal, Trait, and Associationistic theory (Mackler and Shontz, 1965). Primarily, the latter two views are responsible for the recent interest in this area among experimental psychologists. Although a careful consideration of all approaches is usually necessary

when research is conducted in such a complex topic as creativity, it is the purpose of the present study to obtain information relevant to only one of these theories; namely, the Associationistic. Therefore, relatively smaller space will be devoted to the other theories (and some representative research each has generated), while a more extensive coverage of the Associationistic position will be presented.

The Non-Associationistic Approaches

Psychoanalytic theorists interest in this area initiated with Freud's early writings on artistic creativity (1908). From his studies of poets, artists, and writers, Freud developed the concept of "sublimation" to explain the psychodynamics of creativity. He defined the latter as the ability to exchange the original sexual aim for another one that is no longer sexual. Creativity was seen as a substitute, " a means of running from the hardships (of life) in order to achieve some degree, limited at times, of satisfaction" (Freud, 1958, p. 24). The creative person, therefore, was seen as one who turns away from reality because he cannot meet the demands for renouncing instinctual satisfaction; and he turns to fantasy, where he can give full play to his erotic and ambitious wishes. To be successful he must mold his fantasies into a new reality. The product is his creation.

Kris (1952) discussed the place and importance of ego psychology in understanding the creative process. His concept of ego regression is paramount in this context. Central to artistic or any other "creativeness" is a relaxation ("regression") of ego functions, and the word "fantasy" conveys best this disregard of external stringencies.

Schafer (1958) merely elaborated Kris' concept of "regression in the service of the ego". He assumed that this is a partial, temporary, and controlled lowering of the level of psychic functioning to promote "adaptation." The latter in this context, is taken to mean "an increase in the individual's access to preconscious and unconscious contents, without a thoroughgoing sexualization or aggression of major ego functions", (schafer, 1958, p. 122).

Kubie (1958) denied the role of the unconscious in creative work, but maintained the "preconscious system" as the essential ingredient of creativity. Furthermore, he believed that unless preconsciousness can function freely there can be no creativity. His important assumption is that preconscious processes are influenced by conscious processes on the other; and both of these are rigid and do not allow for fantasy and imaginative thinking. He rejected sublimation on the grounds that this concept was based on inaccurate assumptions.

Predominatly, the research bearing on creativity based on psycho-analytic theory has been tested by means of the

Rorschach. Holt and Havel (1960); Pine and Holt (1960); Goldberger and Holt, (1961); and Cohen (1961) used the Rorschach to assess the efficiency of the secondary process in coping with primary process aspects of responses. Since the main variables could not be observed directly, but only through their products, these authors used a scoring system of categorizing responses, and then rated all responses on five to seven point scale. In Pine and Holt's study, validation of the Rorschach as a measure of the primary process, was also a goal. Their results indicated that it could be used for this purpose and that it was related to the quality of imaginative production as evidenced on other tests given. The Cohen study added a new category, an "Adaptive Regression score," to Holt and Havel's system. It was found that when college students, who were differentiated into high creative and low creative groups on the basis of ratings by faculty members, were given Rorschach, the above score significantly predicted the creative from the less creative.

The theory which primarily generated the above studies was, of course, Kris' concept of "regression in the service of the ego."

Gestalt theory's position concerning creativity has been represented almost exclusively by Wertheimer (1945). His ideas seem somewhat akin to many cognitive learning theorists'; that is, "the reorganization of the field" in which the entire process is one consistent line of thinking (continuity).

The Gestalt theory defines creativity as an action that produces a new idea or "insight" full-formed; it comes to the individual as a flash. Wertheimer rejected views of creative or productive thinking based on traditional logic and association theory by stating that novelty arises from the imagination, not from reason and logic.

The only other Gestaltists who have contributed theoretical notions of any importance to the creativity issue are Arnheim and Mooney. Arnheim (1947) discussed how "perceptual preferences for balances" and symmetry as well as "dynamic richness" are expressed in an art form. Mooney (1958) extended Arnheim's views to a Gestalt equilibrium model in which the person, process, environment, and the product are involved in a creative and dynamic interplay of forces. The result is a "new" harmony or equilibrium of the field.

Neither Gestalt nor the next theory, Existentialism, seems to be concerned with constructing empirical measures to support their views on creativity. In fact, nothing can be found in the literature presenting data supporting or refuting their ideas.

Existentialism seems to be mainly interested in what Stein and Heinze (1960) consider to be one of the three major areas into which the creativity literature can be divided; namely, the individual, his characteristics, and the processes through which he arrives at the creative product. May (1959) defined creativity as the process of bringing something new into birth through "the vehicle of the encounter." Schachtel (1959),

agreeing with May, criticized the psychoanalytic approach for their reductive emphasis (as evidenced in the concept of "regression in the service of the ego"). He also clarified May's concept of the encounter by stating that "the openness in the encounter with the world means that one's senses are more freely receptive to new reflections of the environment". (Schachtel, 1959,p. 243).

Wenhart (1960) discussed the "creative moment" as a therapeutic process. Therapy, to her, is a means of restoring the creative moment, when the individual can find some semblance of personal identity, individuality, and worth.

The Interpersonal approach emphasizes Golann's third issue; that is, the creator as innovator and another person or persons who recognize (s) or acknowledge (s) the creation. Such well-known theorists as Adler, Moreno, Fromm, Lasswell, and Tuman give social factors prominence in their views on creativity.

Ansbacher and Ansbacher (1956) stated that Adler's "crowning achievement as a personality theorist was his concept of 'the creative power of the individual'" (Mackler and Shontz, 1965, p. 224). Adler's view placed all other aspects of man in a subordinate position to the so-called "creative power of the individual", yet he later stated that this principle is subordinated to a socio-cultural goal of "social perfection." Some understanding of what is meant by social perfection may be found in his definition of creativity: "the supreme

usefulness", meaning that those individuals who are creative are also more useful in terms of serving a social function.

Moreno (1960) accepted the view primarily (of the existentialists) that humans are endowed with spontaneity and creativity. He believed that creativity or the creative process had four phases: "creativity", "spontaneity", "warming-up process", and "conserve". Creativity, the first phase, is an elementary given, recognized solely by overt acts. Spontaneity is the catalyzer of the given, and the interaction of "spontaneity" and "creativity" is the "warming-up process". The products of these interactions are called "cultural conserves". This last can be crudely classified as those cultural heritages in a given society which have assumed an almost sacred quality.

Fromm (1959), Rogers (1959), Maslow (1953), Tuman (1954), Murphy (1958), Lasswell (1959), Anderson (1959), and Stein (1953) have all stressed the importance of the interaction between the person and the environment in creativity. Briefly, the first three theorists emphasize the "self-actualized" and/or the "well-adjusted" individual as the only one capable of creativity. He who is free from neurotic defenses such as projections, anxieties, and other mechanisms which cause perceptual and cognitive distortions is the latter, the well-adjusted. Tuman discussed the social forces that act as obstacles to creativity. Phrases such as "the need for social acceptance", "status competition" and "social security" are prevalent in his reference to the inhibitory influences on creativity. Finally, Murphy, Lasswell,

Anderson, and Stein, although essentially concurring with the above authors, added the cross-cultural and/or historical approaches to creativity. Murphy discussed "creative eras", times in which society encouraged individuality and de-emphasized status obtained through conformity. Lasswell abstracted the difference in values of cultures and social groups in his definition of creativity. He defined it (creativity) as the disposition to make and to recognize valuable innovations (which varied with different societal milieu). Anderson's only unique contribution was the presentation of historical examples of "social creativity" which emerged from person-to-person interactions, such as the Magna Carta, the Bill of Rights, Constitutions, and Laws. Stein's treatment of the cultural factors that influence creativity seems to be essentially identical with what has already been reviewed. The only reason for his inclusion here is his distinction that group needs and experiences expressed in the culture's developmental stage will define the problems that call for creative solution.

Although two leading research groups in the field of creativity, Getzels and Jackson, and Torrance et. al., represent no theoretical school in particular, they have been concerned with interpersonal, familial, group, cultural, and social factors that affect creativity. Hence, they will be discussed within the interpersonal context.

Torrance (1963) has tried to provide teachers with a guide for what to look for as indications of creative potential in school children. His definition of creativity has been likened to a description of the scientific method (Milholland, 1964) - "the process of sensing gaps or disturbing, missing elements; forming ideas or hypotheses concerning them, testing these hypotheses; and communicating the results, perhaps modifying and retesting the hypotheses" (Torrance, 1962, p. 16). It is obvious that Torrance postulates a variety of kinds of behavior involved in creativity. Therefore, he has developed and used over twenty-five tasks varying greatly in the nature of the stimulus and the assumed type of thinking involved. Although all the tasks require what Guilford and Merrifield (1960) termed "divergent thinking", there are both verbal and non-verbal productions necessary for solution.

Yamamoto (1962), a co-worker of Torrance has presented a similar definition of creativity, but has been more explicit. His seems more like a product of empirical test results than does Torrance's, although both emphasize flexibility in cognitive functioning as a necessary ingredient in the creative process.

Like the Torrance group, Getzels and Jackson (1962) have been concerned with identification of creative people, and how they think and behave. Another important interest of these latter investigators has been the differentiation of two groups of subjects differing in kind of cognitive ability, namely,

creativity versus intelligence. Thus these authors, unlike Torrance, define creativity as a "fairly specific type of cognitive ability reflected in performance on a series of paper-and-pencil tests" (Getzels and Jackson, 1962, p. 16).

Tests chosen to assess creativity by these authors were either adopted from other tests (mainly Guilford's battery, 1959) or developed specifically for their study. In the latter case they report validity studies for their tests. These tests are reported to a verbal, numerical-symbol, and object-space relations. The scoring parallels Torrance's in that the score does not depend on a single, predetermined, correct response, but on the number, novelty, and variety of adaptive responses to a given stimulus task.

Their results, with four hundred-and-forty-nine adolescents enrolled in a Midwestern private secondary school, indicated significant differences between highly intelligent and highly creative subjects on several personal and social variables. Torrance (1962b) replicated Getzels and Jackson's work with elementary school children , and noted that among the upper twenty percent the creative group seventy percent of these would have been eliminated if "giftedness" had been selected on the basis of intelligence scores alone.

Trait theory's views on creativity are dominated by the work of J. P. Guilford. A trait is any distinguishable, relatively enduring way in which one individual differs from

another (Guilford, 1959). Guilford (1950) proposed that a complete application of factor analysis, which involves hypotheses concerning "the primary abilities of the intellect", should be applied to the study of creativity. Once the factors comprising creativity have been identified, according to Guilford, it will then be possible to select individuals on the basis of creative potentiality. In 1959, Guilford described how creativity fits into his "structure of the intellect" model. His model had three dimensions: "contents", "operations", and "products". Guilford and Merrifield (1960) hypothesized that the thinking abilities involved in creativity are "divergent production", "transformation", "convergent production", and "evaluations". Only certain abilities within the convergent production and evaluation categories were seen as creative; thus, not all convergent productions nor evaluations were creative. It is the first ability, divergent thinking, which can loosely be defined as the ability to think in different directions either for reasons of variety or the searching for solutions, which has been employed by Guilford primarily to differentiate creativity from other cognitive abilities.

In much of the previously cited studies on measurement Guilford's tests have been extensively borrowed or modified by investigators who are not included in the trait theory approach. Mackler and Shontz (1965) stated that, as of 1965, there were

thirty-nine tests developed and available for measuring the primary traits including creativity. Guilford, in 1959, cited thirteen validity studies for the factors he is using to assess creativity. The predictive validity correlations range from - .02 to .50 with all sorts of criterion variables used.

DeMille (1963) described "the creativity boom" and the present-day fad of stressing creativity, especially in the schools. He warned that there has been a great temptation among educators and researchers to incorporate incomplete theoretical concepts. Since the worth of most of the above theories and research has not been thoroughly evaluated, much of these educational applications may be too hasty. It is, therefore, the purpose of the next section to trace the development and to present a relatively specific and testable theoretical position concerning a possible operational definition of creativity.

The Associative Approach

The concept of association, as the basic process involved in cognitive activity, goes as far back as the works of the ancient Greek philosophers. Aristotle, in particular, believed that one idea would be followed by another which was similar or contrasting, or which had been present together with the former in one's past experience. Similarity, contrast, and contiguity in space or time came to be regarded as the primary "laws of association". The British philosophers of the eighteenth and nineteenth century also conceived of association as "the basic mechanism of the mind". These empiricists attempted to explain all mental life in terms of past experience. This was only "arm chair psychology", of course, but even today the status of associationism, in various forms, is prevalent in the experimental psychology of learning and the so-called higher mental processes.

In general, when the term "association" is seen in the literature it usually refers to a method and/or a theory. Although most research emphasizing it as a method, other than for clinical purposes, usually implies an associationistic theoretical orientation, in one form or another, for the sake of convenience a survey of the literature involving method, measurement, and parameters in word association studies will be presented first. This will be followed by a brief discussion of the

theoretical framework involved in the associationistic theory of cognitive activities (including basic learning phenomena). Finally, creativity as an associative process will be discussed and the basic hypotheses of the present research presented.

Method, Measurement, and Parameters of Association

It was not until the latter half of the nineteenth century that Francis Galton (1879-1880) began experimentation on associative processes. He used seventy-five stimulus words, mostly nouns, and, at intervals of several days, clocked the association times for the second, third and fourth sets of two responses, by himself, to each of the words. He found he recalled 505 ideas in a total of 660 seconds or at the rate of one recall per 1.3 seconds; of these 505, 57 had come up twice, 36 - 3 times, and 29 - 4 times. Galton concluded that this method was very instructive: "It laid bare the foundations of a man's thoughts with a curious distinctness, and exhibited his mental anatomy with more vividness and truth than he would probably care to publish to the world" (p. 104, 1879).

It was also Galton (1879) who introduced three ways of treating association data quantitatively: 1) the associative reaction time; 2) the frequency of repetition of the same associative response; and 3) a classification of the responses with a count of the number falling in each class. These measures have been used often since that time. (Woodworth and Schlosberg, 1954).

Trautscholdt (1883) and Cattell (1886) used a controlled

association test in which the subject was restricted to some specified type of response such as the opposite of the stimulus word. Galton (1879) used free association, in which any response to the stimulus word was accepted. Besides these two methods, there is a discrete and continous association test, which, when combined with the above, produce a fourfold classification of methods traditionally used in associative tasks. (Woodworth and Schlosberg, 1954).

In continuous controlled association, the subject is instructed to limit his responses in some fashion. The present experiment will employ this method; i.e. "give as many associates to the word table as you can think of."

Baker (1960) listed three aspects of association which will be used as a framework for discussion of the technical problems involved in this area. These were: 1) the associative reaction time (RT): 2) Communality or frequency of occurrence; and 3) content.

An early comprehensive study of associative RT was conducted by Cattell (1886), on controlled association. He used only two subjects but later studies with more subjects confirmed his findings. Using a lip and voice key he found the following mean RT's for different types of associations: 1) to light - 175 milliseconds (M.S.*), other word responses to a stimulus word, limited - 800 MS; and 3) other word responses to a stimulus word, partially limited - 1000MS.

Bousfield and Sedgewick (1944) recorded the speed of continuous association. The associations were partially restricted in that the subject was asked to name objects of a certain class, such as birds, cities in the United States, or college classmates. The cumulative response curve rose rapidly at first but gradually flattened as the subject used up his supply of available responses. The slope of the curve showed the rate of responding, the steeper it was, the smaller the interval between responses. The curve also showed little spurts when the subject hit upon a cluster of interrelated responses. Also there were often rapid starts. Bousfield and Barclay (1950) found that the more common the response, the earlier it tends to appear in the series. This would imply that the rapid starts in the 1944 experiment are with common or more frequent responses.

Free association reaction time has been recorded by many experimenters (e.g. Aschaffenburg, 1895; Jung, 1919; Wreschner, 1907; cason and cason, 1925; and Murphy, 1917). The distribution of times has usually been skewed, with occasional responses delayed for three to ten seconds. The mean has usually been over one second but under two. Anderson (1917) found the free association reaction time for children to be slower than adults: 2600 MS for eight-year-olds to 1500 MS for fourteen-year-olds.

Wreschner (1907), in a badly designed experiment, found free association reaction time to be quicker than controlled; but he used many difficult stimuli in his tests of controlled

association. Therefore, Baker and Elliot (1948) selected ten words which they knew from preliminary tests would produce opposite responses for most subjects. They studied the effect of the type of instructions (free vs controlled and, in the latter, opposites were required) upon the reaction time. They found, in this case, that the controlled situation produced the faster mean RT. Therefore, it can be concluded that an important variable in associative reaction time is the difficulty of the task. Several experiments involving the effects of different parts of speech upon associative reaction time have produced fairly consistent results; namely, that concrete and familiar nouns result in quick associations while adjectives and verbs require more time (e.g. Postman and Egan, 1949).

It was discovered fairly early in association experiments that the responses in a given pupulation are distributed around a central mode or norm. For example, the word chair is associated most frequently with table, etc. The trailing off into less and less frequent associations is produced when an extended list of responses is made. It was found that with what have been called recently "steep hierarchy words" (Mednick, 1962; or Garskoff, 1961) as much as fifty percent of the time subjects will give the same primary response (Thumb and Marbe, 1901). Esper (1918) demonstrated a cross-cultural consistency in this phenomenon in that the same held true in America as well as Germany.

Building upon the findings of Galton, Cattell and Bryant, Marbe and others, an attempt was made in 1910 by Kent and Rosanoff to construct a table of word frequencies that might be referred to by other investigators. They took one hundred familiar English nouns and adjectives and gave them to one thousand subjects. The subjects were asked to respond by giving the first word that came to mind. From these responses, frequency tables, which have been used extensively since, were computed for each of the one hundred words. Three ways have been used to obtain a particular individual's score: 1) Count the number of idiosyncratic responses which are those defined as having a frequency of zero in the Kent-Rosonoff tables. Normal subjects with only a high school or lower education have given a mean of 5.2 of these responses while college subjects have a mean of 9.3 for the list of one hundred words; but some schizophrenic patients, whose responses appear incoherent and unrelated to the stimulus words, give 25-50 percent idiosyncratic responses. 2) Count the number of high frequency responses given by a subject; and 3) the medium frequency value of the subject's responses, if this is high, the subject tends to give common responses, if low, unusual responses (Kent and Rosanoff, 1910; and Cofer, 1965).

In an article in 1958 by Russell and Jenkins, they compared word association norms obtained since the 1910 study. In the majority of cases the same words as in Kent and Rosanoff list have been used although with different populations. For example,

Schellenberg (1930) collected a set of norms from 929 entering students at the University of Minnesota. Woodrow and Lowell (1916) prepared frequency tables of responses on one thousand Minneapolis children aged nine to twelve. O'Conner (1928) in the course of an extensive item analysis of the Kent and Rosanoff test collected data on a sample of male factory workers. In 1952, Russell and Jenkins collected norms from students in introductory psychology at the University of Minnesota. In 1963, norms were collected by Palermo and Jenkins, and published in a manual form, for subjects from the fourth grade through college of two hundred words, one hundred from Kent and Rosanoff and one hundred new ones. Recently and not necessarily as comprehensive are the discrete and continual association norms collected by Bilodeau and Howell (1965). In the Jenkins and Russell study of 1958, it was found, that primary responses (those given first or with the highest frequency) had greatly increased in frequency since 1919. In fact, the first three responses to the stimulus words used by Kent and Rosanoff, accounted for fifty-nine percent of all responses in 1952 (Russell and Jenkins, 1954). Rosenzweig and Miller (1966) compared word association norms in Australia, England, Western Europe, and the United States. They found that Australian and English norms, like United States norms, show high communality of responses while the European norms show greater diversity of responses. Also, they found that norms of the three English speaking countries share more common primaries than do those obtained from different languages.

Content analysis of associations has been used primarily by clinicians, but the usefulness of studying content is not limited to this purpose. Woodworth (1938) suggested that responses might be placed into four categories as follows: 1) definition, including synonyms and supraordinates; 2) completions and predictions; 3) coordinates and contrasts; and 4) valuations and personal associations. Class I has been called, by Woodworth, the "arriving" response, Class II, the "staying-by" response, Class III, "the jumping-away" response and Class IV, the more emotional and personal response.

Jung (1919) found that some educated adult subjects tend toward superficial responses. He said that the subjects conceive of the experiment as an entirely verbal one and maintain a "ready speech-excitation to affix to the first word that comes up; without entering into the meaning of the word" (p. 54, Jung, 1919). Aschaffenburg (1897, Kraepelin (1892), Smith (1922, Wells (1911a), and Wreschner (1907) found that responses became more superficial with fatigue, in the first two references, alcohol, in the second two, and practice, in the last, respectively.

There also have been studies of the relationship between association time and frequency. Thumb and Marbe (1901) found that the more frequent the response, the quicker the RT in free association ("Marbe's law"). Cason and Cason (1925) used the Kent-Rosanoff frequency table and correlated this with the RT.

The correlation for one hundred responses from each of twenty-eight subjects was found to be negative in all cases, ranging from -.11 to - .59 with a mean of -.33. This meant that the greater the frequency value, the shorter the RT.

Schlosberg and Heineman (1950) took into consideration the skewness of most associative reaction time distributions. Their argument was that it is not correct, from a statistical standpoint, to compare means (between RT and Frequency) from two different distributions, unless both are alike. To eliminate the delay introduced by long stimulus words, they used only the monosyllabic words of the Kent-Rosanoff list. When RT's of one thousand reactions were plotted the distribution was found not to be normal but pulled out on the upper end (sigmoidal). They then plotted the distribution with a logarithmic base line and a probability ordinate, and this produced a curve approaching normality. This experiment indicated that the log of associative reaction times is fairly normally distributed and may legitimately be used for comparisons from distribution to distribution. Having done this, Schlosberg and Heineman then proceeded to correlate log RT with communality and found a correlation of -.80, which indicated that the two variables were closely related.

Other more recent studies of associative technicalities have been mainly in the context of verbal learning, but a few of

the more representative ones will be presented.

Garskof (1965) compared single word associative and continual word associative response hierarchies. Response frequencies in single word associations were correlated with the same in continued associations. In the latter, a measure of associative strength was considered which took into account frequency and average order of emission. The correlations between the latter two variables ranged from .52 to .94, and in all cases were higher than the corresponding frequency-frequency correlations. It was concluded that although both methods produce similar hierarchies (meaning the shape of the distribution of frequency counts for all responses), the order of emission is related to the associative strength in continued association.

Cofer, in an earlier study (1958), compared response hierarchies obtained by the two above methods and found that most of the responses that were among the five most frequent in single associations were also present in the same first five positions in continued associatious. Also, mean rank-order of emission in the continued corresponded closely to rankings based on group frequency counts in discrete associations.

On the other hand, Osipow and Grooms (1965) found that hierarchies of chains of word associations did not conform to the notion that the probability of a particular verbal response for an individual corresponds to the probability of that same

response for a group. Therefore, they concluded that Russell and Jenkins' norms have limited use.

Hall (1966) investigated the reliability of free word association responses as a function of high and low frequency stimulus words, and a seven or twenty-one day period between first and second testing. An analysis of variance revealed that neither word frequency, nor interval between sessions, nor their interaction produced a significant effect on number of responses made during the second session which were the same as the first.

Pollio (1964) examined the composition of so-called associative clusters (series of responses given at short intervals between each other) in a continous association method. Four minutes were allowed for responding to each word. He found that although a negatively accelerated exponential curve described quite well the relationship between cumulative associative production and time permitted for associating, an examination of the specific associative rates showed periods of rapid response intermingled with periods of slower responding. Defining the interconnections among words in terms of Deese's (1959) "associative overlap coefficient" in a cluster, he found the following: These alternations in rate may be attributed to the existence of a group of strongly associated words in a so-called semantic cluster which evokes an essentially similar meaning" (p. 207). Pollio, Staats, and Staats (1964)

found that a word and its associates tend to have similar Semantic Differential ratings across the three major dimensions described by Osgood, Suci and Tannenbaum in 1957.

Deese (1962), in a paper not to be overlooked on the theory of associative meaning, investigated the hypothesis that "paradigmatic associates" (words that can occupy the same position in an utterance usually of the same grammatical class), and syntagmatic associates (those which usually occupy other positions, usually contiguous) will occur in different frequencies to stimuli of different form classes. This hypothesis was based on the notion that the mediation that takes place in the successive choice of words (i.e., in a continuous association task) is in the form of a sampling of the hierarchy of responses to any word. It was found that nouns that were syntagmatic with respect to the stimulus word were produced only twenty-one percent of the time, while verbs and adjectives, forty percent and fifty percent of the time, respectively. Adverbs produced the highest percentage, seventy-three percent. In other words, it was found that stimuli of different grammatical classes produced different classes of responses, i.e., that the frequency of occurrence of different response classes is different depending on the form class of the stimulus.

Finally, Laffal and Feldman, (1962) referring to Bousfield and Cohen's (1955) finding that clustering of word associations of high interrelatedness was found in recall studies,

also compared the categories of responses to single versus continuous word associations. His hypothesis was similar to many of the above; namely that the same underlying structures (hierarchies) would be present in both types of associations. Using his own method of categorizing responses, Laffal (1960) found by the method of factors analysis five factors common to single and continuous associations. This also added support to the notion that data developed by single word associations from a group may be taken as paradigmatic of associations developed by other methods when the underlying hierarchies of the associations are considered.

Having listed these above recent experiments, what can be concluded about word association data at present? 1) The trend is toward investigation of the underlying cognitive configuration or structure through word association techniques. 2) And, it seems that this structure is inferred to be hierarchical and referred to as the associative hierarchy. These two conclusions are particularly relevent to the next section.

The Theoretical Basis of Association

Although the reader has probably become cognizant by now of the theoretical framework of cognitive processes based upon an associationistic approach, a brief sketch of its historical development may clarify this position.

Hull (1943), described in detail the concept of the "habit-family hierarchy", which he felt "would prove to have wide application as an explanatory principle in many subtle and otherwise inexplicable forms of behavior described indiscriminately as intelligence" (1943, p. 147).

Before discussing some direct contemporary applications of this notion, it is necessary to give a short summary of its nature:

$$S - r_g - s_g - \begin{matrix} R_1 - s_1 \\ R_2 - s_2 \\ R_3 - s_3 \end{matrix} \begin{matrix} R_g \\ \\ r_g \end{matrix}$$

Fig. 1, A Habit Family. (From A. W. Staats, Psychol, Review, 68, 1961, p. 190).

Figure 1 shows a habit-family in simplified form. A part of the response which originally was elicited by the final stimulus in a sequence becomes elicitable by earlier stimuli.

This partial response (rg) is elicited by the stimulus at the beginning of a sequence and, therefore, may precede other instrumental responses elicited by the stimulus. When this occurs, the rg and the stimuli it produces are contiguous with the instrumental responses, and these stimuli will come to elicit the responses - R_1, R_2, and R_3 in a divergent fashion. The stimuli produced by these three responses will then be associated with the goal response (Rg), and tend to elicit it in a convergent fashion. Staats (1964) stated that "mediated generalization" (different s_1's, s_2's, and s_3's which have their own associates will elicit the same Rg) takes place from one instrumental response to others.

Cofer et al. (1956) used Hull's term, habit-family with respect to language behavior in describing "reasoning". Cofer (1951) conceived of habit-families in "thinking", both as the basis of semantic characteristics of words and as associations between words, i.e., of clusters of words which were related.

Osgood (1953, 1957) [illegible] has stated that different environmental stumuli could become associated with the same mediating response, a convergent mechanism, and this response (or its stimulus could elicit various instrumental responses, a divergent process.

Cofer and Foley (1942), Mowrer (1954), Osgood (1953), and Staats and Nims (1959b) have studied word meaning in terms of Hullian concepts or as implicit mediating responses. In short,

their findings were all interpreted thus: that when a word is contiguously presented with a stimulus object some of the unconditioned responses elicited by the object will be conditioned to the word. When the former becomes stably conditioned, this becomes the meaning of the word. Higher order conditioning of both connotative and denotative meaning responses has been accomplished by Staats et al. in 1960. Osgood's (1953) "representational mediating responses" were an elaboration of Hull's (1934) "rg's" or "pure stimulus acts." This latter concept included conditioned autonomic as well as implicit motor responses. Staats (1961) added conditioned sensory responses to this list.

Skinner (1953) discussed how sensory responses can come to be elicited by formerly neutral stimuli on the basis of classical conditioning. Krasner (1958) and Salzinger (1960) have shown that verbal responses may be strengthened by reinforcement, i.e., Skinner's (1953) "operant conditioning principles" were used. This is the basis for a theory of originality, (Maltzman in 1964), which is closest to the one to be tested in this paper.

Mink (1963) presented a paper on the relation between semantic generalization, assumed by Cofer and Foley (1942) and Osgood (1952) to be similar to Hullian primary and secondary generalization, and word association He tested subjects for

recognition of words from the Russell and Jenkins norms (1954). It was found that a generalization from learned words to test words, which were of known associative frequencies to the former, was obtained by associating the former with an instrumental response. But generalization did not appear to occur on the basis of assumed mediation during the test stage.

Coleman (1964) presented results from other investigators (Deese, 1959; Postman, 1962; Underwood and Richardson, 1956; and Jenkins and Russell, 1952) which supported an argument that learning, forgetting, and problem solving behavior could all be profitably defined simply as changes in response hierarchies. Transfer effects exerted upon verbal behavior by two characteristics of associative hierarchies were discussed - the number of responses and strength of responses preceding the needed or assigned responses and the strength of the needed or assigned responses (in paired associate learning).

Nakamura and Wright (1965), in a study of direct relevance to Hullian learning theory, studied the effects of induced low drive, response mode, and social cues on word association and response speed. The hypothesis was that low drive states facilitate behavior change by increasing the probabilities of relatively uncommon responses to be emitted (i.e; those that are lower on the response hierarchy). This is consistent with certain constructs in Hull-Spence theory (Spence, 1956) concerning the multiplicative relation between drive and habit

strength. The results tended to support the response mode as the most consistent inducer of competing responses.

In summary, the relationship between Hullian notions and word-association can be viewed as follows: In Hull's (1943, 1951) general formula which attempts to include all the factors that determine a learned response, the letter H, for "habit strength", corresponds to previously formed word-associations, and the letter D, for drive, corresponds to the factor of preparatory set or the attitude the subject brings to the experimental situation. If we add to this either Thorndike's (1931) "multiple alternative response" or Hull's habit family hierarchy, we have the ingredients to draw a parallel between modern associationistic views on verbal behavior or cognitive processes and classical behavioristic learning theory. In the association test, the variable H, the habit strength, is not controlled but inferred from the previously mentioned measures, the associative RT and/or the response frequency or communality. If a stimulus word elicits a certain response quickly and frequently, the association between them (SHR) must be strong. As has been stated, studies have shown (e.g. Schlosberg and Heineman, 1950) these two variables to be highly correlated. From Hull's concept of the habit family hierarchy we also have a notion of the reason for the frequent delays in associative RT's observed; i.e., the RT indicates the "net" effect of competing responses in the hierarchy. It is assumed that later responses in a sequence are in greater competition with other responses because their SHR is weaker with other responses, and they are, therefore, slower in being emitted.

Associationistic Theories of Creativity

Two research groups within the last five years have presented definitions and research on creativity (or originality) based upon an associationistic orientation. In both cases, neobehavioristic terminology is employed. These groups are led by Maltzman and Mednick, respectively. The latter will be discussed in detail, since it is the basis of the present experiment, while the former will be only briefly reviewed.

Maltzman (1960,p. 229) defined originality as "behavior which occurs relatively infrequently, is uncommon under given conditions, and is relevant to those conditions." In most of his studies (e.g., Maltzman, Swain, Roskin and Licht, 1960), a word association technique has been a standard method; and the results have been interpreted as supporting the hypothesis that "originality can be learned and the same principles of conditioning hold as in other forms of operant behavior" (1960, p. 230). Research on the training variables influencing originality of responses employed problem materials for which there was no one correct solution (Maltzman, Bogartz and Breger, 1958). They found that inducing subjects to emit uncommon associations in a modified word-association situation resulted in an increased disposition to emit uncommon (original) responses in new situations (the test problem).

Maltzman, Bollosi and Fishbein (1964) cited a series of experiments which were conducted to study associative variables that facilitate problem solving performance when a specific correct solution is called for. Several experiments were conducted with a group form of Maier's (1930) two-string problem. It was found that prior verbal learning of relevent response sequences failed to affect problem-solving performance in the predicted direction. But in an extensive series of experiments employing Mednick's Remote Associates Test of creativity, of which more will be said shortly, facilitation of solutions to the items was found to vary with the extent to which prompting or training stimuli were associated with the items on the test. Therefore, this is evidence that the form of the associative hierarchy affects performance on originality tests (which, in Maltzman's terms is not differentiated from creativity tests).

Mednick (1962), using the introspections of highly creative persons as background material, presented a basic hypothesis regarding the nature of creative thinking in the form of a definition: "the forming of associative elements into new combinations which either meet specified requirements or are in some way useful. The more mutually remote the elements of the new combination, the more creative the process or solution to a problem" (Mednick, 1962, p. 221). The imposition of "requirements or usefulness" is to distinguish creative thinking from originality.

The following are illustrative predictions concerning

individual differences that are presented from this theoretical orientation: 1) An individual must have the requisite elements in his response repertoire necessary to arrive at a creative solution: i.e., an artist, writer, etc., without the adequate response repertoire needed to form new or unique combinations can hardly be creative. 2) The organization of an individual's associations will influence the probability and speed of attainment of a creative solution. From this concept called the associative hierarchy, Mednick predicts the following: a) The associative strength (latency of response) around ideas or words will differ for the high creative (HC) versus the low creative (LC). For example, the LC when asked to associate to the word "dog", in a continual association test, i.e., not chaining, will be restricted to the stereotyped or common associates such as "cat", and may be characterized as having an associative hierarchy with a steep slope (see figure 2). The LC's associative reservoir will quickly deplete after he passes the first few conventional responses to the stimulus word. b) Another individual, the HC, can be conceived of as having a rather flat slope (Figure 2 also). The HC also has as his strongest responses in the conventional associates, but for him these responses are not overly dominant and so it is more likely he will be able to get to the less probable, more remote kinds of associates for a given stimulus. These more remote responses are the requisite elements and mediating terms for a creative solution to any problem.

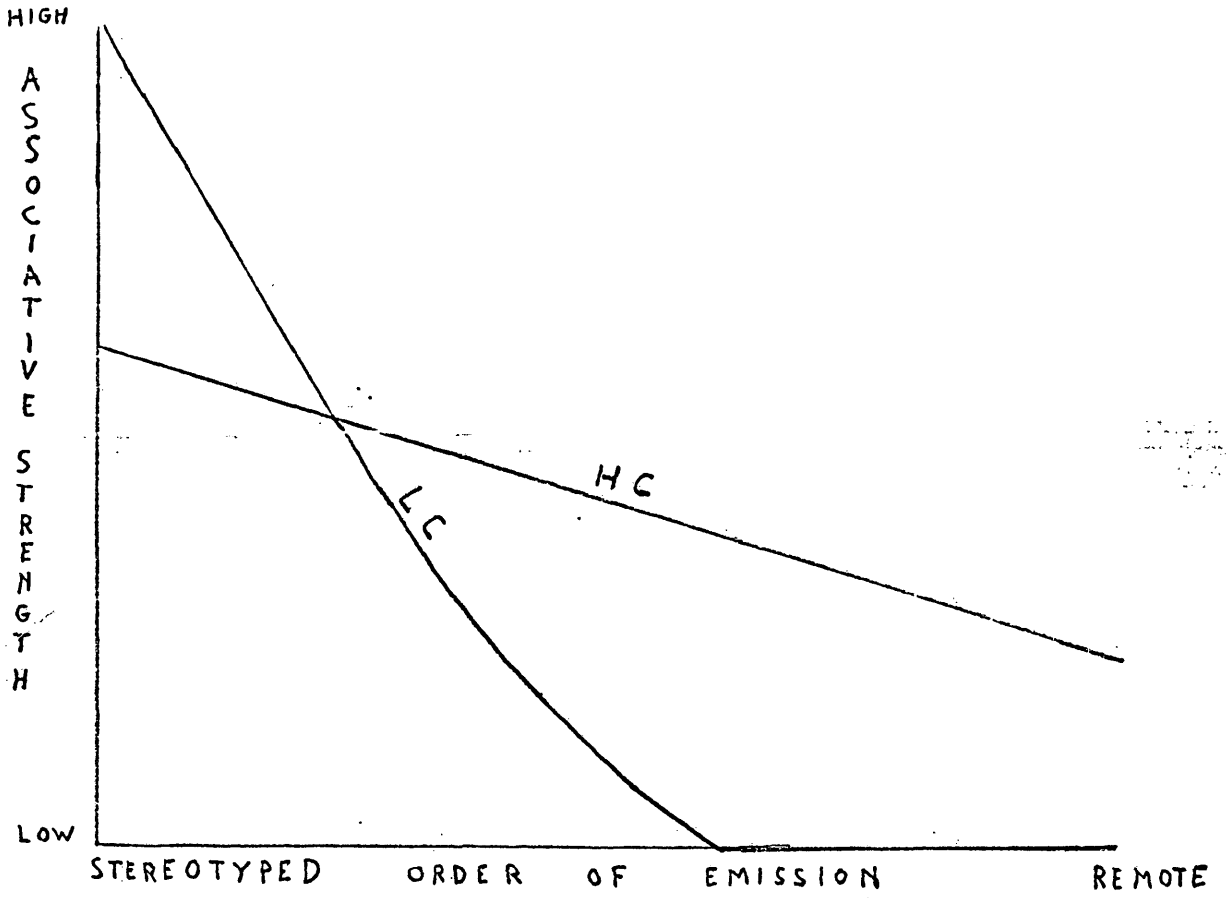


Fig. II. TWO HYPOTHETICAL GRADIENTS OF RESPONSE STRENGTH

c) Bousfield, Sedgewick, and Cohen (1954) found a high negative correlation between rate of association and total number of responses. From Figure 2 it would be predicted that the HC subject would respond relatively slowly and steadily and emit many responses while the LC subject would respond at a higher rate but emit fewer responses. d) It would also be predicted that the greater the concentration of associative strength in a small number of stereotyped associative responses (steep hierarchy), the less probable it is that the individual will attain a creative solution (Mednick, 1962). Mednick, Gough, and Woodrock (1958) have supported this last prediction. Research scientists were rated for creativity and divided into relatively high (N-15) and relatively low (N-15) groups. The LC's gavemmore stereotyped responses on eighty percent of a group of thirty-six test words from the Kent-Rosanoff list (stereotypy was defined by the Minnesota Kent-Rosanoff Word Association Norms, Russell and Jenkins, 1954). 3) The greater the number of associations an individual has to the requisite elements of a problem, the greater the probability of his reaching a creative solution. This variable is affected by the previous one since an individual with a high concentration of associative strength in a few responses is not likely to have a proliferation of associatives. It is also probably not related to speed of creative solution, since it may take a good deal of time to get to the dediating responses that bridge to another requisite element producing the facilitating combination.

In summary, three important variables, according to Mednick, divide the LC's from the HC's: total number of associations to any stimulus word (HC's have more), total number of remote or unique associations (HC's have more), and the rate of responding to a stimulus word (the HC being slower initially but steadier overall).

Mednick, in the same article, goes on to suggest a way of testing individual differences in creativity. The rationale for the test is derived from his definition of the creative process; therefore, "The testee is asked to form associative elements into new combinations by providing mediating links" (p. 222). The structure of the test is such that the testee is provided with stimulus items from three mutually distant associative areas and asked to find a criteria-meeting word which combines them. Words are used which are assumed to be so common that familiarity is high across all fields of interest. These are verbal associative habits that are assumed to be reasonably familiar to almost all individuals brought up in this culture. Such habits, for example, are the associative-bonds between words like "ham and eggs", "bed-bug", and "pool-hall". Therefore, the assessment device, "The Remote Associates Test", (RAT), is one in which a single prescribed verbal term had to be provided by the subject as an associative bridge to unite three given words. It is predicted that high scorers on RAT tests (the high creatives) should manifest flat slope gradients when their associative

hierarchy is plotted as a function of the three critical variables discussed above, while the low scorer should produce the steep-sloped hierarchy.

Mednick, Mednick and Jung (1964) reported a study in which continual word association was investigated as a function of RAT performance, form class (noun or adjective), associative hierarchy, and Thorndike-Lorge word frequency. Subjects were selected as HC, MC, and LC on the basis of their RAT scores. It was found that HC subjects gave the largest number of associations and maintained a relatively high speed of association throughout the two-minute period. The subjects' RAT scores and the stimulus variables did not interact, i.e., HC subjects maintained their higher speed of responding and greater number of associations independently from the type of verbal stimulus. These results confirmed Mednick's (1962) predictions only partially. The high RAT scorers did give many responses and did so in a relatively steady fashion, but in contrast to the prediction they responded at consistently faster speeds thanmmedium or low scorers (MC and LC). Only cumulative number of responses for fifths of the two-minute time period for the "creative group" were presented in the results. On examination of these curves, one finds increasing differences between groups in later stages of the two-minute period. In view of these findings the authors stated that it would be worthwhile to study associative behavior using an extensive

time period. To quote the authors, "this would allow for depletion of the response reservoir and produce a more detailed and complete picture of the relation between RAT performance and associative responding"(Mednick, Mednick and Jung, 1964, p. 514).

Christiensen, Guilford and Wilson (1957) reported a study relevant to the gradient in Figure 2. They found that responses later in time are more unusual and remote than earlier responses.

Finally houston and Mednick (1963) present results showing that stereotyped associates may actually have noxious properties for those high in creativity. These results reinforce Mednick's hypothetical curves in suggesting a reason why they do not intersect the ordinate at the same point.

The purpose of the present research was to test empirically, and as completely as possible, certain deductions concerning associative behavior derived from Mednick's theory; specifically, Mednick's hypothesis being that the higher the RAT schore, the flatter the associative hierarchy; and, conversely, the lower the RAT score, the steeper the hierarchy, in a continual controlled word association test of considerable duration. Therefore, the specific hypotheses of the present study were: 1) RAT scores would vary directly with total number of responses; 2) RAT scores would vary inversely with total mean communality scores; 3) RAT scores would vary inversely with rate of responding in the early portions; and 4) associates, in terms of communality, would be negatively correlated with RAT scores only in the later portions of the sequence; and, therefore, this last hypothesis is related to (2) above.

METHOD

Subjects.---- Subjects were obtained from an Introductory Psychology class ranging from Freshman to Senior, and of both sexes. There were forty-two men and thirty-five women in the sample; the mean age was 20.1 years. Five subjects had to be excluded for various reasons including misunderstanding of instructions, leaving school before taking both tests, etc.

Materials.---- The Remote Associates Test, which purports to measure ability to think creatively was obtained from the authors. RAT scores have been found to correlate significantly ($r=70$m $df=19$, $p.=.01$) with ratings of creativity by faculty members of students who taught design courses at a college of architecture (Mednick and Mednick, 1963). In another study ratings of first year psychology graduate students at the University of Michigan were made by faculty research supervisors. Only the eight highest and eight lowest RAT scores were rated. It was found that six of the eight high RAT scorers were rated high in creativity, while only one of the eight low RAT scorers was rated high. On the other hand, Datta (1964) reported a study whick found a correlation of only + .13 between RAT scores and supervisory ratings of creativity for thirty-one physicists. In this study it was found also that six out of the ten high-rated scientists had low RAT scores (mean=11.0), and that all six of these subjects did not speak English as their native language.

But upon further analysis it was concluded that these six subjects were no different in linguistic fluency than the other subjects. It was concluded, therefore, that the RAT may be limited in its use for differentiating high creatives from low creatives among physicists.

The Spearman-Brown reliability of the RAT has been found to be .92 in one sample of two hundred-and-eighty-seven women (Newcombe, 1963) and .01 in another of two hundred-and-fifteen men (Norman, 1963). The two college-level forms of the test (one co-authored by Mednick, M. T. and the other by Halpern, S.) have thirty items each; the subject is allowed forty minutes; his score is the number correct.

The verbal materials for the word association test were six words chosen from William and Mary norm for discrete responses to one hundred words from the Kent-Rosanoff Word Association Test (McKenna, unpublished, 1964). They were all flat-hierarchy nouns. A word with a steep associative hierarchy elicits one dominant associate and many associates of low response frequency; while words with flat hierarchies do not elicit any dominant responses. The degree of flatness of the stimulus words was determined by counting the number of different responses elicited by any word and dividing this by the number of responses which were in the first five most frequent associations to this word. Therefore, the larger this quotient was, the flatter the hierarchy. The six flattest concrete nouns were used in this study. Specifically, these words were "trouble", "cheese", "memory", "child", "citizen", and "whistle". Mednick,

Mednick, and Jung (1964) found no significant interaction between the type of stimulus word and RAT performance. They did find flat-hierarchy words eliciting a greater number of responses than steep hierarchy words, and nouns eliciting more associates than adjectives. Therefore, only flat-hierarchy concrete nouns were used as stimulus words in order to obtain as much information as possible with a small number of words. SAT verbal and quantitative scores were obtained in order to assess the relationship between these scores and the other variables mentioned.

Procedure.---A pilot study was initially conducted to assess the feasibility of using an unlimited time continual word association test. These results showed that only one subject out of twenty-two, in an unlimited time situation responded beyond ten minutes. These initial sessions were conducted both orally and in writing, and with one subject at a time. It was found that both the individual testing situation and the oral medium of responding affected the results. For example, it was found from questioning some subjects after each session that they would have written more responses and/or they "felt uneasy" with the experimenter sitting there, "waiting for me to answer." It was, therefore, decided that a group-administered, written form of testing was more desirable for eliciting the most responses from a subject. Secondly, it was concluded that ten minutes of

continually associating to each of six stimulus words was sufficient time to approximate exhaustion of most subjects' associative reservoir to any stimulus word.

Also, the pilot revealed the existence of many idiosyncratic responses which did not seem to be associated in any meaningful way to the stimulus word. Therefore, there was some question as to these latter being genuine associations to the given stimulus, and not part of an associative cluster (i.e., derived from previous responses). Since the task called for complete attention to the stimulus word, it was necessary to assess the significance of these idiosyncratic responses in the main study. This was attempted by counting the total number of unique responses to each word and correlating this with all other variables, especially noting its relationship to the communality scores. A copy of the word association test with instructions is included in the appendix.

In the main study, the subjects were given the word-association test in three sessions. A one-minute test interval was used between presentation of stimulus words. Seventy-seven of these subjects were then given the Remote Association Test at a mean interval of two weeks after taking the first test. Rate of responding scores, in terms of mean number of responses per half minute for the first three minutes, the second three minutes, the last four minutes, and for the entire

ten minutes were computed.* These data were obtained by having the subjects check off their last response given at thirty-second intervals for the entire ten minutes. Communality scores for each of the above four periods were also computed. This score for each subject was derived by computing the number of subjects who gave each response in the entire sample for any one word and dividing this score by N (77). This frequency score, the percentage of subjects who gave each response, was then summed for each word for each subject and divided by the number of responses he made in any one period being computed. Thus, the mean communality score for each word for every subject was derived. This was then divided by six, the number of words (assuming from the Mednick, Mednick and Jung, 1964, result that the stimulus word does not interact significantly with the other variables), to obtain the final mean communality score for each subject. Total number of responses and total number of unique responses were also obtained. Finally, Scholastic Aptitude Test (SAT) quantitative and verbal scores were obtained from official records on all subjects as well as computing the number correct on the RAT. Percentile scores on the RAT were later calculated in order to divide the sample into high and low creatives (seventy-five percentile or above=HC and twenty-five percentile or below=LC). These thirteen variables were then entered into a 13 x 13 intercorrelational matrix and Pearson Product-Moment Correlation Coefficients derived for any two variables.

*It might be mentioned here that E had to assume that the curves presented in Figure 1 in the introduction were for ten minute of responding and could, therefore, be divided into three-minute intervals representing the initial, middle and last phases in the associative sequence respectively. E was fully aware of the fact that this was purely an assumption on his part; but there was no evidence that could be found in the literature that gave any indication of the normal temporal duration needed to exhaust an associative repertoire. In fact, no studies could be found which employed any time limit beyond five minutes for responding on a continuous word-association test. Therefore, it could only be assumed, from the pilot, that ten minutes of responding should give information relevant to the curves in Figure 2.

RESULTS

Table I shows the means and standard deviations for the entire sample on each of the thirteen variables. Frequency distributions for variables three through thirteen are plotted in Appendix B (Figures 1 through 11). None of the distributions were observed to be skewed to any large degree except possibly variable thirteen, unique responses. In this latter case a rough estimate of skewness was computed and found to be low (.10). Therefore, it was decided that a Pearson Product-Moment Correlation Coefficient Test was applicable to the data. Table I reveals that only in the case of the communality scores, including unique responses, is there a large degree of variability, although in no case is the standard deviation lower than twenty-five percent of the mean. SAT verbal and quantitative are so close that it can be assumed there is no difference in this sample between quantitative and verbal ability.

TABLE I

MEANS AND STANDARD DEVIATIONS ON ALL VARIABLES

		Mean	Standard Deviation
1.	SAT-V	575.6363	80.5021
2.	SAT-Q	576.0649	78.2937
3.	RAT	18,2987	4,4402
4.	Rate-1st 3	4.9544	1.4096
5.	Rate-2nd 3	3,5925	1.3605
6.	Rate-3rd 3	2.9083	1.1259
7.	Rate-total	3.7246	1.2383
8.	Total R's	74.5167	24.7614
9.	Communality-1st 3	.2037	.0978
10.	Communality-2nd 3	.1393	.0819
11.	Communality-3rd 3	.1248	.1107
12.	Total Communality	.1599	.0763
13.	Unique R's	14.5411	11.6238

The mean number correct on the RAT was 18.3 with a range of 25 (lowest score, 5, highest score, 30). In the Mednick, Mednick and Jung study the medium RAT score was 16.69, no standard deviation was reported but the range was 1-30.

Out of approximately thirty thousand responses obtained from all the subjects to all six words on the word association tests, approximately twenty-one thousand of these were different responses (i.e., about 3,500 per word). The means and standard deviations presented in Table I. for variables 4 through 13 are actually the mean of the mean for each word, i.e., a mean was computed for each word for all subjects, these were then summed across words, and divided by six, the number of words.

It should be noted that rate of responding means for the first three minutes versus the second three minutes decreases more (a difference of 1.4 responses/one-half minute) than for the second three minutes versus the last four minutes (.7 responses/one-half minute difference). The mean rate of responding for the full ten minutes was 3.7. The mean communality scores, the computation of which was described in the procedure, shows the same trend. There is approximately six percent decrease between the first and second three minutes, while only a 1.5 percent decrease is found from the second three minutes to the end of the time limit. The mean communality score for the entire sample was approximately sixteen percent, and the mean total responses, averaged over all

words, was found to be 74.5. Finally the mean number of unique responses was approximately 14.5 although, as stated, the standard deviation was large (11.5) (Table I.).

Table II, the intercorrelation matrix describes the bulk of the results of this study. As can be seen, the RAT did not relate significantly to any other variable except SAT verbal ability. This latter variable did not correlate significantly with any of the continual word-associative measures, with a near zero correlation found predominatly (Index 1 with 4 through 13). SAT quantitative scores showed the same trend except the failure to relate to RAT scores, but this r (.179) was just slightly under the .10 level of significance for a two-tailed test.

The relationship between RAT scores and rate of responding 1, 2, 3 and total, respectively, showed no consistency over time and was always low positive. As can be seen, the correlation goes from being extremely low positive, to zero, to reaching its highest positive (.08) with time (Index 3 with Indices 4-6). The overall correlation (an r of .02) seems to demonstrate this lack of consistency.

Variables 9 through 11, as related to RAT scores, show a slight trend, although none are significant. There is a trend for the relationship to go from positive (.114), to near zero (.01), to negative (-05) with time. Variable 12, the communality score in the full ten minutes, is an approximate mean of this trend, being low positive (.06). Finally, variable 13, number

TABLE II

INTERCORRELATIONAL MATRIX ON ALL VARIABLES

	1 SAT-V	2 SAT-Q	3 RAT	4 RATE 1st 3	5 RATE 2nd 3	6 RATE 3rd 3	7 RATE TOTAL	8 TOTAL R's	9 COMM. 1st 3	10 COMM. 2nd 3	11 COMM. 3rd 3	12 TOTAL COMM	13 UNI QUE
1. SAT-V	1.000												
2. SAT-Q	.610**	1.000											
3. RAT	.352**	.179	1.000										
4. Rate-1st 3	.063	.087	.030	1.000									
5. Rate-2nd 3	.025	.070	.009	.948**	1.000								
6. Rate-3rd 3	.033	.083	.088	.830**	.923**	1.000							
7. Rate total	.040	.074	.023	.956**	.991**	.949**	1.000						
8. Total R's	.041	.076	.022	.956**	.991**	.949**	.999**	1.000					
9. Comm. 1st 3	.069	.010	.114	-.242*	-.246*	-.224*	-.245*	-.245	1.000				
10. Comm. 2nd 3	.073	.012	.013	-.240*	-.287*	-.289*	-.282*	-.281*	.570**	1.000			
11. Comm. 3rd 3	.009	-.004	-.059	-.203@	-.224*	-.271*	-.237*	-.237*	.347**	.371**	1.000		
12. Total Comm.	.061	-.007	.066	-.298**	-.324**	-.326**	-.326**	-.325**	.905**	.787**	.515**	1.000	
13. Unique R's	.030	.013	-.054	.596**	.631**	.626**	.624**	.625**	.529**	-.417**	-.297**	-.571	1.0

@ Significant at .10 level for a two-tailed test or .05 level for a one-tailed test.
* Significant at.05 level for a two-tailed test or .025 level for one-tailed test.
** Significant at .01 level for a two-tailed test or .005level for one-tailed test.

N= 77
df= 75

of unique responses, is slightly negative in its relationship with RAT score and is non-significant.

It is interesting to note that from variables 4 through 13, the rest of the matrix presented in Table II., all of the correlations are significant. Of course, the relationship between variables 4, 5, 6 and 7, the rates of responding at each interval with the overall rate, is spurious; since each of the former is a part of the latter score. Also, all these variables (4-7) contribute directly to variable 8's score, and these relationships are, therefore, spurious also. The same holds true for the interval scores versus the total time scores for both rate and communality, it is <u>not</u> true that the relationship between intervals is necessarily spurious. In other words, rate of responding for the first three minutes is <u>not</u> a part of the same score for the second three minutes, etc.

Scatter plots of all correlations related to the hypotheses (i.e., 3 with 4 through 13) are presented in Appendix C (Figures 12 to 21).

Table III. divides the RAT scores into percentiles with those scoring above the 75th. (N=19) designated as "high creatives" and those below the 25th. as "low creatives" (N=21). Scores ranging from 22-30 were in the high creative group, while those ranging from 5-15 were in the low creative group. The smallest range, from 16-21, were clustered in the middle percentiles (29-70). These latter could be designated as medium creatives.

TABLE III

RAT PERCENTILES

	Number Correct	Percentile	Frequency	
	30	99.4	1	
	26	97.4	2	
22-30	25	94.8	2	
HC's	24	92.2	2	
	23	84.4	10	
N=19	22	76.6	2	75th
	21	70.1	8	
	20	63.6	2	
16-21	19	58.4	6	50th
MC's	18	47.4	11	
	17	35.1	7	
N=37	16	29.2	3	25th
	15	24.0	5	
	14	18.2	4	
	13	12.3	5	
5-15	12	6.5	4	
LC's	11	3.2	1	
	8	1.9	1	
N=21	5	0.6	1	

Yielding no significant correlations related to the main hypothesis, the subjects were then divided into high and low creatives according to percentile norms, as shown in table III; and these means and standard deviations calculated (Table IV).

As can easily be seen from this table in no case did the means differ greatly. Communality distributions for the first three minutes for highs and lows yielded the greatest difference in means (.237 verses .182), and two of the smallest standard deviations; and was therefore chosen as a representative sample of the significance of the difference between the two means (HC's and LC's for any variable). The students' t-test was used to determine the level of significance for these two communality means. This t-value was significant at the .402 level. This being the case, it was decided to forego computing t-values for the other means, since their differences were even smaller than the one computed.

Figures III and IV show the next step in the analysis of the data. In this case, the mean rate of responding and mean communality scores for the HC's and LC's were compared at half-minute intervals. Figure III depicts the mean number of responses as a function of time. Also the mean latency of each response, in seconds, which could only be estimated, is given in parenthesis at each interval. This latter figure was derived by dividing 30 (the number of seconds) by the mean number of responses for each interval. It should be noted that the high

creatives, throughout the ten minutes of responding, remained above the LC's, and therefore, were always responding faster. Also, a relatively rapid decrease in rate of responding was found for both groups after the first thirty seconds. From then on, both groups continued to respond slower and slower, with minor fluctuations, and at a fairly consistent rate. In Figure IV, it can be seen that there was also very little difference between HC's and LC's in mean communality scores at half-minute intervals, with the biggest difference occuring at the end of two minutes; but this was only temporary. Both groups began by giving common associates (twenty-nine percent versus twenty-eight percent in the first thirty seconds. This was followed by a relatively rapid decrease until approximately the end of two minutes of responding, at which time both groups, except for slight fluctuations, continued to decrease in communality (i.e. produce more remote associations), but at a much slower rate than initially.

Figure V shows the rate of responding data as in Figure III, but in the exact form of Mednick, Mednick and Jung's (1964) curves discussed in the introduction. As can be seen, the same result was found in the present study as in Mednick, Mednick and Jung's; namely, that there is an increasing difference in rates between the HC's and LC's with time. This difference was significant at the .001 level using a sign test for two related samples.

TABLE IV

MEANS AND STANDARD DEVIATIONS FOR HIGH CREATIVES AND LOW CREATIVES ON ALL MEASURES

		Rate 1	R. #2	R. 3	Tot Rate	Comm 1	- 2	- 3	Tot. Comm	Uni- ques	Tot. Rs
HC'S	MEAN	5.24	4.0	3.34	4.11	.237	.123	.107	.155	17.49	82.13
HC'S	S.D.	1.37	1.35	1.24	1.29	.016	.014	.010	.114	11.41	25.67
LC'S	MEAN	5.24	3.75	2.86	3.85	.182	.136	.122	.151	17.48	77.06
LC'S	S.D.	1.61	1.47	1.34	1.29	.042	.069	.060	.036	11.63	29.94

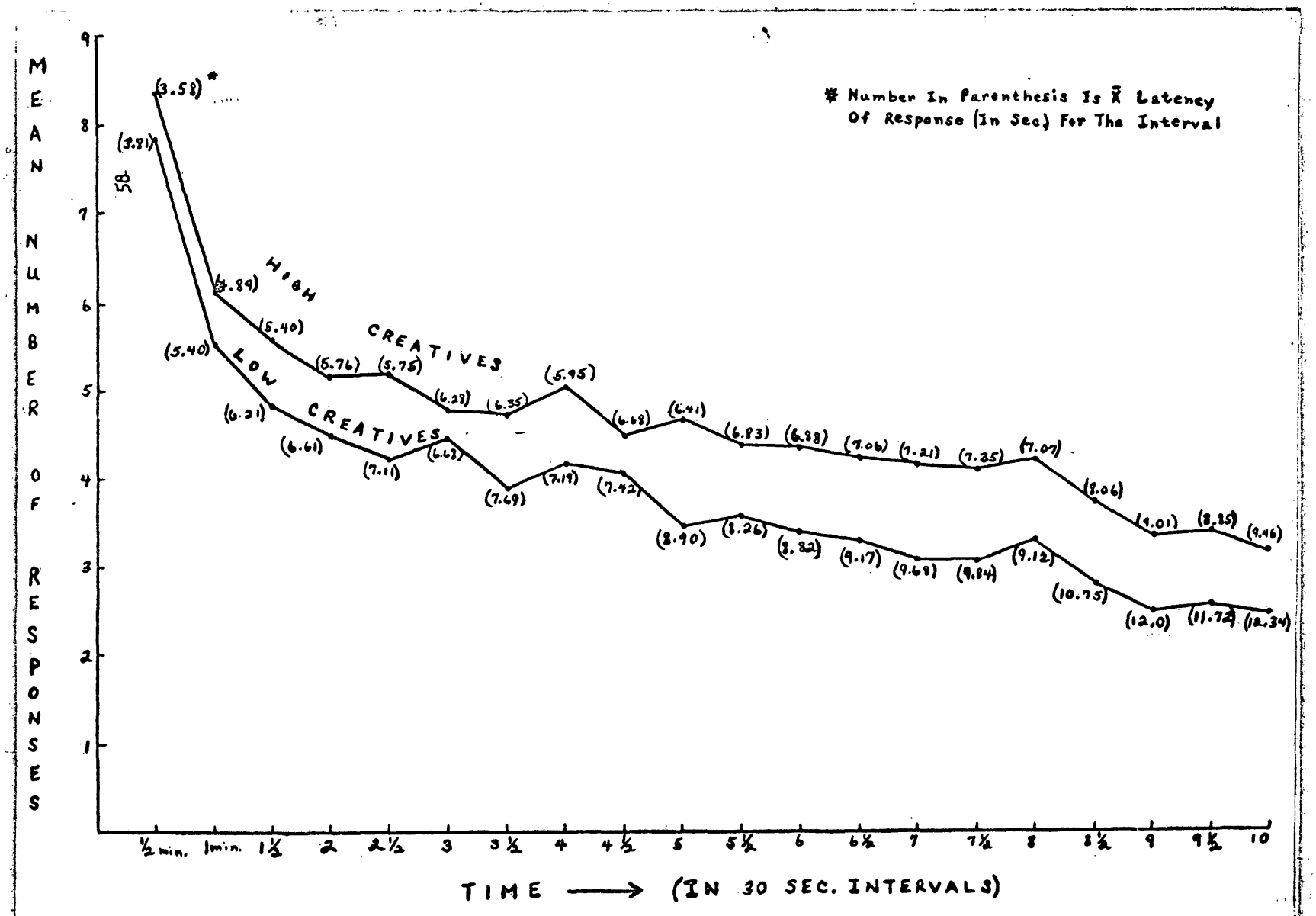


Fig. III. MEAN RATE OF RESPONDING

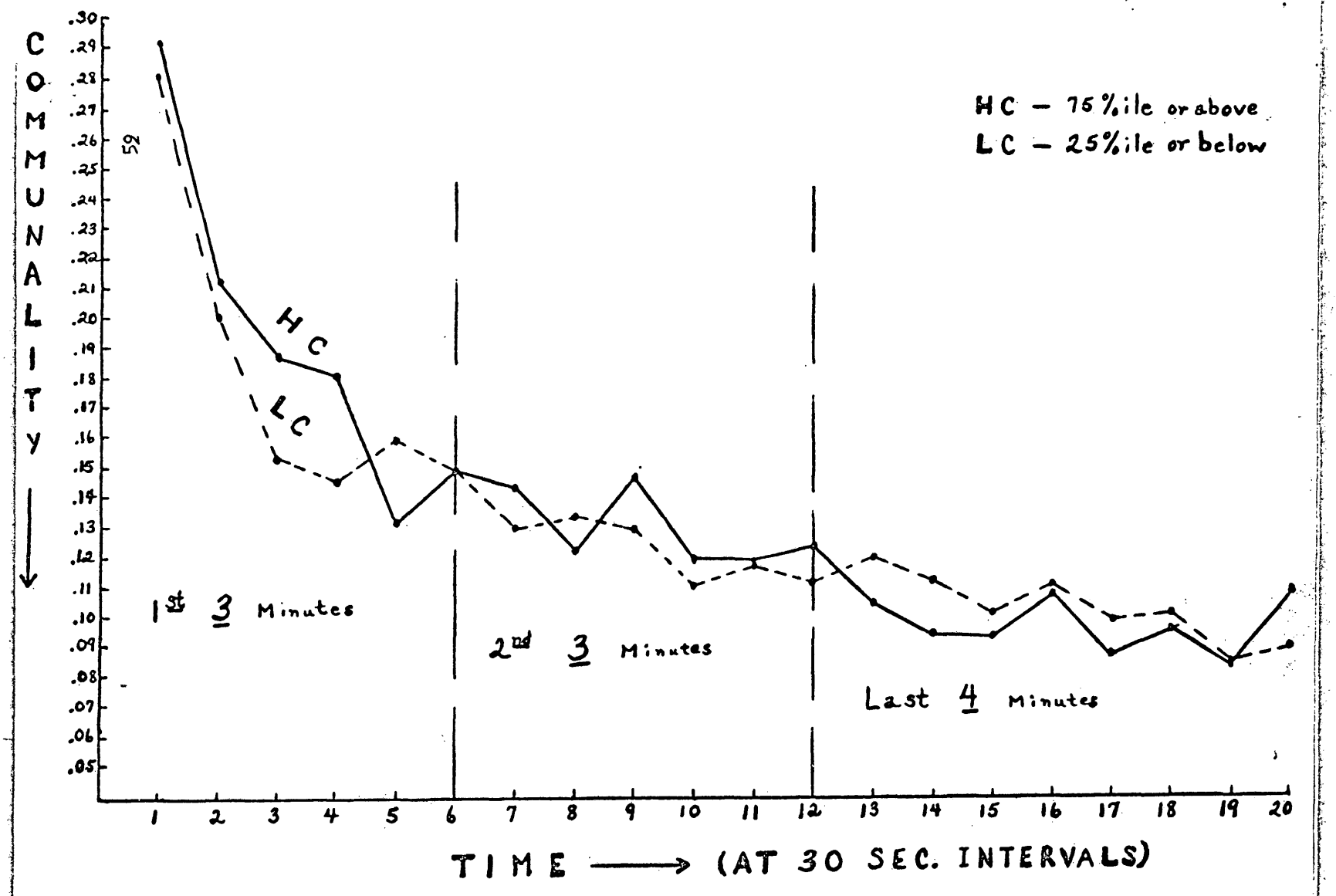


Fig. IV. MEAN COMMUNALITY SCORES

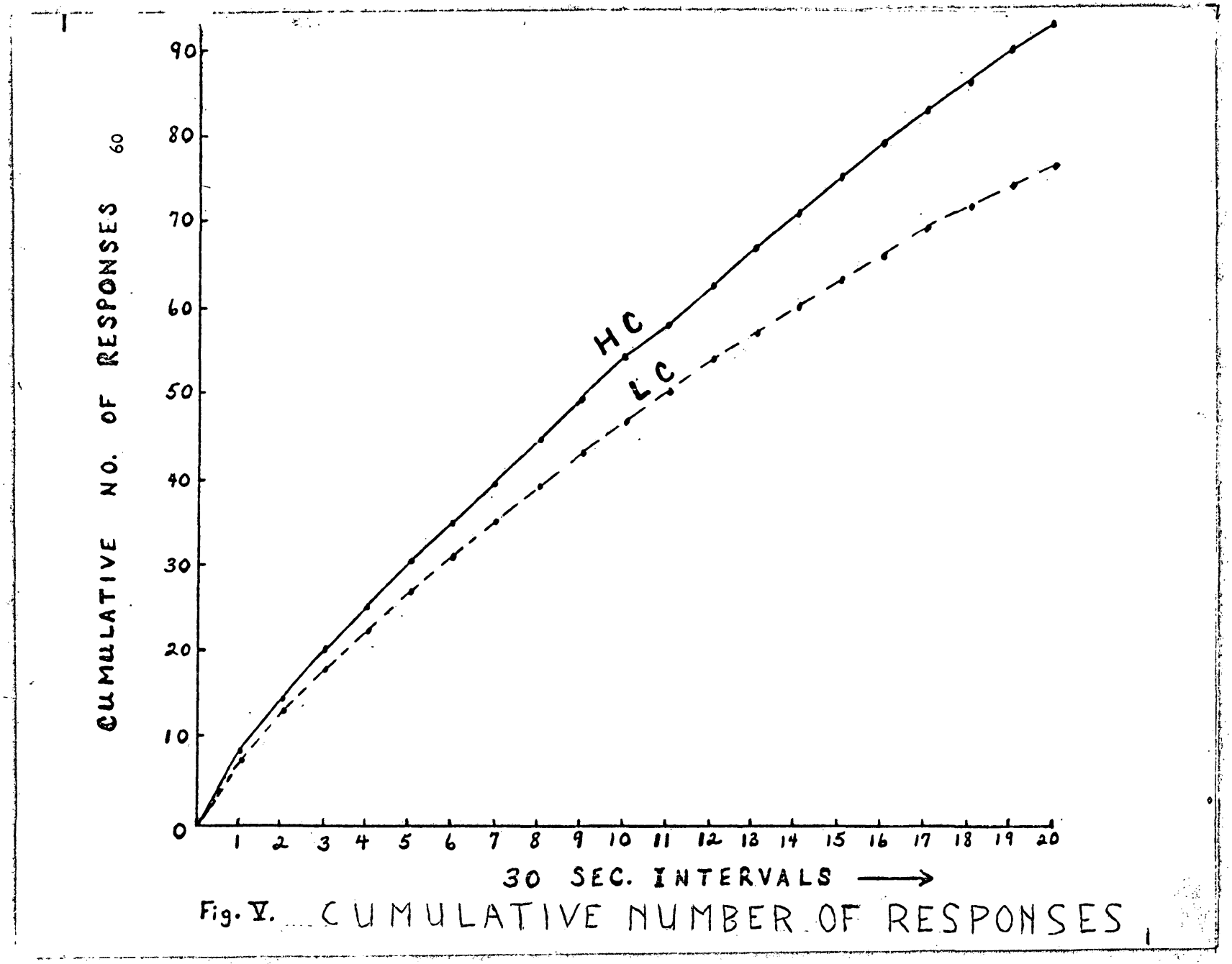


Fig. V. CUMULATIVE NUMBER OF RESPONSES

TABLE V

Mean Latency, Communality and Total Responses
For H.C.'s and L.C.'s - At Half-Minute Intervals

H.C.'s	Latency in Secs.	Comm.	Total R's	L.C.'s	Latency in Secs.	Comm.	Total R's
1st 30 seconds	3.58	.291	8.37	1st. 30 sec.	3.81	.281	7.87
2nd 30 seconds	4.89	.211	6.13	2nd " "	5.40	.199	5.55
3rd " "	5.40	.187	5.55	3rd " "	6.21	.152	4.83
4th " "	5.76	.181	5.21	4th " "	6.61	.146	4.54
5th " "	5.75	.132	5.22	5th " "	7.11	.188	4.22
6th " "	6.28	.150	4.78	6th " "	6.68	.150	4.49
7th " "	6.35	.143	4.72	7th " "	7.69	.131	3.90
8th " "	5.95	.122	5.04	8th " "	7.19	.133	4.17
9th " "	6.68	.147	4.49	9th " "	7.42	.130	4.04
10th " "	6.41	.119	4.68	10th " "	8.90	.110	3.37
11th " "	6.83	.119	4.39	11th " "	8.26	.118	3.63
12th " "	6.88	.123	4.36	12th " "	8.82	.112	3.40
13th " "	7.06	.105	4.25	13th " "	9.17	.120	3.27
14th " "	7.21	.095	4.16	14th " "	9.68	.113	3.10
15th " "	7.35	.094	4.08	15th " "	9.84	.101	3.05
16th " "	7.07	.109	4.24	16th " "	9.12	.111	3.29
17th " "	8.06	.088	3.72	17th " "	10.75	.099	2.79
18th " "	9.01	.097	3.33	18th " "	12.0	.101	2.50
19th " "	8.85	.084	3.39	19th " "	11.72	.085	2.56
20th " "	9.46	.109	3.17	20th " "	12.34	.091	4.43

Table V summarizes and compares the data for the HC's and LC's. Mean Latency of response in seconds, mean communality scores, and mean total responses for each thirty second interval are presented. This further illustrates the little difference found, at any time, between the HC's and LC's. The only difference is in the latency scores, as shown in the previous figure (Figure V).

DISCUSSION

Hypothesis I. The Relationship Between RAT Scores and Total Number of Responses.

It was predicted that RAT scores would relate positively to total number of responses. In other words, the more creative the individual (in terms of RAT scores), the greater the number of associations he would have on a word association test. This was postulated by Mednick to be necessary if a more creative solution was to be found to any problem. Only a very low positive and insignificant correlation was found between these two variables (Table II); therefore, hypothesis I must be rejected. This is in direct disagreement with Mednick's notion that an individual must have the requisite elements in his response repertoire (in this case, more associations to any word), if he is to arrive at a creative solution.

Hypothesis II. The Relationship Between RAT Scores and Total Mean Communality Scores.

Referring again to Table II, it can be seen that a low positive relationship was obtained between these two variables. This, although insignificant, is in the opposite direction from Mednick's prediction and the hypothesis presented in the introduction. Mednick predicted that highly creative subjects must have remote associations (i.e. lower communality scores) since "these more mutually remote elements in new combinations"

(on the RAT) are involved in the more creative processes or solutions. Therefore, hypothesis II must also be rejected.

Hypothesis III. Relationship Between RAT Scores and Rates of Responding at Different Intervals.

If Index 3 is compared with Indices 4 through 7 in Table II, it can be seen that in no interval, including total rate for the whole ten minutes, did RAT Scores vary inversely with rate of responding. Mednick stated that the higher creatives would respond more slowly in the initial stages of an associative sequence because their associative strength around words is less dominant for sterotyped or common responses than low creatives (although both would produce common associates initially). Although RAT scores did vary directly with rate of responding in the last four minutes, this was so far from statistical significance that hypothesis III must also be rejected.

Hypothesis IV. Relationship Between RAT Scores and Communality at Different Intervals.

Since Mednick proposed that high creatives would produce common associatives, the same as low creatives, initially in the associative sequence, but would reach the more remote or uncommon associates later in the sequence; it was predicted that RAT scores would be negatively correlated with communality of associates only in the second and third intervals (second three and last four minutes, respectively). If we again refer to Table II, Index 3

compared with indices 9-11 will show that although the relationships do move in the right direction with time, that is, from positive to negative, none of these are significant. Therefore, hypothesis IV must also be rejected.

Other Correlational Relationships

Although none of the main hypotheses in this study were supported, it is worthwhile to discuss some of the correlations which were significant, particularly as they relate to associative behavior or the RAT.

The only variable which was found to relate to the RAT was SAT - Verbal ability. This is in agreement with the literature in that Wallach and Kogan (1965) reported that there is usually found a correlation from .25 to .45 between tests of creativity and intelligence indices.

Variable 13, unique responses, which was added to the matrix in order to assess the ability or lack of ability of this variable to indicate remoteness of responses, was found to relate to all measures of communality and in the correct direction (negative). Therefore, it can be concluded that unique or idiosyncratic responses are indicative to some degree, of remoteness of responses on an association test. In fact, it was found that this variable contributed approximately thirty-six percent of the variance on variables 4-8, the rate of responding scores and total responses. This was a greater amount of variance than any of the communality scores were able to predict on these variables (compare indices 4-8 with 9-12).

It was found that variables 4-13, all the word association measures, were all related with each other significantly. Of course, as stated earlier, the interrelationships between the

rate and communality scores with their respective total scores is spurious, but it still might be concluded that a three-minute test of word association is as representative a sample of an associative hierarchy as in a ten-minute test. Therefore, Mednick, Mednick and Jung's (1964) criticism of the short time limit usually allowed to respond in association tests may not be applicable here.

The high correlation found between total rate and total responses is to be expected since the faster one responds, the greater number of responses he makes (compare Index 7 with 8). It is interesting to note that rate of responding in the middle three minutes is the most predictive of the total rate. In fact, this middle interval score seems to be the most predictive (of the rate scores) of the various communality indices. Futhermore, if indices 5 and 10 are compared with indices 4 and 9 or 6 and 11, it can be concluded that responses produced in the second three minutes have the greatest number of remote associates among them. Also, if the communality score for the same interval is compared to the communality scores for the other intervals, it can be seen that the former is the most predictive of the other associative variables (e.g. compare Index 9's correlations with 10's and 11's). Therefore, the possibility now arises that a six minute associative test, in which subjects will differentiate themselves in the last three minutes would be more appropriate. Still, from observing Table II it can be seen that in all cases the rate measures and the total response measure are significant in

the right direction with the communality of responses; i.e., the more responses a subject produces the more remote are his associations. This is in agreement with Mednick's theory; but since all of these variables, as stated, are not related to RAT scores, the relevance of these results to the subject under investigation in this paper, in the RAT as a measure of creativity, is unanswered.

Finally, the communality for the first three minutes is most predictive of the overall communality score; i.e., this is more evidence for the first three minutes being a representative sample of the associative hierarchy (.905 = variable 9 with variable 12).

In the conclusion of this section, the author must state that actually more questions than answers were generated in the above discussion of the correlations among the associative variables. For example: Is a three minute or a six minute time limit more representative of an associative hierarchy?)2) Why the high degree of interrelatedness among associative measures: Is this related to creativity, some other congitive construct, or simply due to method variance?

General Discussion

What can be concluded about Mednick's theory of the associative basis of creativity from this study? In general, there seems to be little support for his theory in the data obtained herein. Mednick indicated that a continued word association test should differentiate the high creative individual from others. A correlational approach was used in the present study since he also implied that creativity, as a measureable dimension, is a continuous variable, i.e., one that everybody has to some degree. Since this was the case, the hypotheses presented at the end of the introduction were made, and were based, the author believes, directly upon deductions derived from Mednick's theory of the relationship between creative ability as measured by the RAT and the associative hierarchy.

It seemed logical to use the test proposed by Mednick, based upon his theory, to define degree of creativity. It was expected that the higher the number correct on this test, the more associations an individual will have, the more remote associations he will have, and the slower he will respond early in the test, but the faster, in the later stages. That this did not happen could have meant that the dimension or variable being measured by the RAT and defined as creativity could be discrete; and, therefore, the predictions would hold only when the sample is differentiated into high and low creatives.

This possibly being the case, an attempt, however incomplete, was made to differentiate the subjects into high and low creatives, and investigate differences in the critical associative variables between these groups. From observing the results of this attempt (Figures III, IV and V and Tables 4 and 5), the author must conclude that, overall, little support was found here for the proposed relationship between RAT scores and the slope of the associative hierarchy. What must be concluded from these latter results in that the so-called high-creatives (as measured by the RAT) respond at a faster rate at all times, give more responses, and actually give more common responses than low creatives, on a word association test. Therefore, the only results which are in agreement with Mednick's theory (and also the 1964 Mednick, Mednick and Jung study) are the findings that high creatives produce more total responses (although not significantly more, than in this study), and respond at a faster rate in the later stages of the associative sequence.

Friedman (1965) cited an experiment Caron, Ungler, Pardiff, in 1963, which indicated that the use of Maltzman's technique for training originality did not affect RAT scores. He stated that the failure of Maltzman's procedure may have been due to the fact that it is designed to increase the production of unusual associations; whereas, the RAT is constructed so that the correct response to each item is a commonly associated stimulus word, and are often dominant associates. Thus, he concluded, success on the RAT seems

to depend on the production of many associations in a short time, and not on the number of remote associations a subject can produce over a relatively long time. Friedman attempted to test this notion by training subjects to give many associations in a short time, and found that this group produced 3.90 more mean items correct on the RAT than a control group. This was significant beyond the .01 level.

It seems to the author that Friedman's rationale may be particularly relevant to the present results. Since the higher RAT scorers did give more associations, faster, and more common responses than the lower RAT scorers, it is possible that the RAT may be a valid test for differentiating HC's from LC's, but that Mednick's ideas concerning these individuals associative hierarchy may be questionable.

A number of other possible explanations for the present result seem worthy of consideration and/or further research: 1) The procedure used in the association test was not sensitive enough, meaning that a more precise measure of reaction time, to more words, and with different types of associative tasks (such as respond with ideas, etc.) may be called for. 2) Maybe even more time is needed to completely exhaust any and all subjects" associative repertoire, and it is in the last, undefined intervals that subjects differentiate themselves into higher and lower creatives as defined by RAT scores. 3) Or, the date must be analyzed more closely, i.e., <u>within</u> the half

minute intervals, especially the first. This is relevant to the first possibility in that maybe exact reaction times, for each individual, obtained by the use of a voice key, or as Woodworth and Schlosberg (1954) suggested, a snap switch, is needed. 4) there is the possibility that, as Mayrand* (1966) found, there is a convergent ability involved in scoring high on the RAT. Mayrand found a significant positive correlation between a convergent task and the RAT. Therefore, it may be that those subjects who can give more total responses, and at a faster rate, are not necessarily able to bring these associations together in any kind of coherent, meaningful organization, and are not creative as defined by Mednick. In lieu of this possibility a test which asked subjects to use their associations in some meaningful fashion (such as write a short essay), using as many of the words as possible, might have better differentiated high creatives from low creatives in the present study. 5) There is the possibility that the RAT and its rationals are not valid, and that a search for a criterion that more adequately predicts associative behavior is called for. Of course, there is also the possibility that associative behavior on a word association test, in and of itself, is in no way related to so-called creative behavior. If this were the case, the construct validity of Mednick's associative theory, in general, would be questionable; and one of the other therories presented in the introduction might prove to be a better starting orientation from which to conduct research in this intriguing, though baffling, area.

*Mayrand, C. E. - The relationship of the divergent and convergent associative processes to Mednick's response hierarchy theory of association. Paper presented at The Virginia Academy of Sciences, Harrisonburg, Virginia, May, 1966.

APPENDIX A

RAW DATA FOR ALL SUBJECTS

Subj. #	1*	2	3	4	5	6	7	8	9	10	11	12	13
1	448	546	23	4.63	3.97	3.91	4.15	83.0	.16	.68	.09	.12	75
2	664	629	23	3.83	2.28	1.75	2.53	50.67	.21	.12	.11	.15	56
3	605	565	23	4.44	3.63	3.72	3.98	78.33	.25	.15	.13	.18	33
4	616	626	23	6.95	5.44	5.10	5.75	115.17	.25	.24	.14	.22	14
5	600	571	24	3.22	1.95	1.42	2.12	42.33	.29	.22	.16	.26	2
6	605	514	25	3.75	3.70	3.00	4.06	80.67	.19	.14	.13	.15	39
7	644	398	23	4.33	3.30	2.50	3.29	65.83	.27	.15	.10	.20	13
8	477	431	23	4.05	2.72	7.29	2.95	59.00	.19	.12	.15	.16	45
9	564	562	23	7.19	5.97	5.23	6.04	120.83	.19	.08	.06	.11	84
10	655	690	23	5.83	5.00	4.19	4.92	98.50	.15	.11	.10	.13	78
11	743	712	24	8.69	7.16	5.29	6.87	137.50	.22	.12	.09	.15	52
12	669	622	22	4.72	3.25	2.81	3.52	70.93	.13	.11	.10	.12	118
13	660	674	26	5.58	4.41	3.64	4.45	89.16	.29	.13	.14	.20	21
14	620	617	30	3.58	2.31	1.87	2.52	50.33	.17	.10	.05	.11	105
15	357	389	23	6.58	5.36	4.91	5.55	110.00	.18	.19	.10	.13	81
16	605	573	22	4.22	2.86	2.02	2.93	58.67	.28	.19	.11	.18	13
17	575	576	26	6.19	5.25	4.52	5.19	103.83	.14	.08	.06	.09	90
18	616	697	23	5.11	3.94	2.95	3.90	78.0	.15	.10	.08	.11	68
19	673	635	25	4.75	3.52	2.35	3.42	68.50	.24	.18	.15	.19	8
20	605	496	18	4.83	4.00	3.67	4.11	82.33	16	.17	.10	.15	55
21	548	615	21	4.27	2.83	2.04	2.95	59.00	.26	.14	.15	.21	5
22	586	604	21	3.91	2.38	1.66	2.55	51.16	.26	.15	.14	.20	13
23	515	559	18	6.89	5.58	4.31	5.47	109.33	.11	.03	.09	.09	54
24	613	571	18	4.86	2.64	1.97	3.04	60.83	.22	.18	.12	.19	21
25	591	517	21	2.75	1.77	1.60	7.00	40.00	.24	.13	.14	.17	17
26	587	704	18	2.91	2.14	1.73	7.21	44.16	.26	.16	.17	.20	12

* Variable No's Correspond to those in Table II (Page 37)

RAW DATA (CONTINUED)

Subj. #													
	27	641	643	21	622	4.69	4.06	4.90	9800	.22	.13	.09	.15	45
	28	575	576	21	341	2.19	1.56	2.30	46.16	.25	.14	.13	.18	14
	29	628	640	21	6.52	4.33	3.50	4.65	93.16	.22	.11	.11	.16	38
	30	446	442	17	4.47	3.33	2.89	3.50	70.0	.22	.16	.10	.17	32
	31	703	606	21	4.63	3.41	2.58	3.45	69.0	.19	.08	.08	.15	98
	32	527	598	21	4.03	2.64	2.33	2.93	58.67	.24	.18	.20	.21	9
	33	493	383	19	4.33	3.63	3.10	3.63	72.66	.23	.14	.11	.17	30
	34	586	739	18	4.27	2.58	3.44	3.09	61.83	.21	.16	.07	.15	33
	35	548	490	17	4.16	2.55	2.45	3.00	60.0	.23	.14	.13	.17	28
	36	538	511	17	3.31	1.97	1.68	2.26	45.13	.20	.19	.10	.17	18
	37	611	667	19	5.02	3.58	3.20	3.86	77.33	.13	.12	.06	.10	61
	38	554	631	17	5.66	5.16	4.29	4.96	99.33	.16	.10	.09	.12	75
	39	464	573	16	6.19	5.56	4.08	5.16	103.16	.17	.12	.08	.13	55
	40	650	667	17	6.19	4.39	4.00	4.78	95.5	.19	12	.07	.13	69
	41	602	517	19	6.22	5.27	4.50	5.25	105.00	.19	.11	.11	.14	61
	42	556	483	16	6.00	4,25	3.43	4.45	89.0	.19	.24	.06	.13	66
	43	601	623	18	2.78	1.17	.90	1.54	30.83	.27	.11	.18	.25	9
	44	533	474	16	2.91	1.75	1.54	2.01	40.33	.23	.13	.22	.20	19
	45	684	654	19	4.69	2.98	2.12	3.14	62.83	.24	.14	.13	.18	17
	46	573	535	17	6.61	4.28	3.17	4.53	90.67	.20	.18	.14	.17	47
	47	566	483	20	4.86	3.42	2.81	3.61	72.16	.27	.24	.17	.22	15
	48	506	531	18	2.38	1.25	1.31	1.61	32.33	.24	.12	.12	.22	10
	49	641	517	18	4.88	3.94	3.02	3.85	77.16	.12	.16	.06	.11	81
	50	717	571	18	5.58	3.91	3.29	4.16	83.33	.24	.10	.11	.18	70
	51	606	623	18	4.67	3.25	2.19	3.25	65.0	.17	.10	.06	.13	50
	52	482	504	18	3,80	2.50	1.80	2.62	52.50	.24	.17	.13	.18	21

RAW DATA (CONTINUED)

Subj. #53	656	703	17	5.91	4.94	3.83	4.76	95.83	.18	.12	.99	.13	67
54	515	496	20	5.13	4.03	3.44	4.12	82.5	.27	.15	.15	.20	17
55	656	525	19	2.97	1.69	1.02	1.81	36.16	.29	.21	.22	.25	6
56	676	682	19	3.53	1.81	1181	2.33	46.5	.20	.15	.16	.17	14
57	575	576	12	9.38	8.13	3.50	7.45	149.16	.12	.08	.07	.09	153
58	513	431	5	3.28	2.50	2.46	2.72	54.33	.15	.10	.06	.11	48
59	364	590	13	5.60	4.08	3.18	4.24	84.83	.13	.06	.07	.09	74
60	566	626	13	2.47	1.33	.77	1.45	29.0	.20	.16	.13	.17	18
61	635	843	15	4.58	3.39	2.52	3.40	68.0	.19	.11	.10	.15	42
62	686	715	13	6.36	5.58	5.25	5.68	113.66	.17	.13	.08	.13	87
63	579	658	15	3.97	2.36	2.14	2.74	54.88	.27	.18	.10	.70	13
64	587	563	14	6.83	4.61	3.10	4.67	93.50	.12	.12	.06	.11	77
65	451	487	13	5.33	3.70	2.96	3.89	77.83	.22	.11	.14	.19	30
66	592	505	11	4.86	2.83	2.16	3.17	63.5	.22	.12	.10	.18	39
67	406	464	8	4.72	3.69	2.64	3.58	71.67	.24	.11	.12	.13	44
68	421	590	12	7.11	5.16	2.38	4.63	92.67	.15	.11	.16	.18	82
69	563	582	14	4.03	2.86	2.69	3.14	62.83	.23	.18	.11	.10	32
70	506	553	14	4.67	3.83	3.27	4.00	80.0	.20	.20	.29	.17	30
71	678	663	13	4.47	3.27	2.75	3.42	68.5	.23	.10	.16	.10	27
72	597	517	15	7.08	5.63	4.85	5.75	115.16	.13	.09	.06	.17	112
73	598	607	12	7.75	4.72	2.73	4.83	96.67	.14	.27	.25	.17	80
74	575	576	15	4.77	2.64	1.72	2.91	58.33	.19	.22	.12	.18	18
75	492	590	14	4.00	2.19	1.64	2.51	50.33	.19	.18	.17	.16	17
76	441	497	12	4.64	3.39	2.61	3.45	69.00	.20	.10	.15	.12	43
77	496	541	15	4.00	2.97	2.83	3.23	64.5	.15	.13	.06	.12	35

APPENDIX B

FREQUENCY DISTRIBUTIONS OF VARIABLES 3-11

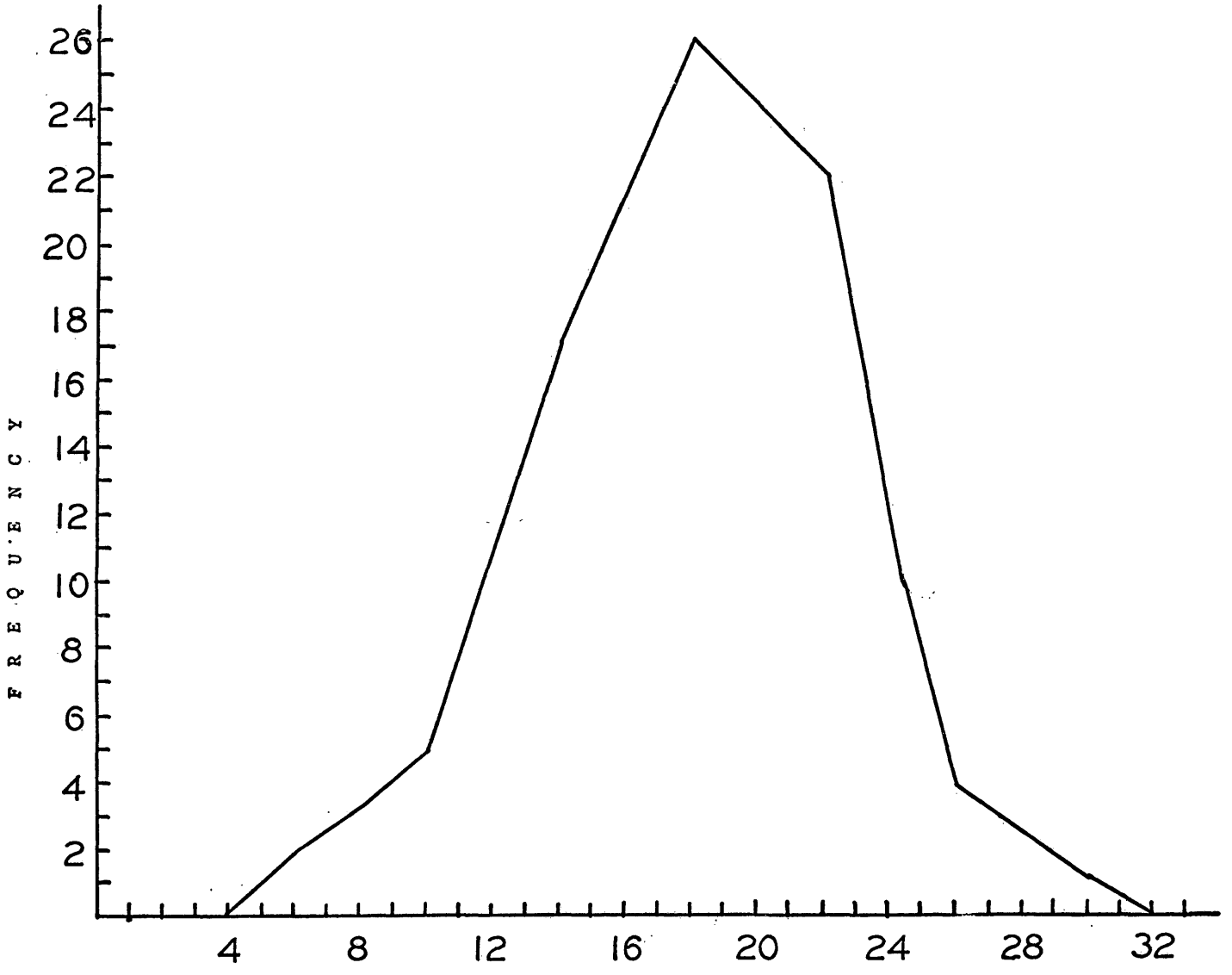

26
24
22
20
18
16
14
12
10
8
6
4
2
FREQUENCY
4
8
12
16
20
24
28
32
RAT - NUMBER CORRECT

FIG. 1

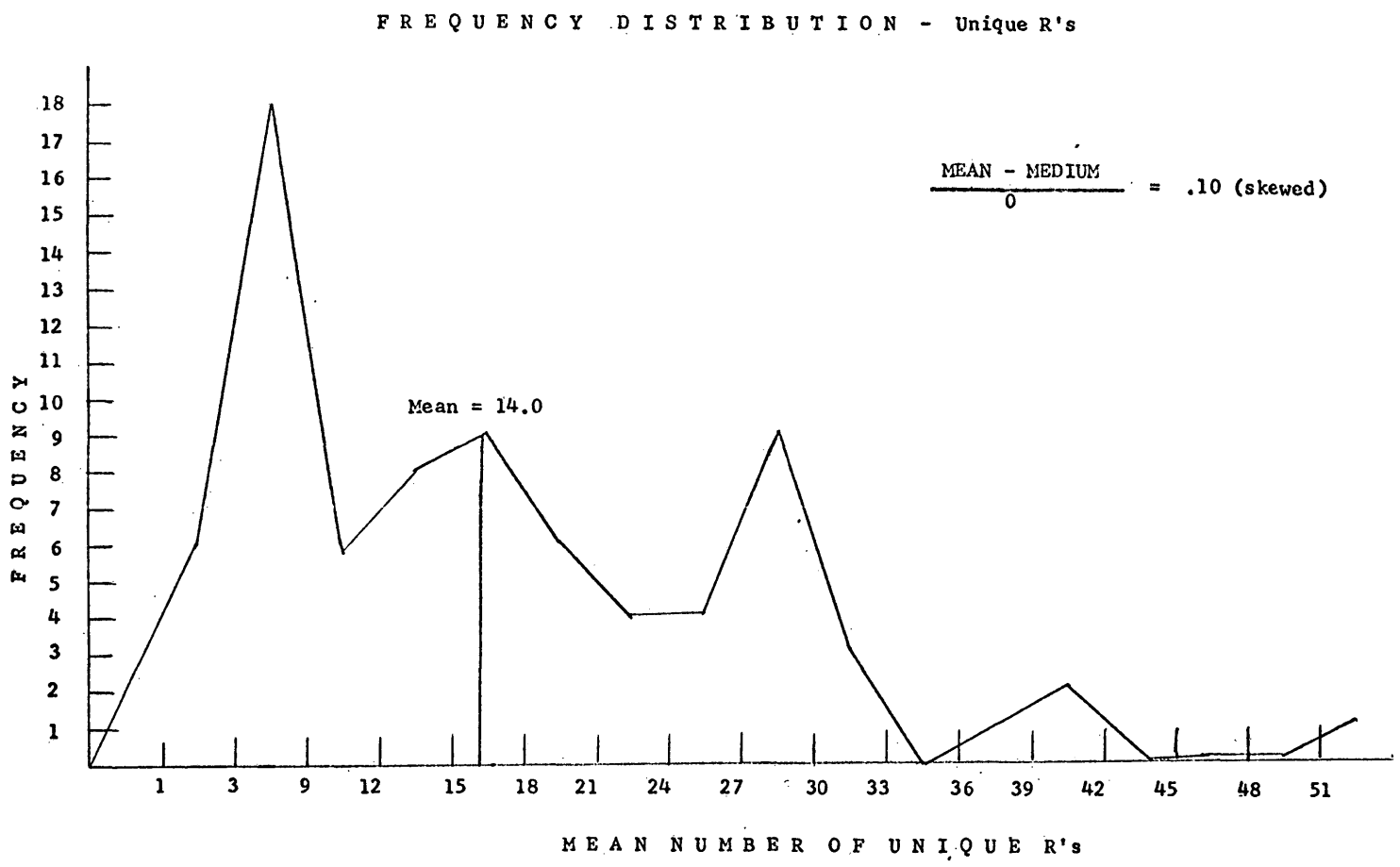

FREQUENCY DISTRIBUTION - Unique R's
MEAN - MEDIUM / 0 = .10 (skewed)
Mean = 14.0
FREQUENCY
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
1 3 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51
MEAN NUMBER OF UNIQUE R's

Fig. 2

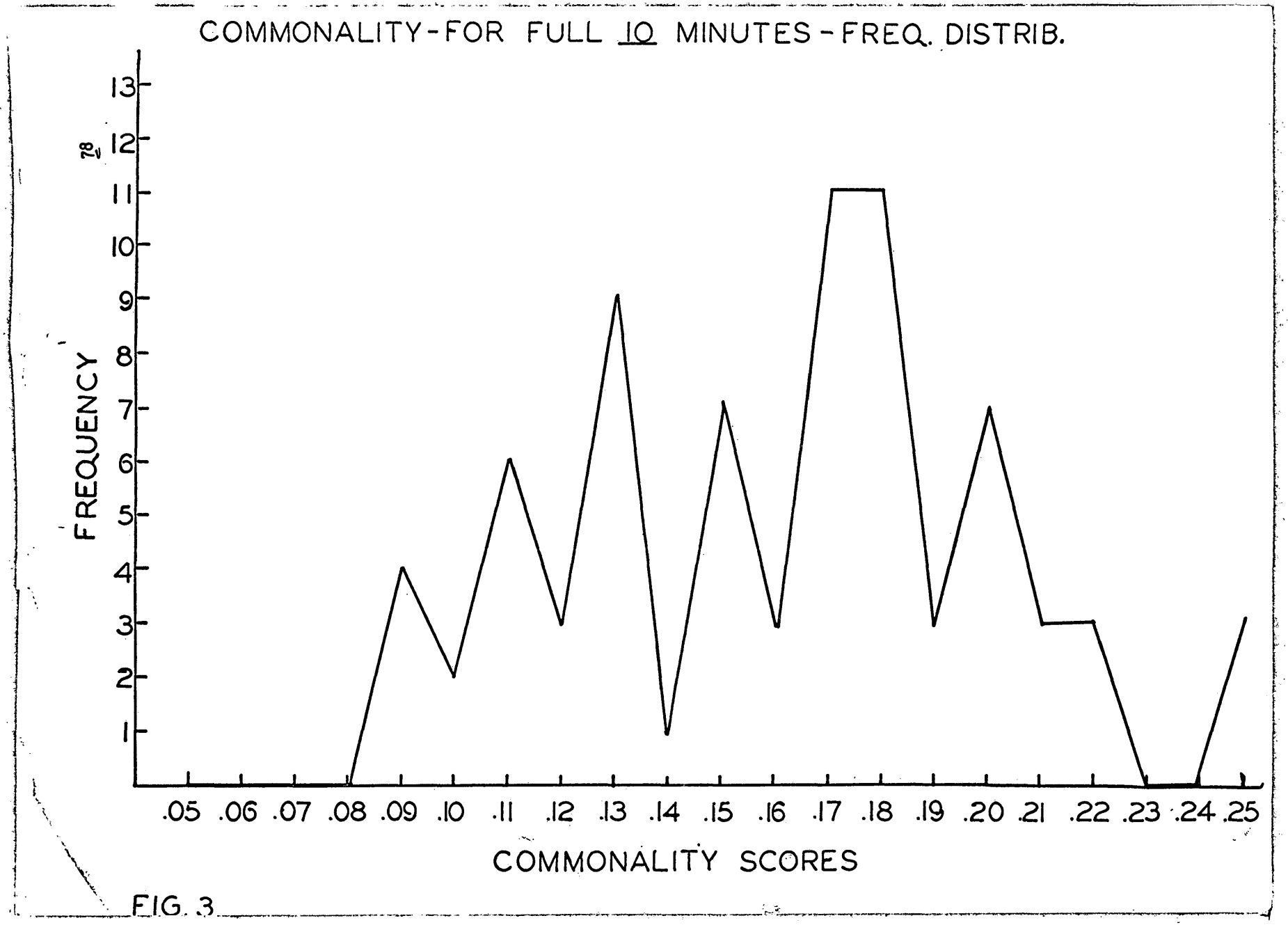

COMMONALITY - FOR FULL 10 MINUTES - FREQ. DISTRIB.
FREQUENCY
78
13
12
11
10
9
8
7
6
5
4
3
2
1
.05 .06 .07 .08 .09 .10 .11 .12 .13 .14 .15 .16 .17 .18 .19 .20 .21 .22 .23 .24 .25
COMMONALITY SCORES

FIG. 3

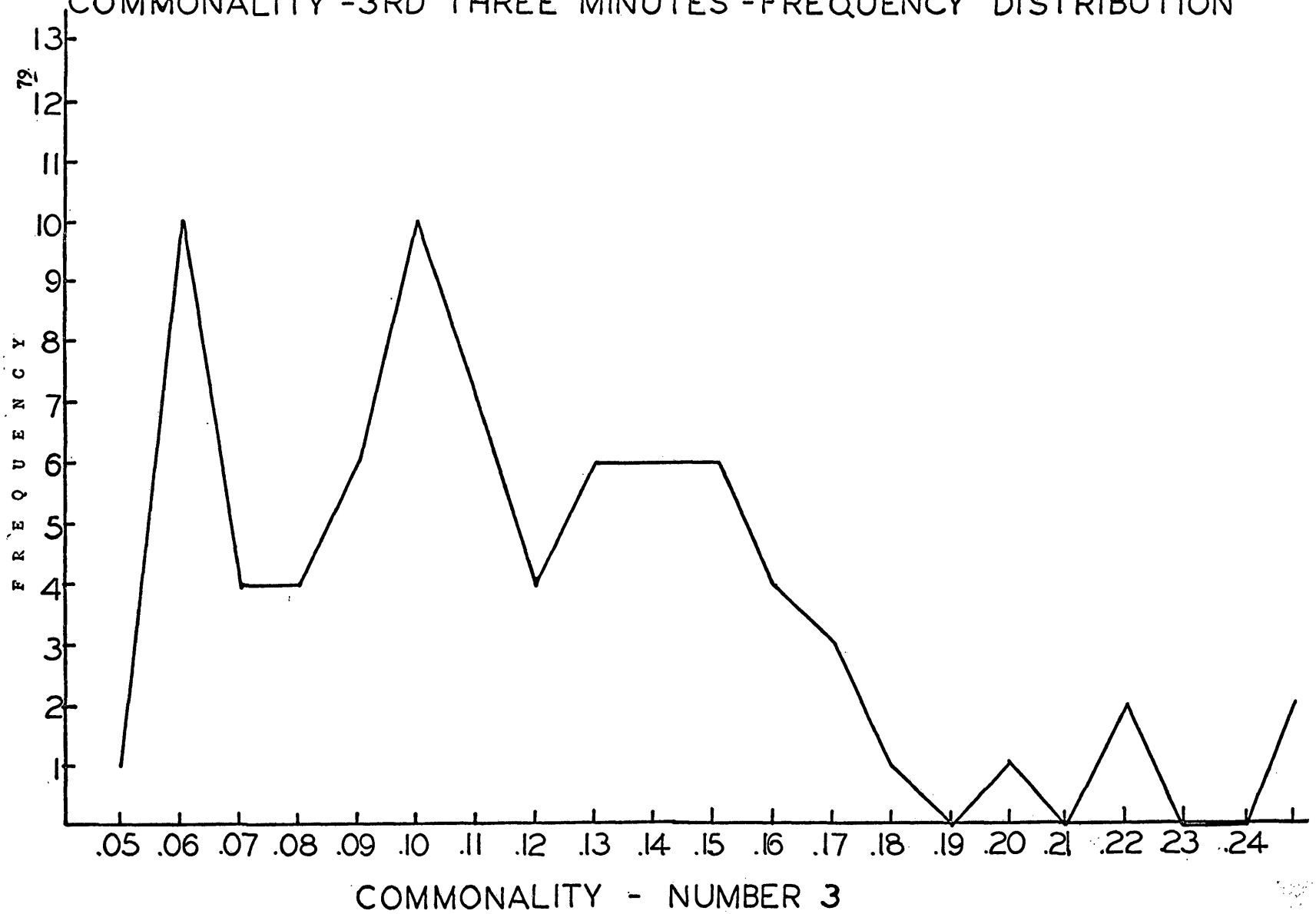

COMMONALITY -3RD THREE MINUTES -FREQUENCY DISTRIBUTION
FREQUENCY
79
13
12
11
10
9
8
7
6
5
4
3
2
1
.05 .06 .07 .08 .09 .10 .11 .12 .13 .14 .15 .16 .17 .18 .19 .20 .21 .22 .23 .24
COMMONALITY - NUMBER 3

FIG. 4

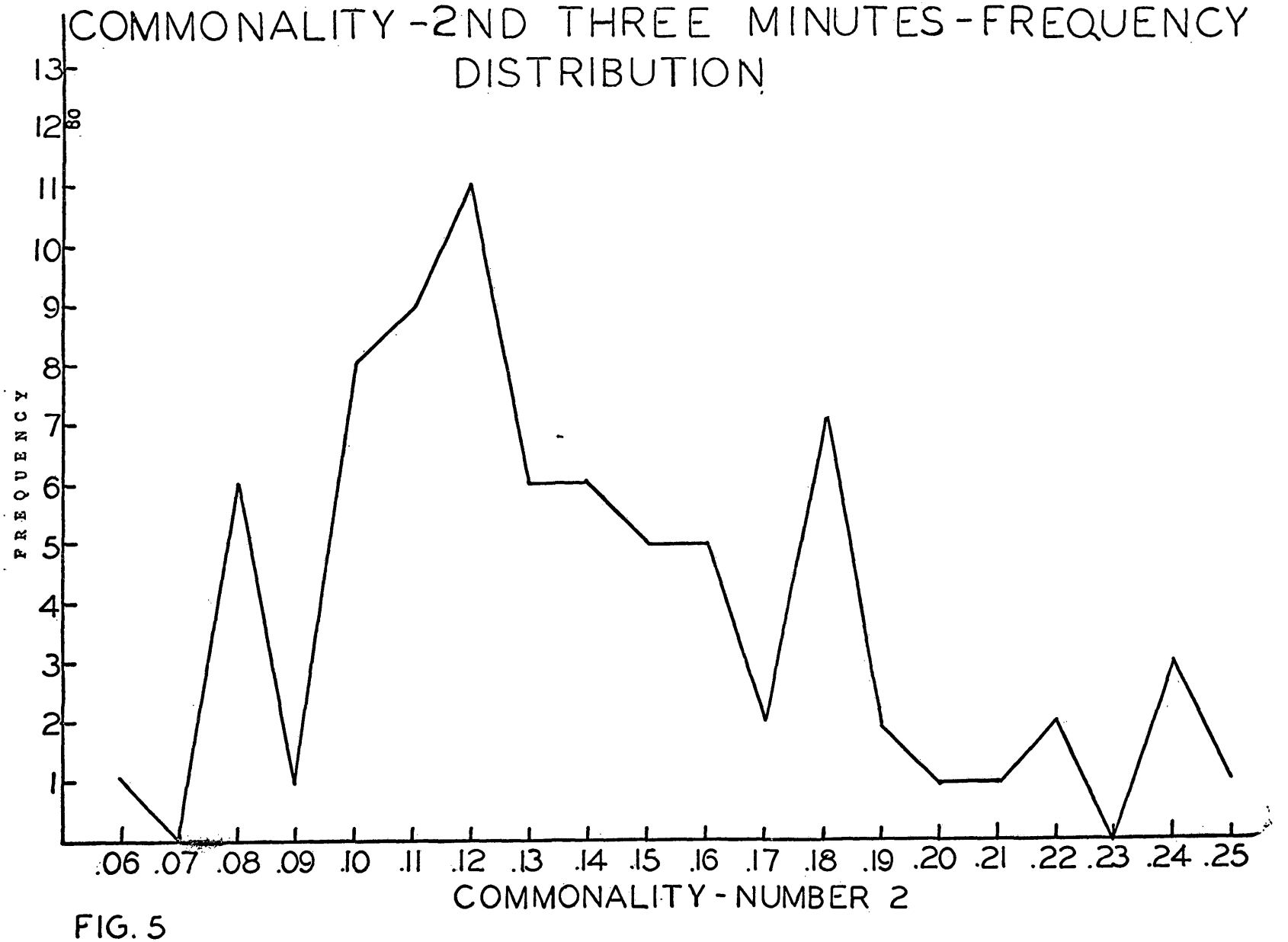

COMMONALITY - 2ND THREE MINUTES - FREQUENCY DISTRIBUTION
FREQUENCY
13
12
11
10
9
8
7
6
5
4
3
2
1
.06 .07 .08 .09 .10 .11 .12 .13 .14 .15 .16 .17 .18 .19 .20 .21 .22 .23 .24 .25
COMMONALITY - NUMBER 2

FIG. 5

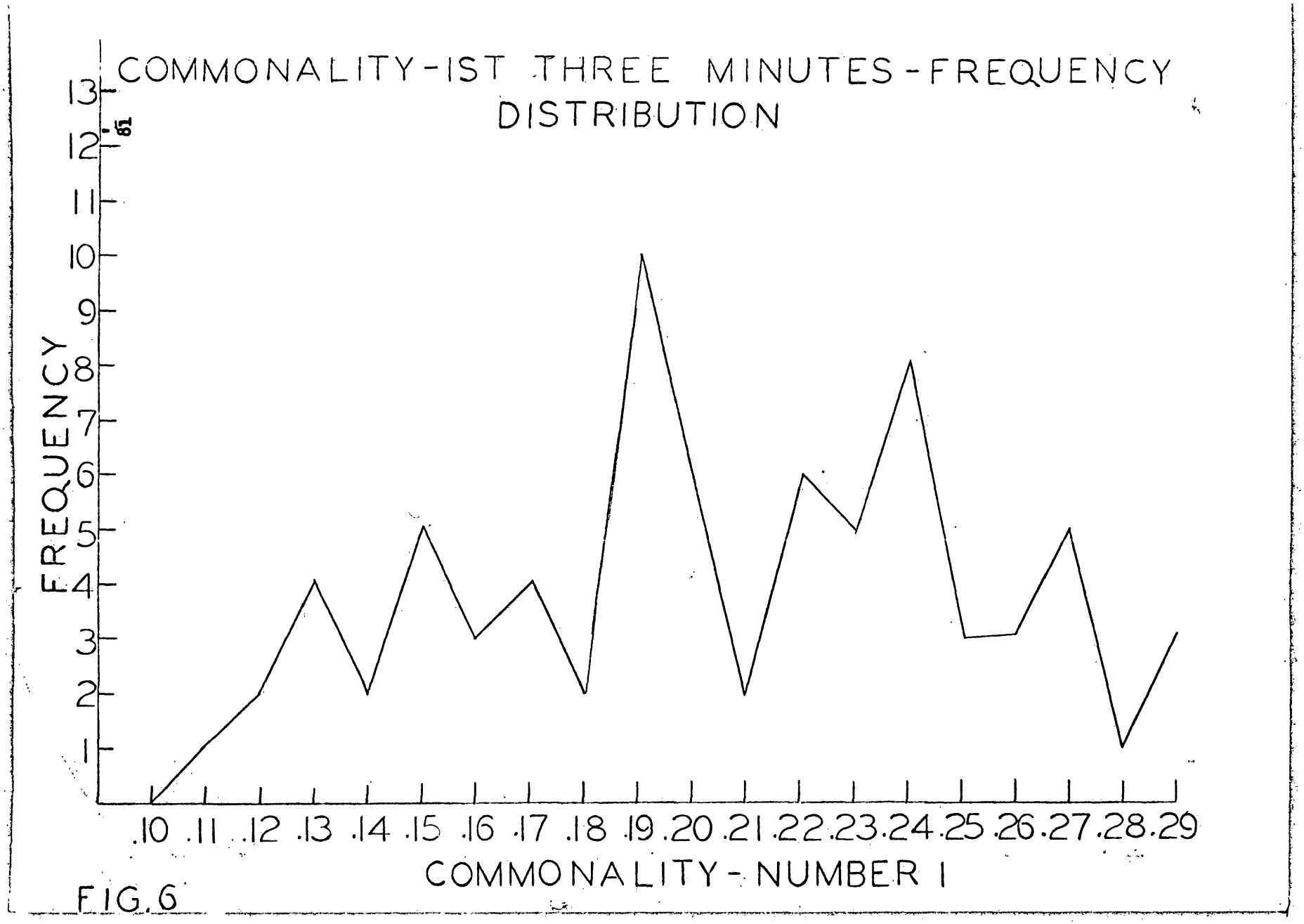

COMMONALITY - IST THREE MINUTES - FREQUENCY DISTRIBUTION
FREQUENCY
13
12
11
10
9
8
7
6
5
4
3
2
1
.10 .11 .12 .13 .14 .15 .16 .17 .18 .19 .20 .21 .22 .23 .24 .25 .26 .27 .28 .29
COMMONALITY - NUMBER 1

FIG. 6

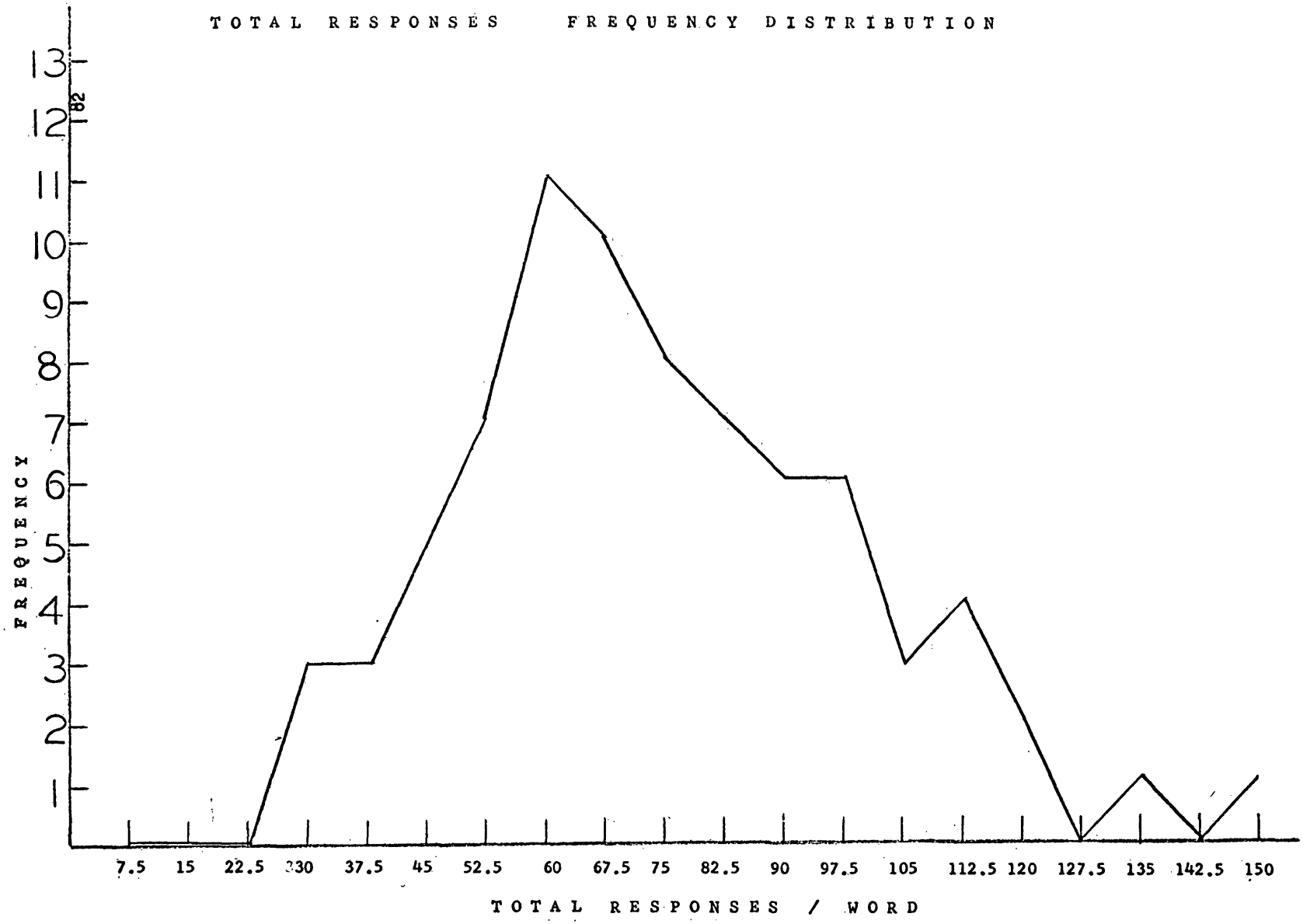

TOTAL RESPONSES FREQUENCY DISTRIBUTION
FREQUENCY
13
12
11
10
9
8
7
6
5
4
3
2
1
82
7.5 15 22.5 30 37.5 45 52.5 60 67.5 75 82.5 90 97.5 105 112.5 120 127.5 135 142.5 150
TOTAL RESPONSES / WORD

Fig. 7

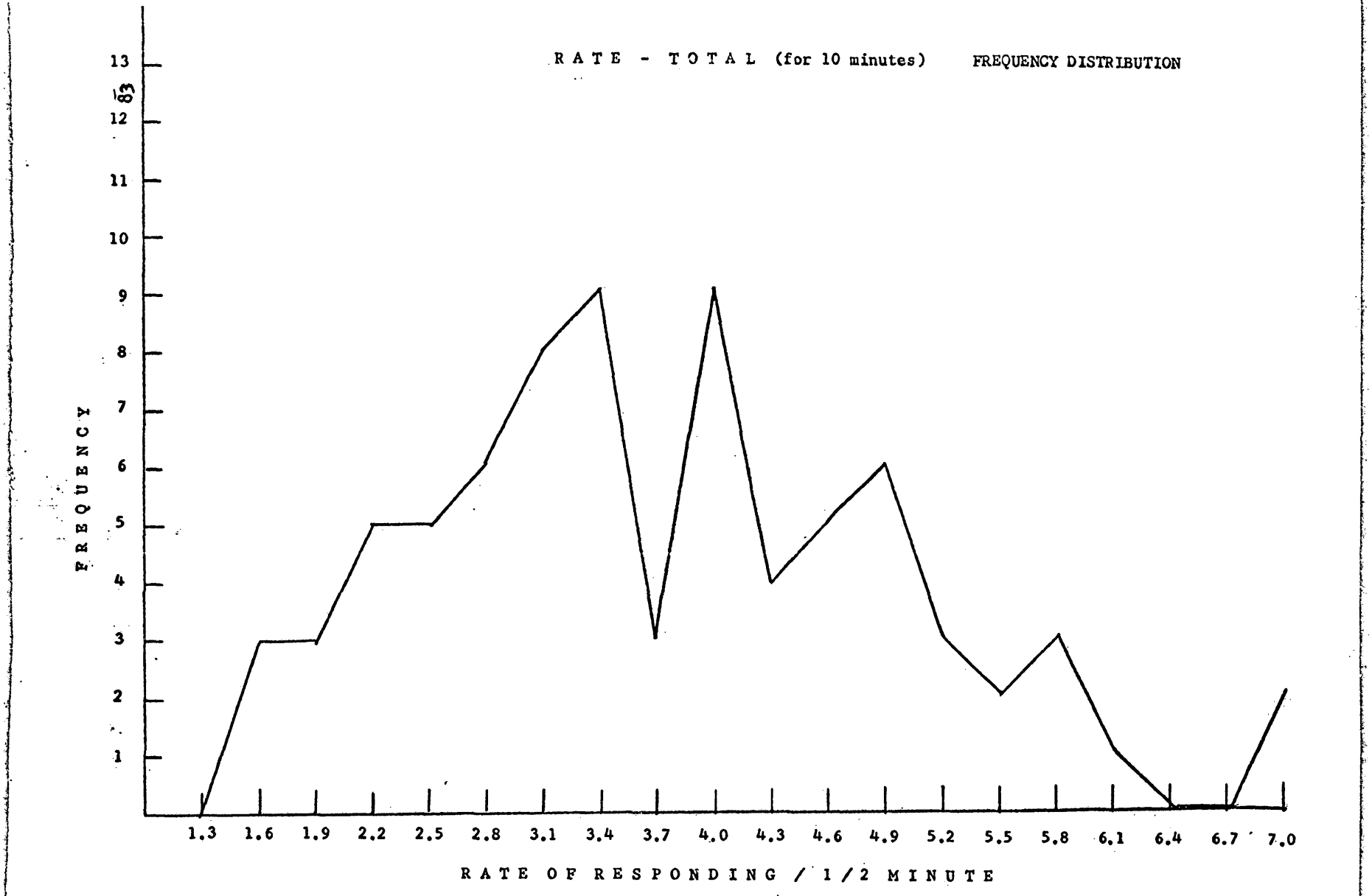

RATE - TOTAL (for 10 minutes) FREQUENCY DISTRIBUTION
FREQUENCY
13
12
11
10
9
8
7
6
5
4
3
2
1
1.3 1.6 1.9 2.2 2.5 2.8 3.1 3.4 3.7 4.0 4.3 4.6 4.9 5.2 5.5 5.8 6.1 6.4 6.7 7.0
RATE OF RESPONDING / 1/2 MINUTE

Fig. 8

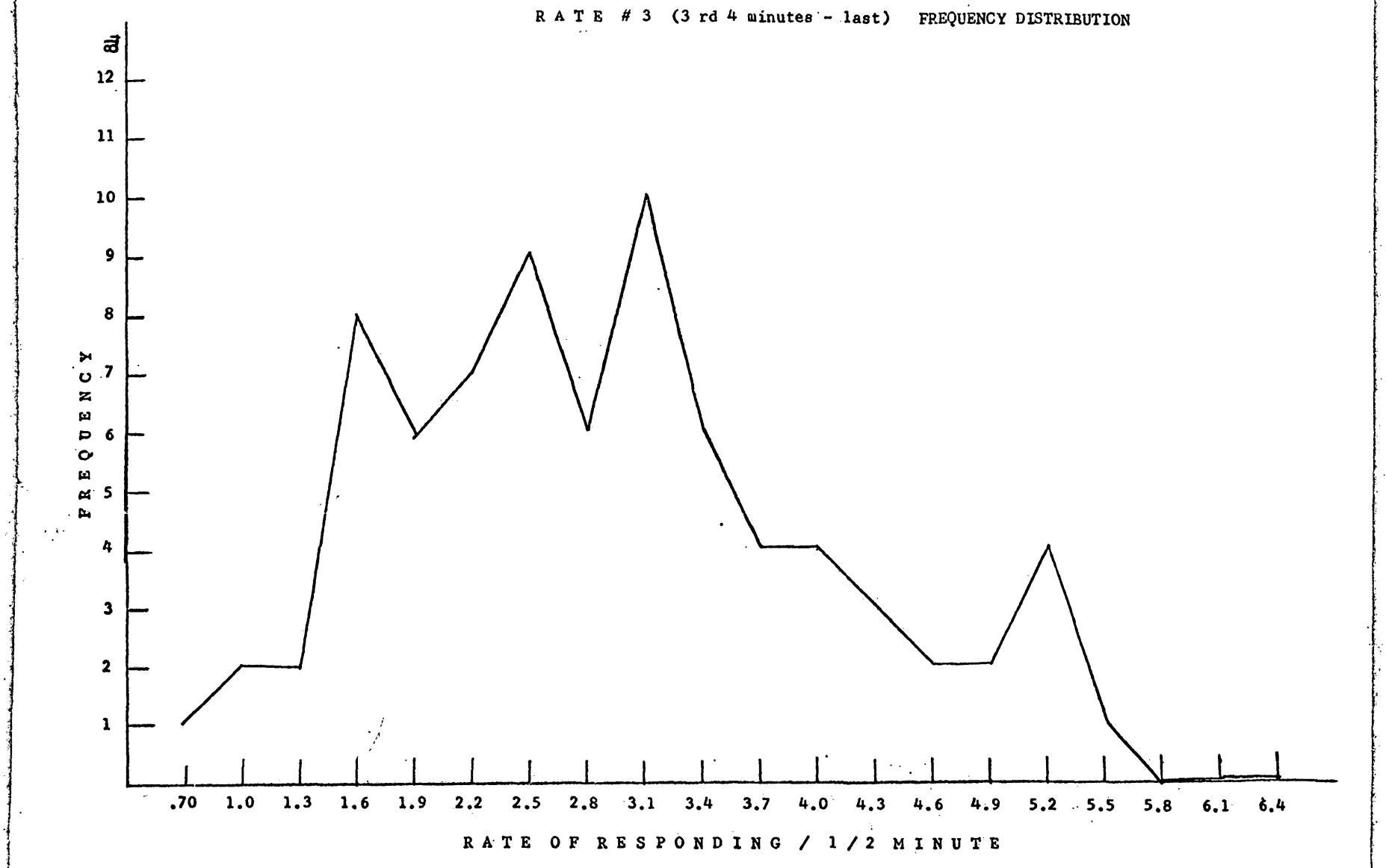

R A T E # 3 (3 rd 4 minutes - last) FREQUENCY DISTRIBUTION
FREQUENCY
12
11
10
9
8
7
6
5
4
3
2
1
.70 1.0 1.3 1.6 1.9 2.2 2.5 2.8 3.1 3.4 3.7 4.0 4.3 4.6 4.9 5.2 5.5 5.8 6.1 6.4
R A T E O F R E S P O N D I N G / 1 / 2 M I N U T E

Fig. 9

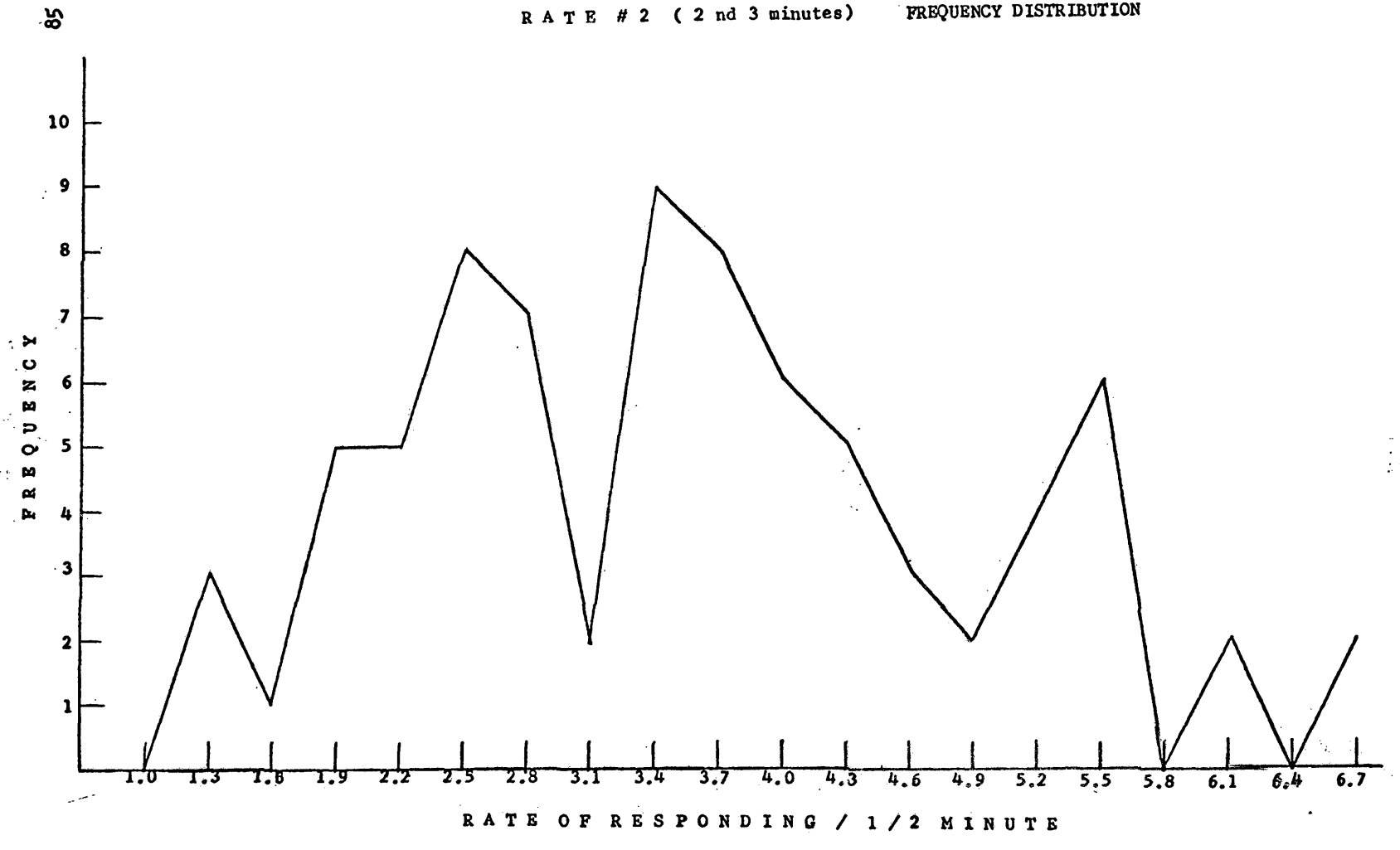

RATE # 2 (2 nd 3 minutes) FREQUENCY DISTRIBUTION
FREQUENCY
10
9
8
7
6
5
4
3
2
1
1.0 1.3 1.6 1.9 2.2 2.5 2.8 3.1 3.4 3.7 4.0 4.3 4.6 4.9 5.2 5.5 5.8 6.1 6.4 6.7
RATE OF RESPONDING / 1/2 MINUTE

Fig. 10

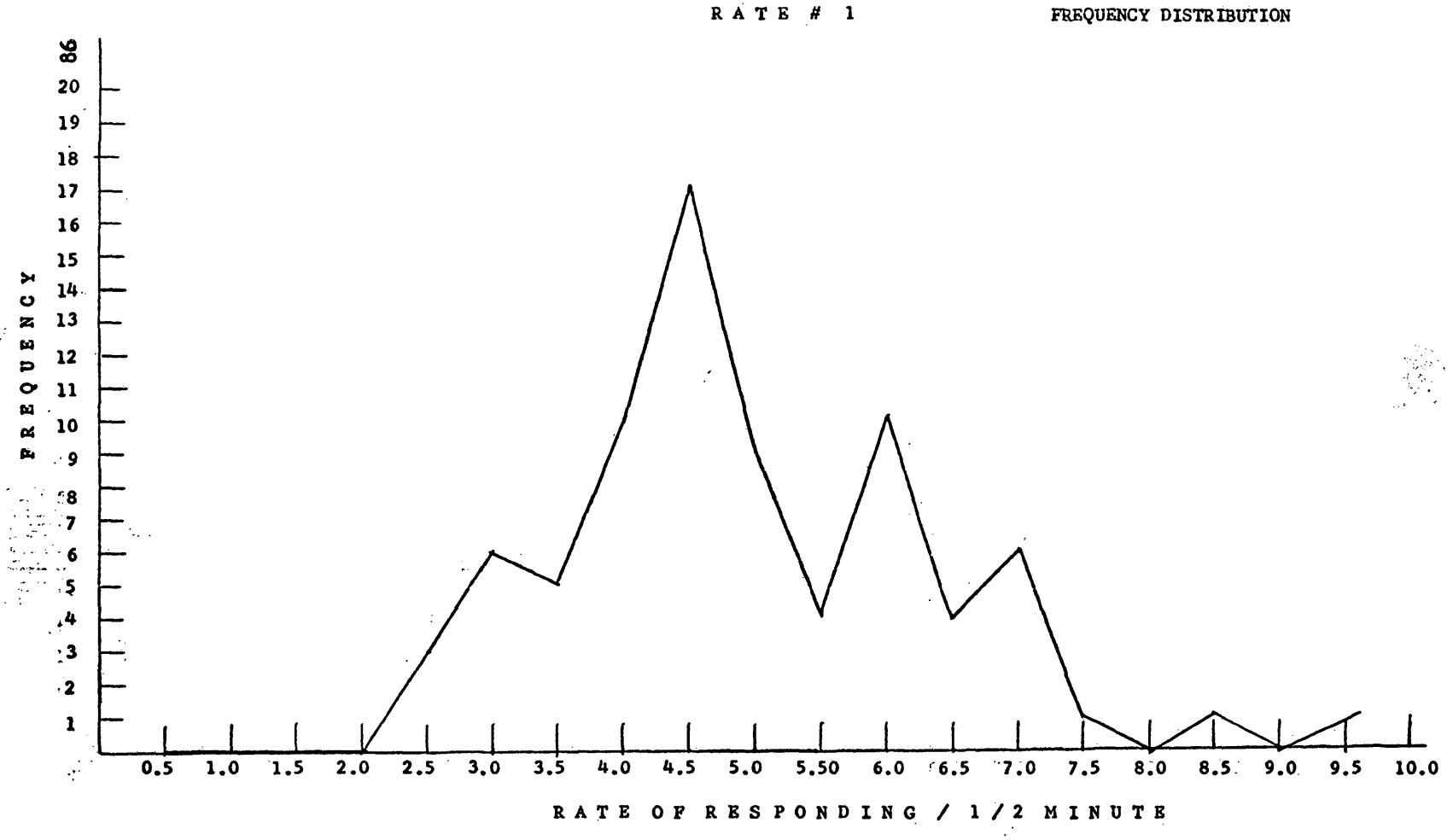

RATE # 1
FREQUENCY DISTRIBUTION
FREQUENCY
86
20
19
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.50
6.0
6.5
7.0
7.5
8.0
8.5
9.0
9.5
10.0
RATE OF RESPONDING / 1/2 MINUTE

Fig. 11

APPENDIX C

SCATTERGRAMS FOR ALL RAT-WORD ASSOCIATION CORRELATIONS

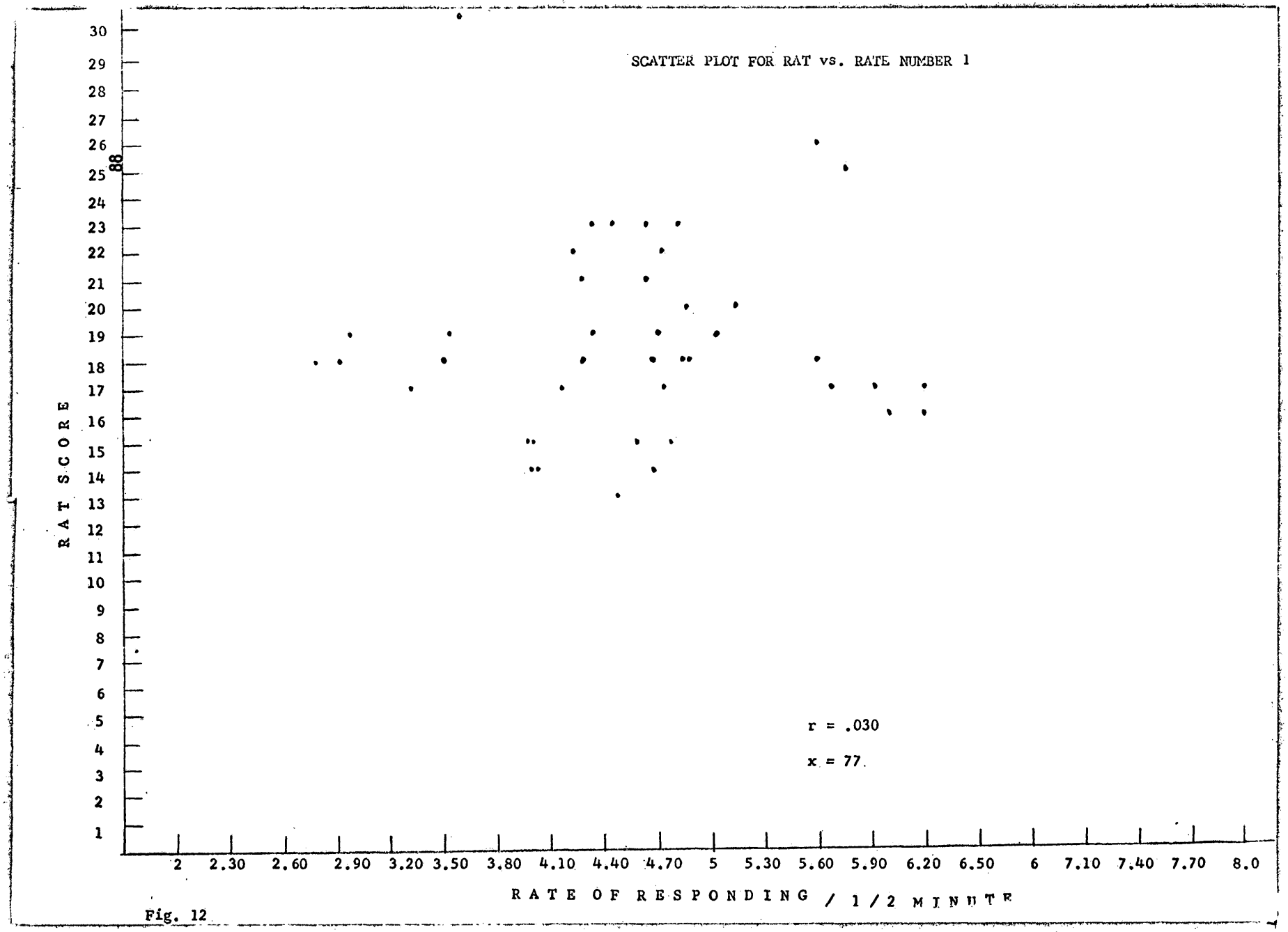

SCATTER PLOT FOR RAT vs. RATE NUMBER 1
RAT SCORE
30
29
28
27
26
25
24
23
22
21
20
19
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
r = .030
x = 77
2
2.30
2.60
2.90
3.20
3.50
3.80
4.10
4.40
4.70
5
5.30
5.60
5.90
6.20
6.50
6
7.10
7.40
7.70
8.0
RATE OF RESPONDING / 1/2 MINUTE

Fig. 12

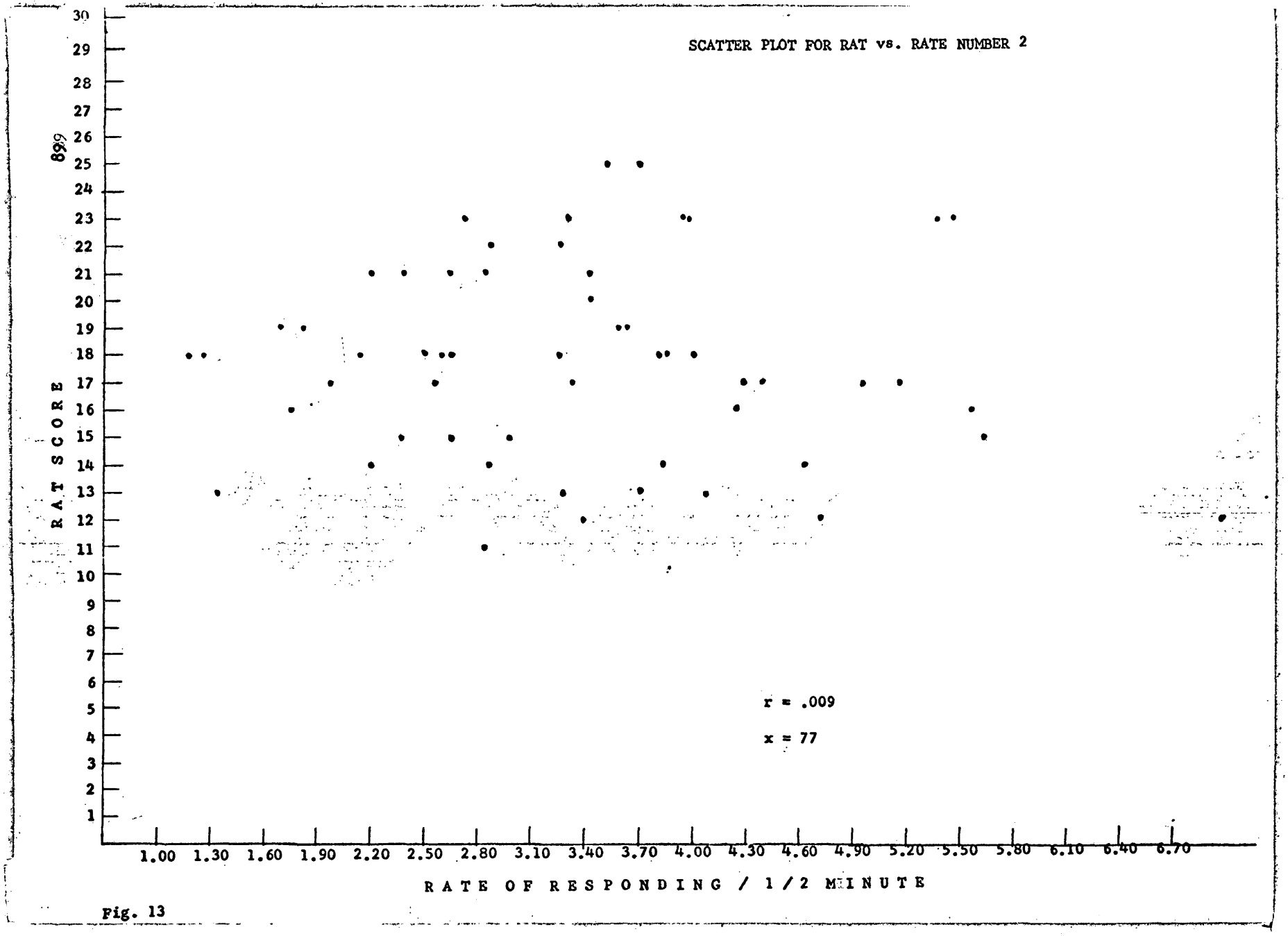

SCATTER PLOT FOR RAT vs. RATE NUMBER 2
899
RAT SCORE
30
29
28
27
26
25
24
23
22
21
20
19
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
r = .009
x = 77
1.00 1.30 1.60 1.90 2.20 2.50 2.80 3.10 3.40 3.70 4.00 4.30 4.60 4.90 5.20 5.50 5.80 6.10 6.40 6.70
RATE OF RESPONDING / 1/2 MINUTE

Fig. 13

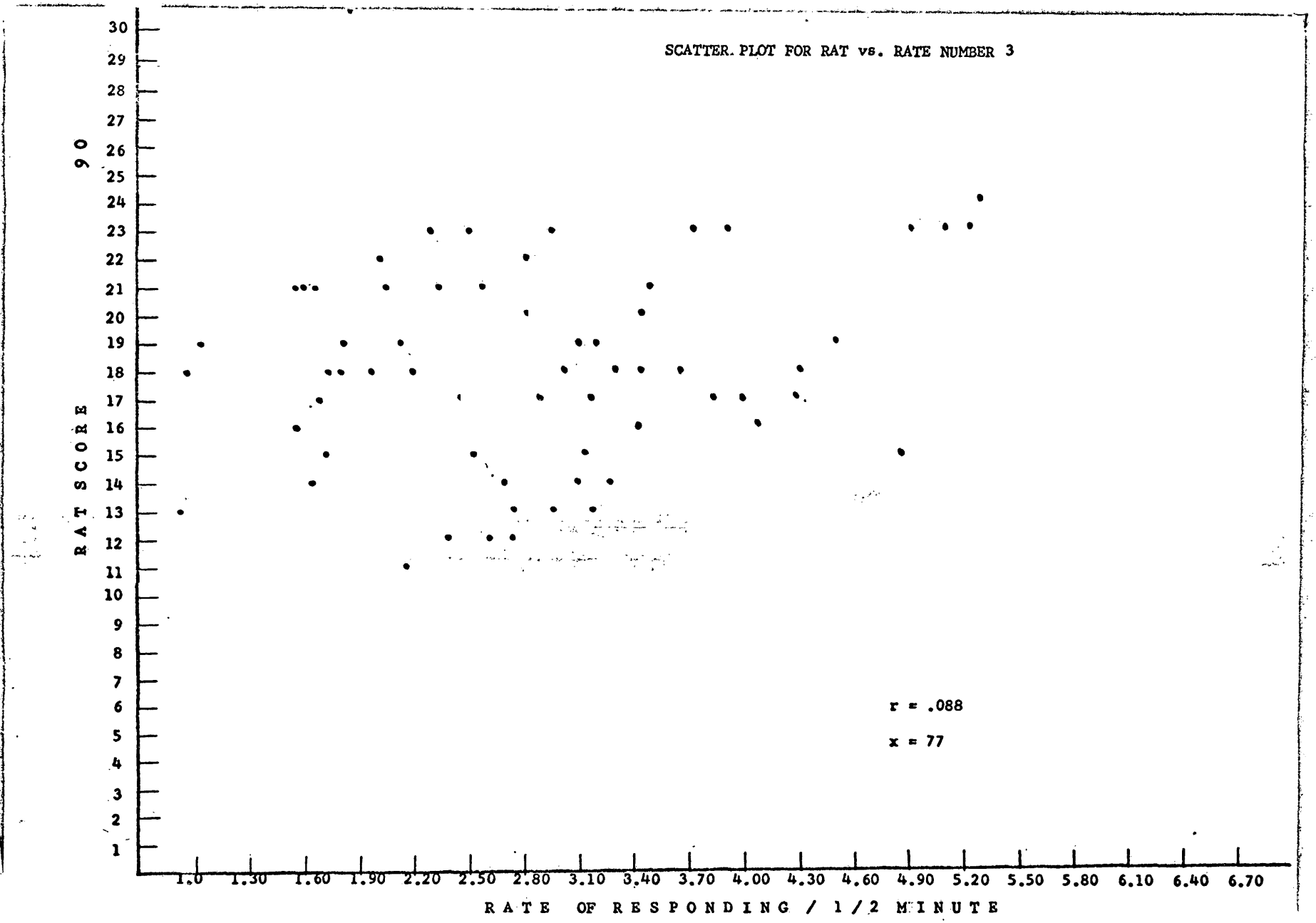

SCATTER. PLOT FOR RAT vs. RATE NUMBER 3
RAT SCORE
90
30
29
28
27
26
25
24
23
22
21
20
19
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
r = .088
x = 77
1.0
1.30
1.60
1.90
2.20
2.50
2.80
3.10
3.40
3.70
4.00
4.30
4.60
4.90
5.20
5.50
5.80
6.10
6.40
6.70
RATE OF RESPONDING / 1/2 MINUTE

Fig. 14

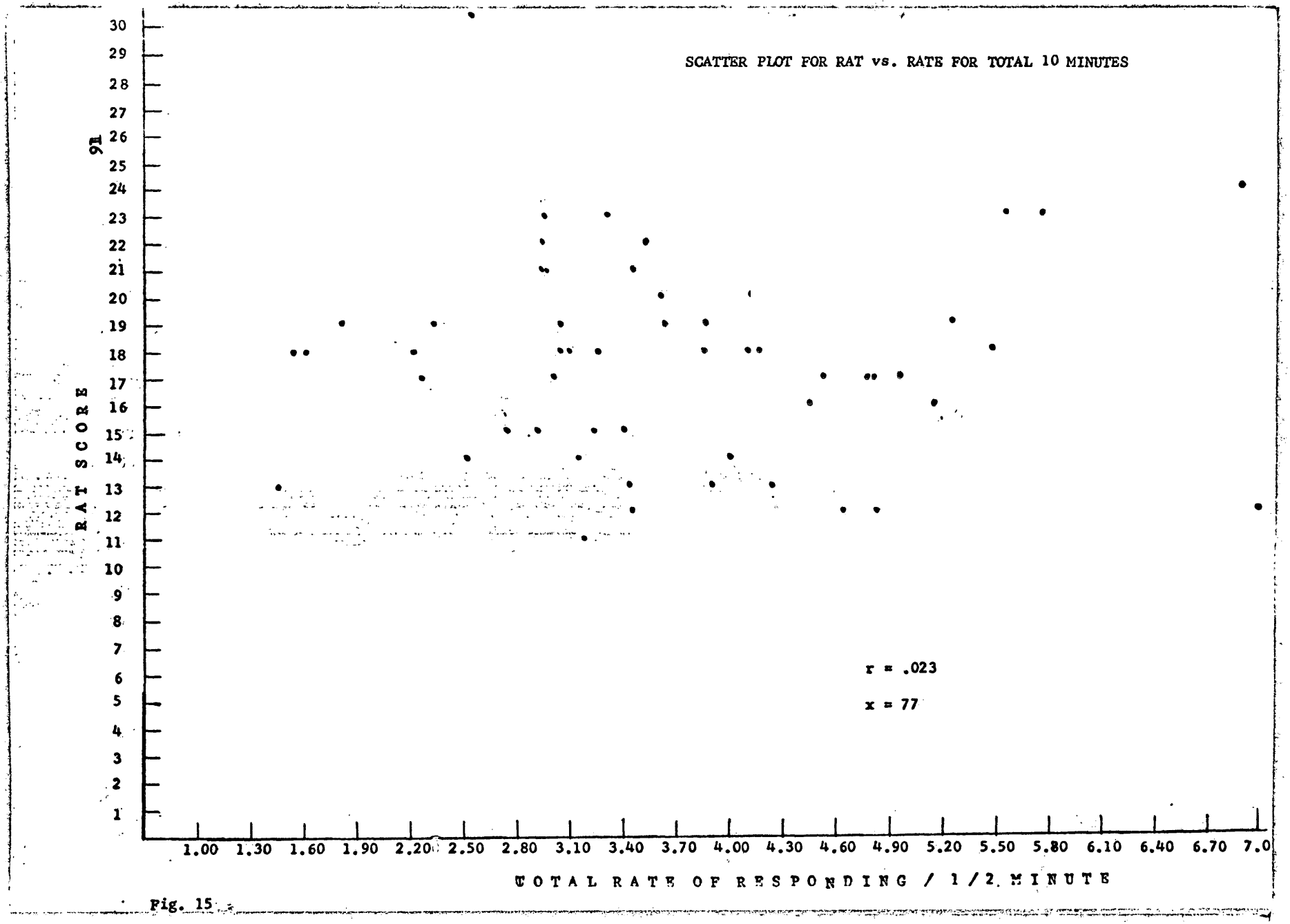

SCATTER PLOT FOR RAT vs. RATE FOR TOTAL 10 MINUTES
RAT SCORE
30
29
28
27
26
25
24
23
22
21
20
19
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
r = .023
x = 77
1.00 1.30 1.60 1.90 2.20 2.50 2.80 3.10 3.40 3.70 4.00 4.30 4.60 4.90 5.20 5.50 5.80 6.10 6.40 6.70 7.0
TOTAL RATE OF RESPONDING / 1/2 MINUTE

Fig. 15

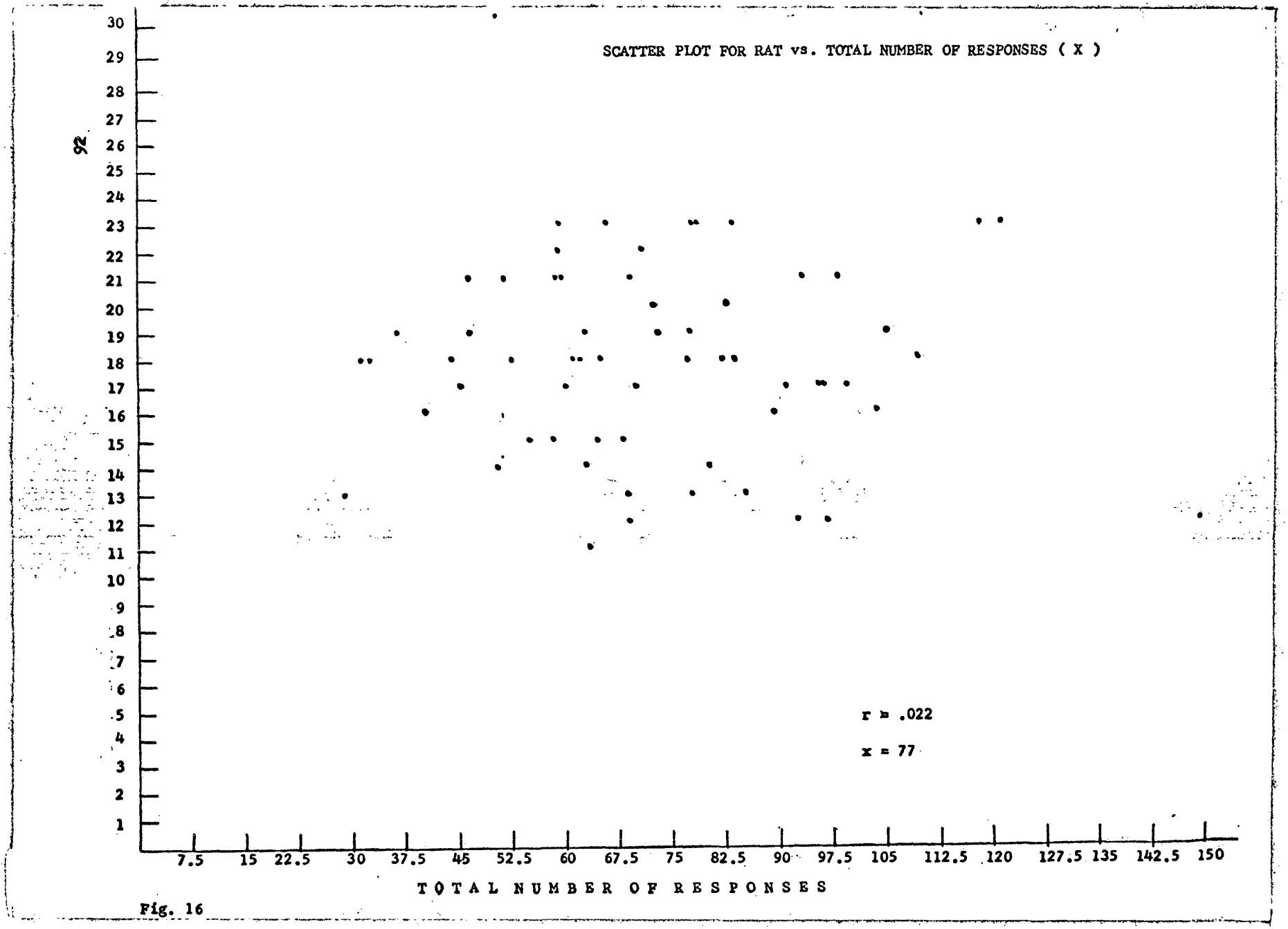

SCATTER PLOT FOR RAT vs. TOTAL NUMBER OF RESPONSES (X)
92
30
29
28
27
26
25
24
23
22
21
20
19
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
r = .022
x = 77
7.5
15
22.5
30
37.5
45
52.5
60
67.5
75
82.5
90
97.5
105
112.5
120
127.5
135
142.5
150
TOTAL NUMBER OF RESPONSES

Fig. 16

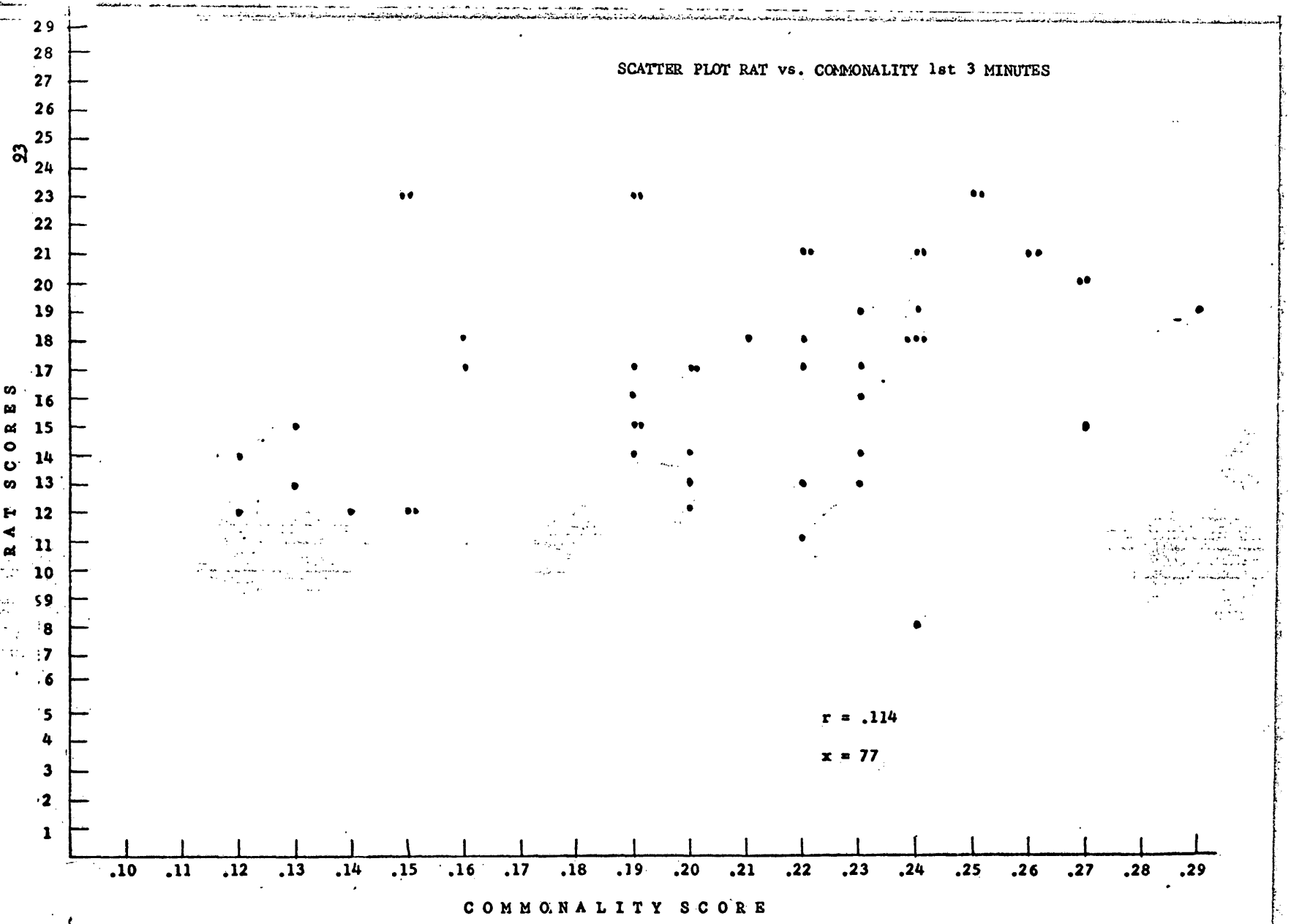

SCATTER PLOT RAT vs. COMMONALITY 1st 3 MINUTES
RAT SCORES
COMMONALITY SCORE
r = .114
x = 77
29
28
27
26
25
24
23
22
21
20
19
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
.10
.11
.12
.13
.14
.15
.16
.17
.18
.19
.20
.21
.22
.23
.24
.25
.26
.27
.28
.29

Fig. 17

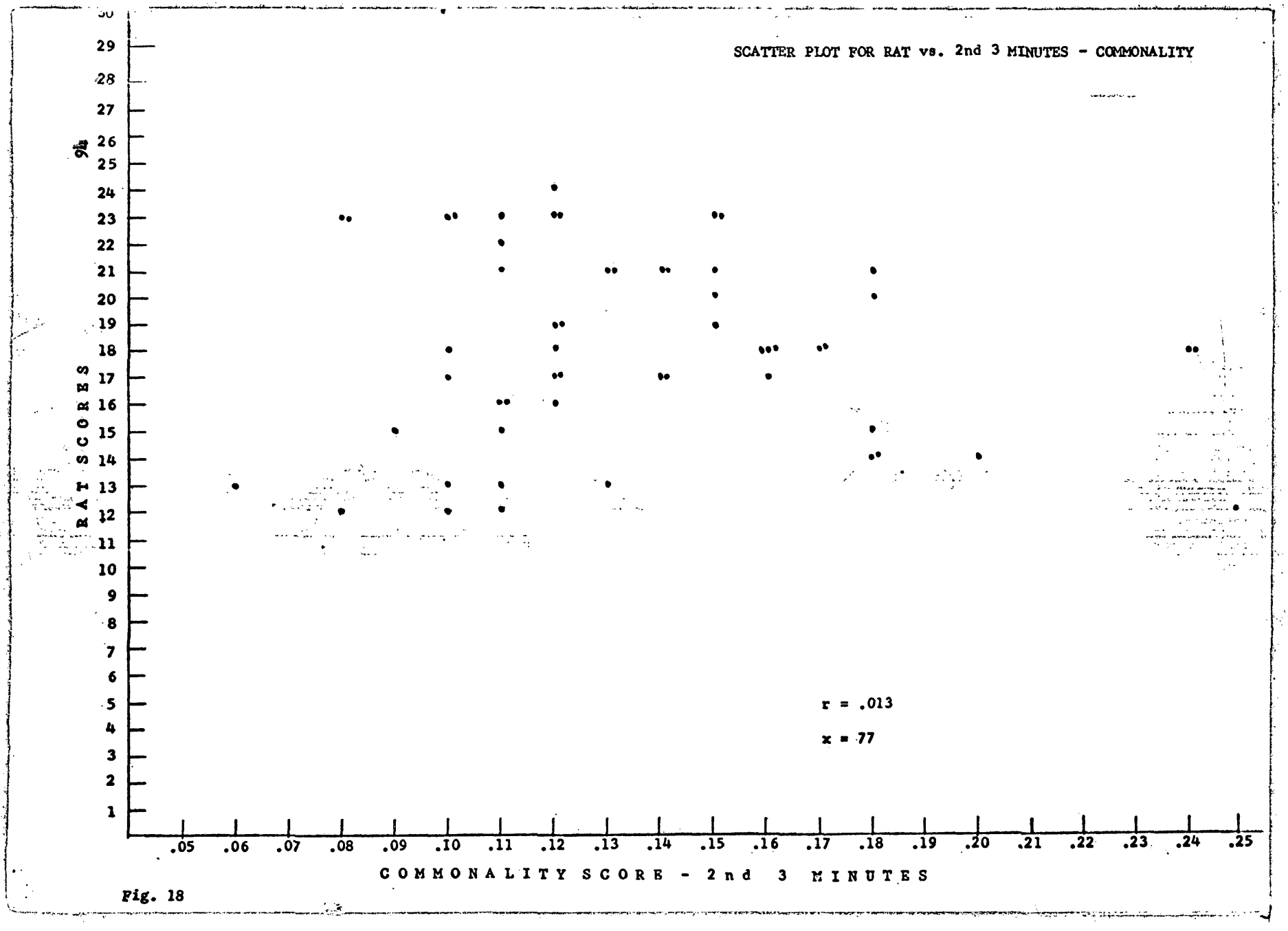
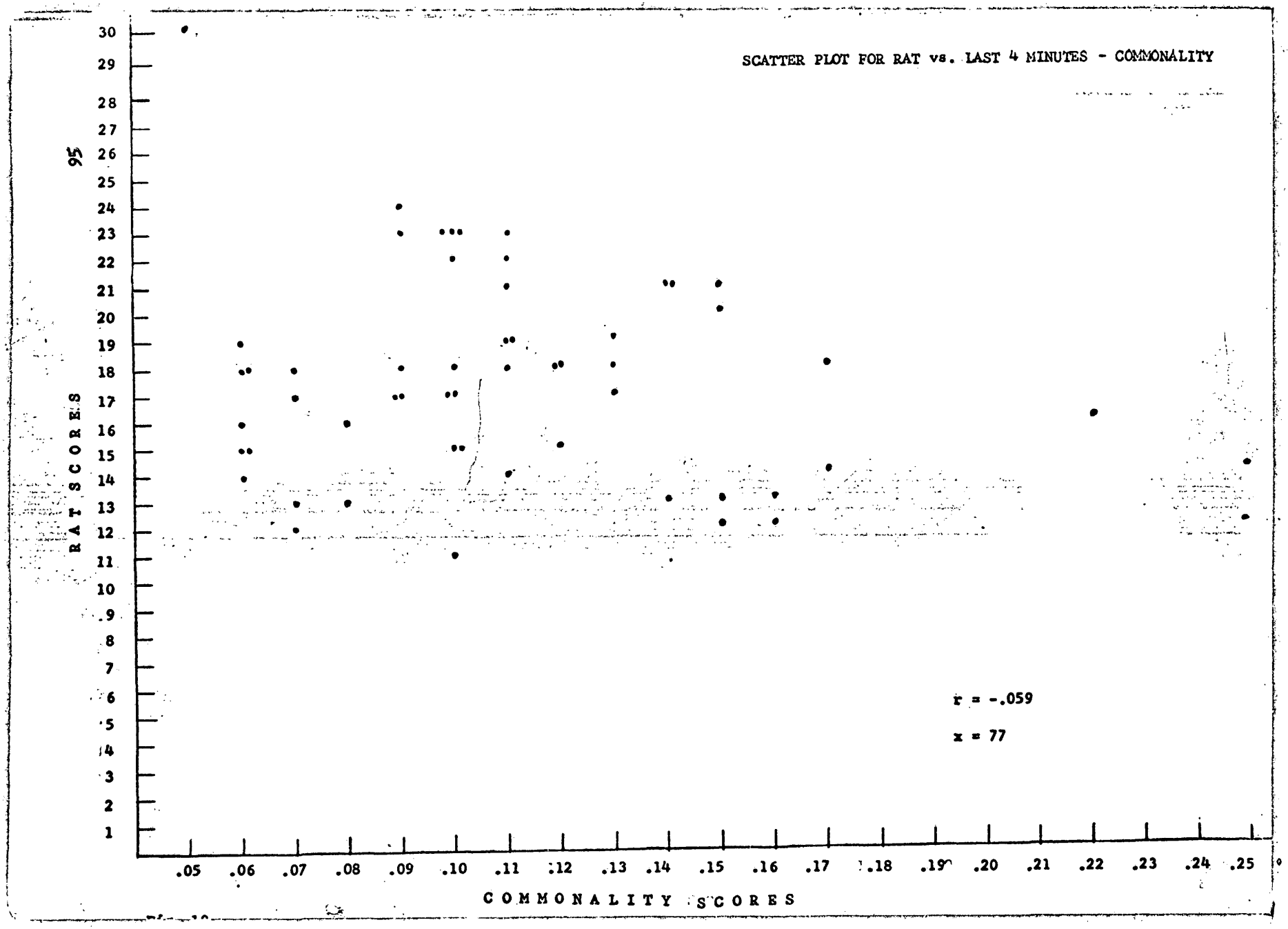
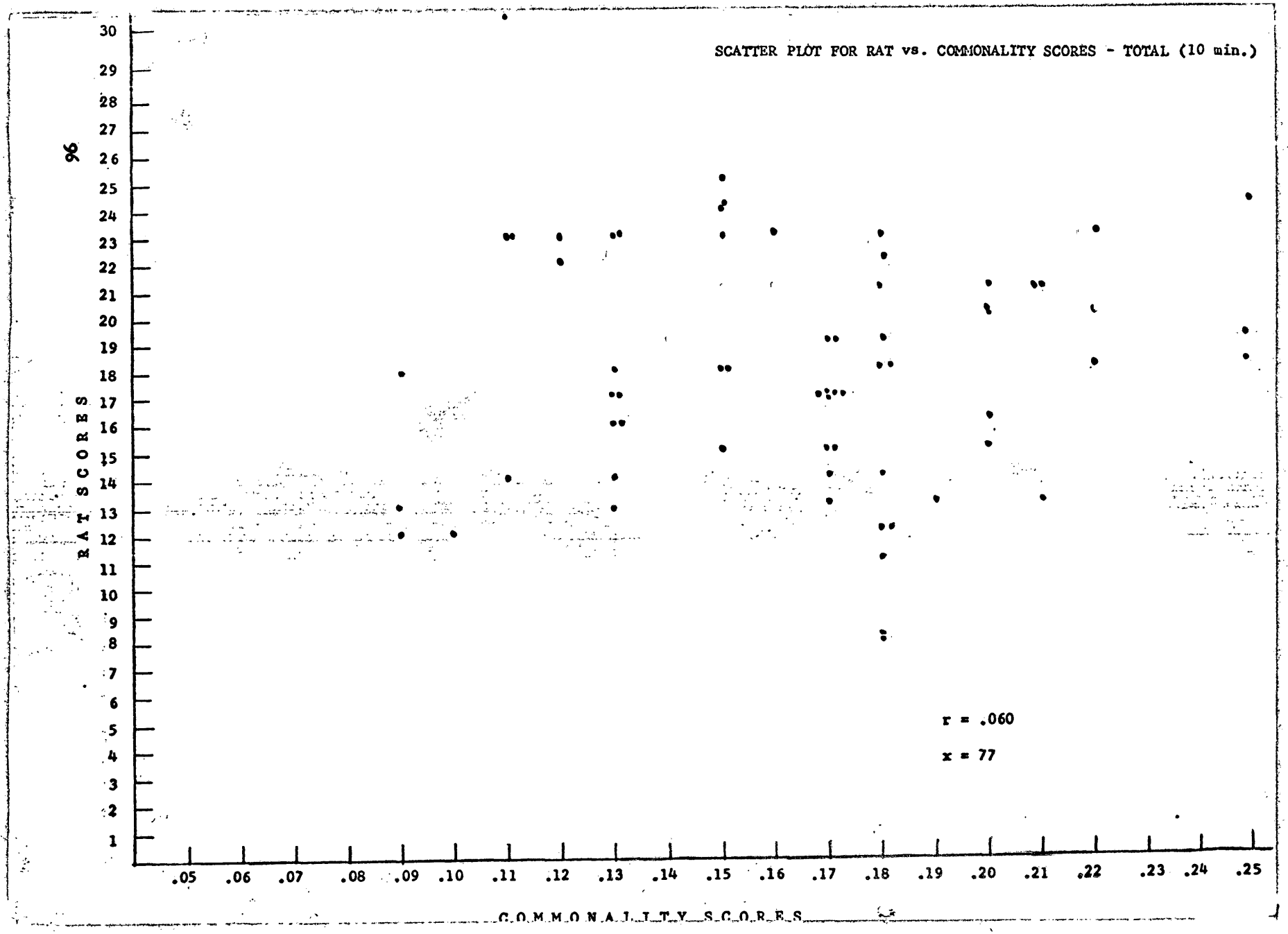

SCATTER PLOT FOR RAT vs. 2nd 3 MINUTES - COMMONALITY
RAT SCORES
29
28
27
26
25
24
23
22
21
20
19
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
r = .013
x = 77
.05 .06 .07 .08 .09 .10 .11 .12 .13 .14 .15 .16 .17 .18 .19 .20 .21 .22 .23 .24 .25
COMMONALITY SCORE - 2nd 3 MINUTES

Fig. 18


SCATTER PLOT FOR RAT vs. LAST 4 MINUTES - COMMONALITY
RAT SCORES
30
29
28
27
26
25
24
23
22
21
20
19
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
.05
.06
.07
.08
.09
.10
.11
.12
.13
.14
.15
.16
.17
.18
.19
.20
.21
.22
.23
.24
.25
COMMONALITY SCORES
r = -.059
x = 77


SCATTER PLOT FOR RAT vs. COMMONALITY SCORES - TOTAL (10 min.)
RAT SCORES
30
29
28
27
26
25
24
23
22
21
20
19
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
r = .060
x = 77
.05
.06
.07
.08
.09
.10
.11
.12
.13
.14
.15
.16
.17
.18
.19
.20
.21
.22
.23
.24
.25
COMMONALITY SCORES

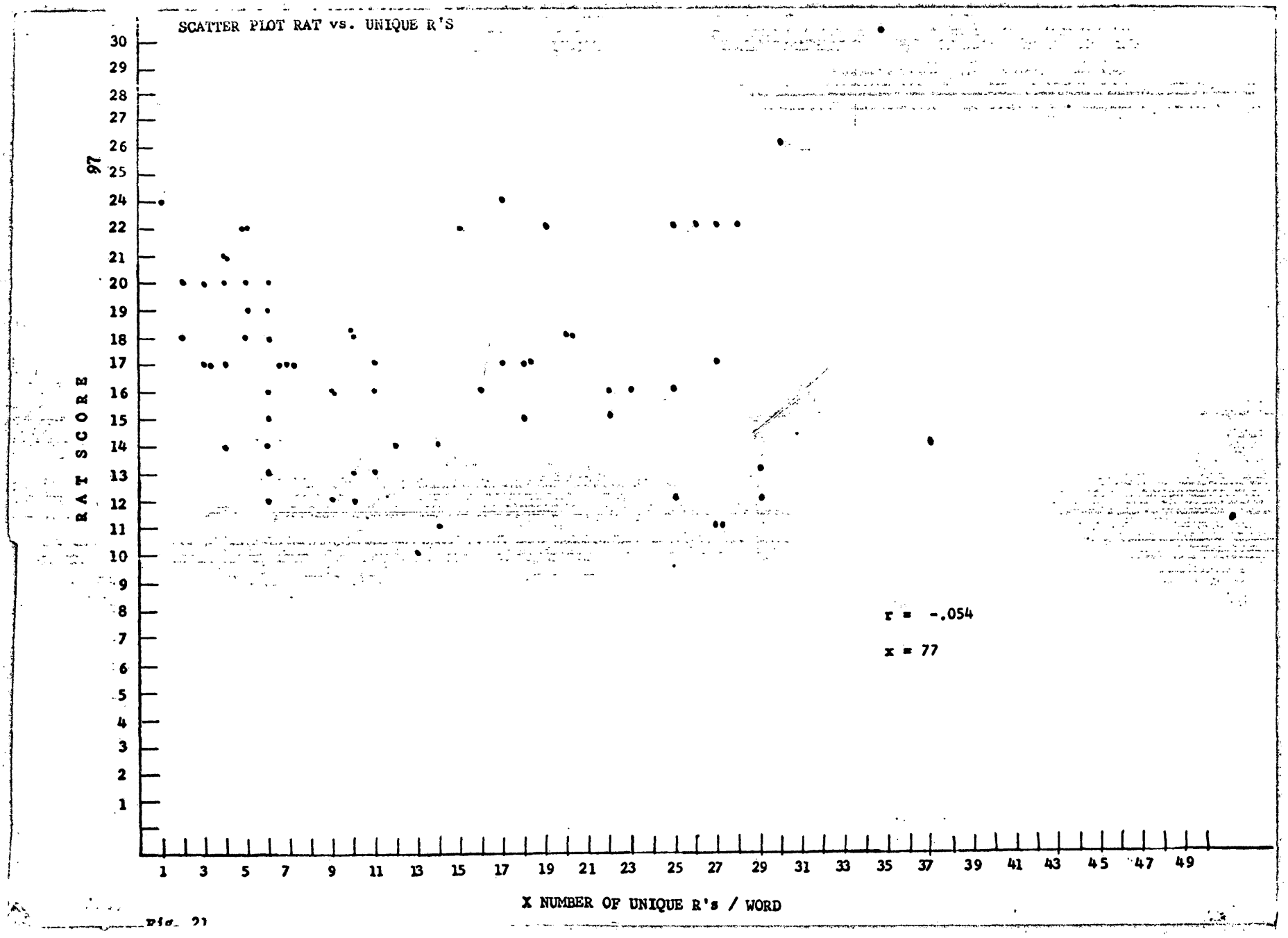

SCATTER PLOT RAT vs. UNIQUE R'S
97
RAT SCORE
30
29
28
27
26
25
24
22
21
20
19
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
r = -.054
x = 77
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39 41 43 45 47 49
X NUMBER OF UNIQUE R's / WORD

Fig. 21

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