

**THE RELATIONSHIP OF THE TORRANCE TESTS  
OF CREATIVE THINKING TO THE EYSENCK  
PERSONALITY INVENTORY AND THE ABSOLUTE  
THRESHOLD FOR LIGHT INTENSITY**



**JANE KEETON BATES**

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THRESHOLD FOR LIGHT INTENSITY

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An Abstract  
Presented to  
the Graduate Council of  
Austin Peay State University

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In Partial Fulfillment  
of the Requirements for the Degree  
Master of Arts

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by  
Jane Keeton Bates

July 1975



## ABSTRACT

The purposes of this study were: to determine the correlation between creativity scores on the Torrance Tests of Creative Thinking and extraversion-introversion scores on the Eysenck Personality Inventory; to determine the correlation between creativity scores of the TTCT and absolute thresholds for light intensity as measured by a 20-trial criterion; to determine the correlation between absolute light thresholds as measured by a 20-trial criterion and extraversion-introversion scores on the EPI.

The subjects were 40 undergraduate psychology students from a small southern junior college in Kentucky. The TTCT (Figural Test, Form A) was administered to two groups of 20 students with the help of the psychology instructor at the college. The EPI was administered to the entire group and absolute thresholds for light intensity were recorded individually by the experimenter. Testing took place over a three week period and scoring and threshold means were determined by this examiner.

Pearson product-moment correlations were computed for all three hypotheses and correlations ranged from .161 to .399 between the TTCT and the EPI. Fluency on the TTCT was significant at the .01 level and flexibility approached significance at the .05 level. The other two creative scores showed positive but insignificant correlations. MATLI showed strong significant negative correlation at the .01 level with elaboration on the TTCT and originality was correlated negatively above

the .05 level. Fluency and flexibility correlated negatively but insignificantly to MATLI. The EPI correlated negatively to MATLI at the .05 level of significance.

The results of this study indicate that when specific areas of creativity on the TTCT are taken into consideration, significant relationships to extraversion-introversion and sensory thresholds do exist . Personality dimensions of extraversion-introversion can be physiologically described by sensory threshold measurements of light intensity.



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by  
Jane Keeton Bates

July 1975


To the Graduate Council:

I am submitting herewith a Thesis written by Jane Keeton Bates entitled "The Relationship of the Torrance Tests of Creative Thinking to the Eysenck Personality Inventory and the Absolute Threshold for Light Intensity." I recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Arts with a major in Education.

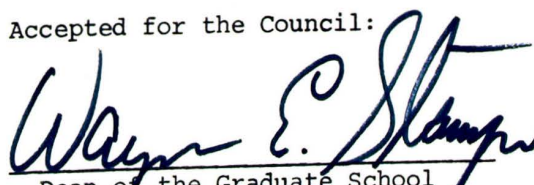
  
Major Professor

We have read this thesis and  
recommend its acceptance:

  
Minor Professor

  
Third Committee Member

Accepted for the Council:

  
Dean of the Graduate School

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## CHAPTER I

### INTRODUCTION

As a general introduction, the next few pages will briefly consider the growing amount of research in the field of creativity, the various approaches to the study of creativity and the diverse ways to define it. Mention will also be made of the relatively shallow background of research in this field and the lack of a unified theoretical basis for experimental studies.

Many studies dealing with creativity have appeared in educational and psychological publications in the past two and half decades. Evidence of this interest can be found by scanning recent writings listed in psychological and educational research. Previous to 1950, Wade (1968) states that less than two-tenths of one percent of the research listed in Psychological Abstracts for the previous century dealt directly with creativity. In the 1965 Abstracts, 130 items were listed; this constitutes a considerable increase in number (Wade, 1968). Parnes (1966) observed that from January, 1965, to January, 1966, the amount of research in the field of creativity equalled that of the preceeding five years. Similarly, Thorndike (1972) points out that the number of references under this heading in the Psychological Abstracts of 1949 was seven out of 6,530, or 1.1 per 1,000, while in 1969 the number was 218 out of 18,068 or 12.1 per 1,000. Clearly, creativity was an important issue in the 1960's and promises to be of major interest in the 1970's.



Researchers have approached the study of creativity in a variety of ways: Some have examined the creative process and its various stages; others have investigated creativity as manifested in artistic and scientific achievement; still others have researched personal traits linked with creativeness. A great deal of research on creativity in the early 1960's tested the relationship between creativity and intelligence (e.g., Guilford, 1952; Torrance, 1959; Meer and Stein, 1959; Barron, 1961; Getzel and Jackson, 1962; Nemas, 1964). MacKinnon (1962) and Wallach and Krogan (1965) focused their investigations on the identification of intellectual and non-intellectual characteristics that distinguish creatives from non-creatives (Aiken, 1971).

Other researchers, like Gallagher (1964) and Maltzman et al. (1958, 1960), have been interested in creativity's relevance to education and are concerned with the school's role in fostering creativity in students (DeCecco, 1968). Maltzman et al. (1958, 1960) studied the possibilities of increasing creativity through training. Torrance and Harman (1961) have presented some evidence that students can be taught to read creatively. In addition, Torrance (1960, 1965) suggests ways for teachers to encourage and reward creative achievement (DeCecco, 1968). Sommers (1961), Anderson (1963), Ragouzis (1965), and others have engaged students in creative thinking activities as an important part of traditional courses.

There are diverse ways to define creativity. Some definitions are formulated in terms of a product while others are in terms of a process, a kind of person, or a set of conditions. The idea of producing something new is included in most all the definitions. Writers often

define creativity as being different from conformity and requiring non-habitual behavior. Some scholars would like to see the term creativity specifically used for only those persons with very rare abilities, while others use the term very generally to apply to creative abilities posed in some degree by most everyone (Torrance, 1967). Occasionally, scientists like Taylor (1959) have recommended that persons think of creativity in terms of various levels. Taylor has suggested five levels of creativity in the following order: expressive, productive, inventive, innovative, and emergentive. These levels range from simple expressive creativity to creativity which involves discovering entirely new principles and ideas.

Creativity to Serebriakoff (1968) is a concept that hardly exists at all. He feels that a great deal of fuss has been made about a surprisingly little body of actual scientific research. To him, any difference between creatives and non-creatives that might exist is their ability to generate a great number of hypotheses.

Gagne (1965) regards creativity as a type of problem-solving which involves combining ideas from widely separated fields of knowledge as well as the ability to make intuitive leaps. Maslow (1954, 1968) includes the components of wholeness and integration of self in his definition of creativity.

Torrance (1965) gives a rather inclusive definition of creativity:

. . . a process of becoming sensitive to problems, deficiencies, gaps in knowledge, missing elements, disharmonies, etc.; identifying the difficulties; searching for solutions, making guesses and formulating hypotheses about the deficiencies; testing and retesting these hypotheses and possibly modifying and re-testing them; and finally communicating the results.

Torrance feels that this definition is one that describes a natural human process with strong human needs involved in each state. His definition enables scientists to begin to operationally define the kinds of abilities and characteristics that facilitate or inhibit the creative process. The definition seems to be generally in harmony with historic usage as well as with other present day definitions of creativity (Torrance, 1969).

A great deal of controversy surrounds the term creativity; controversy exists because research in creativity is in an infant stage and represents a new area of concern. Furthermore, few well-defined, theoretical ideas or concepts bind together the little research presently on hand (DeCecco, 1968). No single widely accepted theory of creativity serves to unify and direct efforts (Treffinger, Renzull, and Feldhusen, 1970). The work of Mednik (1962) illustrates as well as any, the formulation of a theory of creativity. This theory, for a number of reasons, has not attracted many researchers (i.e. Jackson and Messick, 1965; Taft and Rossiter, 1963; Cropley, 1966).

Other theories, like Roger's (1962) and Kubie's (1958) have not resulted in very adequate assessment procedures. Guilford's famous "structure of the intellect" model can't really be classified as theory of creativity but seems to have useful concepts, particularly in describing cognitive abilities related to creativity. Torrance's (1966) tests are basically eclectic in nature and draw from a broad base of available research. Although lacking a unified, comprehensive theoretical base, they seem to represent some of the "best" theory available (Treffinger, Renzull and Feldhusen, 1970).



## Introduction to the Problem

Recognizing the existing array of ideas about creativity, the absence of theoretical unity and the need for further experimental research on creativity, this paper will address itself to the study of the relationship of creativity to extraversion-introversion and the absolute threshold for light intensity.

There are two basic assumptions upon which this paper is based. The first is that a unique psychological dimension, referred to as creativity, does exist in man's repertoire of behaviors. The second assumption is that creativity is complex and multidimensional in nature, being influenced by both heredity and environment.

Much of today's research has failed to take into account the inherited biological differences that account for individual differences (Eysenck, 1964). This study will suggest some possible physiological dimensions of creativity in terms of extraversion-introversion and sensory thresholds.

My hypotheses build on Pavlov's and Teplov's theory concerning the nature of weak and strong nervous systems. Teplov, in particular, believes there exists a negative correlation between the strength of nervous system and sensitivity as measured by absolute sensory thresholds. On a theoretical level, there is a certain similarity between the Pavlov-Teplov weak nervous system and introversion. Further evidence to support this contention has been obtained by such Russian writers as Nebylitsyn and Rozhdestvenskaya (1969) and summarized and verified at a high level of confidence by Gray (1964).

The theory has been broadened by other researchers (Smith, 1966; Corcoran, 1964) to indicate that introverts, in general, have considerably lower thresholds than extraverted subjects. Gray postulates a certain degree of stimulus hunger, sensation seeking or arousal seeking in the extravert, and a certain degree of stimulus aversion in the introvert. Weison's (1963) results seem to support Gray's (1964) hypothesis. Comparing groups of introverted and extraverted subjects, he found extraverts indicated a preference for strong sensory stimulation while introverts did not.

Taking into consideration these experimental results, and others mentioned in the review of the literature, one might find it reasonable to assume that the personality dimension of creativity could be affected by the strength of the nervous system. In this paper, the writer, considering the possibility that creativity is in part determined by biological-neurophysiological factors, will study the relationship between creativity, on the one hand, and extraversion-introversion and the absolute light threshold on the other.

Hopefully, differences will be evident between extraversion and introversion in relationship to these variables. Generally research seems to indicate that extraverts, experiencing a certain degree of stimulus hunger and other relevant characteristics mentioned in the review of the literature, will be more creative. Conversely, introverts possess certain personality dimensions mentioned in the next chapter that suggest they too might tend to be more creative and score higher on the TTCT.

If the relationships between these three variables are significant, then the absolute light threshold measurements might be useful

physiological indices of the creative personality dimensions. In the same way, extraversion-introversion tests might also be helpful indicators of creative potentials.



## CHAPTER II

### REVIEW OF THE LITERATURE

Little research, if any, has been done on the relationship of creativity to extraversion-introversion and sensory thresholds. There is, however, some excellent research on the relationship of extraversion-introversion to sensory thresholds. This chapter will briefly summarize this research, thus establishing the relationship between extraversion-introversion and sensory threshold measurements. Following this summary, the last few pages of Chapter Two will be devoted to research which suggests a possible link between creativity and extraversion-introversion.

Many researchers have studied extraversion-introversion as it relates to sensory thresholds. Predictions about sensory thresholds are often made in terms of excitation leading to the idea that sensory thresholds will be lower for introverts than extraverts because of the higher efficiency of performance associated with cortical excitation--at least at sub-optimal levels (Eysenck, 1967). The Pavlov-Teplov theory concerning the strength of the nervous system and sensitivity as measured by absolute sensory thresholds, has been related to extraversion-introversion by Gray (1964) and several Russian writers (Nebylitsyn, Rozhdesyvenskaya, and Teplov, 1960).

Smith (1966) began work on introversion but was hesitant about testing hypotheses about sensitivity by traditional methods of threshold measurement because he felt difference might pertain more to decision-making habits and risk-taking propensities of subject groups than to their actual thresholds (Eysenck, 1967). This tendency was eliminated by using

a forced-choice technique and adding a guessing correction to the results. All subjects were tested under placebo and drug conditions and results showed the introverted group had considerably lower thresholds than extraverted subjects.

Haslam (1966) has attempted to relate pain thresholds to personality by using a radiant-heat type apparatus. Twelve extraverts and twelve introverts (selected by the Maudsley Personality Inventory-Eysenck, 1959) were grouped and equated for age and mean forehead skin temperature. The mean head pain threshold in  $\text{mc/sec/cm}^2$  was 261 for extraverts and 223 for introverts. (Interestingly, caffeine lowered pain thresholds significantly for both groups.) In another study, Haslam found that while introverts were working at, or were near, their optimum excitation level, the extraverts were working below it. Furthermore, she argued, an increase in excitation would lead to some improvement in the level of the extraverted group. Using electric shock, she found a new threshold of  $197 \text{ mc/sec/cm}^2$ , which amounted to a considerable improvement of 54 points for extraverts and a slight improvement of 22 points for introverts.

Dunstone et al. (1964) has related the threshold of electrical stimulation to personality; absolute thresholds for introverts were found to be lower for introverts and the difference was statistically significant.

In the work of Fischer, Griffin and Rockey (1966), a positive correlation was found between introversion and taste thresholds for quinine. These researchers found that the sensitive tasters of both quinine and 6-n-propylthiouracil can be classified as Sheldonian ectomorph (slender) whereas insensitive tasters of these compounds are of

the Sheldonian endomorph type (heavy). This seems particularly interesting because of the correlation between body type and extraversion (see Schmidtke, 1961).

Wahburn, Hughes, Stewart, and Sligh (1930) found that introverts have a higher threshold in flicker fusion frequency than extraverts, but not a statistically significant difference. Later, Madlung (1936) found a much larger difference and Simonson and Brozek (1952) reported a significant difference showing a five percent superiority in resolving powers for introverts.

Schmidtke (1961) found people with leptomatic (slender) body builds have higher critical fusion frequency than pyknics (heavy). Simonson and Brozek (1952) also report some data supporting the relationship between CFF and body build. Murawski (1960) has found some strong similarities in CFF and identical twins. Data serves to support the hypothesis that CFF thresholds (evidence of cortical excitation) are higher for introverts. In other words, introverts were found to have somewhat more efficient cortical resolution of stimuli than extraverts.

An interesting application of this hypothesis is made by Cocoran (1964) who posits, "If introverts are in general more highly aroused than extraverts, then, assuming that arousal is synonymous with a state of high cortical facilitation, it follows that the effector of an introvert should be greater than that of an extravert when both are equally stimulated." To test this hypothesis, Cocoran placed four drops of lemon juice on the tongue of subjects and as predicted, introverts secreted about twice as much saliva under experimental conditions than extraverts. Using Kendall's tau coefficient, a correlation of .62 between introversion and secretion was found. Later, another group was



tested with citric acid, but no correlation was found. Using a third group, lemon juice was used again and the original finding was repeated. E. B. G. Eysenck, replicating Cocoran's work, found a significant product-moment correlation of .72. Although the fact that no correlation between citric acid and personality was observed tends to weaken Cocoran's hypothesis, the results with lemon juice do support his theory, (Eysenck, 1965).

If, as Cocoran has suggested, introverts tend to have a greater output than extraverts when equally stimulated, then this tendency might be reflected in the fluency scores of introverts on the TTCT. This, along with the idea that introverts seem to exhibit a somewhat more efficient cortical resolution of stimuli than extraverts could lead to the hypothesis that introverts are more creative than extraverts.

An interesting study in light of this paper's interest in creativity is a study by Speilman (1963). In an experimental study she tested the prediction that extraverts would be more susceptible to the accumulation of inhibition and would consequently show more involuntary rest pauses than introverts. Her results confirmed her hypothesis and were later verified by Eysenck (1964). One result of more frequent involuntary rest pauses in extraverts should be more varied output, particularly when compared with the more regular output of introverts (Eysenck, 1964). Speilman's studies seem to clearly support this idea. Other similar comparisons have been made by Reed (1961) and Reed and Frances (1962). They studied audiometric response consistency in children and found extraverted children to be less consistent with a more depressed set of values on successive tests. Howarth (1963) found greater variability for extraverts in line production.



This idea (extraverts producing a more varied output) seems particularly interesting because it is this ability to produce varied ideas that is an important characteristic of creativity. On the other hand, if introverts tend to produce a more regular output, it follows that their output should be greater than that of the extravert when both are equally stimulated; this should lead to higher creativity scores in fluency, where quantity is important.

The ability to adapt quickly to new situations is an important characteristic of creativity. This flexibility allows creative individuals to keep open minds and make adjustments and changes up to the last moment. Some research has shown that extraverts exhibit this same ability to adapt easily to new situations.

In such an experiment, Scott and Wilkinson (1962) have shown a very significant correlation between adaptation on GSR and extraversion ( $\rho=.75$ ). In their experiments, twenty adaptation trials were used and the two most extraverted subjects adapted in three and five trials respectively; the two most introverted didn't adapt at all. (Eysenck, 1967).

In one of the few studies relating specifically to the hypotheses of this paper, Kobayashi (1969) studied the relationship of intelligence and creativity to anxiety and extraversion-introversion in ninth grade Japanese boys. The following tests were administered to the 489 students in small groups: Tanaka Intelligence Test, Torrance Tests of Creative Thinking (Form B, Verbal and Figural), General Anxiety Test and Extraversion-Introversion Test. The Intelligence Test (Tanaka, 1965), standardized in Japan, consists of seven subtests which are scored

and converted into a single I.Q. score. The General Anxiety Test (Suzuki, et al., 1961) is designed to measure anxiety in eight measures: study, human relations, solitariness, guilt feelings, sensitivity, physical condition, neurotic anxiety and compulsion. The Extraversion-Introversion Test (Suzki, Mamiya, and Tatsumi, 1955) has been standardized in Japan and is designed to measure the degree of outward or inward tendencies of personality in five areas: sociability, ways of thinking, inferiority-superiority, nervousness and emotional stability.

The relationship of intelligence and creativity to anxiety measures formed the first part of the study. Kobayashi found that regardless of high or low levels of intelligence, high creative groups were less anxious than low creative groups. No significant difference between high and low intelligence group means was found in any factors of the anxiety scores while significant differences were found between anxiety test scores and high and low creative groups. No significant interaction between intelligence and creativity test scores was found on any factors of anxiety test scores.

The second part of the study examined the relationship of intelligence and creativity variables to extraversion-introversion measures. When considering overall extraversion-introversion variables, Kobayashi found a significantly correlation at the .05 level indicating that high creativity groups were more extraverted than low creativity groups. The main effect of creativity was significant on both anxiety and extraversion-introversion measures and neither the main effect of intelligence or the interaction between intelligence and creativity was statistically significant on both anxiety and extraversion-introversion measures.

In his study, Kobayashi found that all extraversion-introversion measures except emotional stability had significant positive correlations with the total creativity variable and that sociability, inferiority and nervousness were the main factors affecting the creativity variables. Fluency, flexibility, and originality on the TTCT were all significantly correlated with sociability, superiority-inferiority, and nervousness while elaboration revealed a significant positive correlation with sociability.

Considering the relationships of intelligence to extraversion-introversion, no significant correlations were found. Although the main purpose of the study was not to investigate the relationship between intelligence and creativity, the correlation coefficients between intelligence and the creativity measures were found to be negative and insignificant; however, a correlation coefficient of .083 between intelligence and elaboration was significant at the .05 level.

Michael Kobayashi's research establishes a strong relationship between creativity, anxiety and extraversion; creative students seem not to be anxious and tend to be extraverted. An interesting implication of this idea comes to light when Kobayashi's results are combined with those of Eysenck (1960) and Eysenck and Eysenck (1967) who say manifest anxiety has a significant introversion component. If anxiety is positively correlated with introversion and negatively correlated to creativity it would follow that introverts tend not to be creative. This leads to the hypothesis that extraverts, being less anxious, will score higher on the TTCT.

In conclusion, a review of the literature seems to suggest a plausible link between creativity and both extraversion and introversion.

If, as some studies indicate, introverts do tend to have greater and more regular output, have stronger nervous systems, have lower sensory thresholds and higher efficiency of performance associated with cortical excitation, then creativity might be linked to introversion. On the other hand, extraverts, being less anxious, having a more varied output, adapting quickly to new situations and exhibiting a certain degree of stimulus hunger, might tend to score higher than introverts on the TTCT.



## CHAPTER III

### METHOD

In recent years, much evidence has been accumulated to indicate a strong biological basis for personality. Although research on personality is growing, it is clearly a very complex and demanding subject; it has spread to include genetics, neurology, pharmacology, psychiatry, electrophysiology, and related disciplines (Eysenck, 1967). In explaining these curious phenomena of personality, one realizes the difficulty in devising a single, simple experiment to show the relationship of creativity to extraversion-introversion and absolute threshold for light intensity.

#### Research Design

The experimenter in this study administered and scored the TTCT and the EPI tests of 40 undergraduate freshman and sophomore students. The relationship of the four creative variables of the TTCT were correlated to the extraversion-introversion scores of the EPI.

Next, the absolute threshold for light intensity was found for each of the 40 students in the sample. Threshold measurements were determined by a 20-trial criterion and the mean score of these trials was correlated with the four creativity scores and extraversion-introversion scores to determine if any statistically significant relationship existed.

#### Hypotheses to be Tested

Within the context of this study, the hypotheses are stated in

null form. These following hypotheses are to be tested.

1. There is no difference between creativity scores of the Torrance Tests of Creative Thinking and extraversion-introversion scores on the Eysenck Personality Inventory.
2. There is no difference between creativity scores on the Torrance Tests of Creative Thinking and absolute thresholds for light intensity as measured by a 20-trial criterion.
3. There is no difference between absolute light thresholds as measured by a 20-trial criterion and extraversion-introversion as measured by the Eysenck Personality Inventory.

The five percent level of significance will be used for rejection of these null hypotheses.

#### Definition of Terms

Creativity: A personality dimension measured in TTCT.

Extraversion-Introversion: A personality dimension measured by EPI.

Extravert: A person who scores at or above the 70th percentile on the EPI. Typically an extravert (high<sup>E</sup> scorer) tends to be outgoing, impulsive, uninhibited, have many social contacts, and frequently takes part in group activities. He likes excitement, is fond of practical jokes, likes change, has a ready answer, is carefree and easygoing; he is optimistic, likes to keep moving and tends to be aggressive. Since his feelings are not always under tight control, he loses his temper easily and is not always reliable (Eysenck and Eysenck, 1968).

Introvert: A person with a score at or below the 31st Percentile on the EPI. The typical introvert is quiet, introspective, retiring, and fond of books instead of people; he is reserved, keeps his distance, keeps his feelings under close control, and seldom behaves

aggressively or loses his temper. He plans ahead, is not impulsive, and likes a well-ordered mode of life. Taking matters of everyday life with proper seriousness, he is reliable though somewhat pessimistic and places great value on ethical standards (Eysenck and Eysenck, 1968).

Absolute Light Threshold: The minimal physical stimulus value (or maximal for upper thresholds) which will produce a response fifty percent of the time (Underwood, 1966).

### The Sample

The sample used in this study was undergraduate psychology students enrolled at Hopkinsville Community College, Hopkinsville, Kentucky, during the Summer Semester, 1975. All participants volunteered as subjects. The sample was composed of 40 students, of which 30 were female and 10 were male. These subjects were freshman and sophomore students, ranging in age from 17 to 49.

### Description of the Instrument

The Torrance Tests of Creative Thinking (TTCT) by Paul Torrance (1974) is designed to measure four aspects of creative thinking: fluency, flexibility, originality, and elaboration. Scores for both verbal and figural traits are provided (Baird, 1972). These batteries, labeled, "Thinking Creatively with Words" and "Thinking Creatively with Pictures", are available in two forms; this study uses Test Form A, Figural.

"Thinking Creatively with Pictures" involves three activities designed to obtain maximum information from a minimum of testing time. The first task, Picture Completion, is planned to stimulate originality and elaboration. Subjects are asked to make a picture from the tear dropped shape of colored paper. Subjects are encouraged to make complete



unusual pictures that tell an interesting story. In the "Incomplete Figures Activity", incomplete figure sets are presented to the testee and he is asked to complete each from the few lines that are provided. Each completed figure is then scored for these three traits: flexibility, originality, and elaboration. The final activity, Repeated Figures, is similar to the preceding activity and tests one's ability to make multiple associations to a single stimulus. Straight parallel lines are given and subjects are asked to add lines to complete as many unusual and interesting pictures as possible. All four types of divergent thinking are stimulated in this last activity. Again, since time is not adequate, individual response tendencies come into play.

Accompanying the TTCT Verbal and Figural Tests are three manuals: The Norms-Technical Manual, The Directions Manual, and Scoring Guide for both the Figural Test Booklet A and the Verbal Test Booklet A. The Norms-Technical Manual includes such information as the author's and publisher's statement rationale for test activities, reliability, validity, norms, interpretation of scores, references, information about the author, and development of the TTCT.

Torrance feels that several factors should be taken into consideration in assessing the reliability of measures on creativity. Motivational, physical, emotional, educational, environmental, and mental health factors all affect creative functions and reliability. High level of inter- and intrascorer reliability have been obtained with accompanying scoring guides. Generally, no difference in mean occurs and coefficients of reliability are in excess of .90. The Technical Manual mentions several studies of scorer reliability, ranging from .86 to .99 with an



average of .95. Studying scoring guides, classroom teachers achieved mean reliability coefficients for the Figural Tests ranging from .88 for originality to .96 for fluency. On Verbal Tests, mean reliabilities ranged from .94 for originality to .99 for fluency. Lower interscore reliabilities result most often from failure to scan adequately the listed original weights and in failure to give credit for subtle forms of elaboration (Torrance, 1974).

Test-retest reliability coefficients are generally higher for verbal scores than figural ones; fluency and flexibility reliability coefficients are usually higher than originality and elaboration. Baird (1972) reports test-retest reliabilities that range from .50 to .93 over a one to two week period and from .35 to .73 over three year periods. Holland (1968) states that he finds test-retest and equivalent form reliability extensive and satisfactory, with the majority of reliability coefficients exceeding .70. Hoefner (1967) gives test-retest reliabilities ranging from .71 to .93 over two week intervals and .35 to .73 over three year intervals.

Since there is a diversity of definitions of creativity, Torrance finds difficulty in providing satisfactory evidence of validity to satisfy everyone. Reviews of the validity problem underline the complexity of the problem in finding any kind of overall measure of validity for creativity. A consistent effort has been made to base the TTCT on the best theory and research presently available in order to insure content validity. "Analyses of lives of indisputably eminent creative people, research concerning the personalities of eminent creative people, the nature of the performances regarded as creative, research and theory concerning the functioning of the human mind, and the like have been

considered in making decisions regarding the selection of test tasks." Technical or subject matter content have been avoided in test tasks (Torrance, 1974).

The TTCT Norms-Technical Manual reviews a large number of studies conducted that contribute toward construct validity of the test. The majority of the studies compare personality characteristics of high scoring subjects to low scoring ones; others involve correlations between creativity scores and other measures. Most studies utilize children as subjects but information is given on high school youths and adults as well. Baird (1972) feels that many of these studies use extreme groups without much interest in students in the middle. Holland (1968) also mentions an inordinate number of validation studies using extreme group comparisons and mentions the usage of weak designs. Although various opinions are presented in these studies, most of the evidence suggests that the TTCT is internally consistent and that it does measure behavior consistent with the literature (Baird, 1972).

Torrance has not been able to find any acceptable criteria of construct validity, but he lists some deserving studies in his Manual. The TTCT seems to have only slight relations to peer nominations and low relations to teacher nominations. There seems to be a relationship between the TTCT and academic intelligence and educational achievement test scores.

Since the TTCT is a relatively new instrument, few long-range predictive validity studies exist; however, some long-range studies begun in 1958 and 1959 are available. In these studies, researchers tried to determine whether scores on creative test throughout the subject's school years predict socially relevant creative behavior in

adult life. Of the five long-range predictive validity studies, all were significant at better than the .01 level and the resulting correlations ranged from .46 to .62 with the 1971 scoring criteria running consistently higher than those obtained from the 1959 criteria (Torrance, 1972.)

Short-range prediction studies are summarized in the Norms-Technical Manual. According to the table, creativity test scores have predicted such creative behavior as humor and fanatsy, originality in imaginative stories, differential responses to varied curriculum tasks and other creative behavior of high school students and adults.

The current evidence about the TTCT implies some predictive validity but additional evidence is needed about its ability to forecast socially relevant creative behavior (Holland, 1968). Further longitudinal studies will contribute towards the predictive validity of the TTCT.

Torrance is assembling large samples of subjects from all educational levels and a variety of localities in the United States. Additionally, these samples are to be drawn from various types of schools around the country. He has attempted to exclude samples having special characteristics such as blindness, deafness, and mental retardation. The norm group is to be representative of the mid-range of most school populations and is multi-racial and multi-ethnical (Torrance, 1974).

In conclusion, the potential user should note that the TTCT is published as a research edition and still remains in an experimental stage. In developing the TTCT, Torrance has made a significant contribution to the understanding of creativity. However, better norms and more studies of predictive validity are needed as well as an anchoring of the test to real-life creative behavior (Baird, 1972). Thorndike (1972) emphasizes the difficulty in putting together a coherent picture of the validity of



the TTCT and hopes that a more coherent body of research will provide more systematic information both on internal and external correlates. Holland (1968), hopes that the test will be linked to other common tests of originality and to criteria of greater social relevance. Hoeofner (1967) sees the TTCT as an important stimulant for further research and hopes that the author's promises of major improvements will be actualized soon.

The Eysenck Personality Inventory (EPI) measures personality in terms of two pervasive independent dimensions: extraversion-introversion (E) and neuroticism-stability (N). These traits are measured by 24 "yes" or "no" questions, each selected on the basis of factor analysis. To detect any attempts to lie, a response distortion (Lie) scale is used. This study uses Form A, although a parellel Form B is also available. Consisting of 57 questions, the test is brief and can be administered in about ten minutes. All questions are carefully worded so that subjects with low intelligence and/or little education can read them (Eysenck and Eysenck, 1968).

The EPI briefly defines extraversion as referring to persons with outgoing, uninhibited, impulsive and sociable personality traits. Neuroticism refers to the general emotional over-responsiveness and liability to neurotic breakdown under stress (Eysenck and Eysenck, 1968). Both these personality dimensions have been demonstrated to be independent through repeated empirical investigation (Bendig, 1960; Burt, 1948; Eysenck, 1956; Eysenck and Eysenck, 1963d; Farley, 1967).

A manual accompanies the EPI which includes an introduction followed by sections on administration and scoring, standardization and interpretation, development of the EPI, reliability and validity of the



scales, distortion of responses, uses of the EPI and references. Scoring stencils or scoring services are available to the user. American and British Editions can be ordered also.

Reliability indexes of acceptable magnitude are reported in the EPI Manual. The presence of two parallel forms makes it possible for a more rigorous examination of the reliability of the EPI (Linden, 1970). Generally, two forms of reliability are appropriate: test-retest and split-half (internal consistency). Test-retest reliability was studied on two groups of normal English subjects during a one year and nine month period respectively. Very satisfactory reliabilities were obtained, running from .84 to .94 for the complete test and between .80 to .97 on separate test forms.

Internal reliabilities, using the Spearman-Brown prophesy formula, are lower than for test-retest reliabilities. Figures running from .74 to .91 were given for the combined scales. Because of these findings, both forms should be used when individual decisions are made on the basis of the Inventory, but one form is sufficient for experimental studies (Eysenck and Eysenck, 1968).

Some factorial, construct and concurrent validity data for the EPI is presented in the Manual, but it is not extensive and varies in quality and completeness. The test's authors have conducted experimental studies on the MPI scales, the EPI's predecessor; the EPI-MPI correlations are sufficiently high to support claims that the experimental results reported for the MPI may also apply to the EPI (Linden, 1970).

The major evidence of validity is that of factorial analysis. Several independent studies by Bendig (1960), Hildebrand (1958), Eysenck and Eysenck (1962, 1968) and Eysenck, Eysenck, and Claridge (1960) have

verified the existence of the extraversion and neuroticism dimensions.

In discussing construct validity, Eysenck and Eysenck (1968) point out that the present measures of extraversion and neuroticism are incorporated within a theoretical framework. According to their theory, the construction of the scales requires that dysthymic neurotics should have high scores on neuroticism and low scores on extraversion while psychopaths and hysterics should have just the opposite tendencies. In studies, hysterics and psychopaths are found to be significantly more extraverted than dysthymics and all neurotic groups higher on neuroticism than normal groups. In this way, test validity serves as a validation of the scales (Eysenck and Eysenck, 1968). Further research is being conducted in this area and promises to be rewarding (Carrigan, 1960).

Concurrent validity of E and N from the MPI and EPI are highly correlated with other tests purporting to measure these dimensions. Using the original sample of 400 subjects, the MPI Extraversion Scale correlated .79 with the Guilford (1940) Rhythymia Scale and the Neuroticism Scale correlated .92 with the Cycloid Disposition Scale. Correlations are presented for many different scales such as the Taylor Manifest Anxiety Scale, Cattell's IPAT Anxiety Scale, Multiple Affect Adjustive Check List, and the Personal Orientation Inventory and seem to suggest significant relationships. High positive correlations were found with the California Psychological Inventory, giving further evidence of the support of the constructs measured by the EPI (Eysenck and Eysenck, 1968).

Using independent judges to nominate extraverted and introverted or stable and unstable subjects, the authors attempted to establish additional validity data. Mean extraversion scores for those nominated as most

extraverted were approximately two standard deviations higher than those nominated as most introverted. Mean neuroticism scores for those nominated as neurotic were about one and a half standard deviation higher than those nominated as stable (Eysenck and Eysenck, 1968).

Self-ratings were also used to establish validity. Vingoe (1966) using a seven-point extraversion-introversion scale, found that groups divided on the basis of self-rating and on EPI Extraversion scores were significantly different. Self-rated introverts seemed somewhat more aware of their position than extraverts.

The authors acknowledge a shortcoming in reporting norms. Some normative data on American college students is presented in percentiles and the rest of the information on English populations is given in summary form. American norms fail to give the proportions of men and women; this may be a serious omission since women are known to score higher than men on N and lower on E (Lanyon, 1968). Eysenck and Eysenck (1968) state that norms should be used with caution as they are based on the data from undergraduates at a small sampling of colleges and universities. The authors take responsibility for providing more relevant and representative reference data in the future and in the meantime, suggest developing local norms if possible (Linden, 1970).

In conclusion, the EPI was developed as a tool for assessing research on Eysenck's personality theory and is certainly a valid instrument for that purpose. For those wanting to measure the dimensions of neuroticism and extraversion, the EPI is probably the best instrument available and is backed by superior research (Cline, 1969). The EPI Manual, though informative and well-referenced, often refers to unpublished works. Additionally, more validity and reliability data



specific to American samples needs to be presented so that the instrument will be of further use in the United States. Although the EPI shows promise as a useful clinical and educational guidance instrument, at present it has valid use primarily in research (Linden, 1970). Lanyon (1968) also cites deficiencies with American norms and indicates the lie scale should be used with caution since it is not adequately researched.

To determine the absolute threshold for light intensity, a light bulb and socket, a variable AC transformer with units of volts on the dial, an extension cord and recording sheets were used. Performed in a lighted room, relatively free of noise, the pointer dial on the dial was set at zero and turned slowly and smoothly towards the highest volt mark. Moving one volt at a time, the experimenter (X) stopped when the subject (S) indicated by saying "present" that he can see the filament in the light bulb. Ten ascending series were given for each S with X starting well below the threshold (Snellgrove, 1967).

Starting above the threshold, X decreased the voltage until S indicates by the word "absent" that the glow of the light bulb could no longer be perceived. The ten ascending and ten descending series were not presented in any discernible order and X started at different points on the scale for each trial. (Snellgrove, 1967).

According to Underwood (1966) thresholds vary from individual to individual as well as from moment to moment. Since the measured thresholds obtained from one trial may differ from values on the next trial, the best measure is probably the mean and/or median of many threshold measurements. Each S mean and/or median threshold measurement can then be compared to a generalized group threshold mean score to determine high and low threshold values.



Administration and Scoring

The EPI was administered to a group of forty undergraduate psychology students by this researcher with the aid of the psychology instructor at Hopkinsville Community College, Hopkinsville, Kentucky. Following this brief test, the group was divided into two groups of twenty students each and the TTCT Figural Test, Form A was administered by this researcher and the psychology instructor. Tests were hand scored by this researcher using directions from test manuals.

During the following two weeks, absolute light thresholds were measured by this researcher for all 40 students during class time (9:00 to 10:00 A.M.).

## CHAPTER IV

### ANALYSIS OF DATA

The Pearson Product-Moment technique was used to compute the correlation coefficients. EPI scores were compared to the four scores on the TTCT (Figural, Form A). Next, the means of absolute thresholds for light intensity were correlated to the four TTCT scores. Finally, EPI scores were compared to light threshold means. The following tables summarize these correlations.

TABLE 1  
Correlations of the EPI and Four  
Scores of the TTCT

Item	r
1. EPI and TTCT-Fluency	.399 *
2. EPI and TTCT-Flexibility	.310
3. EPI and TTCT-Originality	.161
4. EPI and TTCT-Elaboration	.273

TABLE 2  
Correlations Between Means of Absolute Thresholds for Light  
Intensity and Four Scores of the TTCT

Item	r
1. MATLI and TTCT-Fluency	-.168
2. MATLI and TTCT-Flexibility	-.158
3. MATLI and TTCT-Originality	-.345 *
4. MATLI and TTCT-Elaboration	-.859 *

\* All correlations significant beyond the .05 level

TABLE 3

Correlation Between the EPI and Means of Absolute  
Threshold for Light Intensity

Item	r
1. EPI and MATLI	-.340 *

\* Correlation significant beyond the .05 level.



The following correlations were obtained between the Eysenck Personality Inventory and the four scores on the Torrance Tests of Creative Thinking: fluency, .399; flexibility, .310; originality, .161; elaboration, .273. The results indicate a significant positive correlation at the .05 and .01 level between extraversion scores on the EPI and the creative variable fluency on the TTCT. The positive relationship between extraversion scores on the EPI and flexibility scores on the TTCT approach significance at the .05 level. The other two creative variables of the TTCT show positive but insignificant correlations to EPI extraversion scores. The null hypothesis, that there is no difference between creativity scores on the TTCT and extraversion-introversion scores on the EPI can be rejected on fluency and perhaps flexibility measures, but is confirmed on originality, and to a lesser degree, on elaboration. Thus, extraversion can be seen as playing a role in creativity, particularly in two out of four TTCT variables.

Kobayashi (1969) found higher significant positive correlations at and above the .05 level between fluency, flexibility and originality scores on the TTCT and all but emotional stability on the Extraversion-Introversion Test (EIT). One factor contributing to different correlations found in the present study and correlations found in the Kobayashi study might be attributed to differences in characteristics of students sampled. In this respect, sex, age, geographical location, educational level, grade point average, and socioeconomic background of subjects are variables to be considered. The sample used in this study was over 75% female, half of which were part-time students. Thirty-seven percent of the sample from Hopkinsville

Community College ranged in age from 25 to 49 while Kobayashi's sample consisted of ninth grade Japanese boys. Furthermore, his sample was considerably larger (489 subjects).

Correlations between means of absolute thresholds for light intensity and TTCT scores were negative: fluency,  $-.168$ ; flexibility,  $-.158$ ; originality,  $-.345$ ; elaboration,  $-.859$ . Originality showed significance at the .05 level while elaboration indicated a strong correlation above the .01 level of significance. In other words, findings seem to indicate a relationship between low sensory thresholds (strong nervous systems) and creativity, particularly in terms of originality and elaboration. Elaboration, the ability to add pertinent details to an original stimulus figure, its boundaries and/or the surrounding space is one function of creative ability affected by the strength of one's nervous system. According to findings the null hypothesis that there is no difference between creativity scores on the TTCT and threshold means for light intensity as measured by a 20-trial criterion is rejected for originality and elaboration scores. No significant difference was found in the relationship between fluency and flexibility variables and mean MATLI.

As reported in early chapters, studies and research investigating the relationship of sensory thresholds to extraversion have generally found significant positive correlations and suggest a relationship between low sensory thresholds and introversion. Conversely; extraverts, possessing weaker nervous systems, have high sensory thresholds. However, the results of this study show a negative correlation of  $-.340$ , significant at the .05 level. These results tend to disconfirm Eysenck's theory mentioned earlier and indicate

rejection of the null hypothesis stating there is no difference between absolute light thresholds as measured by a 20-trial criterion and extraversion-introversion as measured by the EPI. In other words, according to this study, sensory thresholds tend to be lower in extraverts than introverts.

This surprising finding may possibly be attributed to several factors. First, threshold measurements in this thesis may lack reliability as a result of lack of sophistication of the examiner as well as lack of ideal testing conditions. Furthermore, parameters require careful control before threshold results can be properly compared to other variables. Brightness, degree of illumination in the testing room, surrounding illumination instruction, and presentation techniques all affect reliability. More importantly, the intensity of the stimuli plays an important part in experimental results (Eysenck, 1967). Since the instrument used in measuring absolute light thresholds was a mild stimuli and appeared to be less sensitive to physiological change, meaningful data was difficult to obtain. It is quite possible, then, that the discrepant results are due to instrument choice.

Secondly, attitudinal factors such as risk-taking are difficult to control unless some form of forced choice is used (Eysenck, 1969). Although a difference in means of ascending and descending threshold scores was evident in extraverts, the difference did not prove to be significant. Smith (1966) has indicated differences using traditional methods of threshold measurement are undesirable because differences in measurements often result because of the decision making habits and risk-taking propensities of the subjects



rather than actual thresholds. He recommended using a forced choice technique and a guessing correction on the results. Because of this and other similar data, a forced choice technique would be advisable in further research.

Thirdly, complications arise concerning neuroticism which appears to be related to CFF and creativity. Wagoner (1960) and Eysenck (1957) have found that subjects with high N scores tend to have poorer resolution, i.e. lower CFF thresholds. Similarly, Kobayashi (1969) has found that anxiety is inversely related to creativity; creative people tend to be less anxious than less creative people. Also, since the sample used in this study was predominately female, some research would suggest that this factor would be affected by anxiety. Clearly, what is required here is a zone analysis taking the effects of neuroticism, sex and anxiety into account.

Fifth, this study did not consider the Lie Scale in determining EPI extraversion score. Although no absolute guidelines are given for its use, Eysenck (1968) cites considerable evidence to show that the score is useful in determining faking and acceptable FPI scores.



## CHAPTER V

### SUMMARY

The present investigation was initiated in order to determine the degree of relationship between the four measures of creativity on the TTCT and extraversion-introversion scores on the EPI. Additional correlations were to be investigated between the four TTCT scores and means for absolute thresholds of light intensity. A final correlation was to discover if a significant relationship existed between EPI scores and threshold means for light intensity.

The experimenter hypothesized a significant positive relationship between extraversion and creativity because research indicated that extraverts tend to be less anxious, have a more varied output, adapt quickly to new situations and exhibit a certain degree of stimulus hunger. These characteristics were expected to reflect in the fluency and flexibility scores of the TTCT. Kobayashi's research resulted in significant positive correlations between extraversion measures and fluency, flexibility and originality and also suggested reason to believe in the extraversion-creativity link. Other research reporting greater and more regular output, stronger nervous systems, lower sensory thresholds and higher efficiency of performance associated with cortical excitation tends to suggest a connection between creativity and introversion.

Results indicate that when specific areas of creativity (fluency and flexibility) are taken into consideration, a significant

relationship does exist. Thus, the relationship between creativity and personality is described positively by certain characteristics of creative personality in terms of extraversion-introversion.

The second hypothesis of the present study was that there was no difference between creativity scores on the TTCT and absolute thresholds for light intensity as measured by a 20-trial criterion. A Pearson Product-Moment Correlation eventuated in a negative coefficient ranging from an insignificant  $-.158$  to a highly significant  $-.859$ . A significant relationship appeared between threshold measurements and originality and elaboration, but not fluency and flexibility. While not all four creative variables are significantly related to MATLI, the strength of the nervous system plays a role in creativity particularly in terms of elaboration.

The final purpose of the study was to determine the relationship between the TTCT measures and the MATLI. The correlation was significant at the .05 level and indicated an inverse relationship between the two variables. Introversion was found to be related to high threshold measurements while extraversion was connected to low threshold measurements. These results conflict with research in the review of the literature, particularly with that of Eysenck's.

Replication of this study might include the following modifications to clarify and expand the findings. Parameters might be more carefully controlled, particularly those affecting illumination, instruction and presentation. The apparatus used to measure sensory thresholds might be stronger and more sensitive physiological change. Attitudinal factors might be more carefully controlled by substituting a forced-choice method and possibly a guessing correction might be used. The

Effects of neuroticism should be considered in subsequent studies. Also, the Lie Scale might be considered in determining acceptable extraversion-introversion scores.

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