A STUDY OF RESPONSE TO ACHROMATIC AND CHROMATIC STIMULI

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ABSTRACT

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by Fernando Colon

This investigation studied the affect of achromatic and chromatic stimulation on the behavior of people. The hypotheses were based upon Shapiro's theoretical rationale which states that various types of response to color reflect different levels of psychological and perceptual organization. He postulates the existence of a psychological-perceptual-differentiation continuum upon which people with different degrees of psychological and perceptual development can be ordered.

To represent parts of Shapiro's continuum the investigator selected three groups from a male student college population by means of the Minnesota Multiphasic Personality Inventory. In terms of positions on the continuum it was assumed that the impulsive group occupied the relatively undifferentiated part; the inhibited group, a more differentiated part; and the normal group, the highly differentiated part.

The hypotheses were as follows: The impulsive group would take less time to respond to the chromatic stimuli than to the achromatic stimuli. The inhibited group would take more time to respond to the chromatic than to the achromatic stimuli. The normal group would take relatively the same amount of time to respond to both chromatic and achromatic stimuli. The chromatic stimuli would be more effective in differentiating the groups than the achromatic stimuli. Finally, the findings would be consistent across the two experimental conditions

used in this study. For all hypotheses the measure used was reaction time.

The stimuli used in the experiment were four homogeneous paper rectangles, 8" by 10", one red, one green, one white and one black, each controlled for brightness. Each stimulus was placed in the center of a gray cardboard, 22" by 30". None of the subjects tested were red-green color blind.

The first experimental condition was the Any Word Association Condition. Each subject was presented with each of the four stimuli in a randomized order. Then each subject was asked to give eleven one word responses that came to mind as he looked at a particular stimulus.

The second experimental condition was the Feeling Word Association Condition. This took place one week after the Any Word Association Condition, using the same subjects. Each subject was again presented with the same four stimuli, in the same order as before. Then each subject was asked to give eleven word feeling responses that came to mind as he looked at a particular stimulus.

The hypothesis concerning the consistency of the results across both of the experimental conditions was not supported. The Any Word Association Condition yielded negative results; but the Feeling Word Association Condition gave highly significant results. It was thought that the results for the Feeling Word Association Condition were relevant to Shapiro's theory whereas the results for the Any Word Association Condition were not. Therefore the remainder of the findings summarized pertain only to the Feeling Word Association Condition.

The hypothesis that the impulsive group would take more time to respond to the achromatic stimuli than to the chromatic was not supported. Neither was there support for the prediction that the inhibited

group would take longer to respond to chromatic stimuli than to achromatic stimuli. In fact, the inhibited group took less time to respond to the chromatic stimuli than to respond to the achromatic stimuli. Support was found for the hypotheses that the normal group would take relatively the same amount of time to respond to both achromatic and chromatic stimuli.

The results did not support the hypothesis that the chromatic stimuli would be more effective than the achromatic in discriminating the groups. Rather, the reverse was true. Furthermore, the groups took consistently different amounts of time to respond to the four stimuli, regardless of whether the stimulus was chromatic or achromatic. The normal group always took the longest to respond, the inhibited group always took the next longest to respond, and the impulsive group always took the least amount of time to respond. Since these results were the most consistent aspect of the data, they indicated that the technique used to obtain the data was quite effective in separating the groups. In the text these results were discussed in terms of differences among the groups in set, in perceptual discrimination, in capacity to control impulses and, finally, differences in affective complexity.

Shapiro's theory predicted that different levels of psychological and perceptual organization in different groups would yield different responses to chromatic stimuli. Nevertheless, the effect of color was neglible upon the normal groups of this study with the exception of the inhibited group where the effect was observable. However, when the results are considered in terms of the ego functions of impulse control and perceptual discrimination they did support Shapiro's theory. When viewed in the context of these ego functions, the findings evinced a progressive increase of perceptual discrimination and impulse control which was consistent with each group's position on Shapiro's

differentiation continuum. Moreover the data of the inhibited group suggested the possibility of deviant groups within the upper end of Shapiro's differentiation continuum which overdevelop certain perceptual apparatuses because of defensive needs.

Finally some implications of the present study for further research were considered.

Approved Bill L. Kell
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By

Fernando Colon

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To Lois Jane
whose patience, support, and love
have made this thesis possible.

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I. INTRODUCTION

Theoretical Background

The nature of a person's response to chromatic stimulation has been a subject of vital interest for many years. Attempts to understand this area have taken many forms ranging from a phenomenological point of view (Rorschach, 1921; Schachtel, 1943) to a psychoanalytic approach (Rapaport, Gill and Schafer, 1946) and finally to a more recent, perceptual understanding of a person's response to color (Shapiro, 1960).

Rorschach (1921) pioneered a description of the phenomenology of a person's response to color in empirical terms when he studied the perceptual response to color on the Rorschach ink-blot test in 405 mentally disordered patients. He described three different types of response to color. The first type was the pure color (C) response which was typically given by emotionally impulsive persons. It was determined by the color stimulus alone. The second type was the color-form (CF) response in which form perception played some role in determining the percept but the color still dominated its delineation. This kind of color response was characteristically given by persons who were emotionally unstable, irritable and suggestible. Finally, he delineated a third type of color response wherein the form perception dominated the response and the color stimulus was harmoniously integrated into the total percept. He believed that this type of color response, the form-color (FC) response, was typically associated with emotional stability and adaptive affective responsiveness. As a result of these findings Rorschach concluded that color answers on the Rorschach ink-blot test,

"Have a 'symptom value', that is, they represent . . . the tendency to impulsive emotional discharge (1921, p. 33)."

After Rorschach's studies Schachtel (1943), Rapaport et al., (1946) and Shapiro (1960) have made the most important theoretical contributions in this area. Schachtel (1943) stressed two factors in the person's experience of color: the directness and immediacy of one's experience of color and the essential quality of passivity inherent in one's response to color. He thought that color stimulation had the capacity to intrude upon one's awareness before the ego's organizing apparatuses of thought, reflection and judgment could be brought into play. Therefore the resulting response had an essential passive quality to it. This passive quality would be particularly true of the pure color and color-form type responses, but not true of the form-color response where the active perceptual apparatuses of form perception exercised the dominant role.

Rapaport et al. (1946) further explicated an understanding of a person's response to color by applying the Freudian concept of the capacity to delay tension discharge to it and explained why some people do not respond immediately to color stimulation. He believed that if a person delayed his response to color such a person would have a more complex psychological organization in terms of his capacity to control, modulate and organize his drives than would the individual who gave an immediate response to color stimulation. In these terms, this more complex psychological organization would enable the person to further elaborate the perceptual and associative processes which in turn are necessary for a harmonious integration of both form perception and color perception.

Shapiro's (1960) recent formulation represented a comprehensive effort to explain a perceptual understanding of a person's response to color. He reviewed studies of children's sorting behavior as it related

to color, developmental Rorschach studies and studies of schizophrenia, and brain-damage conditions as it related to changes in perception. He also reviewed data that described the early visual experiences of previously blind people. On the basis of these reviews and his own wide experience with the Rorschach test, Shapiro arrived at a number of conclusions. He believed that a person's response to color was determined by a developmental process. At the most concrete and primitive level perceptions were determined by the visually most impressive qualities of the stimulus situation, that is, color. At a higher level of psychological and perceptual organization, ". . . there is a somewhat greater tendency toward a detached attitude, and the shapes of objects begin to be articulated, along with the color perceptions" (Shapiro, 1960, p. 164). He found that form perception superseded the perception of color at an even more advanced level of organization. Finally, at the highest level of psychological organization, i.e., normal subjects, "the attitude is a detached and objective one, and the subject is no longer directed by the immediate sensory or perceptual impressions, but can, as it were, make use of these impressions and shift freely from one to another" (Shapiro, 1960, p. 164).

Shapiro's review of data regarding persons who were previously blind further clarified this developmental process. Upon regaining their vision as a result of surgery, these people went through a series of steps before they achieved the form-color-type (FC) color response. At first they were quite attracted to the color stimulation and found it difficult to avoid its vivid impact. Slowly they acquired form perception until they reached what was called a "critical phase" where the sensorially more vivid color stimulation appeared to be antagonistic to the more active and detached articulation of form. He found that the person who acquired the basic tools of form perception was able to resist more readily the compelling, distracting sensory qualities of

color and to perceive form. Thus, he described a process whereby color, which at first was a compelling and dominating aspect of the visual field, was subjected to increased control of active and complex form-perceptual processes.

This explanation raises the question of what happened to the color sensation that ". . . neither disappears nor retains fully its original gripping and too vivid quality" (Shapiro, 1960, p. 169)? Shaprio believed that its place in perception was modified and that it could be integrated in a variety of ways with the now dominant form perception. He suggested the following possibilities:

> 1) Color sensations enrich visual experience by investing it with an ordinarily pleasing sensual quality which is not present otherwise; 2) Simply by adding another dimension to visual experience, color sensations make finer articulations possible, and lend greater individuality to a given form articulation; and 3) Color sensation may be an aid to form articulations, and under optimal conditions can undoubtedly make form recognition easier, faster and more accurate; in this sense, color performs an economical function (1960, pp. 169-170).

Shapiro in his summary concluded:

> Color perception as such is a more immediate and passive experience than form perception, requiring less in the way of perceptual tools or organizing capacity. It is associated with a passive perceptual mode in that it becomes more dominant, more compelling in quality, and perhaps even antagonistic to form articulation in conditions in which active perceptual organizing capacity is impaired or is only rudimentary; at the same time, under optimal conditions, color becomes integrated with form perception, is itself modified in subjective experience and acquires new functions of economy and enrichment (1960, p. 171).

The crux of Shapiro's theoretical formulation was that various kinds of response to color reflected different kinds of psychological and perceptual organization as a function of the way in which a person responded to immediate and direct sensory data.

Statement of the Problem

In Shapiro's terms the capacity to respond to color is determined by the relative complexity of the individual's psychological and perceptual organization. He states that some individuals are relatively undifferentiated psychologically and perceptually. Their responses to color are probably less adequate than the responses of people whose perceptual and psychological apparatuses are differentiated. Thus there is a continuum of responses by individuals, ranging from a relatively primitive and poorly articulated response to color to a highly articulated perceptual response. The central concept in Shapiro's theoretical presentation is the psychological-perceptual-differentiation-continuum; this means that different groups possess different levels of psychological and perceptual development that can be ordered on the basis of this continuum.

It is the purpose of this study to further explore the influence of color stimulation upon the behavior of people.

II. FORMULATION OF THE HYPOTHESES

Review of the Literature

A review of the research literature showed that there were essentially five approaches to the study of the relationship between color and a person's response to it.

The first approach focused upon the color preferences of both normal and pathological groups. In these studies people were asked either to choose two colors or combinations of colors they preferred, or to rate colors on the basis of a scale from pleasant to unpleasant. Guilford's (1945) and Warner's (1949) were examples of these kinds of studies. Although these studies were of interest, they did not shed much light on the subtle complexity of the phenomena involved in a person's response to color.

The second approach attempted to investigate more specifically Rorschach's original formulations regarding affectivity and response to color on the Rorschach ink-blot test. Baughman (1955) reviewed studies in which the effects of color stimulation on people who took the Rorschach were the primary concern. In these studies a person's performance on the Rorschach ink-blots was compared to his performance on an achromatic set of Rorschach cards, as for example, in the following studies: Allen, Mann & Stiff, 1951; Brody, 1953; Buker & Williams, 1951; Crumpton, 1956; Grayson, 1956.

These investigators have used a variety of subjects and research designs. Their populations have included psychotics, neurotics and normals. Their research designs have utilized individual and group administrations of the task, counter-balanced orders of presentation, and administrations of the test to equated groups of subjects, with

readministrations varying from a few days to several months. The dependent variables compared on the two sets of ink-blots have included latency or reaction time, productivity, form accuracy, incidence of popular or commonly seen percepts, preference, content, and behavioral manifestations of color shock, such as signs of surprise or blushing.

Their results, in spite of marked differences in approach, both with regard to the designs and the populations used, were in substantial agreement in showing that the Rorschach test did not reliably show how color influenced people. On the basis of their evidence it was clear that color had no broad pervasive effects upon various kinds of subjects' Rorschach behavior.

The marked discrepancies among clinical theory, clinicians' reports of their work with various pathological groups and the results of research concerning these issues are alarming. However, in the studies reviewed above the only reasonable conclusion is that the relationships between response to color and a subject's behavior have not been clearly established. Another consideration is that many of these studies varied in their definitions of color response which produced negative findings (Keehn, 1953).

However, the important fact is that the over-riding determinant of a person's response to the Rorschach inkblots is the form properties of the blots (Baughman, 1954). If one couples this conclusion with the fact that none of these studies attempted to investigate a person's response to color stimulation alone, separated from the many other stimulus attributes of a Rorschach inkblot, it is not so surprising that the results of studies using the Rorschach test have been so consistently negative. It is possible that other stimulus variables, such as form, shading and contrast, obscured the actual and perhaps significant influences of color stimulation.

A third approach to this problem was to compare performance on the Rorschach test to performance on other kinds of tasks that also involved color (Keehn, 1953; Reusch & Finesinger, 1941; Hamlin, Stone & Moskowitz, 1955; Potter & Sarason, 1947; Holzberg & Schleifer, 1955). Here the results were more favorable, but, again, it was difficult for these researchers to say with any degree of certainty whether or not color had the presumed effect on a person's performance on either the Rorschach test or on the specific task involved. To this writer it appeared that too many stimulus attributes and different levels of tasks entered the situation being investigated. In other words, as long as color was one element used in solving a problem, the differences observed between performances with chromatic stimuli could be due to differences in the difficulty of the two problems, rather than in the influencing properties of color per se.

A fourth approach to the relationship between color and a person's response to it compared various Rorschach indices to different kinds of physiological measures. The typical procedure hooked up the subject to either a psychogalvanic (GSR) apparatus or to other apparatuses designed to measure autonomic activity such as heart beat, pulse, and respiration. At the same time that the subjects were measured on the physiological apparatuses, they were administered the Rorschach.

Some investigators (Frost & Rodnick, 1948; Goodman, 1950; Levy, 1950; Rockwell, Welch, Kubis & Fisichelle, 1947) limited themselves to the study of the relationship of one physiological measure, the GSR, to behavior on the Rorschach. Others studied multiple physiological measures and Rorschach behavior (Hughes, Epstein & Jost, 1951; Jacques, 1946). The results of all of these studies were essentially negative in that color and non-color Rorschach responses were not associated with appreciably different physiological changes.

The fifth and final approach to the study of response to color was to extrapolate the color stimulus from the context of the Rorschach in order to study a person's reactions to color alone. Only three studies approached the problem in this way (Siipola, 1950; Haward, 1955; Drecksler, 1960). Siipola (1950) cut all the colored areas of the Rorschach blots from the original plates and made achromatic copies of these colored areas to use as the stimuli presented to the subjects. Haward (1955) reproduced the colors found on the Rorschach and constructed a set of cards with these colors on them. In addition he constructed an achromatic and a scarlet set of Rorschach inkblots which he used as the stimulus material in his study. Drecksler (1960) projected homogeneous rectangles of bright red, green and gray upon a screen in a darkened room in his experimental procedure.

These investigators obtained reasonably good results, except Haward who used a poor sampling procedure. The results in general supported the idea that color does have a differential influence upon different kinds of people which demonstrates the potential usefulness of this approach for further research.

The Hypotheses of This Study

A normal, an inhibited and an impulsive group were selected on the basis of the Minnesota Multiphasic Personality Inventory to represent different parts of Shapiro's psychological-perceptual-differentiation continuum. It was assumed that these three groups possessed different kinds of psychological and perceptual organization which would result in their giving different reaction times to color.

The normal group was expected to take similar amounts of time to respond to both chromatic and achromatic-stimuli. Their highly differentiated psychological and perceptual organization would enable them to be neither bound by color stimulation nor unduly excited by it.

The inhibited group would presumably respond more slowly to chromatic stimuli than it would to the achromatic stimuli. For the person in this group it was assumed that the impact of color stimulation would be strong. It was anticipated that the inhibited person's defensively organized psychological and perceptual organization would make him delay his response to color.

The impulsive group was expected to respond more quickly to the chromatic stimuli than it would to the achromatic stimuli. Their relatively less well developed psychological and perceptual organizations were expected to cause them to respond quickly and immediately to color stimulation without deliberation, flexible control or delay. It was thought that the impulsive person's behavior would be of an essentially reactive nature, determined primarily by the intrusive impact of the color stimulus.

Therefore the hypotheses for this study were:

1. The normal, inhibited and impulsive groups will respond with different reaction times to achromatic and chromatic stimuli.
   a. The impulsive group will take less time to respond to the chromatic stimuli than it will to the achromatic stimuli.
   b. The inhibited group will take more time to respond to the chromatic stimuli than it will to the achromatic stimuli.
   c. The normal group will take relatively the same amount of time to respond to both the achromatic and the chromatic stimuli.
2. There will be an ordered effect in which the red stimulus will most adequately differentiate the three groups, followed by the green stimulus, the white stimulus and the black stimulus in that order.
3. The hypotheses will hold for both of the experimental conditions of this study, the Any Word Association Condition (W) and the

Feeling-Word Association Condition (F).[1]

The a priori assumption for Hypothesis Two is that if chromatic stimuli have the greater impact then they would differentiate the groups from each other more adequately than the achromatic stimuli. Red is ordered first since it is experienced as being brighter than green. White is ordered before black because it is brighter than black.

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[1]See Procedures, pp. 14-16.

III. METHOD

The Subjects

Approximately 200 male MSU college students from several undergraduate psychology courses were given the Minnesota Multiphasic Personality Inventory (MMPI). The experimenter selected seventy of these students as possible research subjects.

The subjects were selected for the three groups on the basis of their scores on the validity scales and the clinical scales of the MMPI. The validity scores had to meet the standards for research stated by Welsh and Dahlstrom (1960) in order for a subject to be used for the research. Thus, the "Cannot Say" raw score had to be less than 30, the "Lie Scale" raw score had to be less than seven and the "Validity Scale" raw score had to be less than 16.

The standards used for the clinical scales were different for each group. In order for a person to be put into the inhibited group (I) he had to have one or more high scaled scores on the following scales of the MMPI relative to the remainder of the profile: the Hypochondriasis Scale, the Depression Scale, the Hysteria Scale and the Psychoasthenia Scale. High scaled scores on these scales are associated with neurotic difficulties and the inhibition of behavior (Welsh & Dahlstrom, 1960).

Individuals in the impulsive group (E) had to have high scaled scores on the Psychopathic Deviate Scale or the Hypomania Scale relative to the scores on the remainder of the Clinical profile. High scores on these scales are associated with the impulsive expression of behavior (Welsh & Dahlstrom, 1960).

Persons put in the normal group (N) had to have all of their clinical scaled scores on the MMPI within one standard deviation of the mean. This kind of profile is associated with normal behavior (Welsh & Dahlstrom, 1960).

On the basis of these procedures the experimenter placed 20 subjects into each of the three groups and ten subjects into an unclassified group. Then two experts in the use of the MMPI were asked to classify each of the same 70 subjects into one of the four groups on the basis of their clinical profiles. The final selection of subjects was made on the basis of whether or not two of the three judges (one of whom was the experimenter) agreed that the subject belonged to a particular group. By this procedure 15 subjects were selected to be in each of the three experimental groups.

After the above selection process the clinical profiles were examined to see what kinds of MMPI profiles were associated with each of the groups. It was found that the normal group met the criterion of having all the clinical scaled scores within one standard deviation of the mean. In a very few instances scaled scores exceeded the criterion by one or two points in either direction.

Persons put in the inhibited group had two predominant kinds of patterns. One pattern was a high score on either the Depression or the Psychoasthenia scales, or both, relative to the rest of the profile. The other pattern was a high score on either the Hypochondriasis or the Hysteria scales, or both, in comparison to the remainder of the clinical profile. The inhibited group mean scaled scores on the clinical scales used to select this group were: Hypochondriasis 60.13; Depression 64.73; Hysteria 65.73; and Psychoasthenia 66.73. Therefore all members of this group scored high on one or more of those scales that were thought to be important for the purposes of this study. To this extent the group is considered homogeneous.

For the impulsive group all of the subjects were found to score high on the Psychopathic Deviate Scale, or the Hypomania Scale, or both. Thus this group was homogeneous. The group mean scaled scores for the clinical scales used to select this group were: Psychopathic Deviate 67.20 and Hypomania 74.06.

Procedure

The stimuli used in the experiment were four, homogeneous paper rectangles, 8" by 10", one red, green, white and black; all controlled for brightness. Each stimulus was placed in the center of a gray cardboard 22" by 30", for the background. The stimuli were presented under conditions of daylight illumination to the subject by placing the cardboard that contained the stimulus on the table before which the subject was seated. The visual field to the front, to the right and to the left of the subject was colored gray so as to highlight the stimulus that was presented.

Before participating in the experiment each subject was tested for color blindness with the Ishihara color-perception plates so that none of the subjects used for the research was red-green color blind. Each subject was administered the black, white, green and red stimuli independently in a purely random order as determined by a table of random numbers. The same order of presentation was used for the same subject for the two experimental conditions to be described below.

The measure used was reaction time which was the amount of time between the request for the response and the response itself. The time was recorded to the nearest second with a stop-watch.

The first experimental condition was the Any-Word Association Condition (W). In this condition, each subject was asked to give eleven one word responses that came to his mind as he looked at a particular

stimulus. Each time the subject gave a one word response there was a ten second pause before he was asked to give another one word response. Thus each subject gave eleven responses to each of the four stimuli. The instructions for this condition were as follows:

> This is a personality test. I will present you with a series of stimuli. Each of them will be presented to you separately on a large piece of cardboard that will be placed upon the table before you. Upon seeing the stimulus I want you to give me a one word response to it, whatever word happens to come to your mind as you look at it. Each time I will wait until you give a one word response. After you give the one word response to the stimulus continue to look at it until I give you further instructions. (Then the first stimulus is presented to the subject so that the front edge is placed down first on the table with the stimulus still out of sight of the subject. This is so because the stimulus is on a card 22" by 30". Then the back edge is placed down at which time the stimulus is in the view of the subject. At the moment the back edge is placed down the stop-watch is started. Then the instructions continue.) Okay, give me a one word response to it.

Ten seconds after the subject gave his response, the instruction calling for the one word response was repeated. This was repeated until eleven responses with their reaction times were obtained for the particular stimulus. The procedure was then continued in the same manner for the three remaining stimuli.

The second experimental condition was the Feeling-Word Association Condition (F). It was administered one week after the (W) condition. The (F) condition was identical to the (W) condition with the exception that instead of being asked to give eleven one word associations to each of the four stimuli, the subjects were asked to give eleven one word "Feeling" responses to each of the four stimuli. The instructions for this condition were as follows:

> This is a personality test. I will present you with a series of stimuli. Each of them will be presented to you separately on a large piece of cardboard that will be placed upon the table before you. Upon seeing the stimulus I want you to give me a one word response that tells how it makes you feel; whatever

word that comes to mind as you look at it that tells how it makes you feel. Each time I will wait until you give a one word response that tells how it makes you feel as you look at it. After you give the one word response that tells how it makes you feel continue to look at it until I give you further instructions. (Then the first stimulus is presented to the subject as was done in the (W) condition. The instructions then continue.) Okay, give me another one word response that tells me how it makes you feel.

The same procedure was repeated until eleven one word feeling associations and their reaction times were obtained for each of the four stimuli.

The aim was to get ten comparable reaction times for each stimulus in both of the experimental conditions. The first reaction time was not comparable to the others because, unlike the second through eleventh reaction times, it was not preceded by a ten second interval of time. Therefore only the second through the eleventh reaction times were used in the statistical analysis.

IV. RESULTS

Sample Characteristics

After the data for the study was collected, the groups were checked to see if they differed in age. The mean age for the normal group was 21.06 years; for the inhibited group it was 20.93 years; and for the impulsive group it was 20.40 years. These differences among the means were not statistically significant. Therefore differences in age among the groups probably did not affect the results.

The groups were also compared with regard to their verbal ability after the data was collected. It was thought that the outcome of the study could be influenced by differences in verbal ability. If, for example, a person was high in verbal ability, he might be able to give associations fluently, rather than impulsively. The groups were checked by comparing their Verbal scores on the College Qualification tests that all students take upon their entrance to Michigan State University. The verbal test is used as a measure of vocabulary and verbal abilities. Based upon 11 subjects for each group for whom verbal scores could be obtained, it was found that the mean Verbal score for the inhibited group was 36.72; for the normal group it was 47.36 and for the impulsive group it was 59.63. All of these means were statistically significant from each other at the 5% level or better. Since the differences among the groups' Verbal scores are significant, this factor might have influenced the results.

Any Word Association Condition

Table 1 below shows the summary of the analysis of variance for the (W) condition. Only the trials and the group by trials interaction were significant. All of the other factors and interactions were not significant. The results for this condition were wholly negative with regard to Hypothesis 1 which stated that the three groups will respond differently to achromatic and chromatic stimuli. Since both the group and the treatment variables were not significant, Hypothesis 2 regarding the degree of influence of the stimuli in differentiating groups was not supported. Finally, Hypothesis 3, which stated that Hypothesis 1, 1a, 1b, 1c and 2 will hold for both the (W) and (F) conditions, was not supported as is seen by referring to both Table 1 and Table 2 below.

Therefore the results for the Any Word Association Condition were wholly negative with regard to the hypotheses tested in this investigation.

Table 1. Summary of Analysis of Variance for the Any Word Association Condition

Source	Sum of Squares	DF	Mean Squares	F	p
Group (A)	.425.91	2	212.95	1.63	
Error (a)	21,893.66	168	130.31		
Treatment (B)	24.61	3	8.20	.23	
Trial (C)	3,737.67	9	415.29	11.72	.01
A x B	435.47	6	72.57	2.04	
A x C	1,717.15	18	95.39	2.69	.01
B x C	1,161.15	27	43.00	1.21	
A x B x C	2,419.39	54	44.80	1.26	
Error (b)	53,561.14	1,512	35.42		
Total	85,376.15	1,799			

Feeling Word Association Condition

In general the results for the Feeling Word Association Condition were highly significant as shown in Table 2 below.

Table 2. Summary of the Analysis of Variance for the Feeling Word Association Condition

Source	Sum of Squares	DF	Mean Squares	F	p
Group (A)	10,311.10	2	5,155.55	7.00	.01
Error (a)	123,728.52	168	736.48		
Treatment (B)	1,028.78	3	342.93	2.92	.05
Trial (C)	7,170.37	9	796.71	6.77	.01
A x B	1,887.77	6	314.63	2.67	.05
A x C	3,275.18	18	181.95	1.55	<.10
B x C	3,870.18	27	143.34	1.22	
A x B x C	8,587.42	54	159.03	1.35	.05
Error (b)	177,877.35	1,512	117.64		
Total	377,736.67	1,799			

The Group Effect

Reference to Table 2 above shows that the group variable was a significant (p .01) source of variance. That is, the reaction time of the normal, inhibited and impulsive groups were a significant source of variance in the Feeling Word Association Condition.

Comparisons of the group means.-Using Duncan's new multiple range test (Edwards, 1960) for the comparisons of differences between means, it was found that the normal (N) group took significantly (p .01) longer to respond than either the impulsive (E) or the inhibited (I) groups. The (I) group took longer to respond than did the (E) group at the .20 level. Although this latter finding did not meet the generally accepted

standards for statistical significance, there was the suggestion of a difference in reaction time between the (I) and the (E) groups. The groups ranged in reaction time from more to less in the following order: (1) normal, (2) inhibited, and (3) impulsive. The results are shown in Table 3.

Table 3. Comparison of Group Means as Expressed by Reaction Time Scores

Across Group Mean Comparisons	p
(E) 7.30 vs (N) 13.08	.01
(I) 9.35 vs (N) 13.08	.01
(E) 7.30 vs (I) 9.35	.20

The Treatment Effect

Table 2 shows that there was a significant (p .05) treatment effect. That is, the reaction times to the treatment stimuli (black, white, green and red) were a significant source of variance.

The Group by Treatment Interaction Effect

Reference to Table 2 indicates that the group by treatment interaction effect was significant (p .05). Therefore the normal, inhibited and impulsive groups were affected by the black, white, green and red treatment stimuli.

Analysis of the extent to which the achromatic stimuli differentiate the groups.-The data for the black and white stimuli were pooled to form the achromatic category. When the achromatic group means were compared it was found that the achromatic stimuli differentiated

all three groups from each other at the .01 level. These results are shown in Table 4.

Table 4. Comparison of Across Group Achromatic Means as Expressed by Reaction Time Scores

Across Group Achromatic Mean Comparisons	p
(E) 7.05 vs (N) 12.93	.01
(I) 10.22 vs (N) 12.93	.01
(E) 7.05 vs (I) 10.22	.01

Analysis of the extent to which the chromatic stimuli differentiate the groups.-The data for the green and red stimuli were pooled to form the chromatic category. Comparisons of the chromatic group means showed that the (E) group and the (I) group both differed at the .01 level from the (N) group. However the (E) group did not differ significantly from the (I) group on the chromatic stimuli. These results are shown in Table 5.

Table 5. Comparison of Across Group Chromatic Means as Expressed by Reaction Time Scores

Across Group Chromatic Mean Comparisons	p
(E) 7.56 vs (N) 13.24	.01
(I) 8.49 vs (N) 13.24	.01
(E) 7.56 vs (I) 8.49	

The achromatic stimuli were more effective in distinguishing the groups from each other than were the chromatic stimuli. This finding did not support Hypothesis 2 which implicitly stated that the chromatic

stimuli would be more effective in distinguishing the groups than the achromatic stimuli.

Analysis of the extent to which each group responds differentially to the achromatic and chromatic stimuli.-Table 6 below shows the within-group comparison of the achromatic versus chromatic means. It is seen that only for the (I) group does the achromatic-chromatic distinction make a significant (.05) difference. This group took significantly less time to respond to the chromatic stimuli than it did to respond to the achromatic stimuli. The (E) group and the (N) group took relatively the same amount of time to respond to both the achromatic and the chromatic stimuli.

Consequently, Hypothesis 1b, which stated that the (I) group will take more time to respond to the chromatic stimuli than it will to the achromatic stimuli was unsupported. In fact, the reverse occurs at the .05 level of significance.

Nor was support found for Hypothesis 1a, which stated that the (E) group will take less time to respond to the chromatic stimuli than it will to respond to the achromatic stimuli.

However, support was found for Hypothesis 1c, which predicted that the (N) group will take relatively the same amount of time to respond to both the achromatic and chromatic stimuli.

Table 6. Within Group Comparisons of Achromatic Versus Chromatic Means

Within-Group Achromatic Means vs Chromatic Means	p
(E) 7.05 vs (E) 7.56	
(N) 12.93 vs (N) 13.24	
(I) 10.22 vs (I) 8.49	.05

Analysis of the extent to which the individual treatment stimuli differentiated the groups.-This step in the analysis involved comparisons of the individual treatment means across groups. From Table 7 below it can be seen that the white stimulus significantly differentiated all the groups from each other. The red stimulus differentiated all of the groups except the (E) from the (I) group. The black stimulus effectively separated all of the groups but did not separate the (N) from the (I) group. The green stimulus was the least effective in separating the groups in that it was able to differentiate only the (E) group from the (N) group.

Table 7. Comparisons of Individual Treatment Means Across Groups

Treatments	Group Mean Comparisons	p
Black	(E) 6.44 vs (N) 12.23	.01
	(I) 9.92 vs (N) 12.23	
	(E) 6.44 vs (I) 9.92	.01
White	(E) 7.66 vs (N) 13.64	.01
	(I) 10.52 vs (N) 13.64	.05
	(E) 7.66 vs (I) 10.52	.05
Green	(E) 7.77 vs (N) 10.60	.05
	(I) 8.22 vs (N) 10.60	
	(E) 7.77 vs (I) 8.22	
Red	(E) 7.35 vs (N) 15.88	.01
	(I) 8.76 vs (N) 15.88	.01
	(E) 7.35 vs (I) 8.76	

Thus, Hypothesis 2 which predicted that red will be the most effective stimuli in separating the groups, followed by green, white and black in that order, was not supported. Here it is seen even more clearly that the achromatic stimuli were more effective in differentiating the groups than were the chromatic stimuli.

Comparisons of the group by treatment interaction between the (F) and (W) conditions.-Figure 1 illustrates the above findings that deal with the group by treatment interaction for the (F) condition.

Figure 2 on the same page depicts the same group by treatment relationship for the (W) condition so that a comparison of the two is possible. It is clear that the (F) condition discriminated the three groups more effectively than did the (W) condition which had considerable over-lap among the groups.

Analysis of the extent to which each group responds differentially to the individual treatment stimuli.-This phase of the analysis compared the black, white, green and red treatment means to each other within a particular group. From Table 8 below it can be seen that for both the (I) and the (E) groups, there were no significant differences among the individual means within either of these groups. On three of the six possible comparisons of treatment means the (N) group responded differentially at a significant level. Obviously the normal group took different amounts of time to respond to the different stimuli whereas the inhibited and impulsive groups did not.

Table 8. Comparisons of Individual Treatment Means Within Groups

Group	Within Grp. Trt. Mn.			Comparisons		p
(E)	all comparisons					N.S.
(I)	all comparisons					N.S.
(N)	Black	12.23	vs	White	13.64	N.S.
(N)	Black	12.23	vs	Green	10.60	N.S.
(N)	Black	12.23	vs	Red	15.88	.01
(N)	White	13.64	vs	Green	10.60	.05
(N)	White	13.64	vs	Red	15.88	N.S.
(N)	Green	10.60	vs	Red	15.88	.01

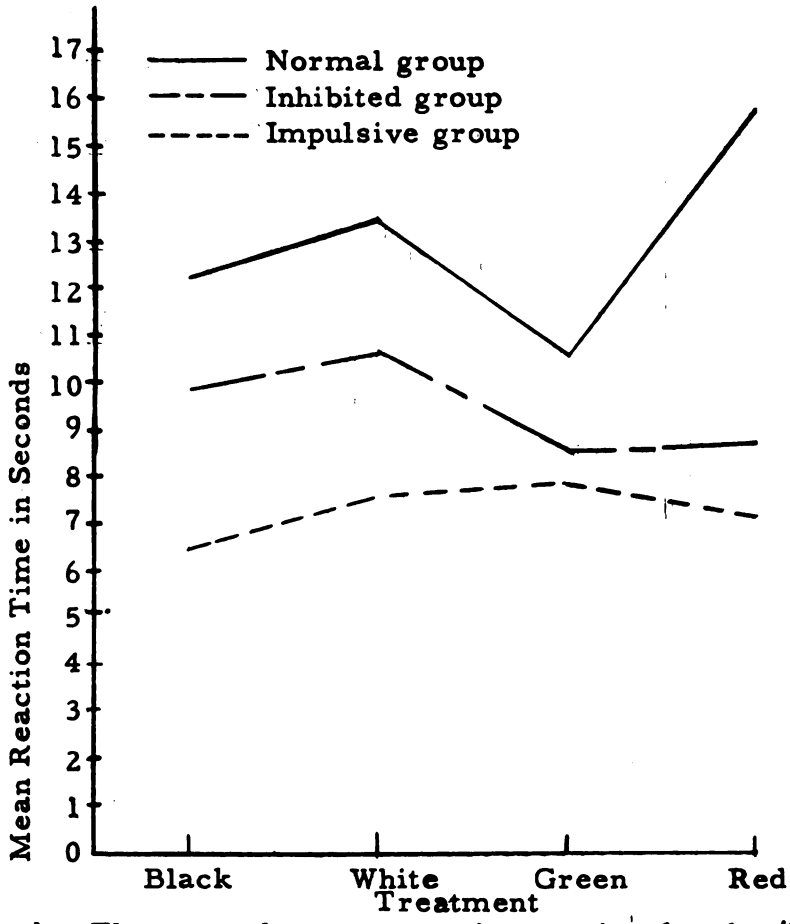

Figure 1. The group by treatment interaction for the (F) condition.

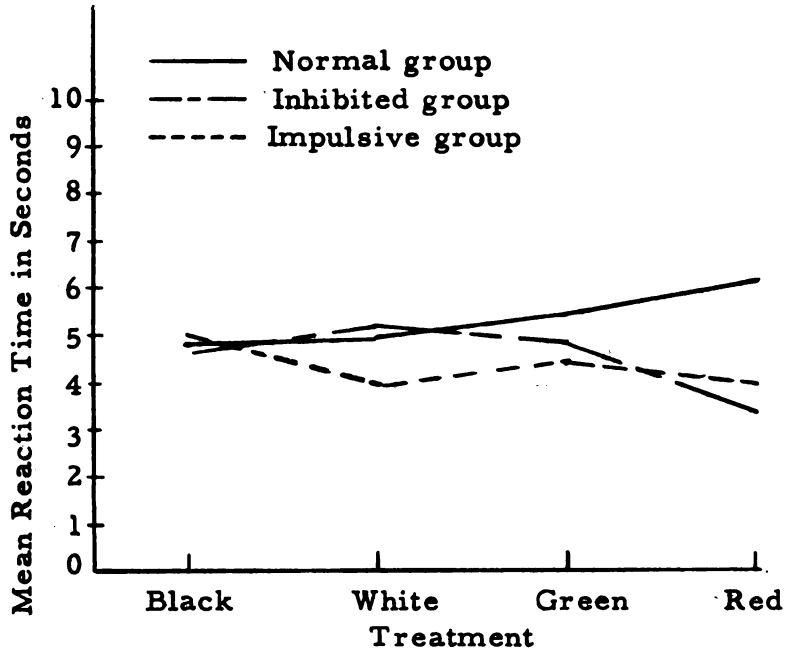

Figure 2. The group by treatment interaction for the (W) condition.

Support for Hypothesis 1 which stated that the three groups will respond differently to achromatic and chromatic stimuli was found. The impulsive group took about the same amount of time to respond to both kinds of stimulation. The inhibited group took significantly longer to respond to achromatic stimuli than it did to respond to chromatic stimuli. Finally, the normal group responded the most differentially to the individual stimuli and apparently did not respond in terms of the achromatic-chromatic dimension as did the inhibited group.

The Trials Effect

In Table 2 it is seen that there was a significant (.01) trials effect. That is, the reaction times to the trials were a significant source of variance.

The Group by Trials Interaction Effect

Table 2 also shows that the group by trials interaction effect approached significance (<.10). Since both the group effect (.05) and the trial effect (.01) were significant, and the group by trials interaction approached significance, (<.10), it was thought that an analysis of the group by trials interaction was justified even though no hypotheses were made concerning this interaction.

Analysis of the extent to which the trials differentiate the groups. - Table 9 below summarizes the comparison of the trial means across the groups. Trial 1 was compared to Trial 1 in each of the three groups, then Trial 2 was compared across the groups, etc. Trials 1, 2, and 4 did not differentiate the groups. In general, the trial's effect was the most effective in distinguishing between the (E) and the (N) groups, moderately effective in differentiating between the (I) and the (N) groups and not at all effective in distinguishing between the (E) and the (I) groups.

The optimal number of trials that might have been used for the groups in this study was six. After Trial 6 nothing different occurred with the exception of Trial 8 which appears to be due to the nature of the (I) group's behavior. This will be dealt with in more detail below.

The trials effect was not as potent in discriminating the groups from each other as was the treatment effect; for out of thirty possible tests among trial means, twelve were significant (40%); whereas out of twelve possible tests among treatment means, eight were significant (66%). Also the treatments could differentiate all of the groups effectively, whereas the trials did not.(see Table 7 above).

Table 9. Comparison of the Trial Means Across Groups

	p Values for the Three Group Comparisons Possible		
	(E) vs (N)	(E) vs (I)	(N) vs (I)
Trial	p	p	p
1			
2			
3	.01		.05
4			
5	.01		.01
6	.01		.01
7	.01		.01
8	.01	.01	
9	.05		
10	.01		

Analysis of the extent to which each group responds differentially to the different trials. -Analysis of the within group trial effect showed that the trials had no significant effect on the (E) group. These people behaved similarly from trial to trial. For the (I) group the trials had a moderate effect; these people behaved somewhat differently as a function of trials. Trials had the greatest influence on the (N) group;

people in this group behaved the most differently from trial to trial. Although this was true, the trial effect within a particular group, even for the (N) group, was not pervasive. Because, of the 135 tests of significance possible, only twenty-two were significant at the 5% level or better. The results are given in Table 10.

Table 10. Comparison of the Trial Means Within the Groups

Group	Number of Tests Significant at the 5% Level or Better	Number of Tests Possible
(E)	0	45
(I)	7	45
(N)	15	45
Total	22	135

Comparison of the group by trials interaction between the (F) and the (W) conditions. -Figure 3 below illustrates the findings for the group by trials interaction for the (F) condition. The groups separated from each other, more on the basis of time than on the basis of trials. The groups ranged in reaction time for the trials from most to least in this order respectively: (1) normal, (2) inhibited, (3) impulsive.

Figure 4 below represents the same relationship between the groups and the trials for the (W) condition. In this condition there was a great deal of overlap among groups. The groups did not separate from each other either on the basis of time or on the basis of trials.

Analysis of the Group by Treatment by Trials Interaction Effect

The last significant source of variance to be considered in Table 2 for the (F) condition is the significant (.05) group by treatment by

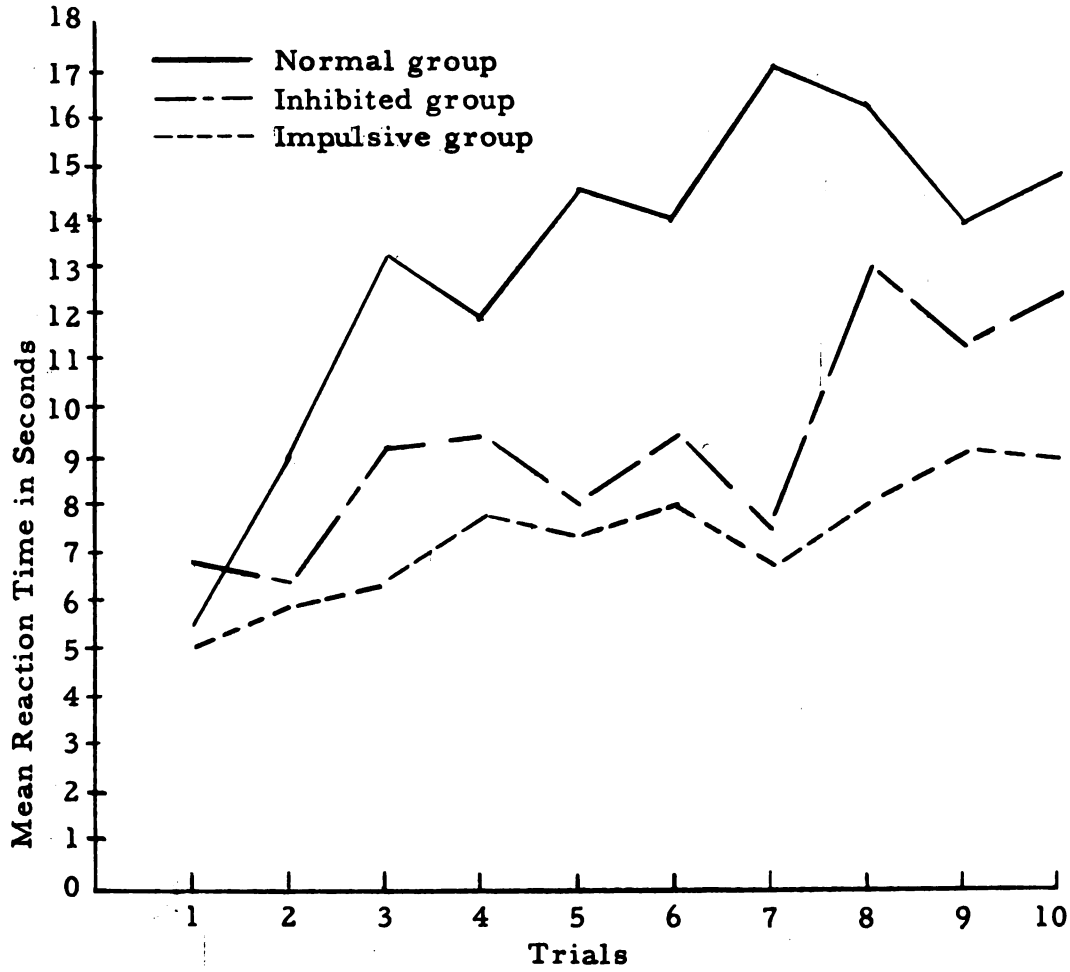

Figure 3. The group by trials interaction for the (F) condition.

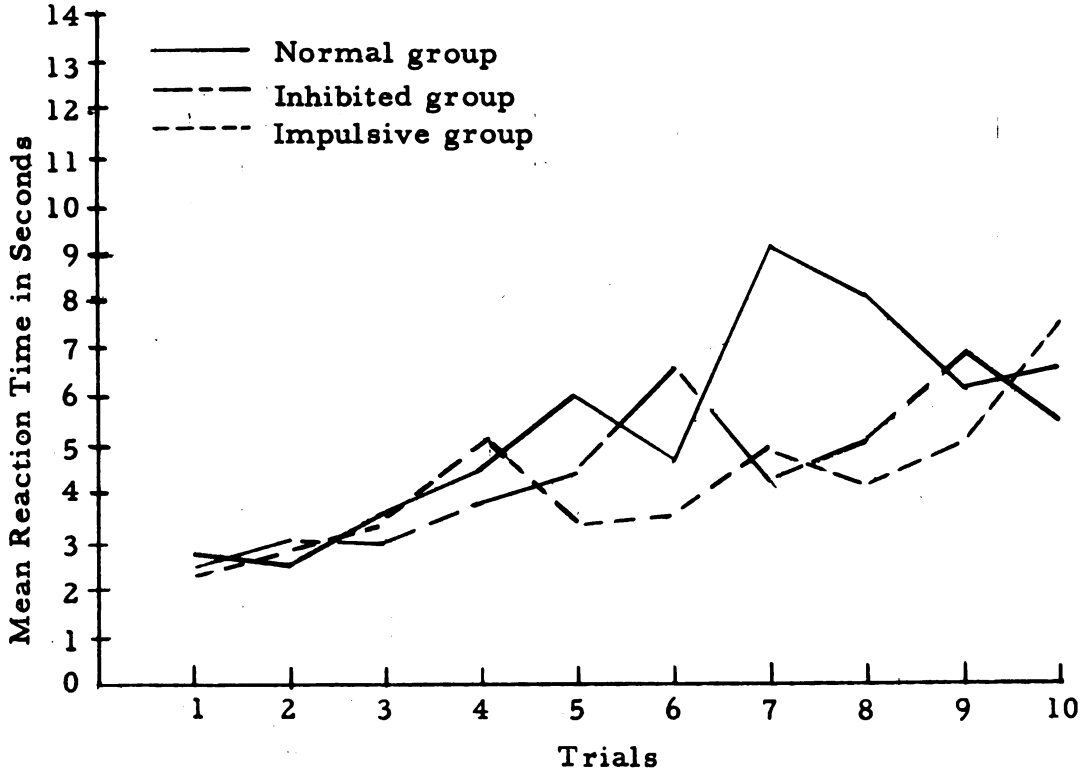

Figure 4. The group by trials interaction for the (W) condition.

trials interaction effect. Reference to Table 2 shows that the group by treatment interaction was significant (.05) and that the group by trials interaction approached significance (<.10). However, the treatment by trials interaction was not significant; therefore the variances that were a function of the group by treatment interaction and the group by trials interaction, were the sources of variance responsible for the significant group by treatment by trials interaction. Since both the group by treatment and the group by trials interactions were statistically analyzed, further statistical analysis of the group by treatment by trials interaction was unnecessary.

Although no hypotheses were stated for the nature of the group by treatment by trials interaction and further statistical analysis of this relationship was not needed, graphic representations of the relationship are instructive. Figures 5, 6, 7 and 8 below illustrate the group by trial interaction for each treatment taken separately.

Figure 5, which illustrates the group by trials interaction for the black stimulus, shows that the mean reaction times across trials for the (N) group generally fell in the upper portion of the graph. The mean reaction times for the (E) group generally fell in the lower portion of the graph. For the (I) group some of the scores fell high on the graph and some of them fell low, while still others fell in the middle.

The same situation occurred for the white stimulus condition (Figure 6) with the (I) group scores behaving the most inconsistently across trials while the (N) scores remained high and the (E) scores remained low.

The green stimulus condition as noted above (Table 7) was the least effective treatment in discriminating the groups. As seen in Figure 7 this was particularly true of the first five trials. Considering only the last five trials the (I) group again did not maintain a relatively constant position on the graph as did the (N) and (E) groups.

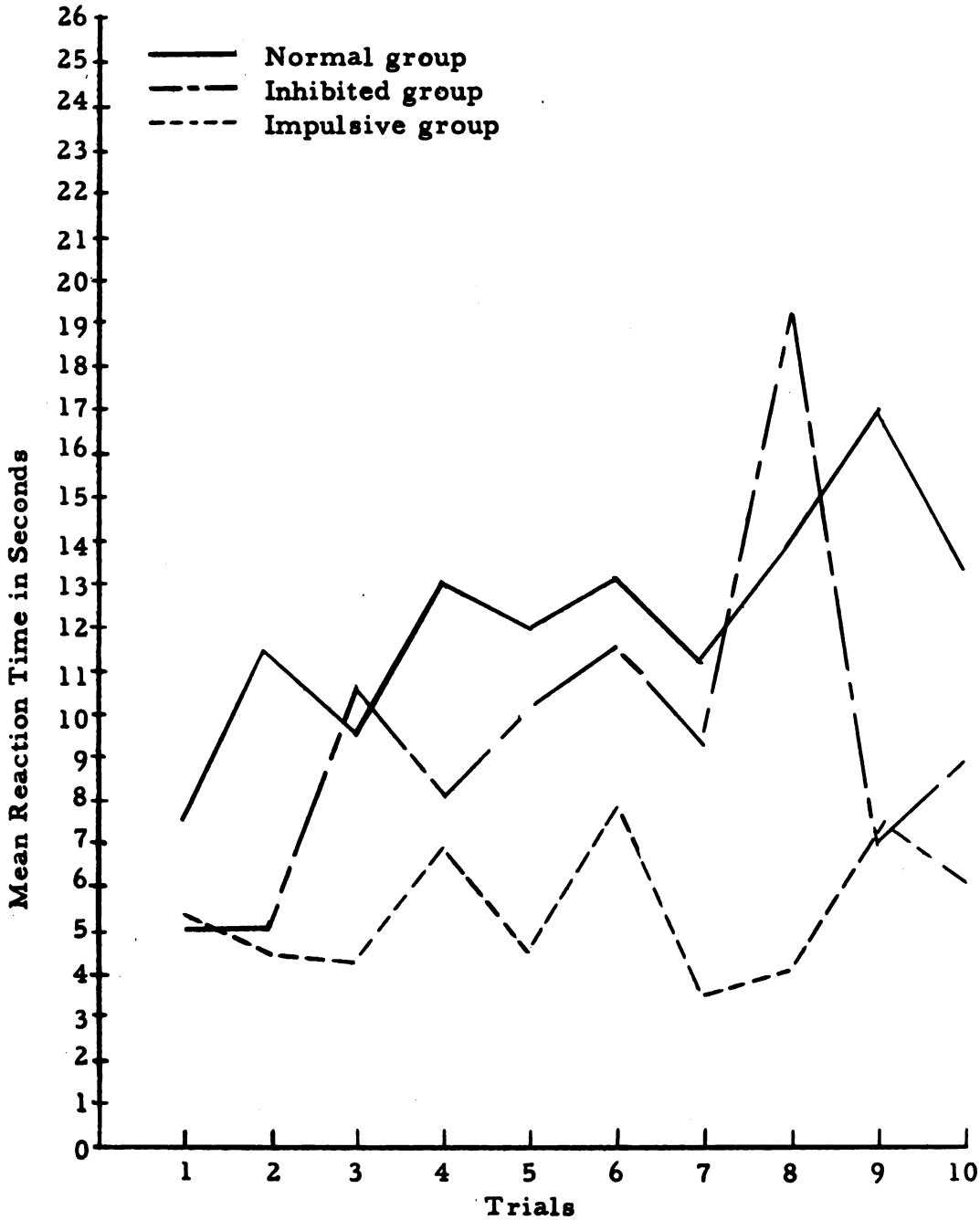

Figure 5. The group by trials interaction for the black treatment in condition (F).

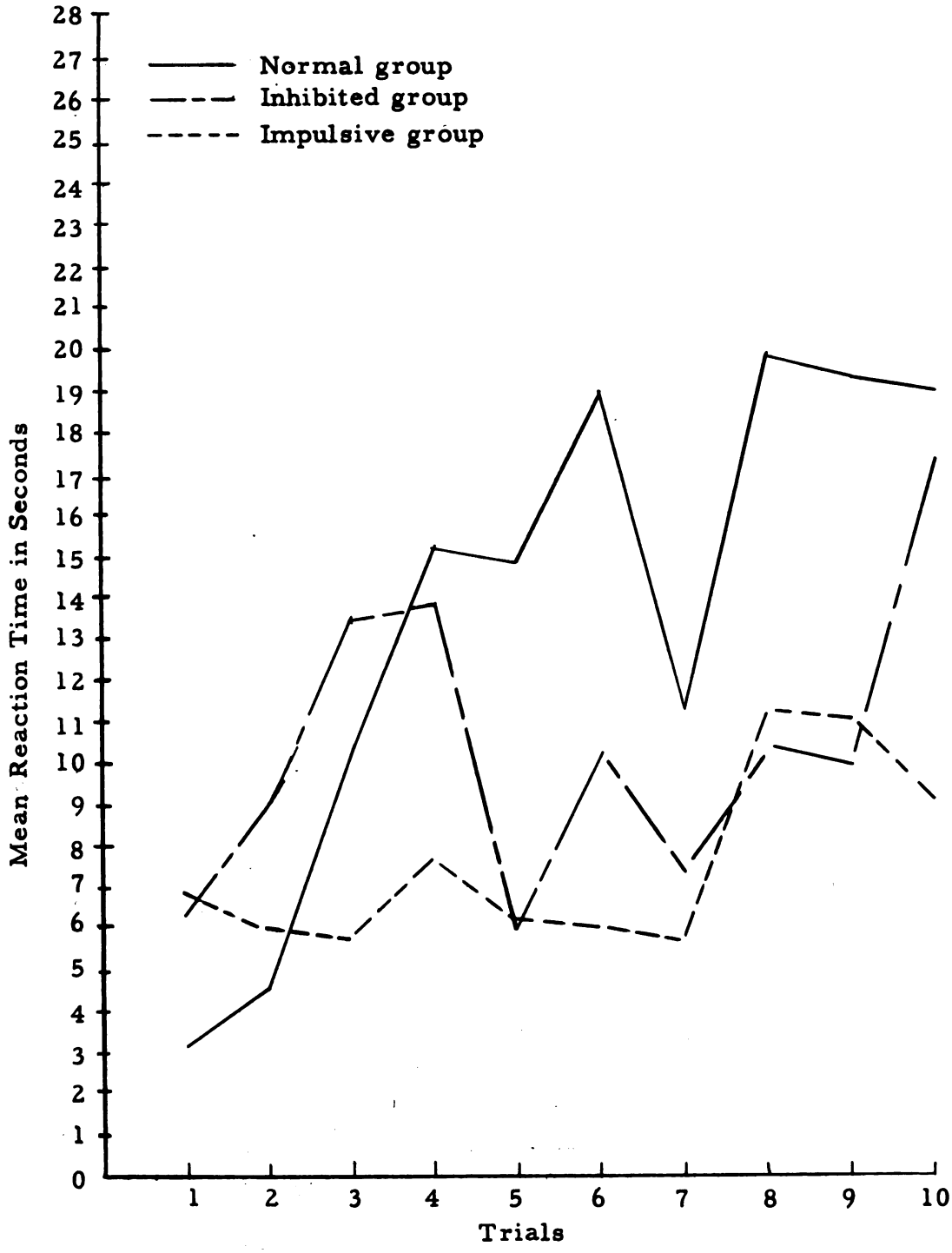

Figure 6. The group by trials interaction for the white treatment in condition (F).

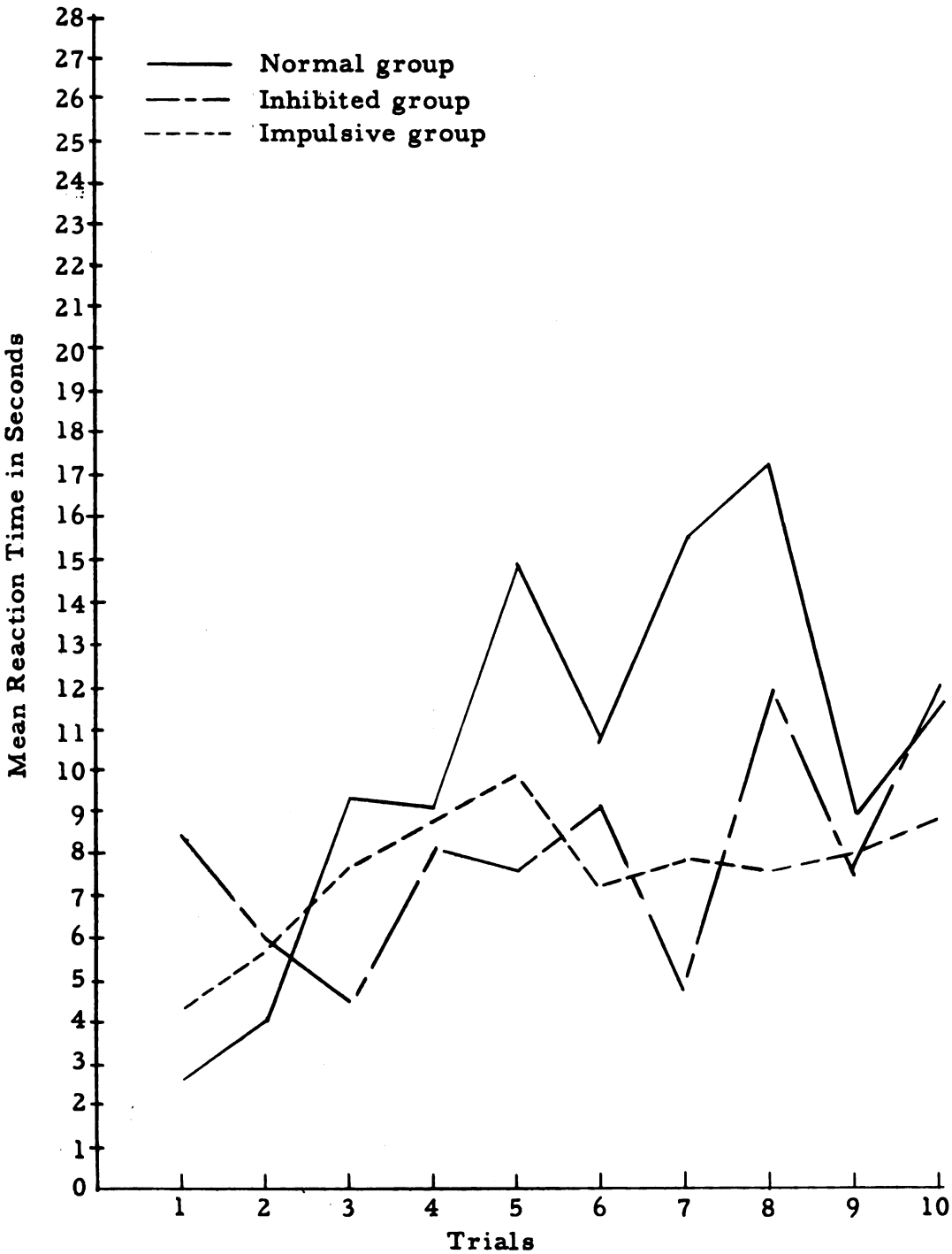

Figure 7. The group by trials interaction for the green treatment in condition (F).

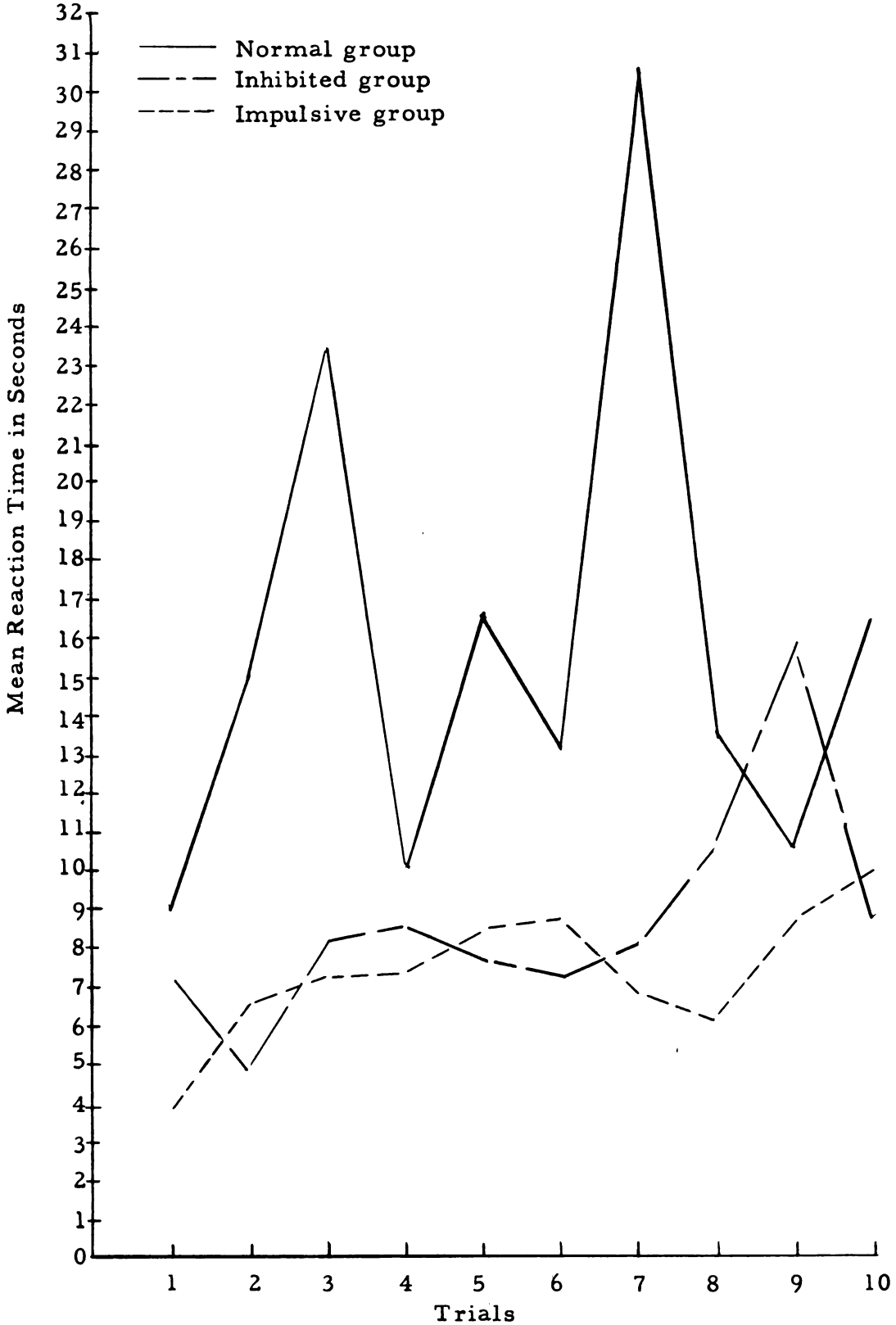

Figure 8. The group by trials interaction for the red treatment in condition (F).

For the red stimulus condition (Figure 8) the (N) group scores were again high, the (E) group scores were again low, whereas the (I) group scores were low on the earlier trials and high on the later trials.

Thus the most striking aspect of the group by trials interaction for each of the treatments was the fact that the (N) group scores, across trials, in general fell on the upper portion of the graph; the (E) group scores fell on the lower portion of the graph; and the (I) group scores fell on all areas of the graph.

Figures 9-18 below, depict the group by treatment interaction for each of the trials (1-10) taken separately. Study of these figures shows the same general trend as was noted for the group by trials interaction for each of the treatments. Again, in general, with the exception of Trials 1 and 2, the normal group treatment mean scores tended to fall in the upper portion of the graph, the (E) groups' scores fell in the lower portion of the graph and the (I) group scores fell on all areas of the graph.

Further Analysis of the Inhibited Group's Data

In the description of the subjects it was noted that the inhibited group had two predominant kinds of MMPI clinical profiles. One was high scores on either the Depression or the Psychoasthenia scales or both relative to the rest of the clinical profile. The other was high scores on either the Hysteria or Hypochondriasis scales or both relative to the rest of the clinical profile. In the inhibited group five subjects had one of these patterns and five subjects had the other pattern.

Since the inhibited group as a whole behaved inconsistently, its data was separated into a Depression-Psychoasthenia sub-group and a Hysteria-Hypochondriasis sub-group to see if the inconsistency persisted.

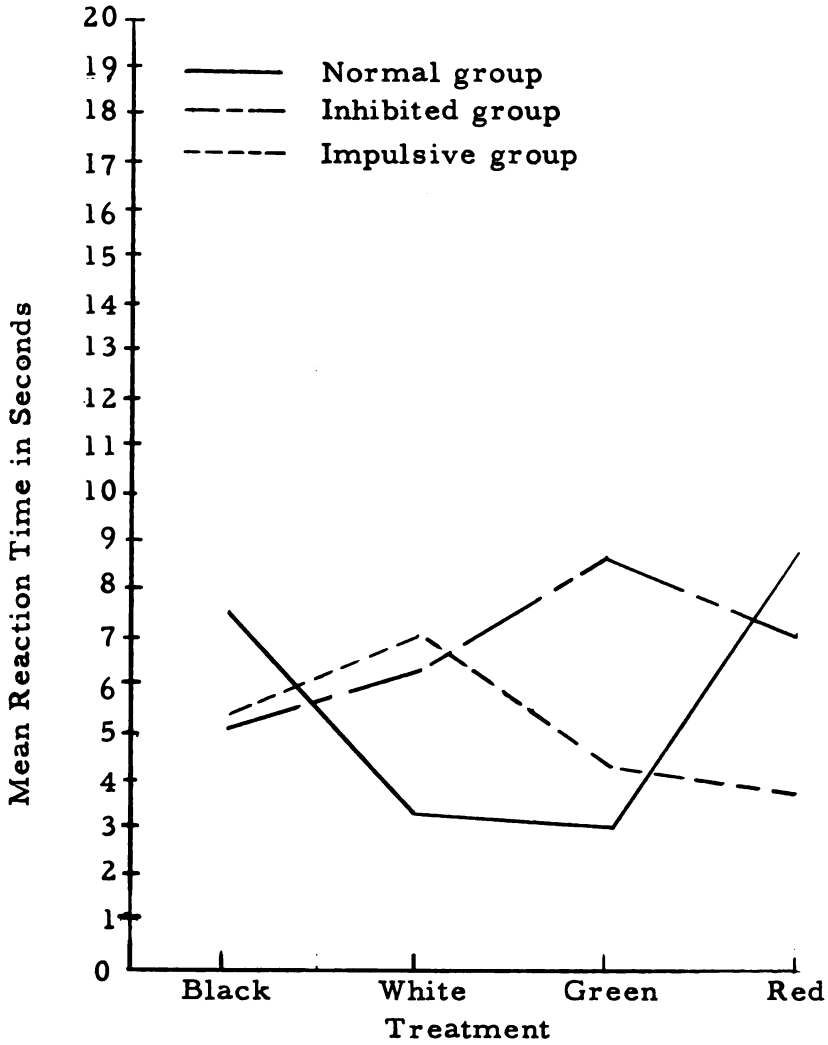

Figure 9. The group by treatment interaction for trial 1 in condition (F).

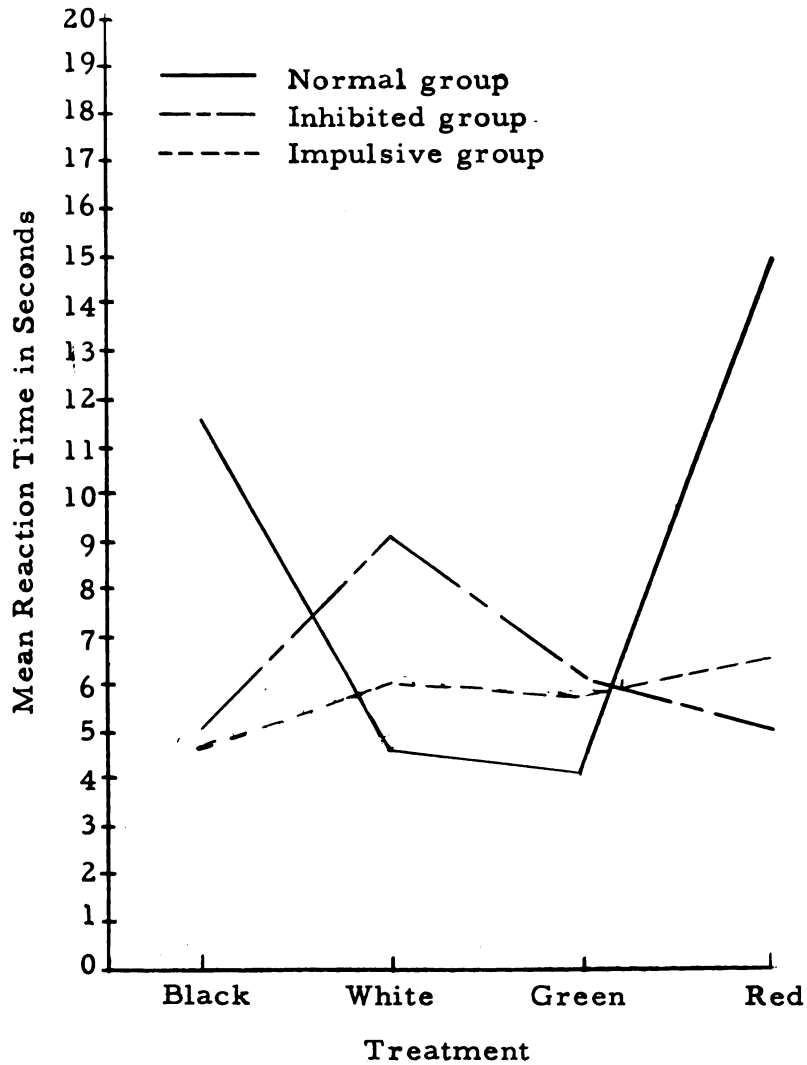

Figure 10. The group by treatment interaction for trial 2 in condition (F).

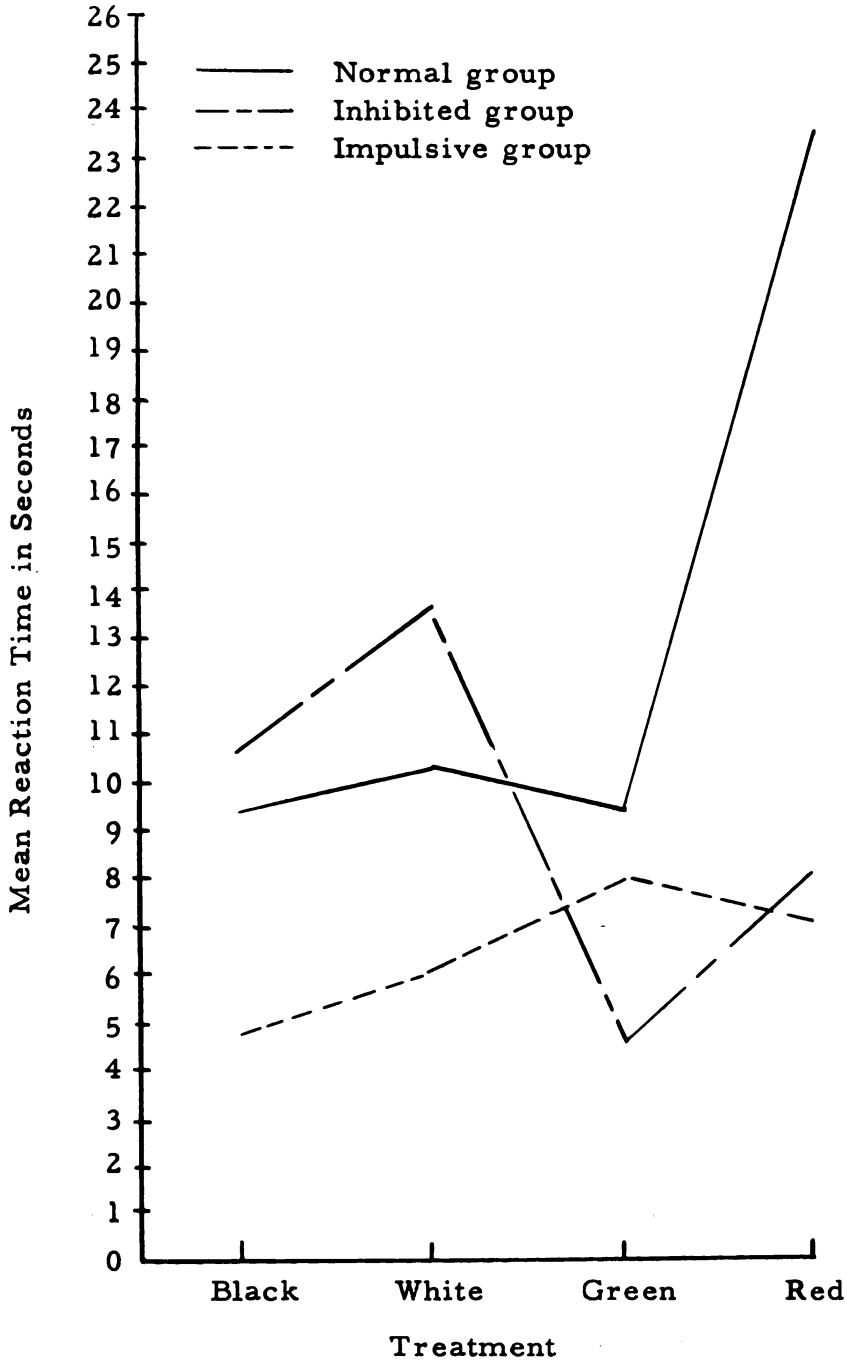

Figure 11. The group by treatment interaction for trial 3 in condition (F).

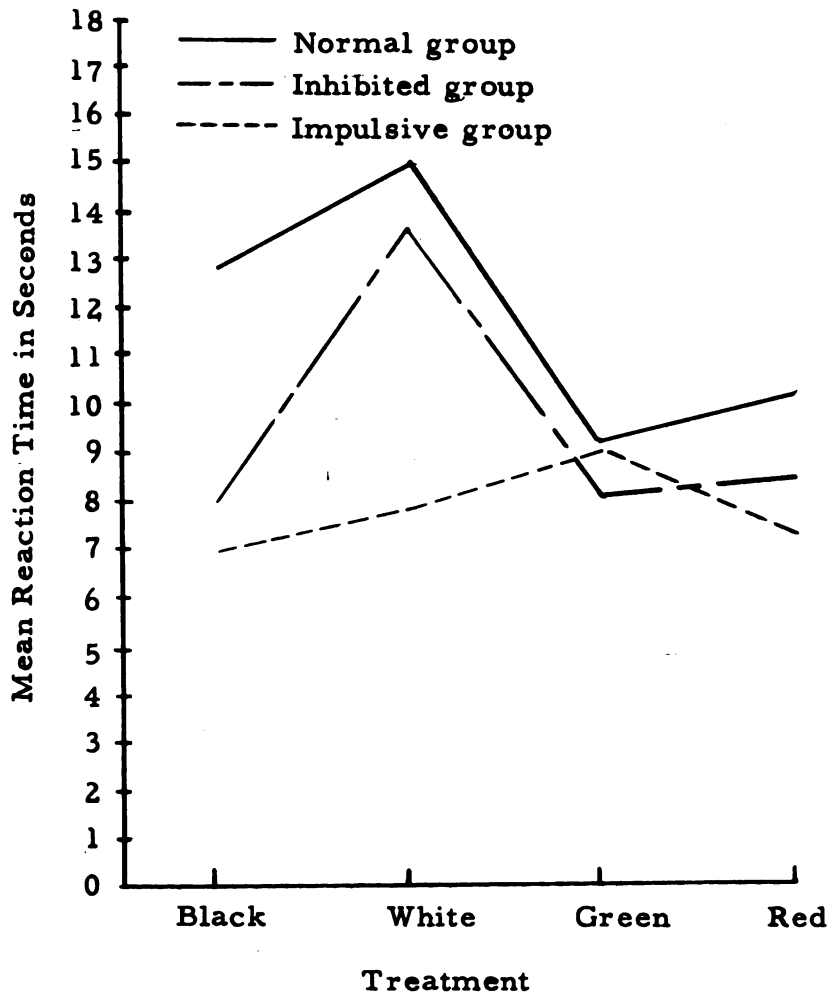

Figure 12. The group by treatment interaction for trial 4 in condition (F).

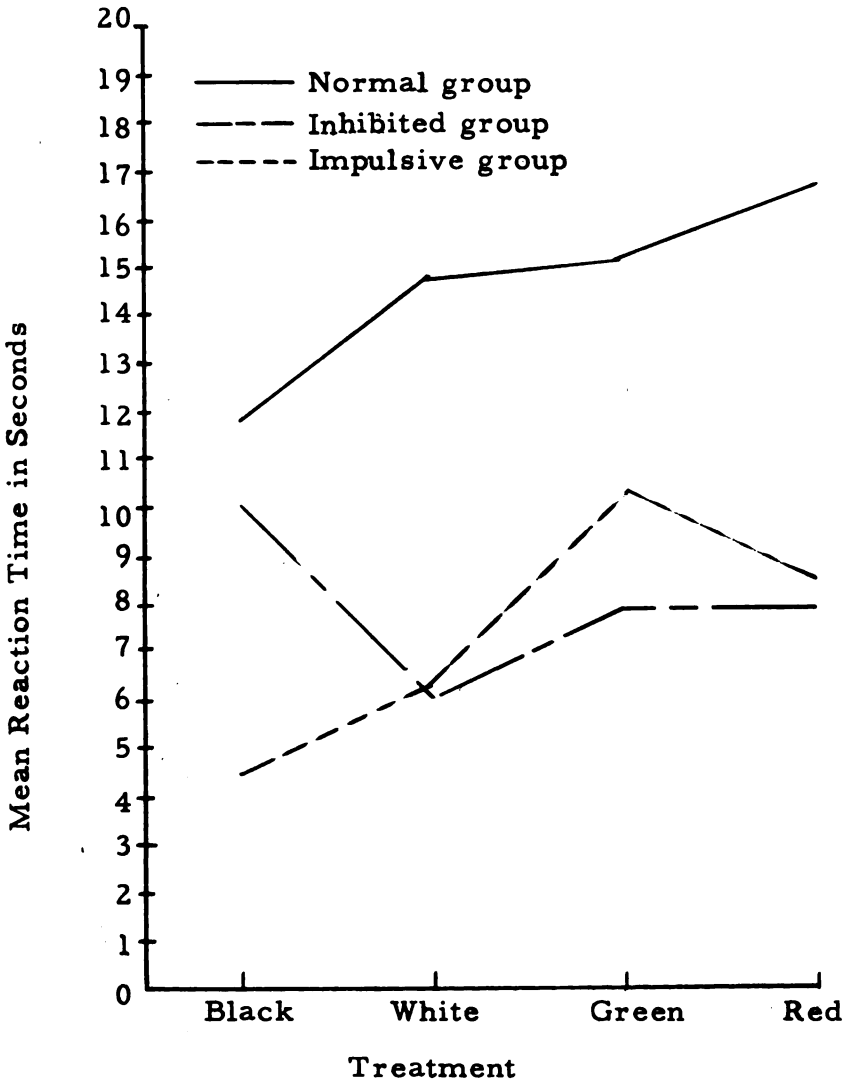

Figure 13. The group by treatment interaction for trial 5 in condition (F).

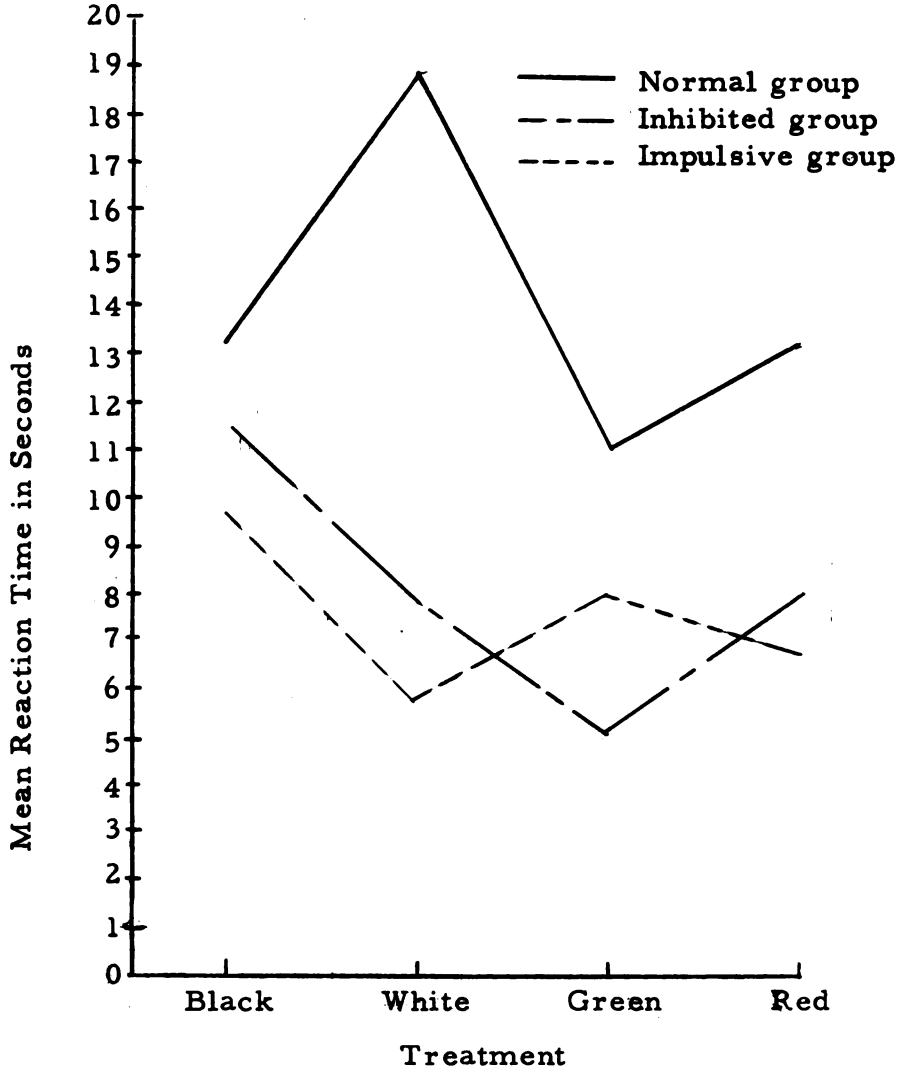

Figure 14. The group by treatment interaction for trial 6 in condition (F).

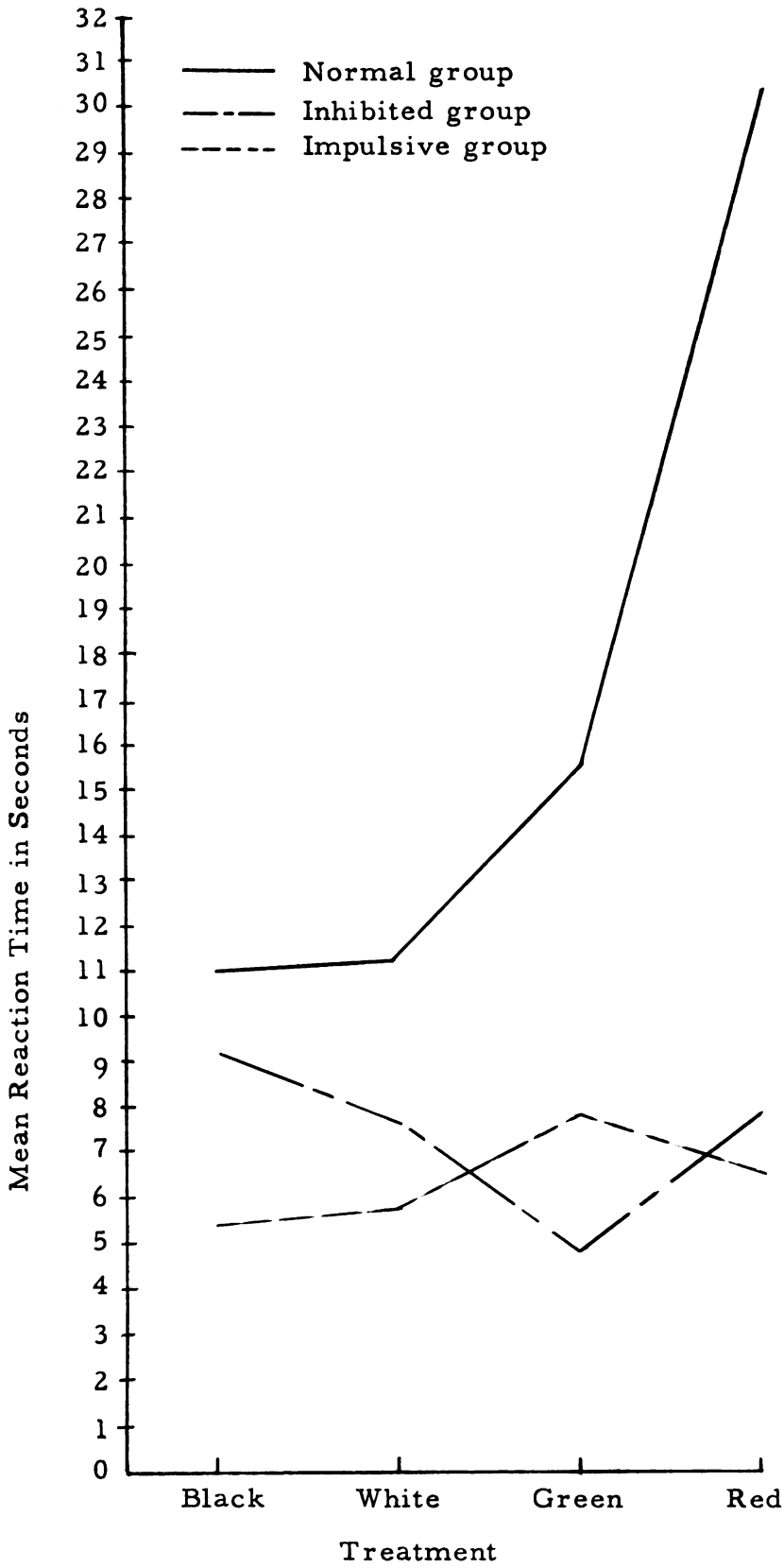

Figure 15. The group by treatment interaction for trial 7 in condition (F).

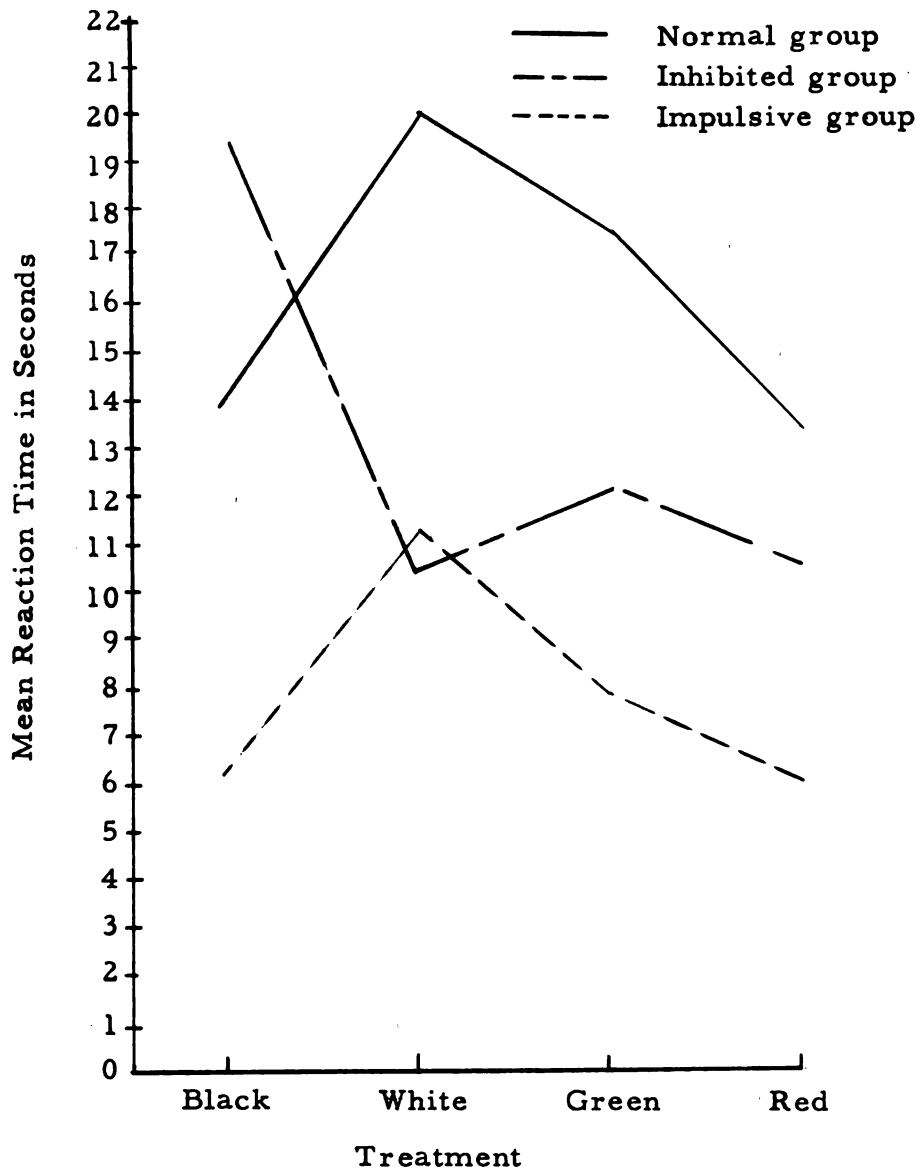

Figure 16. The group by treatment interaction for trial 8 in condition (F).

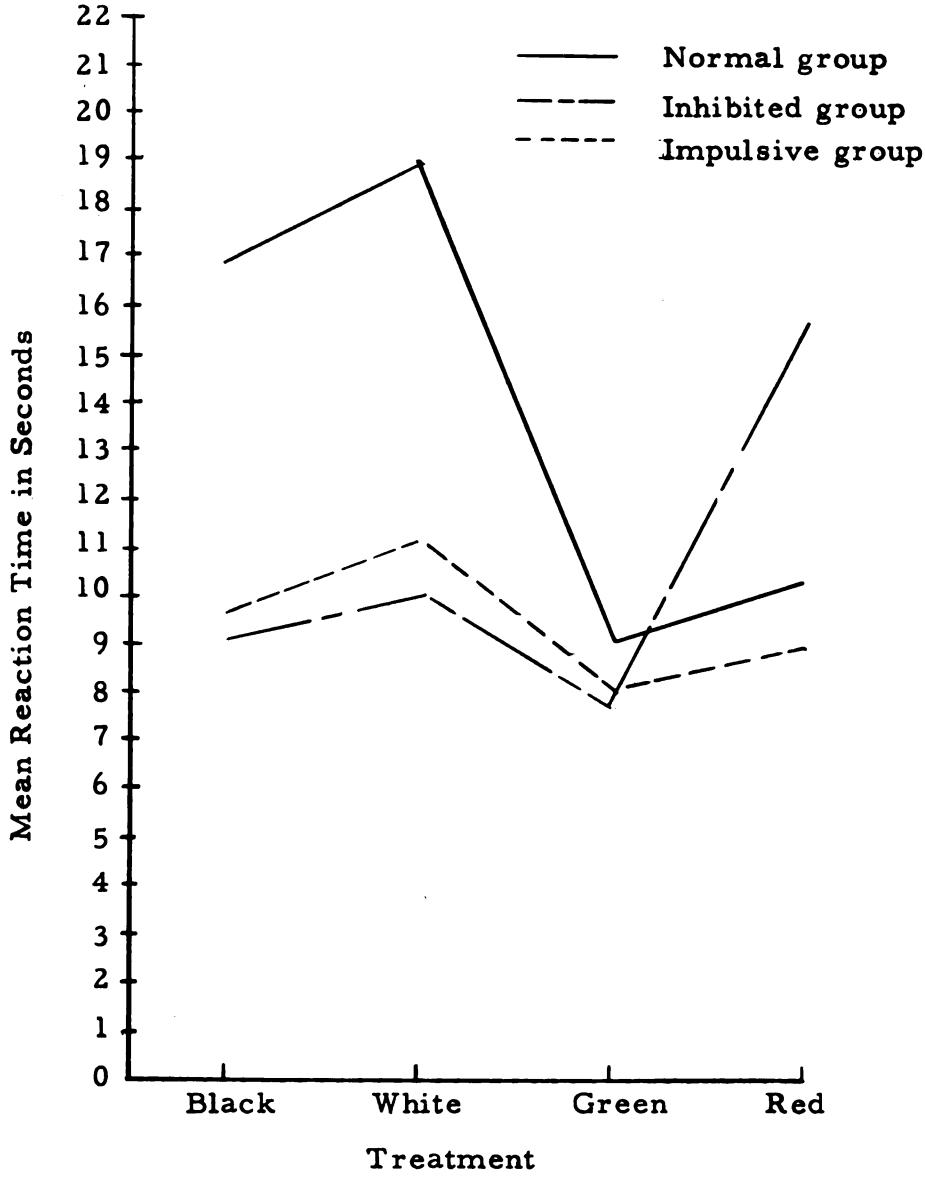

Figure 17. The group by treatment interaction for trial 9 in condition (F).

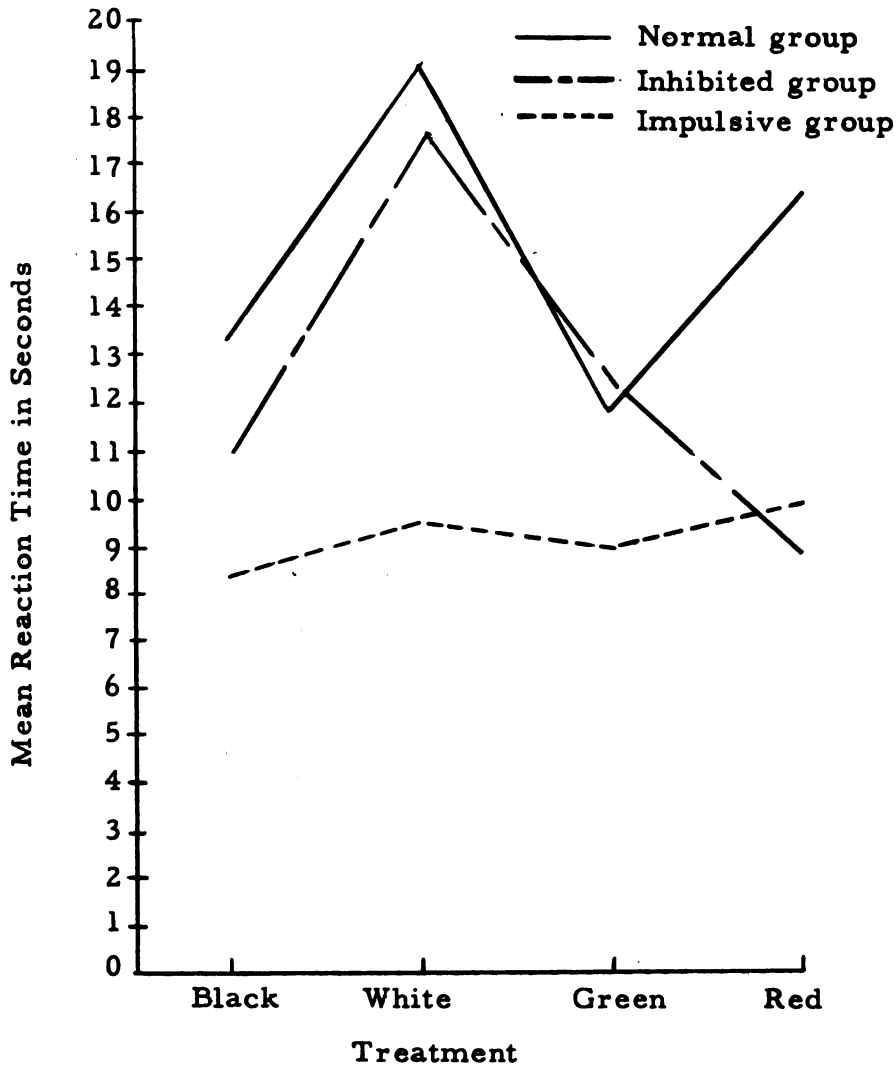

Figure 18. The group by treatment interaction for trial 10 in condition (F).

Figure 19 below shows the two sub-groups for the group by treatment interaction in comparison to the inhibited group as a whole. It is clear that the two sub-groups behaved differently from each other, which is evidence that the inconsistency still persisted. Figure 20 below shows the group by trials interaction for the inhibited group as a whole in comparison to the two sub-groups. Initially the three groups behaved quite similarly but as the number of trials increased, they behaved differently which is to say, inconsistently. The inconsistency was greater for the former interaction than for the latter. The possibility exists that there are two types of inhibited people, each with its own pattern of inconsistency.

Summary of the Data for the (F) Condition

The final and most compelling aspect of the data was the consistent difference found in the amount of time the three groups took to respond, whether it was in terms of the group, treatment, or trial factors. Except for Trial 1, where the differences among the groups were not statistically significant, the normal group always took the longest amount of time to respond; the impulsive group always took the least amount of time to respond; and the inhibited group always took an intermediate amount of time to respond. This highly consistent trend is summarized in Table 11 below which presents the mean values for the three groups on all of the variables analyzed in this study.

Careful study of this table shows that the normal group varied the most in time on treatments and trials. It also shows that the inhibited group varied to some extent on these factors and that the impulsive group varied the least. This aspect of the data is made clearer in Tables 12 and 13 below, which show respectively the largest difference among the trial means within each group and the largest difference among the treatment means within each group.

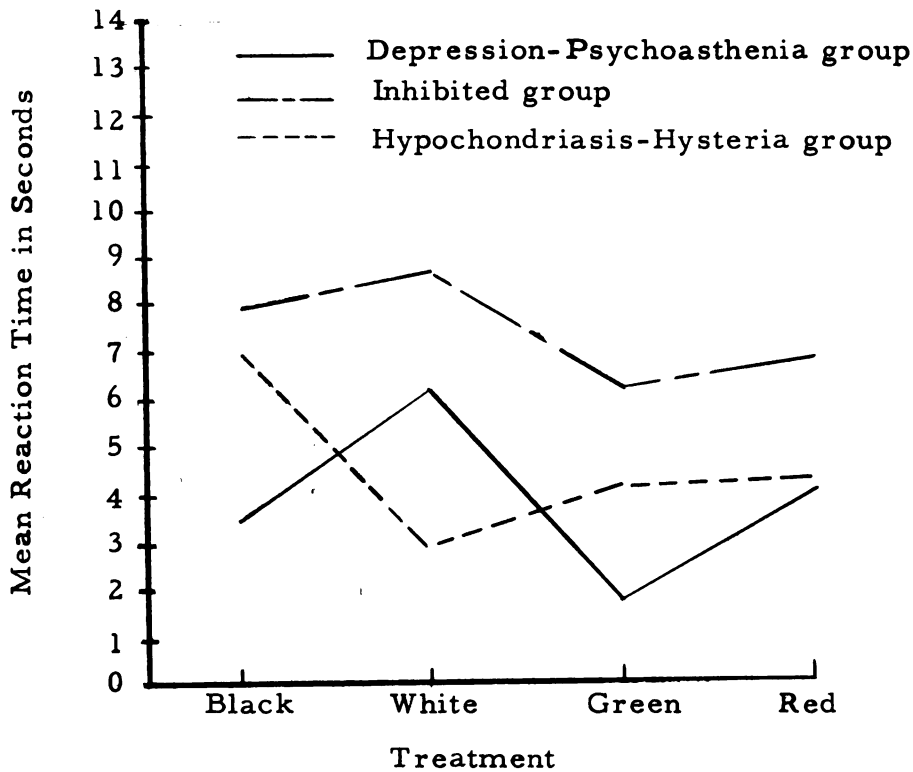

Figure 19. The group by treatment interaction for three inhibited groups in condition (F).

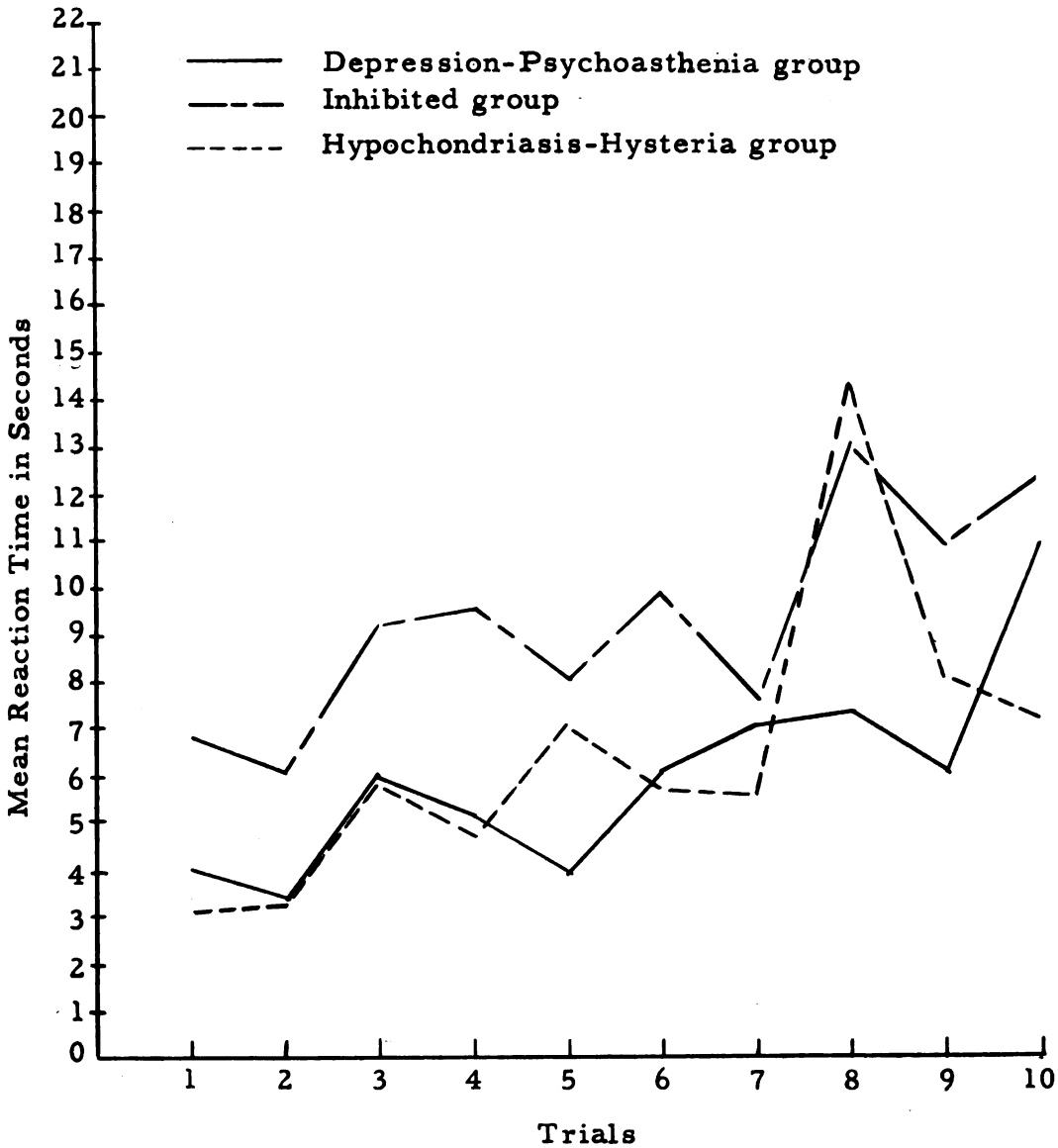

Figure 20. The group by trials interaction for three inhibited groups in condition (F).

Table 11. Summary Table of the Mean Values Across Groups for the Variables Analyzed in This Study

Means	Impulsive	Inhibited	Normal
Group	7.30	9.35	13.08
Achromatic	7.05	10.22	12.93
Chromatic	7.56	8.49	13.24
Black	6.44	9.92	12.23
White	7.66	10.52	13.64
Green	7.77	8.22	10.60
Red	7.35	8.76	15.88
Trial 1	5.08	6.81	5.63
Trial 2	5.71	6.18	8.91
Trial 3	6.30	9.30	13.31
Trial 4	7.76	9.66	11.85
Trial 5	7.30	8.00	14.61
Trial 6	8.03	9.73	14.01
Trial 7	6.51	7.60	17.21
Trial 8	7.90	13.11	16.25
Trial 9	9.35	10.85	13.90
Trial 10	9.10	12.30	15.16

Table 12. The Largest Difference Between Trial Means Within Each of the Groups

Group	Largest Difference Between Trial Means
Impulsive	4.27
Inhibited	6.93
Normal	11.58

Table 13. The Largest Difference Between Treatment Means Within Each of the Groups

Group	Largest Difference Between Treatment Means
Impulsive	1.33
Inhibited	2.30
Normal	5.28

Summary of the Results

The Any Word Association Condition yielded no significant results relative to the hypotheses. The Feeling Word Association Condition yielded highly significant results with regard to the hypotheses. Therefore the summary of the results that follows refers only to the findings in the Feeling Word Association Condition.

The achromatic stimuli were more effective in differentiating the groups from each other than were the chromatic stimuli. The order of effectiveness of the stimuli in differentiating the groups ranked as follows: white, red, black, and green. Red and black were equally effective.

The impulsive group took relatively the same amount of time to respond across trials, across the achromatic-chromatic stimuli, and across all the treatments (black, white, green and red). Therefore the impulsive group responded the least differentially to the experimental variables in this study.

The inhibited group responded in terms of time, somewhat differently across the trials. It took less time to respond to the chromatic stimuli. It responded with relatively the same amount of time to the treatments. Therefore the inhibited group responded moderately differentially to the experimental variables in this study.

In terms of time the normal group responded most differently across the trials, and to the different treatments, and relatively similarly to the achromatic and the chromatic stimuli. Thus the normal group responded the most differentially to the experimental variables in this study.

The groups differed consistently in the amount of time that they took to respond to either the treatment stimuli or the trials. The normal group took the longest to respond, the inhibited group next, and the impulsive group least.

The treatment stimuli were twenty-six per cent more effective in differentiating the groups than were the trials.

Analysis of the group by treatment interaction across trials and of the group by trials interaction across treatments showed that the impulsive group usually took the least amount of time to respond, that the normal group generally took the most, and that the inhibited group responded inconsistently.

V. DISCUSSION

Implications of the Data for Shapiro's Theory

In general the results of this study concerning the color dimension did not support Shapiro's theory. The groups represented different parts of the upper portion of Shapiro's psychological-perceptual-differentiation-continuum. Perhaps color did not differentiate the groups because the groups were drawn from a college student population in which the differences in psychological and perceptual differentiation of color perception was not great. If so, then differences in response to color would not readily manifest themselves.

Although they did not support Shapiro's theory for color the results did support unexpectedly his theory that differences in perceptual discrimination exist. The impulsive group did not differentiate between the achromatic and the chromatic stimuli, nor did it differentiate among the individual treatment stimuli. The inhibited group did differentiate between the achromatic and the chromatic stimuli, but it did not distinguish the treatment stimuli from each other. The normal group did not distinguish between the achromatic and the chromatic stimuli, but it did discriminate among the treatment stimuli. Therefore the findings suggest that there was a progressive increase of perceptual discrimination within each of the groups which was consistent with the group's relative position on Shapiro's differentiation continuum.

Based on the assumption that reaction time is related to impulse control, the results gave unexpected support to another aspect of Shapiro's theory. The data suggested that different degrees of development of the ego function of impulse control apparently do exist.

Whether one considered the achromatic-chromatic variable, the treatment variable (black, white, green or red), or the trial variable, the normal group always took the longest to respond, the inhibited group always took the next longest to respond and the impulsive group always took the least amount of time to respond (see Table 11). On the basis of Shapiro's theory one would expect that the normal group would have the greatest capacity to delay the expression of its impulses, the impulsive group the least capacity to delay, and the inhibited group an intermediate capacity to delay. The results appear to confirm Shapiro's theory that groups--relative to their position on his continuum--possess increasing capacity to control their impulses.

The behavior of each of the groups is better described by combination of the two ego functions discussed above.

The impulsive group in this study probably had well developed psychological and perceptual apparatuses. However, because of its tendency to respond quickly, the impulsive group might not have been able to bring into play these apparatuses. This could account for this group's inability to differentiate between the achromatic and the chromatic stimuli or among the treatment stimuli.

The inhibited group delayed its response to some extent to that it had an opportunity to bring its psychological and perceptual apparatuses into play. This group responded significantly slower to the chromatic stimuli than it did to the achromatic stimuli. This is the reverse of what was predicted. However, the finding suggests that the inhibited group might be perceptually vigilant to the stimulation of color. This group might have an overdeveloped sensitivity to color stimulation because of a defensive need to avoid it. Therefore, the inhibited group discriminated to some extent between the stimuli on an achromatic-chromatic basis, but apparently not beyond this.

The normal group had the most time to differentiate among the stimuli. The findings suggest that the normal group did not distinguish among the stimuli on the basis of the achromatic-chromatic dimension, but rather on the basis of the unique characteristics of the stimulus. Shapiro's theory suggests that the normal group could discriminate on this basis because it had the most highly developed capacity to control its impulses, as well as the most differentiated perceptual apparatuses.

Some support for the findings of this study and Shapiro's rationale is found in Siipola's (1950) work which indicated that when the chromatic variable was added to the stimulus situation, the normal subject took more time to respond to it. Siipola's study suggested that the normal person used more time because he took the added chromatic factor into consideration before giving his response.

Stein's (1949) findings also tend to support indirectly the results of the present study. He found that for normal subjects, color (C) and color-form (CF) Rorschach responses were consistently associated with short exposure times of the Rorschach cards. Moreover, form-color (FC) Rorschach responses, the presumably adaptive Rorschach color response, were consistently associated with long exposure times. Thus, better Rorschach responses for normal individuals as well as finer discrimination among stimuli took more time than poorer Rorschach responses or grosser discriminations among stimuli.

The final aspect of the present study which is relevant to Shapiro's theory is that the (W) condition yielded wholly negative results whereas the (F) condition produced positive results. That the subjects in the (F) condition were asked for words which are associated with impulses probably explains the discrepancy. Therefore the (F) condition was more threatening than the (W) condition in which any-one-word-response was acceptable. One expects that if different groups had to respond to a threatening situation, they would respond differently to it. This might

explain the significant differences among the groups in the (F) condition and none in the (W) condition. On this basis it is clear that the results for the (F) condition are quite relevant to Shapiro's theory whereas the results for the (W) condition are not.

Further Implications of the Data

In addition to Shapiro's theory there are other possible explanations for the findings of this study.

The difference in the findings between the (F) and the (W) experimental conditions may be the result of the (W) condition which required essentially superficial associations (Woodworth and Schlosberg, 1954). The (F) condition asked for words of a far more personal nature, that is, feelings. If the groups were different, we might expect differences in reaction time among the groups to manifest themselves more readily when words of a personal nature are requested.

There are other factors that could have caused the ordered reaction times of the groups. That the groups differed significantly in their verbal abilities is one such factor. On this basis it could be said that the impulsive group took the least amount of time because they had better verbal abilities and could respond more quickly. However this fluency does not explain why the less fluent inhibited group was the next quickest to respond. Similarly, fluency does not explain why the normal group took the longest to respond. Therefore, although verbal ability might have played some role in the findings it cannot clearly account for the consistent ordering of the groups.

Still another factor explaining the order of the groups could be each group's capacity to allow itself to experience a feeling. This, of course, is related to impulse control. The normal group, which was able to delay the longest before responding, perhaps gave itself time

to experience a feeling. The impulsive group might not have been able to delay long enough to experience a feeling. The inhibited group may have delayed long enough to experience a feeling on one occasion but not on another.

The presumed affective complexity of the three groups (Henry & Shlien, 1958) is another factor that could explain the order of the groups. Affective complexity means the extent to which a person can experience or not experience a whole range of feelings. The impulsive person might have a relatively limited capacity to experience different kinds of affect and therefore take little time to choose a feeling from his limited repertoire. The inhibited person might have a larger repertoire and therefore take longer than the impulsive group to respond. The normal person might have the largest repertoire of affective responses to choose from, so that it takes the longest to respond.

It is also possible that the different groups directed their attention on the basis of different sets. The inhibited group perhaps directed its attention toward its inner impulse life, which is often its source of greatest concern. Because of this concern the inhibited group might spend less time in dealing with external stimulation. The normal group presumably had less concern about its inner life so that it focused its attention on the external world where it appropriately belongs. As a consequence it took more time to respond to the stimuli. The impulsive group probably attended to the performance of the act it was called upon to make, so that its response was quickest. It could be that focusing attention in these ways (Woodworth and Schlosberg, 1954) is related to the differences in reaction time found for the three groups.

In general it was found that the normal and impulsive groups behaved more consistently than did the inhibited group (see Figures 5-8 and 9-18). Such a difference does not mean that the inhibited group's behavior varied the most on trials or treatments. Tables 12 and 13

show that the normal group varied the most on trials and treatments. The point is, the inhibited group did not show a generally consistent trend across trials or across treatments to the same extent that the other two groups did. Part of this was because the inhibited group responded differentially to the achromatic and the chromatic stimuli. Possibly the inconsistency of the inhibited group's behavior was caused by a hetereogeneity in this group.

Therefore data for the inhibited group was separated into a Hysteria-Hypochondriasis sub-group, and a Depression-Psychoasthenia sub-group.

Comparison of these two sub-groups to the inhibited group as a whole (see Figures 19 and 20) showed that the inconsistent characteristic of the inhibited group's behavior remained, whether one looked at the group as a whole or at each sub-group separately. Perhaps two kinds of inhibited groups, each with its own pattern of inconsistency, exist.

Another possibility is that this inconsistency in behavior actually represented the nature of the inhibited group's or groups' response process. Part of a person's response process is his defensive system. It may be that the inhibited person's defenses functioned smoothly for awhile. Then as the pressure of the experimental situation built up by demanding more associations from the inhibited person, his defenses weakened at which point he behaved inconsistently. Then he recovered, performed consistently again until the pressure built up and he lapsed another time. This type of behavior is consistent with the clinical behavior of inhibited people who behave appropriately most of the time but who occasionally, when their defenses weaken, manifest sudden temper outbursts or other manifestations of inconsistent, erratic behavior.

Methodological Implications of the Data

It is possible that too few chromatic and achromatic stimuli were used in this study to determine the ability of color to differentiate the groups. Only two chromatic and two achromatic stimuli were used. Perhaps this limited number of stimuli was not an adequate test of the color hypothesis. A greater number of stimuli could very well yield the same, as well as different, results.

No doubt, the nature of the stimuli used influenced the results. All of the stimuli were controlled for brightness. Nevertheless, remarks by the subjects revealed that the white stimulus was experienced as the brightest. Differences in experienced brightness among the stimuli might have caused differences in the impact of the particular stimulus upon a particular observer. This rationale helps to explain why the white and red stimuli were the most effective in distinguishing the groups but it does not explain why black was more effective than green. Possibly a combination of factors was operating here.

Since the black stimulus was very dark it may have evoked definite responses that were different for each group. In traffic situations green is consistently associated with the expectation of responding quickly. This factor might explain why the reaction times for the green stimulus were more alike than different among the groups. For these reasons the achromatic, black stimulus might have been more effective in producing differences among the groups.

A study (Drecksler, 1960) similar to the present one found that the chromatic stimuli were more effective than an achromatic stimulus in eliciting disturbing responses. However, his use of gray as the achromatic stimulus prejudiced the results in favor of the chromatic stimuli. The position of the gray stimulus in the black-white brightness dimension did not exploit the possible effectiveness of brightness per se

to elicit differential responses. The use of white and black stimuli in the present study was a better test of the effectiveness of the achromatic dimension.

Suggestions for Further Research

The results of this investigation indicated that both the theory and the experimental design were quite effective in separating different kinds of people. Therefore this approach ought to be useful in typing people.

Conceivably the results have implications for the two ends of the psychological and perceptual continuum which represent relatively undifferentiated people and differentiated people. The findings suggested that reaction time was associated with the capacity to control one's impulses. Studies of this kind would be particularly appropriate for the investigation of pathological groups who presumably are less differentiated psychologically and perceptually than normal groups. The relevant question--for the undifferentiated groups--may be whether they can adequately control their impulses, rather than how many different kinds of affects they can produce.

If the theory is right the more relevant question for the differentiated groups is to what extent can these people experience a range of feelings? Presumably highly differentiated individuals can adequately control their impulses. Although the feeling associations given in this study were not analyzed, it was noticed that there were great individual differences in the range and variety of feeling words given. Some individuals gave highly similar feeling associations, whereas others gave a wide variety of different feeling associations. This was more true of the pilot subjects, who represented a random sample of people, than it was of the experimental subjects, who were a much more restricted group. However, the impression gained from these observations was

that a study of different kinds of feelings for different differentiated groups might be fruitful.

If a feeling analysis approach were effective it might partially answer the interesting question, "Are certain types of feeling patterns or ranges of feeling experience associated with certain types of vocational endeavor? Conceiveably engineers could have a different range of feeling than artists. This kind of information would be helpful in matching different types of affective patterns to particular vocational fields which possibly require certain kinds of emotional make-up.

This kind of information could also be useful in differentiating between those people who make good psychotherapy candidates from those who do not. It is a commonly shared clinical experience that those people who are able to experience a wide range of affects make better therapy clients.

The typing of various pathological clinical groups might be aided by further study of reaction time behavior. Here we might expect a different level of reaction time response. For example, a depressed person would be expected to take very long to respond. Study of other pathological groups might yield patterns of reaction time behavior that are specific to particular groups.

In addition, the findings indicated that the groups used in this study discriminated among the stimuli in different ways. Such results suggest the potential value of studying the differences in perceptual discrimination among different kinds of homogeneous groups. This could be done by careful manipulation of the properties of simple yet varied color and achormatic stimuli. Moreover, such factors as brightness and the amount of time given to respond to the stimuli could be varied to further track down the nature of these perceptual phenomenon.

This focus on perceptual discrimination would deal with a critical facet of the ego's functioning and would have important implications for

both general psychology and clinical psychology. From such study we might learn how different kinds of normal people make perceptual discriminations. The results of the present study were suggestive of defensive processes especially in the inhibited group. Study of perceptual discrimination in pathological groups could help to further illuminate this area.

Furthermore the findings of this study have tentative implications for Rorschach theory and Rorschach testing. Theoretically people who give many FC color responses on the Rorschach might take longer to respond to the solid uncomplicated stimuli used in this study. People who give many CF and C responses might respond quickly to uncomplicated stimuli.

Another possibility is to develop a whole series of stimuli ranging from very simple ones to complex ones similar to the Rorschach inkblots. In this way we might begin to understand how Rorschach stimuli effect people. Most investigators studied the Rorschach inkblots and obtained essentially negative results.

The experimental design of this study could also be applied to the study of female behavior. No one doubts that females are different than males in many ways. It would be of interest to know if they are different from males in their response to achromatic and chromatic stimuli. It might be that they would not differ with regard to reaction time but that they would differ in their range of emotional responses. It has long been said that women are affectively complex creatures and this would be one way to investigate it.

Still another research possibility is suggested by the finding that the impulsive group had the highest verbal abilities score, followed by the normal and inhibited groups in that order. All of these groups differed from each other in verbal ability at a statistically significant level.

This kind of relationship between verbal abilities and personality variables would be worth pursuing further.

Needless to say, the suggestions for research cited above will require an enormous amount of normative data collection and careful experimentation. The immediate task would be to replicate the present study to see if the findings persist. If they do then further research along the lines suggested above would be warranted.

Conclusions

1. Chromatic stimuli are not more effective than achromatic stimuli in differentiating among the relatively normal groups used in this study.

2. Normal and impulsive persons drawn from a male, student, college population are not effected by chromatic stimulation.

3. Inhibited persons drawn from a male, student, college population are effected by chromatic stimulation.

4. For the relatively normal groups used in this study, differences in perceptual discrimination and differences in impulse control rather than differences in response to color were capable of separating the groups.

5. Further research that utilizes Shapiro's postulate of a psychological-perceptual-differentiation-continuum would be fruitful.

VI. SUMMARY

This investigation studied the affect of achromatic and chromatic stimulation on the behavior of people. The hypotheses were based upon Shapiro's theoretical rationale which states that various types of response to color reflect different levels of psychological and perceptual organization. He postulates the existence of a psychological-perceptual-differentiation continuum upon which people with different degrees of psychological and perceptual development can be ordered.

To represent parts of Shapiro's continuum the investigator selected three groups from a male student college population by means of the Minnesota Multiphasic Personality Inventory. In terms of positions on the continuum it was assumed that the impulsive group occupied the relatively undifferentiated part; the inhibited group, a more differentiated part; and the normal group, the highly differentiated part.

The hypotheses were as follows: The impulsive group would take less time to respond to the chromatic stimuli than to the achromatic stimuli. The inhibited group would take more time to respond to the chromatic than to the achromatic stimuli. The normal group would take relatively the same amount of time to respond to both chromatic and achromatic stimuli. The chromatic stimuli would be more effective in differentiating the groups than the achromatic stimuli. Finally, the findings would be consistent across the two experimental conditions used in this study. For all hypotheses the measure used was reaction time.

The stimuli used in the experiment were four homogeneous paper rectangles, 8" by 10", one red, one green, one white and one black, each controlled for brightness. Each stimulus was placed in the center

of a gray cardboard, 22" by 30". None of the subjects tested were red-green color blind.

The first experimental condition was the Any Word Association Condition. Each subject was presented with each of the four stimuli in a randomized order. Then each subject was asked to give eleven one word responses that came to mind as he looked at a particular stimulus.

The second experimental condition was the Feeling Word Association Condition. This took place one week after the Any Word Association Condition, using the same subjects. Each subject was again presented with the same four stimuli, in the same order as before. Then each subject was asked to give eleven one word feeling responses that came to mind as he looked at a particular stimulus.

The hypothesis concerning the consistency of the results across both of the experimental conditions was not supported. The Any Word Association Condition yielded negative results; but the Feeling Word Association Condition gave highly significant results. It was thought that the results for the Feeling Word Association Condition were relevant to Shapiro's theory whereas the results for the Any Word Association Condition were not. Therefore the remainder of the findings summarized pertain only to the Feeling Word Association Condition.

The hypothesis that the impulsive group would take more time to respond to the achromatic stimuli than to the chromatic was not supported. Neither was there support for the prediction that the inhibited group would take longer to respond to chromatic stimuli than to achromatic stimuli. In fact, the inhibited group took less time to respond to the chromatic stimuli than to respond to the achromatic stimuli. Support was found for the hypotheses that the normal group would take relatively the same amount of time to respond to both achromatic and chromatic stimuli.

The results did not support the hypothesis that the chromatic stimuli would be more effective than the achromatic in discriminating the groups. Rather, the reverse was true. Furthermore, the groups took consistently different amounts of time to respond to the four stimuli, regardless of whether the stimulus was chromatic or achromatic. The normal group always took the longest to respond, the inhibited group always took the next longest to respond, and the impulsive group always took the least amount of time to respond. Since these results were the most consistent aspect of the data, they indicated that the technique used to obtain the data was quite effective in separating the groups. In the text these results were discussed in terms of differences among the groups in set, in perceptual discrimination, in capacity to control impulses and, finally, differences in affective complexity.

Shapiro's theory predicted that different levels of psychological and perceptual organization in different groups would yield different responses to chromatic stimuli. Nevertheless, the effect of color was neglible upon the normal groups of this study with the exception of the inhibited group where the effect was observable. However, when the results are considered in terms of the ego functions of impulse control and perceptual discrimination they did support Shapiro's theory. When viewed in the context of these ego functions, the findings evinced a progressive increase of perceptual discrimination and impulse control which was consistent with each group's position on Shapiro's differentiation continuum. Moreover the data of the inhibited group suggested the possibility of deviant groups within the upper end of Shapiro's differentiation continuum which overdevelop certain perceptual apparatuses because of defensive needs.

Finally some implications of the present study for further research were considered.

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APPENDIXES

Code for Appendixes I and II

A_1 represents the impulsive group

A_2 represents the normal group

A_3 represents the inhibited group

B_1 represents the black treatment

B_2 represents the white treatment

B_3 represents the green treatment

B_4 represents the red treatment

C_1 represents trial 1

C_2 represents trial 2

C_3 represents trial 3

. . . .
. . . .
. . . .
. . . .

C_{10} represents trial 10

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1 represents subject no. 1

2 represents subject no. 2

3 represents subject no. 3

. . . .
. . . .
. . . .
. . . .

15 represents subject no. 15

APPENDIX I. The Reaction Time Raw Data for the Any Word Association Condition

A_1 (W)

B_1	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}
1	2	2	2	9	6	8	5	3	4	45
2	1	3	1	1	1	1	1	6	3	2
3	1	1	1	3	1	1	1	12	1	3
4	1	7	1	14	22	1	1	17	13	5
5	2	2	1	2	1	1	4	1	1	3
6	3	6	10	5	12	5	2	2	2	4
7	1	1	1	2	2	2	2	1	2	2
8	6	1	1	31	3	1	1	1	1	33
9	3	13	1	17	1	2	2	7	13	31
10	4	10	2	11	7	3	6	3	8	20
11	1	2	2	5	1	1	2	25	1	5
12	1	1	2	2	1	3	2	1	2	2
13	2	1	2	2	2	7	5	2	5	3
14	2	3	16	14	1	2	5	13	4	2
15	11	2	12	5	4	5	1	1	2	2

A_1

B_2	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}
1	4	2	5	4	4	3	6	3	3	29
2	1	1	2	4	1	5	2	1	9	1
3	3	3	1	1	2	1	1	1	1	8
4	1	1	2	1	3	12	5	4	7	1
5	1	1	2	3	2	1	3	1	1	1
6	1	1	1	1	6	1	8	1	2	5
7	2	2	1	3	2	3	2	1	1	1
8	2	1	2	1	1	1	3	3	1	4
9	1	2	1	1	2	4	16	1	1	6
10	6	2	8	4	8	3	9	6	19	2
11	2	6	8	2	9	28	11	9	44	10
12	1	1	1	1	2	2	1	1	1	1
13	2	5	3	7	6	5	6	5	12	7
14	2	1	3	10	1	4	2	1	8	4
15	1	1	1	1	2	4	1	1	1	2

A_1

B_3	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}
1	5	2	6	45	2	9	3	2	4	3
2	1	1	1	2	2	1	1	3	1	5
3	1	1	1	1	1	4	1	5	2	1
4	1	1	6	4	5	7	5	6	3	31
5	4	2	3	2	1	2	3	1	3	2
6	1	1	5	7	1	2	3	4	1	12
7	2	3	2	2	1	12	2	2	5	1
8	1	1	1	1	1	1	1	4	1	1
9	4	1	2	22	1	1	12	4	17	20
10	1	4	5	11	3	4	8	4	3	7
11	1	1	2	3	5	3	10	8	22	14
12	1	1	1	1	2	1	2	1	2	1
13	3	7	5	3	7	3	7	6	2	7
14	1	1	4	5	17	3	3	2	14	4
15	1	1	1	1	1	1	4	2	4	14

A_1

B_4	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}
1	3	6	19	5	5	5	3	7	6	14
2	4	2	2	1	3	1	3	4	1	2
3	1	1	1	2	4	1	6	2	1	8
4	1	1	1	2	1	1	1	1	1	1
5	2	2	1	2	3	2	6	1	1	2
6	8	6	7	5	3	2	15	4	1	5
7	2	1	1	2	1	2	2	1	2	1
8	1	1	1	1	1	4	1	3	1	17
9	3	3	1	2	1	1	13	7	5	27
10	1	4	7	3	7	3	1	27	1	2
11	1	2	2	6	4	5	1	3	3	6
12	1	1	1	2	1	2	1	2	1	2
13	2	3	4	2	2	7	14	4	5	3
14	5	9	7	2	9	7	45	4	5	6
15	3	3	2	1	2	1	2	1	2	1

(W)

A_2

B_1

	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}
1	3	4	2	2	1	2	27	1	1	2
2	2	1	1	3	11	3	30	1	6	12
3	2	2	3	3	2	1	7	3	2	4
4	1	6	1	3	1	5	15	5	1	2
5	1	4	5	6	43	45	55	3	17	2
6	1	1	1	2	2	2	1	2	2	1
7	1	1	1	1	1	1	2	1	3	1
8	2	2	1	1	1	9	1	4	9	10
9	2	2	28	2	1	5	11	2	8	16
10	11	5	3	5	6	6	5	6	4	2
11	2	1	2	2	2	2	3	3	2	2
12	1	1	1	3	2	1	2	1	1	1
13	2	1	1	2	1	7	2	4	5	1
14	1	6	1	18	8	1	10	2	5	8
15	2	2	2	2	2	1	2	3	9	2

A_2

B_2

	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}
1	3	2	2	2	2	2	2	2	2	10
2	2	1	1	37	3	2	8	8	12	29
3	1	2	2	1	3	1	6	2	2	2
4	1	1	2	2	12	1	21	21	11	41
5	2	2	3	2	49	2	37	16	17	1
6	1	1	2	3	3	1	2	2	4	2
7	1	1	1	1	1	1	1	1	1	1
8	1	1	1	1	2	22	8	7	2	1
9	2	2	2	6	2	3	19	13	19	2
10	4	2	2	9	4	7	9	7	15	5
11	2	1	1	2	2	2	4	2	1	2
12	1	1	1	2	1	2	1	1	1	1
13	1	1	2	1	2	1	3	4	5	6
14	3	5	10	4	1	2	3	2	10	4
15	1	2	8	5	2	3	3	13	2	5

A_2

B_3

	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}
1	2	1	1	2	1	7	1	2	2	1
2	3	4	2	3	1	4	8	55	13	22
3	1	2	1	2	1	1	18	1	1	2
4	1	2	1	1	15	14	1	56	24	22
5	2	2	1	28	22	14	17	12	9	9
6	1	1	1	2	3	2	1	3	2	1
7	1	1	1	1	1	1	1	2	1	1
8	1	3	2	1	2	1	26	1	12	7
9	1	3	3	9	8	7	5	1	5	4
10	15	20	26	8	47	6	13	10	5	3
11	3	1	1	2	2	2	2	1	2	2
12	3	1	2	1	7	3	2	2	1	1
13	1	1	2	6	1	4	1	9	3	4
14	2	5	3	1	1	3	2	12	5	5
15	2	3	3	4	3	3	3	4	5	4

A_2

B_4

	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}
1	4	3	2	1	2	2	1	2	2	4
2	1	1	10	3	3	4	15	8	1	66
3	2	1	2	2	1	2	3	3	4	2
4	2	1	1	5	8	5	29	47	1	21
5	15	1	6	5	3	15	15	42	29	2
6	1	2	2	6	3	1	2	2	2	3
7	2	1	1	1	2	2	2	1	1	1
8	6	1	7	3	8	3	4	40	13	1
9	7	4	23	16	8	2	4	9	9	7
10	2	7	10	5	18	15	21	11	20	5
11	1	1	2	2	2	2	2	1	1	3
12	1	1	1	1	2	1	1	2	2	2
13	1	1	2	4	8	2	13	1	2	3
14	1	1	2	5	3	7	23	4	6	2
15	1	3	5	3	3	3	7	6	6	12

(W)

A_3

B_1	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}
1	1	5	1	1	1	1	1	2	3	1
2	2	1	7	1	16	16	9	10	8	10
3	1	2	2	2	1	3	16	1	2	10
4	1	1	2	2	1	4	1	1	2	3
5	4	10	2	7	5	4	15	15	6	6
6	2	2	1	1	2	13	4	2	2	2
7	8	20	20	11	7	7	8	25	46	16
8	2	1	1	1	1	2	4	1	1	1
9	3	2	1	4	1	1	1	2	7	1
10	2	4	3	2	2	1	4	1	2	12
11	2	1	1	5	2	1	3	3	2	4
12	1	1	2	1	1	2	1	1	2	1
13	2	1	1	2	3	1	3	3	1	1
14	1	7	3	5	5	13	9	12	11	18
15	1	1	2	2	2	12	3	35	5	3

A_3

B_2	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}
1	1	1	1	2	1	1	2	2	4	5
2	1	1	1	1	10	28	2	1	6	8
3	1	1	1	1	7	18	3	8	14	10
4	1	2	1	1	3	1	1	1	1	1
5	2	6	2	2	7	23	4	4	3	5
6	2	1	1	2	2	2	2	2	3	2
7	4	4	7	17	4	11	3	7	22	17
8	1	1	1	1	1	15	1	1	1	1
9	2	1	1	1	1	4	2	1	1	1
10	2	2	2	3	2	36	9	6	37	18
11	13	7	10	10	5	6	5	4	2	6
12	1	1	2	2	1	1	1	2	1	3
13	2	2	1	1	1	1	2	1	1	1
14	1	1	2	8	2	25	9	5	48	29
15	1	2	6	9	9	9	2	6	3	6

A_3

B_3	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}
1	1	2	1	3	2	1	1	2	1	2
2	1	9	10	13	8	10	9	1	2	8
3	1	1	1	3	9	2	2	2	10	11
4	6	3	8	3	1	1	1	2	15	1
5	3	2	2	2	15	11	22	23	19	5
6	2	2	2	3	4	1	3	2	2	2
7	6	10	5	27	22	6	9	11	32	5
8	1	1	1	1	1	2	3	1	4	2
9	2	1	1	6	5	15	4	14	1	1
10	3	2	2	3	2	8	4	12	8	4
11	2	2	4	5	5	5	10	3	4	5
12	1	1	1	1	1	1	1	1	2	1
13	1	1	1	1	1	1	2	1	1	1
14	2	3	3	4	4	10	2	3	4	6
15	1	2	1	2	1	3	1	1	2	1

A_3

B_4	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}
1	1	2	1	3	1	1	1	3	2	2
2	16	6	7	3	4	4	9	1	1	11
3	1	1	1	2	10	5	3	9	9	3
4	1	1	1	1	1	2	1	1	1	2
5	3	2	3	1	2	1	2	2	3	2
6	1	2	2	5	2	2	2	3	3	1
7	3	6	6	17	6	17	3	7	12	27
8	1	1	2	1	11	1	2	2	1	2
9	2	2	1	1	2	3	6	9	1	1
10	1	1	10	8	3	9	3	4	11	12
11	3	3	1	1	15	1	2	5	10	5
12	1	1	1	1	1	1	1	1	1	1
13	1	1	1	1	2	2	1	2	1	1
14	1	1	3	2	16	4	3	10	6	2
15	1	1	1	1	1	1	9	2	1	1

APPENDIX II. The Reaction Time Raw Data for the Feeling Word Association Condition

(F)

A_1 B_1

	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}
1	3	7	9	8	7	7	4	3	2	32
2	1	3	1	3	2	23	3	14	4	7
3	1	1	1	1	1	1	1	2	1	6
4	2	5	10	20	2	3	14	3	14	5
5	3	2	1	4	2	3	1	2	2	5
6	3	2	3	5	3	3	2	5	4	4
7	1	1	2	2	1	1	3	1	3	4
8	6	2	3	28	5	32	3	7	9	6
9	3	2	2	2	13	4	2	19	14	3
10	3	7	6	3	5	2	6	6	7	2
11	6	10	8	6	3	13	7	14	54	10
12	1	3	3	2	4	5	5	4	5	3
13	5	4	4	4	4	10	18	5	17	3
14	40	15	11	7	13	34	13	5	6	27
15	3	2	2	5	1	5	1	2	1	6

A_1 B_2

	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}
1	16	6	3	8	3	11	13	4	10	14
2	1	1	1	1	3	1	1	1	1	3
3	4	1	6	6	3	1	4	2	7	5
4	1	15	7	20	3	9	9	20	63	2
5	2	3	1	1	2	5	2	4	3	4
6	11	4	2	6	6	6	5	5	4	8
7	2	11	4	2	5	2	1	2	3	7
8	1	7	15	42	9	8	5	24	10	22
9	23	4	1	2	3	15	5	29	6	1
10	4	3	8	5	5	5	7	8	10	6
11	27	20	8	10	20	7	22	19	18	39
12	2	3	2	1	1	1	1	3	3	3
13	1	5	3	3	9	4	2	11	3	8
14	5	8	26	7	20	16	7	37	24	16
15	3	1	1	3	1	2	2	1	2	2

A_1 B_3

	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}
1	5	2	15	10	3	9	10	7	5	18
2	1	1	1	1	3	18	1	9	9	1
3	2	1	1	3	1	10	7	3	17	3
4	1	1	13	3	2	6	13	13	1	3
5	1	3	3	3	5	1	7	2	4	4
6	2	2	2	2	1	2	4	6	3	4
7	1	1	3	8	3	1	1	2	5	1
8	33	7	14	10	50	6	21	20	22	3
9	2	5	3	3	23	9	13	19	14	10
10	3	2	8	8	3	6	2	5	2	4
11	1	18	18	33	27	18	4	5	22	41
12	2	1	1	2	3	1	1	3	3	5
13	2	4	5	9	10	5	3	5	5	2
14	8	39	28	39	18	13	26	15	7	29
15	1	1	2	2	1	9	7	4	2	6

A_1 B_4

	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}
1	5	8	4	10	5	2	7	6	10	6
2	11	4	7	7	2	6	5	7	8	16
3	1	1	1	5	8	4	8	1	4	1
4	1	1	24	1	28	4	3	2	1	23
5	1	2	2	2	6	3	2	2	2	3
6	2	2	3	2	2	3	4	9	8	8
7	1	2	2	2	1	2	2	2	2	1
8	3	12	3	11	16	5	3	8	15	19
9	6	9	9	11	6	42	19	13	41	10
10	5	8	3	4	7	12	2	1	2	6
11	2	2	22	35	10	1	30	10	9	27
12	4	4	2	3	5	2	3	4	2	5
13	4	3	2	6	10	9	6	5	17	3
14	8	38	22	13	13	25	7	21	8	20
15	2	1	1	1	7	9	1	3	1	1

(F)

A_2

B_1

	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}
1	5	21	16	93	11	52	18	2	6	18
2	18	37	33	2	21	22	29	60	68	17
3	2	9	2	5	5	3	4	4	2	10
4	2	14	9	5	14	15	10	49	47	21
5	9	4	6	10	33	21	13	13	21	31
6	4	2	4	4	5	4	10	9	2	7
7	1	1	1	1	1	1	3	4	1	1
8	6	19	15	5	8	10	2	2	7	51
9	38	46	36	36	8	21	10	4	25	5
10	2	1	2	3	16	5	12	36	4	6
11	2	2	2	3	1	1	2	3	2	2
12	1	3	1	1	2	2	2	1	3	1
13	15	2	3	3	10	1	3	5	10	11
14	1	11	11	10	36	20	4	3	46	15
15	8	3	4	13	8	20	46	12	10	5

A_2

B_2

	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}
1	5	8	15	22	25	6	15	13	3	3
2	4	8	13	18	45	4	8	71	64	36
3	1	2	2	2	2	4	7	6	3	9
4	3	3	12	2	2	1	26	46	5	14
5	1	2	16	5	14	43	15	35	6	19
6	2	1	4	5	8	21	3	7	22	11
7	1	1	1	1	1	1	1	1	1	1
8	7	6	61	12	27	29	11	29	32	12
9	11	18	5	19	17	9	15	13	38	20
10	2	2	6	22	3	1	15	8	30	15
11	1	2	2	3	5	3	8	2	2	3
12	1	4	2	3	7	5	1	5	9	1
13	1	1	5	29	50	35	11	31	18	6
14	7	6	5	59	8	95	20	17	10	110
15	3	4	16	24	9	26	15	15	44	24

A_2

B_3

	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}
1	3	15	8	9	10	2	2	15	4	5
2	2	2	3	44	34	5	17	37	12	28
3	2	2	2	1	3	3	5	5	5	10
4	1	4	2	8	6	14	15	12	9	4
5	1	15	22	8	20	57	56	67	9	5
6	2	7	5	5	14	4	4	2	5	14
7	1	1	1	1	1	1	1	3	1	1
8	1	1	2	2	24	18	59	20	18	17
9	1	3	8	9	17	3	5	20	22	20
10	2	1	10	15	11	11	11	21	3	6
11	7	7	2	2	2	2	3	3	3	4
12	10	1	5	1	1	2	13	4	6	1
13	3	1	11	5	48	20	2	17	9	5
14	1	2	47	17	21	12	15	27	11	3
15	6	2	17	10	13	7	28	11	20	55

A_2

B_4

	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}
1	2	15	7	2	12	3	3	15	10	7
2	39	14	46	4	20	39	82	2	9	37
3	1	1	1	3	2	1	6	2	5	4
4	1	1	2	3	15	6	15	7	1	26
5	35	51	50	8	40	40	36	23	17	15
6	4	12	27	7	2	2	5	3	13	3
7	2	1	1	1	5	1	1	1	1	1
8	4	4	59	49	13	8	131	52	45	62
9	12	29	28	6	22	26	37	27	17	7
10	1	34	4	25	2	3	34	7	3	16
11	1	1	3	2	5	3	3	4	2	3
12	1	1	2	3	1	3	2	1	1	2
13	5	21	10	15	32	10	5	10	11	18
14	5	28	06	10	57	43	60	17	11	14
15	18	15	8	16	22	11	38	34	10	32

(F)

A_3

B_1	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}
1	1	1	1	2	5	14	13	3	1	2
2	1	1	10	1	4	2	18	13	21	10
3	3	2	2	2	2	2	3	8	1	5
4	1	3	2	1	13	2	1	9	2	1
5	30	9	11	11	4	6	14	21	4	40
6	1	1	3	2	2	7	5	49	6	9
7	2	9	7	6	26	7	30	23	22	23
8	1	1	26	4	6	2	3	65	13	1
9	3	1	1	11	2	2	3	23	1	2
10	13	10	3	3	10	44	6	8	3	8
11	1	14	2	5	2	4	3	5	5	20
12	1	1	1	1	1	1	1	2	3	4
13	4	3	2	1	4	6	4	2	2	1
14	5	9	4	2	12	11	2	2	1	4
15	10	9	84	67	59	64	36	58	54	31

A_3

B_2	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}
1	2	4	1	1	1	1	1	1	1	1
2	28	12	9	4	5	2	21	19	5	9
3	1	1	1	13	2	3	10	13	32	17
4	3	1	2	1	1	2	1	1	1	1
5	3	4	53	8	6	3	27	16	4	39
6	8	6	6	4	7	4	4	2	7	7
7	10	5	6	7	18	13	6	7	7	16
8	1	1	1	1	9	2	4	20	5	13
9	1	1	17	1	11	7	1	7	7	16
10	3	32	29	11	2	18	5	22	40	18
11	8	15	7	6	1	1	6	5	2	3
12	1	2	1	3	2	1	4	2	5	1
13	2	2	3	5	2	2	2	1	2	2
14	6	7	2	14	5	17	2	17	7	36
15	18	41	67	130	20	81	22	22	27	85

A_3

B_3	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}
1	1	1	1	1	1	1	1	14	1	1
2	2	16	2	15	10	10	9	13	16	17
3	4	14	3	6	10	9	2	5	8	12
4	1	2	2	2	4	2	6	2	2	4
5	16	10	17	8	11	20	15	3	13	12
6	2	5	4	11	8	12	7	7	7	10
7	12	7	7	13	10	11	9	33	8	25
8	1	1	2	1	11	2	1	5	21	7
9	14	16	1	6	10	13	3	41	8	40
10	67	8	2	2	20	21	7	9	15	29
11	2	3	6	8	2	6	4	5	3	5
12	1	1	1	1	1	2	2	2	1	1
13	1	1	2	2	4	3	1	4	3	3
14	1	3	6	7	6	4	2	19	5	4
15	3	2	14	41	10	26	8	21	8	13

A_3

B_4	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}
1	1	1	1	6	1	5	1	1	1	2
2	5	1	4	10	50	1	15	17	2	1
3	5	2	3	3	6	3	17	7	14	28
4	3	1	3	3	5	8	1	4	2	3
5	2	2	17	14	3	24	27	19	18	3
6	5	3	5	3	3	12	10	14	10	12
7	7	12	36	22	9	5	6	7	37	8
8	1	1	1	1	1	3	2	18	11	1
9	48	21	27	25	2	8	20	15	123	9
10	1	8	3	6	7	4	5	29	7	26
11	2	4	3	2	17	2	1	10	2	11
12	1	1	1	2	1	1	3	1	5	4
13	2	2	1	3	1	3	5	1	1	4
14	7	2	4	3	3	17	5	3	3	4
15	19	12	15	25	9	15	3	12	5	14

ROOM USE ONLY