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The effect of color in the Rorschach test and in selected intellectual tasks.

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THE EFFECT OF COLOR IN THE RORSCHACH TEST
AND IN SELECTED INTELLECTUAL TASKS

by

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CHAPTER I

INTRODUCTION

Research workers, clinicians and psychologists generally have asked for a more explicit statement of the assumptions which underlie the Rorschach test and for verification of these assumptions. The following study was designed to examine the effect of color stimulus in the Rorschach test and in performance tests of intelligence.

In the Rorschach test the influence of the color stimulus is considered to be widespread. Reactions to it presumably relate to the affective life of the subject as revealed in his perceptual and conceptual behavior. Until recently there have been few experimental attempts to verify the assumptions about stimulus color.

The relevance of this study for clinical and general psychology is best understood against a background of the present experimental and theoretical status of the Rorschach test. Rorschach theory consists mainly of ideas developed from the experience of people who administered the test to varieties of groups and subjects. The differences between subjects and their responses have been used to interpret the meanings of the various aspects of the blots and have become the basis for evaluating subsequent protocols. In the past
decade this test has found such extensive application that theoretical and experimental developments have lagged behind the many ideas which emerged from its use.

Most of these ideas, however, are merely refinements and restatements of the astute observations of Hermann Rorschach (32) who designed the test. From administration of the test to 405 varied subjects he concluded that Form perception relates to intellectual processes, Color to affective—environmental relationships, and Movement to the fantasy or creative thinking of the subject.

The basic theory underlying these conclusions is that the individual's manner of responding to the ink blots is characteristic of his personality structure and manner of experiencing the world. As stated above, the nature of responses as they involve Movement, Form, and Color, among other things, are assumed to be expressive of specific aspects of personality such as cognition and emotion.

Consistent with current perceptual theory, the processes in the Rorschach test situation may be represented in a bipolar context. Perceptual activity and any Rorschach response may be understood as emerging from the interaction between the preestablished "inner structure" of the perceiver's personality (needs, attitudes, etc.) and the various aspects of the "outer structure" or stimulus field.¹

¹Gardner Murphy (23) gives perhaps the most detailed exposition of the function of perception in personality.
In the Rorschach test emphasis is put on eliciting the unique, individualized "inner structure" of the subject. "The projective technique gives the subject the opportunity to invest situations with his own meaning, to impose upon them his own values and significance, especially affective significance." 2

This is achieved in the Rorschach test by using relatively unstructured ink blots and simply asking the subject to tell what they remind him of. Marked individual differences in perceptual and conceptual activity are thus elicited. They are evidenced in the manner and degree to which various aspects of the stimulus field such as Form, Color, and Location are utilized by the subject. These variables are represented and measured by the different Rorschach scores which refer at the stimulus side of the bipolar process to specific dimensions of the blots and at the perceiver side of the process to particular personality variables.

The final interpretation of the test protocol and the individual personality diagnosis is based on the assumed meanings of these different scores. An overall personality interpretation is stated in terms of the configuration and interrelationship of the personality variables that these scores presumably represent.

Verification of Rorschach theory has been largely in terms of validation studies using this final overall

2Lawrence K. Frank (10), p. 47.
interpretation of the test protocol. Independent interpretations or diagnoses of different psychologists on the same subject may be compared or test interpretations correlated with independent clinical data. Bell (4) and Hertz (13) adequately review the general literature of the test and appear to agree that this type of validation study is adequate for practical, clinical purposes. An important reason the Rorschach test has achieved such widespread use is because in this pragmatic sense psychologists have been increasingly able to contribute to description and diagnosis of personality.

In evaluating studies of this interpretive type, however, it is important to realize that they focus predominantly on the subject side of the bipolar process and contribute little to our knowledge of the function of specific stimulus characteristics of the test. The possibility of examining and verifying the assumed correspondence between specific stimuli and specific personality variables is limited in that type of study. This important aspect of Rorschach theory has been little tested in research until recently. Experimental focus on the stimulus qualities of the blots is necessary and that is the general problem of the present study.

Thurstone (43) suggests that we should show "The experimental evidence and the psychological theorizing by which color shock, the movement response...become significant in the larger setting of psychological interpretation". He
then points out that, "It is a challenging problem to discover variant methods of getting at the same types of appraisal so that the nature of the underlying processes may be better understood."

There is a wealth of theory among Rorschach workers but, as deplored by Rickers-Ovsiankina (31), little of it is relatable to general psychological theory and most of it is in untestable form. This situation calls for an articulation of theory about test processes and stimulus rationale in such a way that experimental verification can be approached within the framework of general scientific psychology. An attempt is made to do this for the Rorschach variable, color, in this study.

A testable proposition was derived from an analysis of Rorschach color theory. The effect of color was determined by varying the color stimulus from the standard test process to color-free blots. The standard cards were compared with similar cards having color deleted. In this way their configuration and structure was not destroyed and standard procedure could be maintained. In addition intellectual performance tests with and without color were used in an attempt to establish some generality for the role of color in perceptual and conceptual activity.

Stimulus color was selected as a research problem in view of the theoretical and experimental status of the Rorschach test, as just briefly discussed, and because the influence of color on the subject's responses is assumed to
have far reaching importance. The problem area is particularly relevant at this time since recent experimental results attempting to deal with it have been equivocal. In order to make explicit the proposition from which testable hypotheses were derived and to delimit our problem, we turn to a review of theoretical and experimental literature.
CHAPTER II

HISTORY AND DELIMITATION OF THE PROBLEM

I. THE RORSCHACH COLOR SCORE.

Form and color are intimately related in the Rorschach test. Cards 1, 4, 5, 6 and 7 are achromatic. Cards 2 and 3 are black and red and cards 8, 9 and 10 are multicolored. Since each colored detail or area of the chromatic blots has form boundaries, in most responses utilizing color there is also a form aspect. The scoring of the color response is made in terms of the relative dominance of form or color in the percept. Going from the most to the least form determination, the scoring scale symbols are F, FC, CF and C.

In Rorschach's original formulation we find:

In the interpretation of form, associative (cognitive) factors come into play; in the interpretation of color, emotional factors are influential.\(^1\) The more stable the emotions, the better the form visualization; the more labile the emotions, the more inexact the form visualization.\(^2\)

He based these conclusions on the responses of 405 subjects of whom 117 were normals. The typical color response of the normal subjects was form dominated (FC).

\(^1\)Hermann Rorschach (32), p. 33.
\(^2\)Ibid., p. 31.
Rorschach interpreted this as follows:

The FC responses represent the capacity for affective 
rappor and adaptability, a kind of combination of 
affective and intellectual adaptability. They are, in 
general, characteristic of the normal individual who is 
well adapted and is capable of making new adaptations.3

At one extreme of color scoring is found the pure 
color response in which there is virtually no form consider-
ation (C). These were characteristically given by acutely 
disturbed and severely brain damaged subjects. They were 
impulsive in expression and their associative, integrative 
functions had been impaired. At the other extreme, he found 
subjects who avoided using the color, relying on form alone 
(F). They were depressed, pedantic, and emotionally re-
strained subjects who depended excessively on critical, in-
tellectual functions and avoided emotional expression.

Neurotics with excessive self-criticism and inhibition 
of affect may avoid using color, but those unable to control 
impulsiveness give color responses partially determined by 
form (CF)—according to Rorschach.

There has been little subsequent disagreement with 
these original formulations. Beck (3), Klopfer (16) and 
others (26), (30) in clinical research have established that 
with a disturbance in the balance between intellectual and 
affective processes, there appears a correlative disturbance 
in Rorschach color reactions as measured by the color score.

3Ibid., p. 199.
There appears to be adequate evidence for the generality of color reactions. They apparently are not specific to the Rorschach test. Ruesch and Finesinger (35) found a significant, positive relationship between the number of Rorschach color responses and the extent to which color was used in drawings. They concluded that the orientation of the individual in relation to color is independent of test procedure.

Oeser (24) reports that subjects whose perceptions were more determined by color than form in a tachistoscope experiment also used more color in the Rorschach test. He said, "It seems as though the predilection for either form or color is something inherent in the psycho-physiological structure."

Both Oeser and Ruesch and Finesinger found that subjects who were color dominant in their respective experimental tasks used larger location areas on the Rorschach. Ruesch and Finesinger's subjects who were color dominant on the Rorschach used larger areas in their drawings. They concluded, "These are people whose interest is directed to the outside world in terms of motor activity...unhampered by the more critical, rational functions."

These experiments and the clinical data involving the color scale may be viewed from either side of the bipolar field. Focusing on the stimulus side and holding the subject side constant, so to speak, it appears that stimulus color
tends to elicit affective reactions in the general population. The more color is utilized, or perceptually selected to the exclusion of form; the more impulsive and less controlled by intellect the individual is apt to be.

Focusing on the subject side and examining more closely the extreme reactions on the color scale, a clearer conception is obtained of the personality dimensions involved in the equation of color and affective life. The pathological groups tend to be found at the extremes of the scale as pointed out by Rorschach.

Schachtel (39) has discussed the meaning of the pure color response (C). He characterizes the subject as giving an immediate, uncritical response to stimulation, with an absence of deliberative thought. The direction of force is from the object, color, to the subject. The individual is passively taken over by the stimulation, "seized" by the emotions.

Schachtel's reasoning derives, in large part, from Goldstein's experimental work. The subject giving the pure C response may be thought of as "stimulus bound". Goldstein (12) found that stimulation of patients by red caused outgoing bodily movements and overestimation of the size and weight of physical objects. He concluded, "This corresponds to the experience of being disrupted, thrown out, abnormally attracted to the outer world."

The disruptive effect of color which Goldstein mentions
ties in with Rorschach's concept of adaptability. Those individuals with adequate integration of affective and intellectual processes can express feelings with discriminating control and respond to stimulation commensurate with the demands of a situation and the expectation of other people. A balance between intellectual, cognitive functions and affective, expressive functions would appear necessary for adaptive efficiency according to Rorschach's theory. Extreme imbalance of these two personality processes implies lack of adaptive efficiency. This has been most clearly demonstrated clinically where color preempts form in the Rorschach test as shown in Table I. It is an analysis based on the tabulation of color responses of Rappaport's subjects. The most characteristic response of the normals is FC, of the neurotics is CF and of the psychotics is the pure C response.

Williams (49) experimentally tested the hypothesis that form quality and form-color integration on the Rorschach are indices of the functional level of control in personality. He defined intellectual control as how well a person uses mental processes when faced by strong emotional stress.

He had 25 male students, 18 to 25 years old, do the Digit Symbol tests of the Wechsler-Bellevue scale under normal conditions and under threat of electric shock. Correlating the "average decrement under stress" on the
TABLE I

PERCENTAGE OF RAPPAPORT'S SUBJECTS\(^a\)
GIVING DIFFERENT TYPES OF COLOR RESPONSES

<table>
<thead>
<tr>
<th>Group</th>
<th>Number</th>
<th>No Color Response</th>
<th>FC</th>
<th>CF</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normals</td>
<td>54</td>
<td>0.22</td>
<td>0.67</td>
<td>0.44</td>
<td>0.09(^b)</td>
</tr>
<tr>
<td>Neurotics</td>
<td>78</td>
<td>0.26</td>
<td>0.49</td>
<td>0.55</td>
<td>0.26</td>
</tr>
<tr>
<td>Psychotics</td>
<td>.99</td>
<td>0.27</td>
<td>0.38</td>
<td>0.43</td>
<td>0.54</td>
</tr>
</tbody>
</table>

\(a\) Percentages were computed from Rappaport's (30) scoring data, Appendix I.

\(b\) Since each score (FC, CF and C) was tabulated separately, the sum of percentages within any one diagnostic group does not equal 100.
Digit Symbol test with three Rorschach scores yielded these results:

<table>
<thead>
<tr>
<th></th>
<th>MEAN</th>
<th>SD</th>
<th>r</th>
<th>LEVEL OF SIGNIFICANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>F-plus % (All Cards)</td>
<td>81.56</td>
<td>6.59</td>
<td>-.606</td>
<td>.01</td>
</tr>
<tr>
<td>F-plus % (Color Cards Only)</td>
<td>75.48</td>
<td>9.28</td>
<td>-.724</td>
<td>.01</td>
</tr>
<tr>
<td>Form-Color Integration</td>
<td>0.88</td>
<td>0.20</td>
<td>.354</td>
<td>.05</td>
</tr>
</tbody>
</table>

The subjects with the least impairment of performance under stress had the highest F-plus percent and the lowest form-color integration scores. The latter indicates color responses dominated by form considerations since the form-color integration score he used was the "sum of the conventional values of the various color responses divided by the total number of color responses".

Williams thus demonstrates that F-plus percent is a valid index of functional level of intellectual control and says, "The theoretical interpretation that poor integration of form with color in the Rorschach reflects poor control and non-efficient mental activity in the emotional situations of everyday life is borne out".

Baker and Harris (1) took essentially the same hypothesis as Williams but correlated variation of Form-plus percent from a standard mean and form-color integration with variability of speech intensity while subjects were doing an unrelated tapping test under threat of shock. They report a correlation of .45 with F-plus percent and .42 with form-color integration. The correlations were in the expected
directions but not quite statistically significant for the form-color factor with only fourteen cases.

These two studies demonstrate that the nature of form-color integration on the Rorschach is probably representative of the general adaptive functioning of individuals.

Sarasen and Potter (37) analyzed the Kohs Blocks performance of thirty-one behavior problem children in relation to their general intellectual levels and Rorschach color responses. Those subjects who had a Kohs Block score below their I.Q. level had a high incidence of color dominated form responses, poor form level (Form-plus percent) in their color responses, and color naming. These signs of poor control of color on the Rorschach were absent in the subjects whose Kohs scores were above their I.Q. level.

In this work no tests for statistical significance were reported. In addition the subjects did not have a similar block task without color. Thus, impairment may have been due to some factor other than color in the Kohs Blocks. It does suggest, however, that disruption of efficiency in intellectual performance tasks involving color may be associated with poor control of color by form on the Rorschach test.

Excessive control of affective expression, as reflected in avoidance of a color response on the Rorschach, has not been demonstrated to be generally characteristic of inefficient adaptation as has the extreme lack of control. Depressive psychotics, inhibited neurotics and many emotionally restrained
and pedantic normals give no scorable color response as indicated by Table I. The characteristics of the subjects leave little doubt, however, that this extreme of the color reaction scale, where color is altogether avoided, represents an overemphasis on critical, rational functions which is frequently disabling.

The concept of a color reaction continuum may be useful for a summary representation of color theory as related to the color score and the personality variables involved. As outlined in Table II, it should be considered a most general statement of relationships. It is an attempt to integrate facts and theories so that testable propositions may be derived for further experimental work.

It has been pointed out that reactions to color are not only specific to the Rorschach test but are probably generalized dispositions as reflected in other perceptual tasks and motor behavior. Individuals appear to be consistent in the nature of their color preferences and reactions under varied circumstances.

The evidence, thus far, also suggests that color reactions in terms of form-color balance represent emotional reactions of definite types in the general population. The personality processes involved are intellectual ones on the side of form and affective ones on the side of color.

The balance of intellectual and affective forces in personality, as measured by the Rorschach color score,
### TABLE II
PREDOMINANT COLOR REACTIONS OF MAJOR DIAGNOSTIC GROUPS AND CORRESPONDING PERSONALITY VARIABLES

<table>
<thead>
<tr>
<th>RORSCHACH COLOR SCORES</th>
<th>PERSONALITY VARIABLES WHICH CORRESPOND</th>
<th>CHARACTERISTIC ADAPTATION</th>
<th>GROUP</th>
</tr>
</thead>
<tbody>
<tr>
<td>No color FORM</td>
<td>INTELLECT</td>
<td>Liable to disability</td>
<td>Psychotic</td>
</tr>
<tr>
<td></td>
<td>Critical, analytic reason. Inhibition</td>
<td></td>
<td>Neurotic</td>
</tr>
<tr>
<td></td>
<td>of affect. Avoid stimulation. Delay</td>
<td></td>
<td>Normal</td>
</tr>
<tr>
<td>FORM-COLOR</td>
<td>Affective expression</td>
<td>Adaptive Efficiency</td>
<td>Normal</td>
</tr>
<tr>
<td></td>
<td>with discriminating control, in harmony</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>with demands of situation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>COLOR-FORM</td>
<td>Impulsive expression</td>
<td>Partially disabled</td>
<td>Neurotic</td>
</tr>
<tr>
<td></td>
<td>with marginal control</td>
<td></td>
<td></td>
</tr>
<tr>
<td>COLOR No Form</td>
<td>AFFECT</td>
<td>Disabled</td>
<td>Psychotic</td>
</tr>
<tr>
<td></td>
<td>Impulsive, failure of rational control.</td>
<td></td>
<td>Brain-damaged</td>
</tr>
<tr>
<td></td>
<td>Immediacy of response.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>&quot;Stimulus Bound&quot;</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
appears to be an important determining factor in the adaptability and efficiency of people. This has been demonstrated in clinical data and adequate experimental tests.

The theory which relates color and affect appears to be rather adequately supported by the facts as far as the scored color responses are concerned. The avoidance of color, however, which we assume to be one extreme of color reaction, seems to be found in subjects with varying degrees of adaptive efficiency. They are people who rely heavily on critical rational functions to avoid affective expression.

II. RORSCHACH COLOR SHOCK

Rorschach pointed out a specific set of reactions to color which he called color shock. They are not related in scoring to the direct use of color in responses which has previously been discussed. Although color shock is in some ways similar to the avoidance reaction, it is specific to the neurotic segment of our population.

Color shock as originally formulated by Rorschach referred to a rather sudden associative blocking, a delay in giving responses. It was accompanied by some astonishment and perplexity. According to Rorschach it began on card 8—the first multicolored card which is always preceded by four achromatic cards. Thus it was partly the introduction of color stimulation in the sequence of card presentation which upset the neurotic subject.
These subjects suddenly became helpless though previously they had been interpreting very well. They find the colored plates more difficult to interpret than the black plates, and they react with astonishment or vexation. Such subjects are always 'emotion-repressors', neurotics of varying grades of severity. 'Emotion-controllers' show the phenomenon to a lesser extent, not showing shock but scant production with the colored plates. Subjects who are timid in showing their emotions are found between these two groups: interpretations of the colored plates occasionally become hasty and more frantic after an initial indication of helplessness before the problem.

The expression 'color shock' best sums up these phenomena. The presence of them reaffirms the internal relationship which must exist between color perception and the dynamics of affectivity.4

The scoring factors reflecting color shock according to Rorschach would be a delay in time taken to give the first response, rejection or failure to respond at all to a colored card, fewer responses, and a generally poorer interpretive performance on the colored cards.

Subsequent workers have extended the indices of color shock until they include approximately a dozen "signs" associated with the colored cards. Those used by Brosin and Fromm (6) are the same that Klopfer and Kelley (16) recommend. They are:

1. Delay in reaction time preceding the first response to chromatic cards.
2. Exclamations indicating newly aroused emotions.
3. Comments indicating tension, stress and irritability.
4. Decline in number of responses, particularly to cards 8, 9 and 10.
5. Decline in form quality of responses.
6. Impoverished content
7. Rejection--Failure to respond to colored cards.

4Hermann Rorschach (32), p. 35.
8. Irregular succession of responses
9. Decreased number of popular responses
10. Color shyness--comments about color without utilizing it in responses.

In addition to these factors, Beck includes the appearance of anatomy responses and a decrease in his "organization" score. He especially emphasizes decline in the form level of responses using color.⁵

Brosin and Fromm and Beck suggest that color shock may be considered present when several of these signs appear on more than one chromatic card. It has become common clinical practice to determine color shock by comparing the performance of a subject on the chromatic cards with his performance on the achromatic cards for these indices.

There is general agreement with Rorschach's statement that color shock is characteristic of neurotics. Klopfer and Kelley, for instance, consider color shock "the most important single sign of neurotic reaction"⁶ and Bell says it is "typical of the neurotic".⁷

Miale and Harrower-Erickson (22) studied the protocols of forty-three neurotics and twenty normals. They found color shock present in 98% of the neurotics but only 20% of the normals on the basis of signs 1, 2, 3, 5 and 7 of the Brosin and Fromm list.

Brosin and Fromm (6) consider color shock a "catastrophic reaction". They reason, somewhat as Rorschach, that since neurotics repress affect, the presence of color sets up the necessity for further defense. This is because color arouses affect and constitutes "a frustrating or threatening situation". The result is an inferior performance. Beck (3) defines the shock as a momentary startle but agrees that it results in inefficient performance.

Color shock and the color score previously analyzed represent two different aspects of the influence of color in the Rorschach test. The color score reflects the various ways color is utilized in relation to the form determinant. There is a higher incidence of specific color scores (CF, FC, C) in particular groups of the population. The meaning of the color scores was verified in terms of the consistent characteristics of these groups and the differences between them or by correlating color scores with experimental variables.

Color shock does not primarily concern the direct use of color in the immediate test performance and is assumed to be primarily characteristic of one segment of the population—the neurotics.

Color shock is a disturbance which is a function of the test situation itself. Whereas the color score reflects the more permanent condition of affective life of subjects and its control by intellectual processes, color shock
presumably represents a temporary change in immediate intel­
tellectual functioning due to arousal of affect. Con­sequently, the question raised by color shock and the ex­per­imental methods used to verify its existence differ somewhat from those used to verify the meaning of the color score.

The basic problem raised by the assumptions of color shock is—does color as a stimulus in the Rorschach test modify or impair intellectual functioning and mental control.

It will be noted that although the color score and color shock are two different aspects of the Rorschach test, the personality variables involved in each are the same—in­tellect and affect, and their functional relationships.

The term intellectual is used here as referring to the adaptive processes commonly considered intelligent behavior; not to specific levels of ability, but to func­tional levels of efficiency characteristic of the organism as a whole. These processes include clarity of perception, analysis, organization, associative thought and discrimina­tive judgment of such a nature as to integrate the stimula­tions and requirements of a situation into an appropriate, adaptive response or performance.

The disruptive effect of color which is postulated would not be limited to the mentally retarded or any
particular intelligence level. The functioning of individuals within any given level of intelligence may be temporarily modified due either to an excess of inhibitory control or to a liability for impulsive expression. This modification of behavior, like reactions to other stress situations, would be evidenced by deviation from a base line of an individual's usual mode and level of adjustment and/or by sharper deviations from a culturally defined group norm.

The view taken here is that intelligence and measurement of it, as well as affect and the concepts we use in reference to it, are categorical concepts—abstractions. In the functioning individual we see a total configuration of interactive forces and adaptive processes. The functions we call "intellectual" or affective may be relatively more dominant at any one time in a specific individual or in one individual compared with another. As Wechsler (48) has recently said,

General intelligence cannot be equated with intellectual ability, but must be regarded as a manifestation of the personality as a whole...personality traits enter into the effectiveness of intelligent behavior, and, hence into any global concept of intelligence itself.

III. PREVIOUS EXPERIMENTAL STUDIES OF COLOR SHOCK

In reviewing the experiments that have dealt with color shock, we will look for evidence that color in the Rorschach test changes the intellective-affective balance.

Steinberg (41) obtained galvanic skin response measures
for twenty-two male and twenty-two female college students
during individual Rorschach administration. He assumed
GSR was a measure of emotional behavior. By inspecting the
Rorschach tests for incidence of color shock as defined by
Beck, he separated the subjects into a color shock and a
non-color shock group. He found:

1. Color shock subjects had a significantly higher
average GSR on each of the ten Rorschach cards than did
the non-color shock group.

2. For both groups there were no significant differ­
ences in average GSR between any two consecutive cards.
However, when he computed average GSR accompanying the
first ten seconds for each card, both groups had signifi­
cantly higher GSR on Card VIII than on Card VII. There
were no other significant differences for any two con­
secutive cards.

3. Card I elicited the highest average GSR of all
ten cards in both groups. In a subsidiary experiment
where Card II was given first in administrative order,
it had the highest GSR of all the cards.

Steinberg concluded:

Differences are not elicited by specific cards, except
for Card VIII, but rather by the Rorschach test situation
as a whole.

It is probable that the 'shock' is evoked by the fact
that this is a test rather than by the fact that this card
is colored or that card is black. In other words it is not
the color per se which is the stimulus for the shock but the
transition from one type of stimulus to another type. 8

8Arthur Steinberg (41), p. 138.
Steinberg's work suggests that the Rorschach test situation for his normal sample was one of "normal stress" as reflected in the highest GSR's on the first card. It further appears that one specific effect of color may be a mild startle when card VIII with color follows card VII which is achromatic. We tend to disagree with the conclusion that his results, "Argue against the validity of the practice of specifying Rorschach shock in terms of individual cards." The validity of color shock, a set of reactions assumed by all Rorschach workers to be mainly characteristic of Neurotics, cannot be adequately tested with a normal group.

Rabin and Sanderson (28) administered individual Rorschachs to thirty-four student nurses in the standard order of card presentation, I to X, and a reversed order which ran from card X to I. They found that the time to first response on each card as well as the number of responses to each card remained consistent regardless of order of presentation. Cards IX and X (chromatic) had the longest reaction times and the lowest number of responses in both orders. They conclude, "The difficulty in 'shifting' cannot be used as an explanatory principle in color shock. It may as well be due to actually greater difficulty of certain cards".

They found color shock, as indicated by longer reaction

\[\text{Ibid.}, \ p. \ 138.\]
times, reduced number of responses, and appearance of poor form level to be fairly frequent among their normals on the first administration and attributed it to the "element of surprise". This finding appears to agree with Steinberg's opinion that the test itself may constitute a stress situation for normal subjects. The discrepancy between the results of Rabin and Sanderson and Steinberg as to sequence or transition effect may be due to their different methods. The necessity of exploring this factor in a neurotic group to which the color shock theory mainly applies is evident.

Their suggestion that some of the chromatic cards may be more difficult seems plausible. However, their conclusion that "'color shock' cannot be considered as a major 'sign' in the diagnosis of psychoneurosis" does not appear warranted in view of the limitation of their experiment with normal subjects.

Since the middle of 1948, four independent papers have appeared which utilize variations of an experimental method that appears especially well adapted to investigating the color shock problem. It consists of administering two sets of blots—one set is the standard series and the other is the standard series with color deleted from the five chromatic cards. A comparison of the two series can then be made for any shock index. Differences between the series reflect the influence of color. This method is employed in the present study.
The first of these studies to appear was Wallin's (45). He restricted his study to simply the likes and dislikes evoked by each Rorschach card in both standard presentation and achromatic reproduction. He used 419 men at an army training station. Seventy-one of these were independently classified as "unstable". He found that the multicolored cards VIII, IX and X were usually liked better than their achromatic copies but the unstable group had a significant preference for the uncolored copies of cards II and IX. When asked the reason, their responses suggested that unstable men often tend to dislike the red color since it reminds them of blood. This was the case mainly in Card II.

He also found that Card VI, a card without color, aroused significantly more dislike reactions in unstable men than in normals. Achromatic reproductions of cards III, IX and X were reliably less popular with the unstable men compared with the normals.

In an attempt to deal with the problem of card order and shock, he asked the normals for likes and dislikes of the cards in regular order and in reversed order. He found a tendency for the cards appearing later in the series to be liked better regardless of any specific order. In the unstable men this tendency was not so marked. They disliked some cards later in the series, i.e. VI and IX, as much as the initial cards.
Wallin says:

A useful hypothesis is that in vague, unstructured situations there is anticipatory anxiety (task shock) which fades as the task becomes clearer and the subject feels more competent. The intensity of the shock is apparently greater in tense, anxious people.

His general conclusion concerning color effect is that "color in the special shapes used in the ink blots facilitates verbal and imaginal associations having strong affective tone and thus disturbs the flow of thought". This paper seems to demonstrate that unstable, neurotic individuals have affective reactions to some Rorschach cards that differentiate them from a normal group. Further, it suggests that not only color in the blots but certain blots in their very form and structure may arouse affective reactions. It appears that in some instances color per se may be a critical factor producing shock but in general, as Wallin says, it is probably a function of color in the particular shapes that are found on the Rorschach cards.

Schactel (38) has pointed out the difference between "abstract" and "dynamic" form perception. The latter type involves more deviative and personal associations. The point is that in unstable people the very form of some blots may evoke disturbing association on the Rorschach. Experimentally the problem is to determine to what extent forms on the chromatic cards, 238910, may be disturbing and whether color creates additional disturbance beyond that. There has been a tendency in clinical work to assume that any disturbance
on cards 238910 is due mainly to color.

Sappenfeld and Buker (36) gave an achromatic and a chromatic series of Harrower-Erickson Rorschach cards to 238 college students. They were given in group administration seven days apart. They tried to determine if color in the last three colored cards made a difference in the number of responses to cards 8, 9 and 10 in proportion to the number of responses to all ten cards (8--10%). When the achromatic series was compared with the chromatic series the difference was negligible. They suggest that blots 8, 9 and 10 have different configurations from the other seven cards and individual differences in responsiveness to these cards may be due to differential figure-ground contrast factors in the blots.

Lazarus (18) used 100 high school students in a similar experiment with the Rorschach blots. He scored each protocol for all the basic scoring categories and for twelve color shock categories. He used the group method of administration.

In the basic scoring categories he found a significant increase in number of space responses and a significant increase in number of popular responses in the non-color series over the standard color series. He comments, "Because it happened essentially in the achromatic slides, it is hardly justifiable to attribute the increase in popular responses to the absence of color".
Lazarus analyzed the records of the total group and the records of thirty subjects, "who showed the greater number of signs of 'color shock'", for most of Beck's indices of color shock except the time to first response.

A comparison of all ten cards in the color series with all ten cards in the non-color series as well as a comparison of the chromatic cards 238910 in the color series with the same cards in the non-color series yielded no significant differences in any of these indices for the group as a whole.

Comparing the achromatic cards, 14567, in the color series with the same cards in the non-color series, he found a significant increase in the index "lowest response total" in the color series. Since this occurred only in the achromatic cards, he assumed it was not due to the effect of color.

In the separate analysis of the records of the thirty color shock subjects, the achromatic cards again show a significant "lowest response total" when in the color series. His conclusion about the factor, without discussion, is, "It is not valid to attribute this to the removal of color from the series since the difference was found to occur in the achromatic slides only."

A second index, "F-minus appears", was significantly less frequent in the color shock subjects for cards 238910 in the non-color series. Lazarus says, in the body of his
Nearly all of the F-minus answers that dropped out when the color had been deleted from the slides were actually FC and CF responses, that is, responses making direct use of color. Therefore, when color was deleted these responses could not be given. Apparently, then, it was the attempt to integrate the color with the form into a response that produced the higher incidence of poor form quality in the color series.

No other index of 'shock' showed a significant difference between color and non-color presentations. Consequently it must be concluded that the term 'color shock' may be a misnomer, and, with the possible exception of the index 'poor form quality', is not a function of the presence of color in the Rorschach test.

In his summary of conclusions, however, he says:

Within the limits of the present research design, the following general conclusions seem to be warranted:

1. The assumption that color influences performance on the Rorschach test is not valid, with the possible exceptions of the popular and space responses.

2. The concept of 'shock' as induced by the presence of color in the slides is not supported.

Although he had made a possible exception to lowered form quality in the body of his report, it is conspicuously absent in his final conclusions. Its exclusion is particularly misrepresentative since he fails to mention at any point the common assumption that color shock is predominantly characteristic of the neurotic subject. He would not seem to be justified in calling color shock a "misnomer" on the basis of a lack of positive results with a normal group. His lack of positive findings, considered in the light of little other evidence to the contrary, rather substantiates the hypothesis that normals are generally able to integrate color stimulation into a smooth performance. This would be
commensurate with their adequate intellectual-affective balance and adaptive capacity.

When Lazarus neglected to state the existing assumptions about color influence in relation to population groups and minimized his finding of lowered form quality, he missed an important implication of his results. It was precisely in that sub-group of thirty out of his 100 subjects which he selected on the basis of the greatest incidence of color shock that the difference in form level appeared. This group, though part of a normal sample, may well be assumed to border on the neurotic area of the population continuum. There is a high probability that any normal sample of this size would include such a subgroup.

To determine whether an explanation of shock might be found in the relative difficulty of the color cards, 238910, Lazarus ranked the ten cards in each of the two series in order of frequency of the color shock indices. The correlations obtained on index frequencies between the colored and noncolored versions of the slides were all significant and high. He also found that some of the chromatic cards, 238910, were more difficult in terms of the indices regardless of whether color was present or not.

His conclusions about these findings are:

There appears to be little justification in comparing the subject's performance on the chromatic slides with his performance on the achromatic slides. Only when the stimulus value of each slide is known through careful normative studies can this comparison, which is the basis of 'shock evaluation', be made.
If, then, in the presence of such norms, 'shock' or some disturbance is then demonstrated, it will be necessary to look for variables other than color to account for that reaction pattern.

In view of our previous criticisms, this last statement should be carefully qualified. The chromatic cards may prove to be more difficult in some respects for all groups along the population continuum but it remains for a test on a population to which color disturbance theory applies to ascertain whether or not color imposes some difficulty over and above that due to form and structure alone. His general finding on this point is important since Wallin and Rabin and Sanderson had similar evidence as to differential difficulty among the Rorschach cards. This is a variable that will have to be evaluated in any subsequent studies with color in the Rorschach.

To summarize the work of Lazarus, it appears that he has demonstrated three important things:

1. Color does not have a significant, widespread effect on the responses of normal individuals obtained in group administration when these responses are represented by the common scoring categories and color shock indices. We have noted the assumption of Rorschach workers that color interferes least in responses of normals who integrate the color stimulus relatively smoothly.

2. For thirty subjects selected from his sample of normals on the basis of the highest incidence of color shock, as clinically determined, there was a significant
lowering of form quality in the chromatic cards of the colored series. We have noted the high probability that there would be some subjects bordering on the neurotic in any normal sample. It appears important that the crucial form quality factor appeared influenced by color for this subgroup.

3. There are probably factors other than color that operate to make chromatic cards, 238910, difficult in terms of the indices used to measure "color shock". This finding, which corroborates those of Wallin and others, will have to be taken into account in future experimental work.

The most recent experiment comparing colored and non-colored Rorschach ink blots is that of Siipola (40). She cut out 20 of the colored areas of the chromatic blots, 238910, and asked a group of seventy-two women college students to give a single, immediate response to each—"a first spontaneous conceptualization". The same procedure was followed with a similar group of sixty students but the same twenty area blots were achromatic. Both groups were asked for their likes and dislikes of all blots.

Siipola found that the subjects who were shown chromatic blots took a longer time to respond than the subjects who were shown the non-colored blots. There were fifteen percent more "likes", nine percent more "dislikes" and neutral responses were half as frequent for the group
shown the colored blots compared with the group shown the non-colored ones. The "associative blocking" reflected in longer response time and the increased frequency of "emotional response" were not consistently related to any one hue. Siipola turned to a content analysis in an attempt to determine what the "affect-laden stimulus" might be.

Her study differed from others in that she treated the achromatic blots essentially as norms and traced the effect of adding color. Others have examined deletion of color. She says about the initial content analysis:

The most striking feature of the results is the general similarity of the basic conceptual content in the two groups. This result suggests that the dominant stimulus influence for both groups must be the form of the blot, since form (if shading is included in it) is the only stimulus variable common to the two groups. Achromatic blots, as well as chromatic blots, elicit primarily concepts associated with particular hues, not those associated with black and grey. Thus the responses to achromatic blots represent, for the study of the special effects of color, a valid norm.

She had two main groups of results from her content analysis. One was changes in response frequencies and the other was behavior relative to blots which elicited the most variation. Content categories "Stain," "Food," "Plant" and "Human" responses were more frequent with the colored blots. Percent of rejection was greater while percent of detail responses was less on colored blots.

As to the variable blots, her analysis showed that certain specific blots elicited the radical changes in the
colored presentation. When traced down, a specific way was found in which color operates.

Broadly stated, the underlying principle seems to be that the manner and degree to which the presence of color affects the content of the response will depend upon whether the specific hue of the blot happens to be appropriate or inappropriate to the conceptual objects suggested by the form of the blot.

She determined relative congruence or incongruence of form and hue for each blot by analyzing the content of the achromatic blot responses (normative) and judged whether or not the specific hue of each chromatic blot was congruent or incongruent with the normative achromatic content. Color acted two ways. Categories popular in the achromatic presentation were less frequent on the chromatic cards when the form and hue were incongruous. The congruent content responses that were low in frequency on the achromatic blots were higher in the chromatic set.

She found three major sources of confirmation of the incongruence thesis:

1. The most incongruent blots had a greater average increase in reaction time (47%) than did the least incongruent blots (19%).

2. Rejections, indicative of severe associative blocking, were twice as frequent to the incongruent blots.

3. The nature of novel conceptualizations to the incongruent blots was suggestive of "behavioral disorganization and primitivization of the conceptual
process". She says that approximately 20% of responses to the chromatic blots were novel conceptualizations.

These, and the more frequent rejections, are interpreted as behavior which "suggest that severe stress and conflict may result from the difficulties in dealing with hue-form incongruity". She states that the color introduces a basically different conceptual problem for the subject since it imposes a restriction on the freely operative form associations that were characteristic of the achromatic responses.

From her results and the logic of her proposition, it seems probable that Siipola has made one of the few contributions to Rorschach color theory since Rorschach's original work. Some of the stress-like reactions as manifested in color shock indices may be due to the difficulty imposed by hue-form incongruity.

There are several reasons why there should be considerable caution in applying the hue-form incongruity theory to the standard Rorschach protocol and assuming that it may be the basis of color shock phenomena. Siipola destroyed the standard structure and configuration of the chromatic cards when she cut detailed areas out for separate, single presentations. Test procedure was radically different.

There is a liability in her experimental design also. Each subject was not her own control since she used the responses of one group as a basis from which to judge the
responses of a different group. The precision of equating the two groups would have to be very fine. Without more information than she gives in her report, an adequate judgment of the equation of groups cannot be made.

Perhaps the most important point of information which is lacking in Siipola's report is the percent of subjects responding to the chromatic blots who accounted for the disorganized novel conceptualizations and rejections. She says that 20% of responses to the chromatic blots were of the novel type but gives no indication of what percent of subjects were involved. Rorschach color theory assumes that normals have little difficulty with color but, as pointed out in the evaluation of Lazarus' study, there is a high probability of including some neurotics in any normal sample. Since we do not know how representative of her normal sample this response was, we cannot evaluate this important aspect of her work. It is possible that only 20% of her sample gave the deviative responses. (It will be remembered that in Lazarus' sample, 30% of his subjects contributed the important result, and that in Miale and Harrower-Erickson's clinical study 20% of the normals showed color shock.)

From the review of color theory and experimental investigation it appears reasonably clear that the general meaning of the Rorschach color score has been documented and verified. The specific disturbance due to color in the
immediate standard test situation, as reflected in "shock" indices, remains problematical however.

The evidence and factors involved in color shock experiments to date may be summarized as follows:

1. Color does not appear to influence the Rorschach protocols of most normal subjects as reflected in the usual color shock indices when the standard test procedure and materials are essentially maintained (18), (22), (36) and (41). Siipola found marked evidence of disruption in conceptual processes and more affect in responses to colored blots of a normal group. However, the structure of the test procedure as well as the normal configurations of the Rorschach cards were far from standard in her experiment and it cannot be determined how characteristic of the normal group as a whole her results were.

2. Some portion of normal groups appear to evidence disturbance in relation to color on the Rorschach blots. Miale and Harrower-Erickson report 20% of normals evidencing color shock as clinically determined. Lazarus reports that the thirty of his 100 normal subjects who had the highest incidence of color shock, as clinically determined, had lower form-level associated with color, when color was experimentally varied. This was not found in his total group. The probability of the inclusion of some neurotic subjects in any normal sample
was emphasized. It was suggested on the basis of his results that there is some evidence that color interferes with intellectual functioning in an important respect since form-level has been well validated as a measure of intellectual control.\textsuperscript{10}

3. There was only one experiment which utilized a group of subjects clearly classified, independently of the Rorschach, as unstable or neurotic. Wallin found that affective reactions, in terms of dislikes of some of the chromatic Rorschach cards, reliably differentiated an unstable group from a normal group.

4. The effect of the sequence in which the colored cards are usually presented in the Rorschach test is not clear. Sequence appeared to have no measurable effect on the shock indices, time to first response and number of responses, for Rabin and Sanderson's normal group. It did seem to be a factor in the emotional behavior of Steinberg's normal group as measured by a higher galvanic skin response on Card VIII than on Card VII. As has been pointed out, in view of his other results Steinberg concluded that color was not a major determinant in the higher GSR but that it was due to the transition from one type of stimulus to another and the fact that the test situation was a mild stress. The latter conclusion derived from

\textsuperscript{10}Cf. ante, pp. 13-14.
his findings that GSR was highest on the first card administered in the Rorschach series.

5. Other investigators found indications that the Rorschach test may be a stress situation. Wallin mentioned the gradual fading of initial anticipatory anxiety or "task shock" when later cards were liked better than earlier ones. Rabin and Sanderson spoke of the "element of surprise" in taking the test when they found the incidence of color shock, as clinically determined, to be somewhat decreased on a second administration of the test. Since it is a common observation that people generally tend to be somewhat tense before a test situation, it is interesting that some evidence of initial stress was derived rather incidentally from these various experiments.

6. Another finding common to several experiments is that apart from the color factor the very form and structure of some chromatic blots makes them more difficult than the achromatic blots with which they are commonly compared. This was indicated in terms of the color shock indices in the reports of Lazarus and Rabin and Sanderson and in terms of affective responses in the work of Wallin. This is an extremely important factor to evaluate since color shock is judged on the basis of a comparison of cards 238910, the chromatic cards, with cards 14567, the achromatic cards. If cards 238910 are
more difficult to respond to than cards 14567 for various reasons aside from color, an experiment designed to adequately test the effect of color would first have to assess the nature and degree of differences between the two sets of cards when color was not present. Then the extent to which color modified these differences could be reasonably determined.

7. Since Rorschach's original observation that color shock was characteristic of neurotics it has become common clinical practice of considerable practical value to use indications of color shock for differentiating neurotics from normals and psychotics. Color shock theory consists of the assumption that color is disturbing to neurotics as manifested in the shock indices. On the basis of their lack of strong positive evidence for color shock in normal groups, Steinberg, Rabin and Sanderson and Lazarus concluded either that shock was not a function of color effect or that the concept of color shock was invalid.

A lack of experimental evidence of color shock in normals would not seem to be an adequate basis for discounting the concept of color shock in view of the fact that theoretically color shock is not assumed to be characteristic of the normal population. The evidence to date, dependent as it is on the experimental methods and populations employed, points to the conclusion that the concept of color
shock has not yet been tested with an appropriate population, Wallin's work excepted. The overall lack of evidence in normal populations tends to substantiate the fundamental Rorschach assumption that color does not generally disrupt the performance of normal people. They integrate color into an adequate response commensurate with the adaptive control of affective expression which characterizes them as a group.

In view of the present status of color shock theory it appears important to focus on experimentally determining just what the effect of color stimulus is on a clearly diagnosed group of neurotic subjects. This study is not primarily concerned with why color in the Rorschach may be an adequate stimulus for eliciting behavior expressive of the degree of intellectual control over affect.

IV. THE GENERAL PROPOSITION AND RESEARCH DESIGN

The present research is concerned with the following proposition: **Color as a stimulus in visual perception may modify or interfere with intellectual processes and mental control.** This proposition is seen to be a testable statement abstracted from color shock theory but pertinent to Rorschach color theory in general. A statement of the general theory is that reactions to color are representative of the nature of the balance between intellectual and affective personality processes. The nature of this balance in turn is a major determinant in the adaptive adequacy of the
individual.

Since the intellectual and affective processes are considered functionally related in the individual subject, it is inferred that a change in intellectual processes as defined\footnote{fr. ante, p. 21.} and measured is accompanied by a change in the affective state of the individual.

This research is designed in two experiments. The first one tests the proposition in relation to the Rorschach test itself. Two series of Rorschach cards were administered to a neurotic group; the standard series and a similar series with color deleted from the usually chromatic cards. The purpose of the second experiment with intellectual performance tasks was to test the generality of this proposition. In the second experiment standard Wechsler-Bellevue performance tasks were given to normals and neurotics in both colored and non-colored versions. The method of varying the color stimulus within the test procedures closely approximates standard clinical testing conditions yet permits experimental evaluation of the influence of color. The two experiments are then related by correlating the reactions to color of neurotics in the first experiment with reactions of neurotics to color in the second experiment.
CHAPTER III

EXPERIMENT I

THE EFFECT OF COLOR IN THE RORSCHACH TEST

I. HYPOTHESES

The theoretical Rorschach assumption is that color produces a shock in neurotic subjects which results in an inefficient and inferior performance. The purpose of Experiment I is to test the general proposition that color as a stimulus in visual perception interferes with the intellectual functioning and the mental control of neurotic subjects on the Rorschach test.

In Rorschach practice the impairment of response processes is usually measured by comparing various scores on the chromatic cards 238910 with the same scores on the achromatic cards 14567. It was decided to use ten of these accepted scores or indices of color shock in this experiment.

The hypotheses are that the differences between responses to the chromatic cards and achromatic cards in the standard Rorschach presentation--differences commonly attributed to the presence of color--will also appear in responses to an experimental reproduction of the cards, similar in form but with color deleted. The differences
will be equivalent when measured in terms of the following indices:

1. Number of responses. This factor will be designated subsequently as "#R". Decreased #R on the chromatic cards is usually interpreted to mean a constriction of association.

2. Form-plus percent. This factor will be designated subsequently as "F+%". Decreased F+% on chromatic cards is interpreted to indicate less efficient attentive concentration and perceptual discrimination.

3. Reaction time preceding the first response. "T 1/R". Increased T 1/R is indicative of associative blocking.

4. Number of popular responses. "POP". Decrease in POP is indicative of reduced conformity to the most clear and commonly given percepts.

5. Number of content categories. "Cont". Decrease in CONT is indicative of reduced range of associations.

6. Number of responses to cards 8910 in proportion to total number of responses to all 10 cards. "8-10%"

7. Percentage of responses involving animal percepts. "A%". Increased A% is indicative of stereotypy.

8. Number of rejections; i.e., failure to respond to a card. "REJ". REJ indicates extreme blocking.

9. Number of anatomy responses. "ANAT". Increase in ANAT is suggestive of body concern and anxiety.
10. Number of animal details and human details perceived where whole figures are commonly perceived. "X". X responses suggest constrictive anxiety.

II. PROCEDURE

A. Subjects. Thirty-two patients hospitalized on the neurotic wards at Cushing Veterans Administration Hospital were administered the standard Rorschach test and an experimental test from which color had been deleted. These patients were 20 to 40 years of age with a positive diagnosis of psychoneurosis. They had no demonstrable neurological or somatic pathology and no question of alcoholism or psychosis, either in their history or at the time of testing. All had completed a minimum of six grades of school. Patients were selected in conference with their doctors randomly, as they met the above criteria.

Each patient was asked if he had seen the Rorschach cards before and his record checked to determine previous tests he had received. No subject was included who was known to have seen the test before. There were no subjects included in the experiment who were weak in color vision or visual acuity as measured by the Jenson Test (15) for Color-Blindness.

Table III gives the age, educational level and diagnostic characteristics of the thirty-two neurotic subjects.
### TABLE III

CHARACTERISTICS OF NEUROTIC SUBJECTS

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<tr>
<td>Mean</td>
<td>112.12</td>
<td>114.44</td>
<td>109.81</td>
</tr>
<tr>
<td>S.D.</td>
<td>12.36</td>
<td>14.20</td>
<td>9.66</td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>29.19</td>
<td>30.25</td>
<td>28.13</td>
</tr>
<tr>
<td>S.D.</td>
<td>4.12</td>
<td>3.41</td>
<td>4.48</td>
</tr>
<tr>
<td>Grade of school completed</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>10.84</td>
<td>11.37</td>
<td>10.31</td>
</tr>
<tr>
<td>S.D.</td>
<td>2.09</td>
<td>2.28</td>
<td>1.72</td>
</tr>
<tr>
<td>Diagnostic b</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>categories</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anxiety reaction</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>reaction</td>
<td>12</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Conversion reaction</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>reaction</td>
<td>4</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Passive dependency reaction</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>reaction</td>
<td>5</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Phobic reaction &amp; obsess.-comp.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>reaction</td>
<td>3</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Somatization reaction</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>reaction</td>
<td>8</td>
<td>5</td>
<td>3</td>
</tr>
</tbody>
</table>

a. Based on Information, Similarities and Vocabulary tests of Wechsler-Bellevue Intelligence Scale, Form I.

b. Diagnoses were made by the doctors and conformed with Veterans Administration nomenclature (44).
B. **Materials.** The standard ten Rorschach cards made up one test series. The experimental test series consisted of standard cards 14567 and black and white photographic reproductions of the chromatic Rorschach cards 238910. After many trials with negatives and prints, a set of these reproductions was judged adequate for experimental purposes by a group of eight psychologists. In the reproductions of cards 238910 the color was absent but the configurations, details and shading of the blots were retained. The non-colored reproductions of cards 238910 were pressed on cardboard the same size and thickness as the standard cards and placed in their usual sequence with the five standard achromatic cards, thus composing the experimental series.

Subsequently cards 14567 in the standard series will be referred to as "SA"; meaning the achromatic cards in the standard Rorschach series. Cards 238910 will be referred to subsequently as "SC"; meaning the regular chromatic cards in the standard series. Cards 14567 in the experimental series will be designated subsequently as "EA". Cards 238910 in the experimental series will be designated as "EC"; meaning cards 238910 with color absent.

C. **Testing.** The Rorschach and experimental tests

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1We are indebted to Maynard Cheeney, Cushing Hospital photographer, for his careful work in making the experimental cards.
were administered individually in separate testing sessions which were conducted in the usual clinical manner. The patient was informed by his doctor that he would have an appointment with the psychologist as part of his routine clinical procedure. Beck's (2) standard Rorschach instructions and procedure of test administration were used.

Half of the group of 32 patients took the standard test in the first test session and the experimental test in the second session. The other half of the group had the reverse test order. A comparison of the characteristics of these two experimental subgroups is given in Table III.

The second test was given two weeks after the first. This time lapse was considered a compromise between too short a time between tests, which would emphasize memory and adaptation factors, and too great a time lapse, with the possibility of changes in the patient's clinical condition due to continued hospitalization.

Parts of the Wechsler-Bellevue intelligence scales were included in each test session; they were used in Experiment II\(^2\) and as a measure of intellectual level.

The testing schedule is represented below.

**First Session:**

a). Wechsler-Bellevue Tests--Information, Similarities, Picture Completion, Block Design, and Digit Symbol

\(^2\text{Cf. post, p. 88 et seq.}\)
b). Rorschach Test

Second Session:

a). Wechsler-Bellevue Vocabulary Test
b). Second Rorschach Test
c). Draw-a-Person and Jenson Color-Vision Tests

D. Scoring. With the exceptions noted below, all scoring of the Rorschach tests followed Beck's criteria as stated in the revised edition of Volume I (2).

When Beck's Form-Level tables did not contain a given response, Hertz's (14) tables were consulted, but Beck's scoring took precedence wherever possible. When neither set of tables included a response at least two psychologists were consulted to determine the scoring. A separate list of such responses was maintained for consistency.

The \( F_{\%} \) score was based on all responses rather than just on those responses involving form alone. The Form-Level tables were adequate in this respect since they rate the basic form element in most responses regardless of the other determinants which might be involved such as movement, color and shading. The \( F_{\%} \) based on all responses seemed more representative for the purposes of this experiment since \( F_{\%} \) was calculated separately for C cards (238910) and A cards (14567). It also made for a better equation of the \( F_{\%} \) on the two sets of cards within a series because it included color responses on the SC cards. The correlation between the standard \( F_{\%} \) and the \( F_{\%} \) based on all responses for the 32 cases was \( 0.864 \).
The experimental and standard protocols were scored separately. Independent scoring of 50 randomly selected responses by two psychologists yielded a percent of agreement of 97.5 for 143 separate scores. This suggested adequate scoring reliability.

Each of the ten standard shock indices was separately scored for the C cards (238910) and for the A cards (14567). For the purpose of computation, a factor score on the A cards was subtracted from the factor score on the C cards for each subject and for the standard and experimental tests separately. This yielded a difference score on each test series for each subject. In the case of a ratio was used, the number of responses to C cards divided by the total number of responses to all ten cards.

The basic formula for experimental comparison of C and A cards may be represented as follows:

**Standard series:**

{\[
\text{Chromatic cards } 238910 - \text{Achromatic cards } 14567 = \text{Difference score}
\]}

**Experimental series:**

"Chromatic" cards 238910 - "Achromatic" cards 14567 = Difference score

In terms of the abbreviations which will be subsequently used in referring to the various sets of cards, the scoring is represented as follows:

3The author is indebted to Raymond Gilbert, Cushing Hospital Psychology Department, for his assistance in scoring.
(1) \( \text{SC -SA} = \text{Difference}, S(C - A) = \text{S Score} \)
(2) \( \text{EC -EA} = \text{Difference}, E(C - A) = \text{E Score} \)
(3) \( \text{S -E} = \text{Difference of Differences or Subject's "Color Score"} \)

A specific case will illustrate the use of the factor scores for experimental computations:

Subject number ten gave four responses to SC cards and seven responses to SA—a total of eleven responses to series S. Since for this factor a ratio was used, his score for the S series was \( 4/11 \) or 36. He gave five responses to EC and seven responses to EA yielding a ratio of \( 5/12 \) and a score of 42 for the E series. The S-E score \( (36-42) \) or \(-6\) indicates that subject ten gave relatively fewer responses to C cards when color was present in the S series compared with the E series when color was absent.

Subject No. ten had an \( \text{F\%} \) of 75 on SC cards and an \( \text{F\%} \) of 83 on SA cards. By formula C-A his S series score was \( 75-83 \) or \(-8\) which meant he had a lower \( \text{F\%} \) on the chromatic cards than on the achromatic cards in the standard series. His \( \text{F\%} \) on EC was 80 and EA was 86 so his E series score was \(-6\). S Score minus E score, \((-8) \) \((-6)\), gave him a "color score" of \(-2\) which meant that with color present (SC) his \( \text{F\%} \) was relatively lower.

8-10% This percent is by definition the ratio of the number of responses on cards 8, 9 and 10 to the number of responses to all ten cards. It is a single figure
on the S series and a single figure on the E series. Thus subject number ten had an 8-10% of 18 on series S and of 25 on series E. S-E was -7, indicating that he gave relatively fewer responses to cards 8-10 when color was present.

The other seven shock factors were scored by the difference method illustrated by F/%. This general scoring scheme had several advantages for experimental purposes.

1. The actual distribution of the difference scores for all factors except REJ, ANAT and X responses seemed to be consistent with a normally distributed population. This permitted the use of more precise statistical analysis for seven factors.

2. The average C-A scores on the experimental series represent the differences in responses to the C and A cards due to variables other than color. The comparison of average C-A scores on E series with average C-A scores on S series reflects the influence of color on responses of the group as a whole. The individual's color score, based on the formula S(C-A) - E(C-A), represents the degree to which color effects one subject's response and was used for correlation computation.

This experimental method of measuring the effects of color is similar to the clinical method of determining color shock. In both cases chromatic cards are compared with achromatic cards. There is a difference between them however.
From the review of the literature it seemed apparent that, in the clinical practice of comparing standard chromatic cards with standard achromatic cards, differences in the color shock indices reflect several variables, such as form, configuration, and shading, as well as color.

In the scoring method used here where average group scores on E and S are compared or the individual's color score S-E is used, a measure is obtained of the degree of deviation of responses to color per se from a base line of responses to similar materials without color.

3. In this scoring system generalized practice effects are cancelled out. Scores represent relationships between C and A cards within each series. Comparison between one series and another are based on the C-A difference. If familiarity with the first test brought a general decrease of T 1/R on the second test for instance, a direct comparison of EC with SC might show a great drop in T 1/R. If the data on A cards were considered, as it was in the scoring system employed, a different picture might be seen. Subject number four's reaction times illustrates the point.

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>C-E</td>
<td>A-S</td>
<td>Difference</td>
<td></td>
</tr>
<tr>
<td>1st Administration SC 49&quot;</td>
<td>S 49&quot;</td>
<td>52&quot;</td>
<td>-3&quot;</td>
</tr>
<tr>
<td>2nd &quot;</td>
<td>EC 13&quot;</td>
<td>E 13&quot;</td>
<td>8&quot;</td>
</tr>
<tr>
<td>S-E Difference 736</td>
<td>(SC-SA) - (EC-EA)</td>
<td>45&quot;</td>
<td>-8&quot;</td>
</tr>
</tbody>
</table>
Without taking into account the times on A cards, the general lowering of reaction times on second administration would not be weighted. In that case it could be assumed either that practice effect lowered the reaction time greatly or that the effect of deleting color was reflected. In the difference scoring system, practice effect is cancelled out and it is seen that there was actually an increase of reaction time on C cards relative to A cards in the E series. With practice effect considered, it might then be suggested that the effect of color was actually in the direction of a decreased reaction time.

The scoring system employed here seems to maintain the essential features of clinical practice and permits a more accurate experimental measurement of the influence of color.

In the presentation of results, tests of significance will be designated at the .05 level by a single asterisk or at the .01 level with a double asterisk in accordance with standard practice. In evaluating the importance of the significance level of any particular statistic, the number of significance tests made on the general data and the inflation of probabilities was considered. This was weighted with the soundness of psychological rationale which the statistic represented, in drawing conclusions.

III. RESULTS

A. The difference between "chromatic" cards (C) and achromatic cards (A) in the experimental series.
Tables IV and V give the average group scores for nine of the shock factors on the A cards and C cards in experimental series and the differences between them. The 8-10% for this series is also given. The significance of the difference reaches the .05 level or less for seven of the nine factors. Thus EC cards (238910) differ in important respects from EA cards on the basis of the very form and structure of the blots, with color absent. In this group EC cards elicit:

- Greater #R
- Lower F^2\%
- Longer T 1/R
- More POP responses
- Wider range of content
- Lower animal percent
- More ANAT responses

Although the difference is non-significant as tested by chi-square, there were ten subjects who rejected a total of nineteen cards among EC and only six who rejected a total of ten cards among EA.

The lower F^2, more rejections, and longer reaction times on EC compared with EA means that the EC cards were more difficult than EA cards for this group, without color present. With the greater number of anatomy responses there are four factors whose direction is suggestive of shock behavior. With color absent it is presumed that the very blot structure, and configurations, including shading, of the EC cards accounted for the differences between them and the EA cards.
TABLE IV

DIFFERENCES BETWEEN AVERAGE CHROMATIC SCORES
AND AVERAGE ACHROMATIC SCORES
IN THE EXPERIMENTAL SERIES FOR 32 NEUROTIC SUBJECTS

<table>
<thead>
<tr>
<th>Scoring factor</th>
<th>Average EC</th>
<th>Average EA</th>
<th>EC - EA difference</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td>#R</td>
<td>9.56</td>
<td>7.53</td>
<td>2.03</td>
<td>3.83**</td>
</tr>
<tr>
<td>F%</td>
<td>79.97</td>
<td>85.06</td>
<td>-5.09</td>
<td>3.09**</td>
</tr>
<tr>
<td>T 1/R</td>
<td>17.31</td>
<td>14.22</td>
<td>3.09</td>
<td>2.40*</td>
</tr>
<tr>
<td>POP</td>
<td>3.31</td>
<td>2.22</td>
<td>1.09</td>
<td>5.32**</td>
</tr>
<tr>
<td>Content</td>
<td>3.91</td>
<td>3.03</td>
<td>0.88</td>
<td>5.30**</td>
</tr>
<tr>
<td>A%</td>
<td>50.75</td>
<td>66.59</td>
<td>15.84</td>
<td>6.65**</td>
</tr>
</tbody>
</table>

8-10%a            32.50

a. 8-10% is a single index for the experimental series.
## Table V

Number of Subjects Having Specific Types of Rorschach Responses on the Chromatic Cards Compared with Achromatic Cards in the Experimental Series

<table>
<thead>
<tr>
<th>Type of response</th>
<th>EC</th>
<th>EA</th>
<th>EC - EA difference</th>
<th>X²</th>
</tr>
</thead>
<tbody>
<tr>
<td>REJ</td>
<td>10</td>
<td>6</td>
<td>+4</td>
<td>0.74</td>
</tr>
<tr>
<td>ANAT</td>
<td>19</td>
<td>9</td>
<td>+10</td>
<td>6.34*</td>
</tr>
<tr>
<td>X RESP</td>
<td>4</td>
<td>4</td>
<td>0</td>
<td>0.00</td>
</tr>
</tbody>
</table>
In the other direction, not consistent with shock theory, EC cards elicit more responses, more POP responses, more varied types of content and fewer animal percepts than cards EA.

In summary, without color as a stimulus, in the experimental Rorschach series, cards EC differed from cards EA in most of the factors measured. The nature of these differences in several respects, such as $F_\%$, suggest that the form, configurations and variables other than color in the chromatic cards make them more difficult to interpret than the achromatic cards.

There were other important differences, due to form and variables other than color, which were not characteristic of shock behavior as traditionally conceived, since cards EC elicited more responses and a more varied type of content.

B. The differences between chromatic cards (C) and achromatic cards (A) in the standard Rorschach series.

The average group SC and SA scores for nine factors and the average 8-10% for the standard series are given in Tables VI and VII. SC cards, with color present, differed significantly from SA cards in eliciting:

- More responses
- Lower $F_\%$
- More popular responses
- Wider range of content
- Lower animal percent
- More anatomy responses
There were three more subjects who rejected SC cards than there were who rejected SA cards and there was a slightly longer reaction time to SC than SA cards but neither of the differences was statistically significant.

The standard chromatic cards 238910, with color, appear to be more difficult to interpret for this group of neurotics particularly as measured by $F_{f%}$. The average $F_{f%}$ on SC cards was 14.69% below the $F_{f%}$ on SA cards.

The lack of a significant difference in the number of subjects rejecting SC cards in comparison to SA is an important point concerning the nature of the difference in difficulty between the two sets of cards however. The SC cards did not seem to be more difficult than the SA in terms of this measure of severe blocking on the standard series. Longer reaction time to the chromatic cards was not particularly evidenced either. Instead of fewer responses to SC, as is considered indicative of color shock, there was an average of almost three more responses to SC than to SA, accompanied by a greater average number of popular responses and more varied content.

For this group then, the standard chromatic cards compared with achromatic cards elicited behavior consistent with color shock theory in two out of nine factors, lower $F_{f%}$ and more anatomy responses. There were only a few more subjects rejecting chromatic cards than achromatic cards while other factors showed no difference or differences
TABLE VI
DIFFERENCES BETWEEN AVERAGE CHROMATIC SCORES
AND AVERAGE ACHROMATIC SCORES IN THE
STANDARD RORSCHACH SERIES FOR 32 NEUROTIC SUBJECTS

<table>
<thead>
<tr>
<th>Scoring factor</th>
<th>Average SC</th>
<th>Average SA</th>
<th>SC - SA difference</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td>#R</td>
<td>10.68</td>
<td>7.84</td>
<td>2.84</td>
<td>2.92**</td>
</tr>
<tr>
<td>F/P</td>
<td>72.62</td>
<td>87.31</td>
<td>-14.69</td>
<td>8.92**</td>
</tr>
<tr>
<td>T 1/R</td>
<td>17.53</td>
<td>16.59</td>
<td>0.94</td>
<td>0.71</td>
</tr>
<tr>
<td>POP</td>
<td>2.94</td>
<td>2.19</td>
<td>0.75</td>
<td>3.66**</td>
</tr>
<tr>
<td>Content</td>
<td>4.28</td>
<td>3.22</td>
<td>1.06</td>
<td>4.65**</td>
</tr>
<tr>
<td>A%</td>
<td>50.66</td>
<td>68.13</td>
<td>-17.47</td>
<td>7.34**</td>
</tr>
<tr>
<td>8-10%</td>
<td>33.81</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### TABLE VII

NUMBER OF SUBJECTS HAVING SPECIFIC TYPES OF RORSCHACH RESPONSES ON THE CHROMATIC CARDS COMPARED WITH ACHROMATIC CARDS IN THE STANDARD SERIES

<table>
<thead>
<tr>
<th>Type of response</th>
<th>SC</th>
<th>SA</th>
<th>SC - SA difference</th>
<th>$\chi^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>REJ</td>
<td>11</td>
<td>8</td>
<td>$\chi_3$</td>
<td>0.68</td>
</tr>
<tr>
<td>ANAT</td>
<td>18</td>
<td>8</td>
<td>$\chi_{10}$</td>
<td>6.48*</td>
</tr>
<tr>
<td>X RESP</td>
<td>7</td>
<td>6</td>
<td>$\chi_1$</td>
<td>0.00</td>
</tr>
</tbody>
</table>
in the opposite direction to that assumed by color shock theory. The standard series results for this group of neurotics suggest that the chromatic cards were much more difficult to achieve good, clear form discrimination on than the achromatic. However, they did not elicit the more extreme blocking and constriction assumed to be characteristic of color shock as measured by increased rejections, increased reaction times and fewer responses.

C. The effect of color as measured by a comparison of the standard and experimental Rorschach series.

Tables VIII and IX give the differences between C and A cards in the standard and experimental series. From a comparison of these differences it appears clear that the only strong effect of the presence of the color stimulus was a reliably lower F.f%. Even though F.f% for EC cards averaged 5.09% below F.f% on EA cards, with the presence of color in SC cards F.f% averaged 14.69% below that for SA cards. In other words color appeared significantly to impair the quality and adequacy of form perception in this neurotic group.

With the exception of F.f% the greatest differences between C cards and the A cards were apparently due to variables other than color, presumably the structure, shading and configuration of the blots. This is apparent since the seven factors which significantly differentiated
TABLE VIII

DIFFERENCES BETWEEN AVERAGE CHROMATIC (C) SCORES AND AVERAGE ACHROMATIC (A) SCORES IN THE STANDARD SERIES (S) COMPARED WITH THE EXPERIMENTAL SERIES (E) FOR 32 NEUROTIC SUBJECTS

<table>
<thead>
<tr>
<th>Scoring factor</th>
<th>Average SC - SA</th>
<th>Average EC - EA</th>
<th>S - E difference</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td>#R</td>
<td>2.84</td>
<td>2.03</td>
<td>0.81</td>
<td>0.60</td>
</tr>
<tr>
<td>F/0</td>
<td>-14.69</td>
<td>-5.09</td>
<td>-9.60</td>
<td>4.12**</td>
</tr>
<tr>
<td>T 1/R</td>
<td>0.94</td>
<td>3.09</td>
<td>-2.15</td>
<td>1.19</td>
</tr>
<tr>
<td>POP</td>
<td>0.75</td>
<td>1.09</td>
<td>-0.34</td>
<td>1.18</td>
</tr>
<tr>
<td>Content</td>
<td>1.06</td>
<td>0.88</td>
<td>0.18</td>
<td>0.42</td>
</tr>
<tr>
<td>A%</td>
<td>-17.47</td>
<td>-15.84</td>
<td>-1.63</td>
<td>0.49</td>
</tr>
<tr>
<td>8-10%</td>
<td>33.81</td>
<td>32.50</td>
<td>1.31</td>
<td>0.60</td>
</tr>
</tbody>
</table>
TABLE IX

DIFFERENCE IN NUMBER OF SUBJECTS HAVING A GREATER NUMBER OF SPECIFIC TYPES OF RORSCHACH RESPONSES ON CHROMATIC (C) CARDS THAN ON ACHROMATIC (A) CARDS IN THE STANDARD SERIES COMPARED WITH THE EXPERIMENTAL SERIES

<table>
<thead>
<tr>
<th>Type of response</th>
<th>Stand. C &gt; A</th>
<th>Exper. C &gt; A</th>
<th>S - E diff.</th>
<th>$X^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>REJ</td>
<td>8</td>
<td>7</td>
<td>$41$</td>
<td>0.00</td>
</tr>
<tr>
<td>ANAT</td>
<td>16</td>
<td>17</td>
<td>$-1$</td>
<td>0.63</td>
</tr>
<tr>
<td>X RESP</td>
<td>7</td>
<td>3</td>
<td>$44$</td>
<td>1.07</td>
</tr>
</tbody>
</table>
the C from the A cards in the experimental series, Tables IV and V, did not significantly change in the standard series, except for Ff/.

There is some slight evidence, non significant statistically, that with the presence of color there were more responses, fewer of the popular type of response but more of the X type, and faster reaction times.

The increase of responses and faster reaction times are not consistent with color shock theory which assumes that the influence of color is in the direction of a decrease of responses and slower reaction times.

The approximately equivalent number of subjects rejecting C cards when color was present and absent and the slight decrease in reaction times in the presence of color suggests that color definitely did not elicit blocking of associations in this group, over and above that accounted for by variables other than color.

In summary, the differences in structure and variables other than color between the chromatic and achromatic Rorschach cards appeared, in this experiment, to account for the major differences in indices assumed to reflect traditional color shock, except for Ff/%. Stimulus color does appear to have impaired form perception in this group but it does not appear to elicit extreme blocking of associative processes.
D. A comparison of the effect of color according to the sequence of administration of the standard and experimental series.

Half of the neurotic group, sixteen patients, took the E series first followed by the S series. The other sixteen took the S series followed by the E series. The characteristics of these two sub-groups were given in Table III, page 48. Tables X and XI show the differences between C and A cards in the S and the E series for both orders of administration.

When the E series preceded the S series, the C cards were seen first without color and later with color in them. In this sequence there was a significantly lower average F% and faster average time to first response when color was present. In other words, for half of the group color seemed to evoke quicker responses yet the form perception was much less adequate in them.

In the other group who saw the C cards first with color and later saw the C cards without color, form perception was significantly impaired and popular responses were inhibited, that is, when color was present, on SC cards, compared with when it was absent, on EC cards.

No other factors appeared markedly influenced by color in the different administrative sequences of the two tests. There is some suggestive evidence of a general increase in responsiveness with color when E series preceded
TABLE X

THE DIFFERENCES BETWEEN AVERAGE CHROMATIC (C) AND ACHROMATIC (A) SCORES IN THE STANDARD SERIES (S) COMPARED WITH THE EXPERIMENTAL SERIES (E) ACCORDING TO ADMINISTRATIVE SEQUENCE

<table>
<thead>
<tr>
<th>Scoring Factor</th>
<th>C - A</th>
<th>E 1st</th>
<th>C - A</th>
<th>S 2nd</th>
<th>S - E</th>
<th>t</th>
<th>C - A</th>
<th>E 1st</th>
<th>C - A</th>
<th>S 2nd</th>
<th>S - E</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td>#R</td>
<td>1.19</td>
<td>3.12</td>
<td>1.93</td>
<td>1.87a</td>
<td>2.56</td>
<td>2.88</td>
<td>-0.32</td>
<td>0.68</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F4%</td>
<td>-4.25</td>
<td>-17.44</td>
<td>-13.19</td>
<td>5.67**</td>
<td>-11.94</td>
<td>-5.94</td>
<td>-6.00</td>
<td>2.57a</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T 1/R</td>
<td>6.06</td>
<td>1.50</td>
<td>-4.56</td>
<td>2.51*</td>
<td>0.38</td>
<td>0.12</td>
<td>0.26</td>
<td>0.14</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>POP</td>
<td>0.50</td>
<td>0.88</td>
<td>0.38</td>
<td>1.31</td>
<td>0.62</td>
<td>1.68</td>
<td>-1.06</td>
<td>3.66**</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Content</td>
<td>0.88</td>
<td>1.38</td>
<td>0.50</td>
<td>1.54</td>
<td>0.75</td>
<td>0.88</td>
<td>-0.13</td>
<td>0.40</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A%</td>
<td>-18.94</td>
<td>-17.94</td>
<td>1.00</td>
<td>0.30</td>
<td>-17.00</td>
<td>-12.75</td>
<td>-4.25</td>
<td>1.28</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8-10%</td>
<td>32.19</td>
<td>35.12</td>
<td>2.93</td>
<td>1.34</td>
<td>32.50</td>
<td>32.81</td>
<td>-0.31</td>
<td>0.14</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

a. .10 level of significance
TABLE XI

DIFFERENCES IN NUMBER OF SUBJECTS HAVING A GREATER NUMBER OF SPECIFIC TYPES OF RORSCHACH RESPONSES ON THE CHROMATIC (C) CARDS THAN ON THE ACHROMATIC (A) CARDS IN THE STANDARD (S) COMPARED WITH THE EXPERIMENTAL (E) SERIES ACCORDING TO ADMINISTRATIVE SEQUENCE

<table>
<thead>
<tr>
<th>Type of response</th>
<th>C &gt; A</th>
<th>E 1st</th>
<th>C &gt; A</th>
<th>S 2nd</th>
<th>S - E</th>
<th>x²</th>
<th>C &gt; A</th>
<th>E 1st</th>
<th>C &gt; A</th>
<th>S 2nd</th>
<th>S - E</th>
<th>x²</th>
</tr>
</thead>
<tbody>
<tr>
<td>REJ</td>
<td>4</td>
<td>3</td>
<td>-1</td>
<td>0.00</td>
<td>5</td>
<td>3</td>
<td>2</td>
<td>0.17</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ANAT</td>
<td>8</td>
<td>9</td>
<td>1</td>
<td>0.00</td>
<td>7</td>
<td>9</td>
<td>-2</td>
<td>0.12</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>X RESP</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>0.29</td>
<td>4</td>
<td>2</td>
<td>2</td>
<td>0.20</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

N = 16
S series. This was reflected in greater number of responses and greater variety of types of content.

An important aspect of these results is the consistency with which impairment of form perception appears associated with color stimulus regardless of the order of series administration.

The second important finding is that for this group of 32 neurotics there were several respects in which sequence of test administration did make a significant difference in the measurable effects of color. When color in the C cards was preceded by lack of color there was the greatest impairment of form-perception accompanied by some increase in responsiveness, and the responses were given more quickly in the presence of color.

When color preceded lack of color, there was little evidence of greater responsiveness or quicker response times and there was less impairment of form-perception though it was still significant. In this sequence, S 1st and E 2nd, an index showed up that was not evidenced in the sequence E 1st and S 2nd. It was inhibition of popular responses in the presence of color.

E. Correlations between the shock indices.

So far the averages of group scores have been considered. To test the interrelationships of the shock indices, correlations were run between seven of the ten indices. The appropriate question here is--do individuals
who react to color in a specific direction on one index react in a consistent direction on other indices? The individual's score on any factor was derived from the formula: \((SC - SA) - (EC - EA) = \text{Color Score}\). This score represents the extent to which \(C\) scores were greater than \(A\) scores on the standard series with color present, over and above their difference in the experimental series when color was absent. The correlation results are given in Table XII.

A number of significantly high correlations emerged which, however, mainly reflect the functional relationships which exist between these factors in standard Rorschach scoring procedure. These correlations tell little about relationships among the several indices of color reaction. For example, when there was an increase in number of responses to SC cards, there was naturally associated with it an increase of number of responses to the last three SC cards, 8, 9 and 10 (.66) and a decreased number of rejections of SC cards (-.65). The correlation coefficients above .4 represent functional relationships of this sort, primarily a function of the total number of responses.

There are three correlations that approach significance:

\(F\%\) correlated with \(T1/R\) .36

This suggests that in the presence of color a decrease in form level may be associated with faster reaction times.
TABLE XII

CORRELATIONS BETWEEN RORSCHACH COLOR SHOCK FACTORS

<table>
<thead>
<tr>
<th></th>
<th>F4%</th>
<th>T 1/R</th>
<th>POP</th>
<th>Cont.</th>
<th>8-10%</th>
<th>REJ</th>
</tr>
</thead>
<tbody>
<tr>
<td>#R</td>
<td>-.11b</td>
<td>-.12d</td>
<td>.47</td>
<td>.56</td>
<td>66b</td>
<td>-.65</td>
</tr>
<tr>
<td>F4%</td>
<td></td>
<td>.36</td>
<td>.09</td>
<td>.09</td>
<td>-.31b</td>
<td>.36</td>
</tr>
<tr>
<td>T 1/R</td>
<td></td>
<td></td>
<td>.02</td>
<td>-.13</td>
<td>-.05</td>
<td>.20</td>
</tr>
<tr>
<td>POP</td>
<td></td>
<td></td>
<td></td>
<td>.04c</td>
<td>.52</td>
<td>.03c</td>
</tr>
<tr>
<td>Content</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.32</td>
<td>-.02c</td>
</tr>
<tr>
<td>8-10%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-.50</td>
</tr>
</tbody>
</table>

a. Based on individual's color score derived by formula (SC - SA)-(EC - EA)
b. Pearson Product Moment Coefficient .35 = .05 level of significance
c. Phi Coefficient based on Chi square .61 = .05 level of significance
d. All other coefficients are Biserial .39 = .05 level of significance
F% correlated with REJ \( .36 \).

This suggests that decrease in form-level may be associated with fewer rejections when color is present.

F% correlated with 8-10\% \( -.31 \).

This suggests that decrease in form-level may be associated with increase in percent of responses to cards 8, 9 and 10.

Taken singly these correlations are only suggestive. When all the possible correlations between F%, T 1/R, REJ, and 8-10\% are considered, a cluster of factors appear that may be indicative of functional relationships of color reactions. The correlations rounding out this cluster of factors are:

T 1/R correlated with REJ \( .20 \).

This is a slight indication that decrease in time to first response may be associated with fewer rejections when color is present. Both factors approached significance in their association with F%.

REJ correlated with 8-10\% \( -.50 \).

This indicates the necessary scoring relationship between these two variables; the fewer rejections, the more responses to the last three colored cards.

8-10\% correlated with T 1/R \( -.05 \).

This is a coefficient so low that no relationship probably exists between the time taken to give first response and the percent of responses to the last three colored cards.
There were six possible correlations between the four indices F_/%, T 1/R, REJ, and 8-10%. Of these, five suggested a consistent association of the factors in a cluster and one of these was neutral. This consistency is highly suggestive of a functional relationship between these measures of reactions to color and the presence of some common denominator.

The evidence implies that in this neurotic group the individuals whose form perception was impaired by color may also have given more responses to the multicolored cards, given a faster first response and not have blocked in the presence of color.

IV. DISCUSSION AND CONCLUSIONS

The hypotheses tested in this experiment were that the differences between the chromatic and achromatic cards in the standard and experimental series would be equivalent, in terms of ten common color shock factors.

The results indicated that a significant difference appeared in F_/% which was impaired when color was present. Under particular conditions of test sequence there were significant differences in T 1/R, which was faster when color was present, and in POP responses, which were fewer when color was present. The null hypothesis as stated in terms of equivalence of differences is thus rejected in the case of F_/% and conditionally rejected in the case of T 1/R and POP. Within the limits of this experiment it is accepted in the other seven instances.
Form level is representative of the degree to which forms of the blots are clearly discriminated and responses to them appropriate to the stimulus, as defined by standards based on the responses of healthy normals and pathological subjects. It involves clear focusing of attention on the stimulus, an integration of its features into relevant associational patterns and adequate conceptualization of relationships between outer structure (stimulus matrix) and inner structure (memory patterns, needs, affective states, etc.).

Form-plus percent has been validated experimentally as an index of intellectual control, of the adequacy of cognitive processes in stress situations. The finding in this experiment was that the test determinant most clearly validated as an index of intellectual control was significantly lower when color was present. This is interpreted to mean that color as a stimulus in the Rorschach blots measurably impaired intellectual processes in this group of neurotics. Color, in its Rorschach setting, appeared to constitute some sort of difficulty or stress in the Rorschach test for subjects known to have difficulty in control of their affective life.

The previous experimental work most comparable to the present one is that of Lazarus since he used the standard shock indices also. He had found form-level unchanged in the presence of color for his total group of

4Cf., pp. 13-14.
100 normals, but a significant drop in form-level for the sub-group of thirty normals. It appears quite likely, since he selected the thirty because they had the highest incidence of color shock, that they represented the mildly neurotic portion of the population which would be expected in any sample of normals.

In view of the available experimental evidence on form-level in relation to color, it is proposed that the broad assumption of color shock theory, that normals are able to integrate color stimulation into Rorschach response processes without disturbance while neurotics are disturbed, appears validated as measured by the single but important index of form-level.

This research was not designed to deal with the problem of the effect of the sequence in which chromatic cards appear after the achromatic cards within the standard Rorschach test. In the administration of the standard and experimental series however, the problem of sequence arose in a slightly different context.

The half of the neurotic group who took the experimental series first and the standard second had a faster reaction time to the first response when color was present. The other half, who took the standard series first and the experimental second, had no change in reaction time in the presence of color. They did have, however, fewer popular responses. A number of variables appear to be involved

\[5\text{Cf. ante, p. 68.}\]
here.

The two discrete sub-groups of sixteen patients might represent different samples of the neurotic population having different characteristics. An examination of the incidence of diagnostic categories in each group, Table III page 48, showed such a relatively similar incidence of neurotic types in each of these two groups that this factor appeared improbable. Differences in age, education and verbal intelligence level in the two groups do not appear significant, and thus, are not considered crucial in these results.

Practice effect, a greater familiarity with the test, could result in decreased reaction times (E 1st and S 2nd) and increased popular responses (S 1st and E 2nd). However, the analysis of responses employed cancelled out overall practice effect such as any general decrease in response times or general increase in number of responses. The experimental scores used represented the extent to which there were changes in one set of five cards (C) within a single series (E or S) in relation to the other set of five cards (A) within the same series.

These results might be attributed to chance fluctuations. One .05 level of significance would be expected in twenty significance tests and one .01 level in 100 such tests when the variables are independent. However, on the administrative sequence data there were only 14 "t" tests
made and two .01 and two .05 levels were found. Thus it is considered that real differences are represented in the time and popular response indices.

The remaining known variables are color, sequence, and the two indices involved which are reaction time and the popular response.

What the results suggest, in the instance of reaction times, is that when C cards were seen first without color it took a longer time to give a first response than when the same cards were seen next with color, relative to A cards. If it is assumed then that color elicited faster reaction times, the question arises as to why it was not evidenced in the administrative sequence where color came first.

One possibility is that color may have elicited faster reaction times when first seen but when seen again in non-color they were responded to on the basis of previous experience with the same cards. The second possibility is that the transition from non-color to color (E 1st and S 2nd) may have constituted a difficult, stress-like change in comparison with the transition from color to non-color (S 1st and E 2nd). Some additional evidence that this sequence (E 1st, S 2nd) may be important is seen in the fact that, besides faster reaction times, there was far greater impairment of form-level and a suggestion that more responses were given in this sequence compared with the reverse sequence.
Although transition from non-color to color may be a contributing factor in those results, it is not an adequate explanation for other results. Form-level was impaired and popular responses were fewer when color preceded non-color, (S 1st, E 2nd).

One explanation of the lack of change in popular responses when the C cards were seen with non-color first and color second may reside in the nature of the popular response. The popular responses are those which are most frequently seen in the Rorschach blots. It may be assumed that, if they are seen most readily, they are seen most easily because of their form quality. Thus when seen in E series without color, they were seen clearly and when they came next in the S series with color, they were more easily remembered and utilized. The influence of color may not have been sufficient to inhibit these very clear forms after they had already been seen without color.

The inhibiting effect of color on these popular forms was evidenced clearly when color came first (S 1st and E 2nd). When seen a second time without color, there was a significant increase in utilization of these commonly perceived forms on the C cards.

To conclude the discussion about administrative sequence, it is strongly suggested that in this neurotic group color elicited faster reaction times and inhibited popular responses.
These effects of color, as measured in this experiment, appeared to be enhanced or subdued according to the factor involved and the particular sequence of administration. The effects of color were not entirely dependent upon any one sequence, however, since at least two factors showed significant differences in each order of administration and one of these was common to both.

In the clinical practice of comparing chromatic cards with achromatic cards the explicit assumption is that the differences in responsiveness to them are predominantly due to the influence of color. It is often recognized however that the chromatic cards have more discrete areas separated by white spaces, are more broken up and dispersed in configuration, than the achromatic cards which presumably makes them harder to deal with.

On the basis of results with the experimental Rorschach series alone and in its comparison with the standard series it seems clear that, with the exception of F7%, by far the most significant and extensive differences between the chromatic and achromatic cards were due to differences in variables other than color, such as greater configurational dispersion. This tends to confirm the conclusions of Lazarus, Wallin, and Rabin and Sanderson.

Cards 238910 without color elicited more rejections, longer reaction times, more anatomy responses, and lower form-level. Since such effects are often attributed to the
effect of color, the clinician should exercise caution in attributing them indiscriminately to the disruptive effect of color. They may well be due to a greater difficulty imposed by the more dispersed configurations of the chromatic blots.

Over and above the differences due to form and configurations, color stimulus per se on the average elicited still lower form-level, faster reaction times and more responses but fewer of the popular type. The lack of an increase in rejections due to color, over and above those due to form, considered with the decrease in reaction times and increase of responses, means that this group as a whole did not have the traditional blocking of associations and constriction in reaction to color. The typical reaction to color per se of this group can be described as more impulsive and verbally responsive but less adequate.

The discrepancy between these results and the reactions specified in color shock theory may be partly a function of the fact that the experimental measurement here employed reflects the influence of color per se. In clinical practice which is the basis of shock theory, the effects due to color and other variables in the blots are not easily discriminated. Thus, gross differences found between chromatic and achromatic cards reflect a number of factors. Accordingly the results of Experiment I may reflect the true effect of color stimulus on the perception of most neurotics
and be representative. The role of color may be to elicit more responses, hastily and carelessly given.

The effect of color evidenced in this experiment may be a function of the particular sample of neurotic subjects as well as the method of measurement employed. Although randomly selected from the neurotic wards of a veterans hospital, the incidence of diagnostic categories shows that there were only three out of thirty-two subjects with an obsessive-compulsive, phobic reaction and none with a depressive reaction. These are the very types of neurotics who would be presumed to react to color or any stress with blocking and constriction.

It may well be that in this veterans hospital the criteria for admitting patients makes for a selection of those with certain types of neurotic problems. Informally it has often been observed that there are relatively few patients with the type of pathology which is manifested in clearly obsessive and depressive symptoms. From a perspective of the social ecology of the hospital it is possible that this sample correctly expresses more of one general type of neurotic reaction than another.

Accordingly, it is suggested that this group of neurotics may not be generally representative of the neurotic population as a whole but that their reactions to color illustrate a type of color shock which differs from that stated in the literature.
A discrepancy between theory and practice exists because while the practice of many clinicians is to consider shock evidenced if any index deviates markedly in either direction, increase or decrease, when the chromatic cards are compared with the achromatic, the literature states shock phenomena in terms of single specific directions of deviation. This may be because the literature has not kept abreast of practice.

The assumption of clinicians however is that there are multiple expressions of neurotic disturbance. Neurotic difficulties are personality difficulties. Disturbances may be manifested in different ways depending upon the life history of the individual. There may be ideational, somatic or motor disturbances; fight or flight when there is stress or situational difficulty. Reactions to the presumed stress or difficulty of color in the Rorschach test, as in other situations, are seen in two generalized types of deviations. One consists in constraint of expression and an avoidance of the problem of mastering stress. It has been assumed that this type of reaction is reflected on the Rorschach in rejections, longer reaction times or fewer responses, which means blocking, avoidance and constriction.

The other consists in relative abandonment of restraint, impulsive acting out in response to stimulation, but with lack of planning and discrimination. The assumption is that this type of reaction is reflected in the Rorschach in faster reaction times, more responses or poor form perception.
In neither of these reactions, however, has the clinician assumed that more than one or two indices need be markedly deviative and it is not uncommon to see mixtures of these types in a specific patient.

In both the literature and in clinical practice there seems to have been little consideration of the relationships between the various color shock indices in terms of the psychological functions which they presumably measure. The practice is followed of considering shock indicated when one or two indices appear markedly on more than one chromatic card.

The correlations run between the color shock factors were an attempt in this research to obtain some evidence both on the problem of direction of deviation and of relationship between the indices for this group of neurotics.

Several indices appeared consistently related to one another. The evidence was not marked but suggested that in the presence of color the individual with lowered form-level had faster reaction times, fewer rejections and gave more responses to the multicolored cards. Since these were linear correlations the relationships would obtain in the reverse direction also, that is, higher form-level associated with more rejections, a longer reaction time, and fewer responses.

On the basis of these correlations, it is therefore
suggested that there may be a series of relationships between some of the color shock indices indicative of a dimension of reactions to color in this neurotic group. If viewed as a continuum, at one extreme would be the faster response with a lack of associative blocking accompanied by impaired form perception; at the other extreme would be the slower response with associative blocking and clear but constricted form perception.

As suggested on the basis of these correlations, the variables in this dimension of color reactions are similar to those which are apparently represented in the scale of the Rorschach color response proper. While the correlations suggest that neurotic reactions to color may deviate in either direction, the average group reactions offered little evidence of the blocking, constrictive type of response. The extent to which this may have been due to the method of measurement or to a bias in the population sample is somewhat problematic. Future research should attempt to clarify this aspect of color shock. A study of Rorschach color reactions in two different groups who would be selected on the basis of personality characteristics markedly extreme with respect to impulsivity and constriction, as defined by independent clinical criteria, might be appropriate for this purpose.

Summary. On the basis of the results with this neurotic group and within the limits of this experimental

6cf. ante, p. 16.
design, the following conclusions are drawn:

1. With the exception of $F/t\%$, the greatest differences between the chromatic and achromatic Rorschach cards are due to variables other than color.

2. As reflected in $F/t\%$, color is an adequate stimulus for the impairment of discriminative perception and intellectual functioning in the Rorschach test in individuals who have known difficulty in maintaining affective control under stress.

3. The sequence in which color and non-color are experimentally presented may be an important but not crucial condition for evoking behavior assumed to be characteristic of color shock.

4. With the exception of $F/t\%$, the average reaction of this group of neurotics did not conform to the traditional conception of color shock as stated in the literature. This may be a function of the small sample and its bias in the direction of the type of patient who evidences intolerance of tension and stress more by impulsive reaction than by constricted reactions, or it may be a function of the experimental method of measurement.

5. As determined by a cluster of six correlations, there may be functional relationships between several of the color shock indices and the personality variables they presumably reflect. Impairment of intellectual control ($F/t\%$), faster reactions ($T_{1/R}$), lack of blocking ($REJ$), and
greater productivity on the multi-colored cards (8-10%) were moderately but rather consistently associated.

6. Two important problems are suggested for color shock theory and research. They are posed by two questions; what aspect of color-in-stimulus-matrix constitute a stress for neurotics? What concepts and variables are necessary and adequate for the integration of Rorschach color theory with more general personality theories?
CHAPTER IV

EXPERIMENT II

THE EFFECT OF COLOR IN INTELLECTUAL PERFORMANCE TASKS

I. HYPOTHESIS

The general proposition of this study is that color stimulus may modify or interfere with intellectual processes and mental control. It was derived from an analysis of Rorschach color theory which relates various reactions to color with the state of balance between intellectual and affective processes in personality.

Experiment I was designed to test this proposition in the Rorschach test, in terms of the specific phenomena of color shock, with a group of subjects clearly diagnosed as neurotic. Color disturbance as reflected by color shock is assumed to be characteristic of neurotics.

The purpose of Experiment II is to test the proposition more generally, in terms of different types of tasks and population samples. Rorschach color theory, including color shock theory specifically, assumes that normals have little difficulty integrating color stimulation into an adequate performance but that neurotics are disturbed and impaired by it.

The problem of Experiment II is to determine how color affects the intellectual functioning of normals compared with neurotics. The specific hypothesis tested was that
intellectual functioning of a neurotic group would be more impaired than that of a normal group on tasks involving the color stimulus as compared with similar tasks without color.

II. PROCEDURE

A. Subjects. The neurotic group was composed of the first 24 of the thirty-two neurotics used in Experiment I. The twenty-four normal subjects were civil service employees at Cushing Veterans Administration Hospital; clerks, laborers, corrective therapists and cooks. As determined by interviews and case histories, no subject in either group had a history of neurological or somatic pathology. No subjects were included who were weak in color vision or visual acuity as measured by the Jensen Test (15) of Color Vision. All were between the ages of twenty and forty and had completed a minimum of six grades of school.

For the neurotics a positive diagnosis of neurosis was required, for the normals a negative neuro-psychiatric history was required. Through interviews and history taking no normal was included in the study who had hospitalizations of the type possibly connected with neurotic symptoms, an NP service disability or inconsistent work history. The normals were told that the testing was part of a research program and that all information was confidential.

Characteristics of the normal and neurotic group are given in Table XIII.
### TABLE XIII

**CHARACTERISTICS OF 24 NORMALS AND 24 NEUROTICS IN EXPERIMENT II**

<table>
<thead>
<tr>
<th></th>
<th>Normals</th>
<th>Neurotics</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age</strong></td>
<td>Mean 29.33</td>
<td>29.17</td>
</tr>
<tr>
<td></td>
<td>S.D. 4.04</td>
<td>4.39</td>
</tr>
<tr>
<td><strong>Grade of school</strong></td>
<td>Mean 12.17</td>
<td>10.84</td>
</tr>
<tr>
<td>completed</td>
<td>S.D. 1.72</td>
<td>2.09</td>
</tr>
<tr>
<td><strong>Verbal I.Q.</strong>&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Mean 118.17</td>
<td>113.33</td>
</tr>
<tr>
<td></td>
<td>S.D. 9.36</td>
<td>13.32</td>
</tr>
</tbody>
</table>

<sup>a</sup> Based on Information, Similarities and Vocabulary tests of Wechsler-Bellevue Scale, Form I.
B. Materials. Three of the Wechsler-Bellevue Performance scale sub-tests were used for this experiment. In addition the Verbal sub-tests Information, Similarities and Vocabulary were used to obtain measures of intellectual level. Draw-a-Person and the Jensen Color Vision tests were given.

Each of the three performance tests was administered to all subjects in two forms, Form I (46) and Form II (47). All subjects were given two versions of each of the three performance tests, one achromatic and one chromatic. Throughout the presentation and discussion of this experiment, the following abbreviations will be used:

"A" means achromatic  
"C" chromatic  
"I" subtest Form I  
"II" subtest Form II  
"1" the first version of a particular subtest to be administered  
"2" the second version of the same test to be administered

The Wechsler scales were selected for this experiment because of their adequate standardization, reliability and validity. The Picture Completion (PC), Block Design (BD) and Digit Symbol (DS) subtests were selected on the basis of their amenability to color variation, variation in type of task and the equivalence of Forms I and II.

The Picture Completion subtests I and II each had a colored version and a standard achromatic version for this
experiment. The two colored sets were painted with water colors to match as closely as possible the hues of the Rorschach test. The fifteen cards in each set were randomized as to red, blue, green and orange. As nearly as possible equivalent types of pictures and levels of difficulty had the same hues in each set. For example card 1 of both sets was painted entirely red, card 2 was painted blue, etc.

On the Digit Symbol sub-test the squares with the numbers and the empty squares corresponding with them were colored in with the same water colors as were used in the Picture Completion tests. The first ten squares where the subjects write were painted red, the next orange and the third green, in both sets alike. This color sequence continued until all the squares were colored. As with the Picture Completion tests each form of this sub-test had a colored and an achromatic version.

The blocks used in the Block Design test have red, yellow, blue, and white sides as normally used, but just the red and white sides are necessary to form the standard stimulus patterns. To make the standard set achromatic the red was painted with black enamel, the yellow with a light grey, and the blue with a dark grey. The white remained untouched. Painted in this fashion, the time taken to turn the blocks to the appropriate red colored side would still have to be taken to turn the blocks to find the black side.
The red portion of the seven stimulus patterns for each Form, I and II, were painted black while the white remained the same. As in the other tests there was an achromatic and chromatic version of each of the two Forms, I and II.

C. Testing. The normals did not have the Rorschach test and completed all the tests in one session. The order of administration is represented below:

(a) Information and Similarities tests
(b) Picture Completion test—alternate subjects $A_1C_2; C_1A_2$
(c) Block Design $D_1B_1$ Digit Symbol $D_2B_2$
(c) Neurotics had their first Rorschach at this point, completing their first session. Normals had the Vocabulary test which the neurotics took in their second session.
(d) Draw a Person and Jensen Color-Vision Tests. (Neurotics had this in their second test session.)

The order shown above for the performance tests is PC, BD and DS. The first twelve subjects in each group had that order; the last twelve — BD, DS, PC. In both orders Forms I and II and chromatic and achromatic versions of each of the three tests were randomized in the following manner:

<table>
<thead>
<tr>
<th>Subj. no.</th>
<th>Picture Completion</th>
<th>Block design</th>
<th>Digit symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Achromatic, Form I, then chromatic, Form II</td>
<td>$A_1$ $C_1$</td>
<td>$A_1$ $C_1$</td>
</tr>
<tr>
<td>2.</td>
<td>Chromatic, Form II, then achromatic, Form I</td>
<td>$C_1$ $A_1$</td>
<td>$C_1$ $A_1$</td>
</tr>
<tr>
<td>3.</td>
<td>Achromatic, Form II, then chromatic, Form I</td>
<td>$A_1$ $C_1$</td>
<td>$A_1$ $C_1$</td>
</tr>
<tr>
<td>4.</td>
<td>Chromatic, Form I, then achromatic, Form II</td>
<td>$C_1$ $A_1$</td>
<td>$C_1$ $A_1$</td>
</tr>
</tbody>
</table>

1Cf. ante, p. 47.
This pattern was repeated and continued for all the twenty-four subjects in each group so that every other subject within each of the normal and neurotic groups got the achromatic version of each of the three sub-tests first and chromatic version of each second. Alternate subjects had the chromatic version of each test first and the achromatic second.

Standard Wechsler (46) (47) procedure was employed throughout. When the second version of a subtest came, the examiner said, "This is a similar task," and then repeated the instructions for that test a second time.

D. Scoring. The three performance tests were scored according to Wechsler standards. The weighted scores for each test were used in the first overall analysis of the data. In all subsequent analyses the individual's weighted score on the achromatic version of each test was subtracted from his weighted score on the chromatic version, chromatic minus achromatic. This yielded a color score ranging from plus to minus. The plus indicates a higher performance on the colored than on the non-colored version of that test and vice-versa. The plus and minus color scores (C-A) were used on all charts, but for ease of computation a constant was usually added to all scores to make them all positive.

The difference scores in Experiment II, like those in Experiment I, seemed to be consistent with a normally distributed population and thus amenable to analysis of variance.
The color score in this experiment had the advantage of reducing the number of variables since it combined each of the three sets of two scores for a subject into three single scores which could then be manipulated in terms of the important factors such as type of test, test order, practice effect and relation to outside criteria.

As in Experiment I, tests of significance will be designated at the .05 level by a single asterisk or at the .01 level with a double asterisk.

III. RESULTS

1. The first overall analysis of the data employed a variance analysis of the factors of color (A and C), of forms of the tests, (I and II), of test-retest or practice effect, (1 and 2) and of groups (normal and neurotic). The scores used were the sums of the three weighted test scores. Types of tests were pooled but the two variations of the tests, chromatic and achromatic, were kept separate. The results of the analysis are given in Table XIV.

The lack of a significant difference between the average achromatic and chromatic score\(^2\) for the total group of forty-eight subjects indicates that adding or deleting color in these three performance tasks did not modify the materials enough to seriously disturb their equivalence. In that sense the reliability of the tests remains adequate.

\(^2\)A table of means for these factors will be found in Appendix, p. 141.
### TABLE XIV

**ANALYSIS OF VARIANCE OF WEIGHTED PERFORMANCE TEST SCORES INVOLVING FOUR VARIABLES**

<table>
<thead>
<tr>
<th>Source</th>
<th>Sum of Squares</th>
<th>d.f.</th>
<th>Variance estimate</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Color: A, C</td>
<td>7.59</td>
<td>1</td>
<td>7.59</td>
<td>3.28</td>
</tr>
<tr>
<td>Form: I, II</td>
<td>55.51</td>
<td>1</td>
<td>55.51</td>
<td>24.03**</td>
</tr>
<tr>
<td>Practice: 1, 2</td>
<td>23.01</td>
<td>1</td>
<td>23.01</td>
<td>9.96**</td>
</tr>
<tr>
<td>Groups: No., Nu.</td>
<td>787.76</td>
<td>1</td>
<td>787.76</td>
<td>21.07**</td>
</tr>
<tr>
<td>C x F</td>
<td>1.26</td>
<td>1</td>
<td>1.26</td>
<td>0.54</td>
</tr>
<tr>
<td>C x P</td>
<td>178.76</td>
<td>1</td>
<td>178.76</td>
<td>77.38**</td>
</tr>
<tr>
<td>C x G</td>
<td>31.51</td>
<td>1</td>
<td>31.51</td>
<td>13.64**</td>
</tr>
<tr>
<td>F x P</td>
<td>38.76</td>
<td>1</td>
<td>38.76</td>
<td>16.78**</td>
</tr>
<tr>
<td>F x G</td>
<td>3.01</td>
<td>1</td>
<td>3.01</td>
<td>1.30</td>
</tr>
<tr>
<td>P x G</td>
<td>0.26</td>
<td>1</td>
<td>0.26</td>
<td>0.11</td>
</tr>
<tr>
<td>C x F x P</td>
<td>2.34</td>
<td>1</td>
<td>2.34</td>
<td>1.01</td>
</tr>
<tr>
<td>C x F x G</td>
<td>14.26</td>
<td>1</td>
<td>14.26</td>
<td>6.17*</td>
</tr>
<tr>
<td>C x P x G</td>
<td>78.26</td>
<td>1</td>
<td>78.26</td>
<td>33.88**</td>
</tr>
<tr>
<td>F x P x G</td>
<td>12.76</td>
<td>1</td>
<td>12.76</td>
<td>5.25*</td>
</tr>
<tr>
<td>F x P x G x C</td>
<td>7.09</td>
<td>1</td>
<td>7.09</td>
<td>3.07</td>
</tr>
<tr>
<td>Intersubject</td>
<td>1495.33</td>
<td>40</td>
<td>37.38</td>
<td>16.18**</td>
</tr>
<tr>
<td>Error (residual)</td>
<td>92.50</td>
<td>40</td>
<td>2.31</td>
<td></td>
</tr>
</tbody>
</table>

Inter-class correlation, $r_c = \frac{1 - 2.31}{19.85} = .884a$

**a.** Kogen (17) showed that the average inter-trial correlation for variance analysis with more than one independent group and with repeated measurements within each group is given by the formula, $r_c = 1 - \frac{s_{PE}^2}{s_{TC}^2}$
The inter-class correlation of .88 is perhaps a better evaluation of overall reliability. Although based on a pooling of the three tests, this correlation between the two versions of the tests compares favorably with those reported by Gibby (11) between Form I and Form II. He found .87, .87, and .81 for Picture Completion, Block Design and Digit Symbol respectively.

Form I was easier than Form II and the second version of the tests showed improvement. Consequently when individual color scores were later used for correlation purposes, it was decided to adjust the original weighted scores to moderate the differences in these two factors. The average difference between Forms I and II and between first and second versions of each test was separately determined for the normals and neurotics and the two different test orders separately. Adjustments were made to individual scores on the basis of these differences. In this way there was a closer approximation of the effect of color alone in the individual's score and a more adequate color score was obtained.

A significant difference between groups in overall performance level was found. The normals had higher scores on the average than the neurotics. To determine to what extent intelligence might be a factor in color reactions, a covariance analysis was made between verbal intelligence, as measured by Information, Similarities and Vocabulary, and
color reactions as measured by the subjects color scores (C-A). This analysis was made using the color scores for the twelve normals and twelve neurotics who had the Picture Completion test first.

The between groups variance of the color scores remained significantly greater than the within groups variance of the color scores when the variance estimates had been adjusted for the correlational effect of intelligence. Thus there remained a significant difference between the normal and neurotic groups in color reaction when they were statistically equated for intelligence.

The significant difference between normals and neurotics in color scores was evidenced in the analysis of variance (C x G). In comparison with their respective performances on the achromatic versions of the tests, the normals got higher scores on the chromatic tests while the neurotics got lower scores on the average. There was also a significant difference between the normals and neurotics in reaction to color depending upon the sequence of administration of the achromatic and chromatic forms (C x F x G).

The other significant interaction effects noted in the Variance Table XIV involve the factors of practice and form. They have been commented upon as separate factors and are not pertinent to the main problem of the influence of color, except as noted for correlational purposes and the

3Of. post, Appendix, p. 142.
interaction of Color, Practice and Group factors. The latter is dealt with subsequently.

2. The second analysis of the data was made using the color scores (C-A) rather than the weighted scores. The color score represents the extent to which the chromatic weighted score was higher or lower than the achromatic weighted score. Variance Table XV shows the effects of color in the two groups, in the particular tests and in the two orders in which the tests were administered.

This analysis demonstrates that the greatest difference between normals and neurotics came on particular tests in a particular order of the three tests (GTO).

Figures 1 and 2 illustrate the meaning of this interaction of the three variables. It gives the average color scores for normals and neurotics on the three different tests for the two distinct orders in which the tests were given. The differences between the mean scores necessary for .05 and .01 levels of significance are listed. From these figures it appeared that it is the first test given in order, regardless of the nature of the task, in which color differentiates normals and neurotics. This was substantiated statistically by a variance analysis in which the first tests in the two orders were omitted, both Picture Completion when it came first and Block Design when they came first. Variance Table XVI demonstrated that there was a non-significant difference between the color scores of
### TABLE XV

ANALYSIS OF VARIANCE OF PERFORMANCE COLOR SCORES

<table>
<thead>
<tr>
<th>Source</th>
<th>Sum of Squares</th>
<th>d.f.</th>
<th>Variance estimate</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Groups: No., Nu.</td>
<td>14.06</td>
<td>1</td>
<td>14.06</td>
<td>5.72*</td>
</tr>
<tr>
<td>Tests: PC, BD, DS</td>
<td>4.18</td>
<td>2</td>
<td>2.09</td>
<td>0.85</td>
</tr>
<tr>
<td>Order: PC₁, BD₁</td>
<td>0.34</td>
<td>1</td>
<td>0.34</td>
<td>0.14</td>
</tr>
<tr>
<td>T x O</td>
<td>3.60</td>
<td>2</td>
<td>1.80</td>
<td>0.73</td>
</tr>
<tr>
<td>T x G</td>
<td>4.54</td>
<td>2</td>
<td>2.27</td>
<td>0.92</td>
</tr>
<tr>
<td>G x 0</td>
<td>0.01</td>
<td>1</td>
<td>0.01</td>
<td>0.00</td>
</tr>
<tr>
<td>G x T x 0</td>
<td>33.35</td>
<td>2</td>
<td>16.67</td>
<td>6.78**</td>
</tr>
<tr>
<td>Intersubject</td>
<td>108.25</td>
<td>44</td>
<td>2.46</td>
<td>1.00</td>
</tr>
<tr>
<td>Error (residual)</td>
<td>217.00</td>
<td>88</td>
<td>2.47</td>
<td></td>
</tr>
</tbody>
</table>

Inter-class correlation, \( r_c = 1 - \frac{2.47}{2.46} = .004 \)

### TABLE XVI

ANALYSIS OF VARIANCE OF PERFORMANCE COLOR SCORES
FIRST TESTS OMITTED

<table>
<thead>
<tr>
<th>Source</th>
<th>Sum of Squares</th>
<th>d.f.</th>
<th>Variance estimate</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Groups: No., Nu.</td>
<td>14.27</td>
<td>1</td>
<td>14.27</td>
<td>0.10</td>
</tr>
<tr>
<td>Order: BD₂, DS₂</td>
<td>1.76</td>
<td>1</td>
<td>1.76</td>
<td>0.01</td>
</tr>
<tr>
<td>G x 0</td>
<td>0.00</td>
<td>1</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Intersubject</td>
<td>4,575.22</td>
<td>46</td>
<td>99.46</td>
<td>0.51</td>
</tr>
<tr>
<td>Error (residual)</td>
<td>8,933.24</td>
<td>46</td>
<td>194.20</td>
<td></td>
</tr>
</tbody>
</table>
FIGURE 1
AVERAGE COLOR SCORES OF NORMALS AND NEUROTICS ON PERFORMANCE TESTS PC;

FIGURE 2
AVERAGE COLOR SCORES OF NORMALS AND NEUROTICS ON PERFORMANCE TESTS BD;

FIGURE 3
AVERAGE COLOR SCORES OF NORMALS AND NEUROTICS ON PERFORMANCE TESTS WITH TESTS COMBINED ACCORDING TO ORDER

Differences in means necessary for levels of significance.

<table>
<thead>
<tr>
<th>N</th>
<th>Groups</th>
<th>.05</th>
<th>.01</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>Correlated</td>
<td>1.00</td>
<td>1.41</td>
</tr>
<tr>
<td>12</td>
<td>Independent</td>
<td>0.94</td>
<td>1.28</td>
</tr>
<tr>
<td>24</td>
<td>Correlated</td>
<td>0.66</td>
<td>0.90</td>
</tr>
<tr>
<td>24</td>
<td>Independent</td>
<td>0.65</td>
<td>0.88</td>
</tr>
</tbody>
</table>
the normal and the neurotic subjects when the first tests were omitted.

Figure 3 combines the tests of Figures 1 and 2 according to their position in the order of administration. It clearly illustrates the fact that on the initial tests of the series of three there was a marked improvement in the performance of normals and a marked impairment in the performance of neurotics in the presence of color. On the subsequent tests color had little effect on the performances of either group. This diminishing of the influence of color will be called an adaptation effect in subsequent discussion.

The average improvements of the normals on the PC test and on the BD test and the average improvement on both combined was short of the .05 level of significance. The average impairment of neurotics however reached the .01 level except on the BD test where it was just short of the .05 level. The difference between the improved performances of normals and the impaired performances of neurotics when color was present in the first tests reached the .01 level with both the PC and the BD tests.

3. The third analysis of the data was made on the basis of the evidence in the first analysis that there were significant differences between color reactions of normals and neurotics depending upon whether the chromatic or achromatic version of each test was given first. Figure 4 gives
Figure 4
AVERAGE DEVIATION OF CHROMATIC SCORES FROM ACHROMATIC SCORES ON PERFORMANCE TESTS WHEN ACHROMATIC PRECEDED CHROMATIC TEST VERSION

Figure 5
AVERAGE DEVIATION OF CHROMATIC SCORES FROM ACHROMATIC SCORES ON PERFORMANCE TESTS WHEN CHROMATIC PRECEDED ACHROMATIC TEST VERSION
the average color scores (C-A) of those subjects who took the achromatic test version before the chromatic. Figure 5 gives the average color scores of the subjects who had the chromatic test versions preceding the achromatic. In each figure the achromatic averages have been converted to zero to provide a base line from which the C-A scores may be shown as positive or negative deviations. Each line represents six subjects since there were two independent test orders and two independent sequences for the twenty-four subjects in each group.

Table XVII indicates the differences, on the first tests only, between the average achromatic and chromatic scores for each subgroup and between the average color scores of normals and neurotics.

There were no significant differences between the average chromatic and average achromatic scores in any group on any tests except the first test in order. There were no significant differences between normal and neurotic groups on any tests except the first in order.

In the first tests the performance of the normals was significantly facilitated by color in the BD test and on the PC and BD tests combined but only when the achromatic version preceded the chromatic version of the tests ($A_1$ and $C_2$). In the first tests the performance of the neurotics was significantly impaired by color in the PC test and in the PC and BD test combined when achromatic preceded chromatic ($A_1$ and $C_2$).
TABLE XVII

AVERAGE COLOR SCORES (C-A) ACCORDING TO SEQUENCE
AND DIFFERENCES BETWEEN SEQUENCES FIRST, TESTS ONLY

<table>
<thead>
<tr>
<th>GROUPS</th>
<th>N</th>
<th>Average C-A</th>
<th>2 Seq's.</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>A1C2 C1A2</td>
<td>Diff. Bet.</td>
<td></td>
</tr>
<tr>
<td>NORMALS ON P. COMP.</td>
<td>6</td>
<td>1.17 0.17</td>
<td>1.00</td>
<td>1.56</td>
</tr>
<tr>
<td>NORMALS ON B. DESIGN</td>
<td>6</td>
<td>1.83 -0.67</td>
<td>2.50</td>
<td>3.90**</td>
</tr>
<tr>
<td>NORMALS ON P.C. ≠ B.D.</td>
<td>12</td>
<td>1.50 -0.25</td>
<td>1.75</td>
<td>3.87**</td>
</tr>
<tr>
<td>NEUROTICS ON P. COMP.</td>
<td>6</td>
<td>-2.33 -1.17</td>
<td>1.16</td>
<td>1.81</td>
</tr>
<tr>
<td>NEUROTICS ON B. DESIGN</td>
<td>6</td>
<td>-0.83 -0.83</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>NEUROTICS ON P.C. ≠ B.D.</td>
<td>12</td>
<td>-1.58 -1.00</td>
<td>0.58</td>
<td>1.29</td>
</tr>
<tr>
<td>NORMALS V. NEUROTICS ON P. COMP.</td>
<td>6</td>
<td>3.50 1.33</td>
<td>5.46**</td>
<td>4.81**</td>
</tr>
<tr>
<td>NORMALS V. NEUROTICS ON B. DESIGN</td>
<td>6</td>
<td>2.67 0.17</td>
<td>4.16**</td>
<td>3.30**</td>
</tr>
<tr>
<td>NORMALS V. NEUROTICS ON P.C. ≠ B.D.</td>
<td>12</td>
<td>3.08 0.75</td>
<td>6.81**</td>
<td>7.29**</td>
</tr>
</tbody>
</table>

Table to read: The six normals who had sequence A1C2 did an average of 1.17 weighted scores better on the chromatic version of Picture Completion test, compared with the achromatic version.

The difference between the average color scores of normals and neurotics on the Picture Completion test when the sequence was A1C2 was 3.50 weighted scores.
and only in the combined tests when chromatic preceded achromatic ($C_1$ and $A_2$).

The differences between the facilitation of the normals' performance and the impairment of the neurotics' performance with color was significant on both the first tests but only when the achromatic version preceded the chromatic. This means that the differences between normals and neurotics on the initial tests depended upon the order in which achromatic and chromatic test versions were seen but was independent of the type of task involved. For purposes of subsequent discussion this will be called sequence effect. The tendency for differences between normals and neurotics to diminish after the initial tests was called adaptation effect. Apparently adaptation effect is a function of diminishing sequence effect.

In comparing Figures 4 and 5 it is interesting to contrast, however, the greater variation in color scores within and between the normal and neurotic groups even on the second and third tests in sequence $A_1$ and $C_2$ than in $C_1$ and $A_2$.

These results may be summarized as follows:

(1) The performance of normal subjects was facilitated and that of neurotics impaired on intellectual performance tests with color compared to similar tests without color.

(2) The effect of color appeared to be independent of the type of task involved and differences in reaction
to color in these tests were significant over and above differences due to intelligence as measured by three verbal tests of the Wechsler-Bellevue scale.

(3) There were three different tests administered in two different orders. The differences between normals and neurotics were only significant on the initial test of the three in each order. This was called adaptation effect.

(4) The differences between normals and neurotics in reaction to color were significant only when the achromatic version of the first tests preceded the chromatic version. They were not significant when the chromatic version preceded the achromatic.

IV. DISCUSSION AND CONCLUSIONS

The hypothesis that color would interfere more with the intellectual performance of neurotics than of normals cannot be rejected. However there are several modifications of the original hypothesis suggested by the results. The hypothesis implied that the performances of normals might be impaired with color. Instead it was found that color facilitated the performance of normals while it impaired that of neurotics. Also the differences in reaction to color between the two groups were significant only when achromatic tasks preceded chromatic tasks. These differences diminished after the initial tasks.

The impairment of the performance of neurotics is
consistent with reactions to stress. Stress may be defined in terms of prearranged conditions of known difficulty, distraction or shock and reactions to these situations measured. On the other hand stress may be inferred to inhere in a situation to which there are measurable reactions of the type often accompanying known difficulty, distraction and shock. In these results stress is inferred.

As stated previously, the problem of this research was not primarily to determine why color might impose difficulty or stress but rather to ascertain whether or not it does impair mental control and, as measured, constitute a stress. The poorer performance of the neurotics suggests a stress reaction as customarily conceived. Impaired performances frequently result from the additional energy which must be diverted to dealing with added difficulty or distraction.

The improvement of normals with color appears somewhat unusual in terms of the most common conceptions of stress reactions and in terms of Rorschach theory about color. The Rorschach theory is that normals will have little difficulty integrating color stimulus into response processes and the assumption is implied that it does not constitute a stress for them, although it does for neurotics.

The results of this experiment suggest that color may have constituted a mild stress for both normals and neurotics and elicited reactions of the type which represent their respective
ways of handling mild stress generally.

The neurotic dissipates a great deal of energy in dealing with his internal tensions or in impulsive reactions so that there is not sufficient energy available for mastering the stimulations of common situations and ordinary stress. This is clearly the case of the neurotic subjects in this experiment since their lack of ability to bring constructive activity to bear on everyday problems necessitated hospitalization. The normal, freer from energy-taking inner conflict, can bring constructive activity to bear in situations of moderate stress and is often stimulated to better solutions that would be made without stress.

Woodworth (50) reviews many experiments which involved the performance of tasks with greater tension or distracting stimuli. The results of several suggested better performance accompanying tension and almost all showed that more energy is exerted on the tasks in order to overcome distraction and disturbing stimuli.4 Recently Dingman (8) measured recognition thresholds of normals and neurotics with and without distraction tasks or threat of mild shock. He found that normals increased their constructive activity in terms of sharper focus of attention and faster recognition times. He did not find this to be true for the neurotics however. He concluded that, "Neurotic conflict is one

of the significant determinants of the capacity to mobilize energy."

This principle seems to be inherent in the present color experiment results. The presence or absence of neurotic conflict appears to be reflected in reactions to color under these conditions. It is concluded that color is an adequate stimulus for the modification of intellectual functioning. The directions of these modifications in the normal and neurotic groups appears consistent with their respective ways of dealing with everyday situations of tension and stress.

Whatever stress color imposed in these tasks was probably mild, as evidenced in the adaptation effect. Its temporary nature is suggested by the fact that the deviations of both groups in their performance on the colored tasks were marked only on the first in the series of tests.

Steinberg and Wallin concluded that the Rorschach test seemed to constitute a stress for their subjects, color aside, and it is a common observation that people generally become more tense before a test situation. Since the results of this experiment showed that the significant differences between normals and neurotics came on the second version of the first test, A1C2, the effect of color must be presumed to have been over and above any initial test.

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5Paul Dingman (8), p. 57.
anxiety that may have been present. The chromatic test version showed impairment or improvement in comparison with the achromatic version which preceded it. As the subjects became used to the alternation of achromatic and chromatic materials (A C, A C, A C,) the effect of the color stimulus and the stress it imposed was seen to diminish.

The differences between the performances of normals and neurotics depended upon the sequence of test administration where the achromatic version of the initial task preceded the chromatic version. This sequence effect may be considered in terms of the general phenomena of set and expectancy to some extent. In the sequence A1C2 the subjects dealt with an achromatic version of the test first and then, immediately afterwards, color was introduced with a similar task. This involves a change and some discrepancy between what had previously been dealt with and the immediate situation. The discrepancy between the subject's expectations and the actual situation may have introduced a temporary, additional problem into the tasks which might have contributed to the stress-like reactions.

It seems clear, however, that the stress associated with the transition from non-color to color in the materials was not a function of the change per se. If any change were to constitute a stress under the given conditions, the transition from color to non-color should have elicited significant differences between the groups. This was not the case.
The performance of neurotics was significantly lower on the chromatic version of the tasks when it preceded the achromatic, additional evidence that color is the necessary stimulus for significant deviations of performance.

Accordingly, although the sequence in which color appears seems to be an important determinant of these results, the evidence suggests that it was not just the transition from one stimulus to another that constituted the stress. Transition to color was the necessary condition in this experiment. It is concluded that there are probably properties of the color stimulus per se different from the non-color stimulus which initiated the stress-like reactions that were evidenced.

This is an important point for the application of color theory to diagnostic tests. It is well known that many types of change, particularly the introduction of unexpected stimuli, are upsetting for the neurotic. The assumption of the color shock concept is that color is an adequate stimulus for eliciting this characteristic disturbance of neurotic behavior, represented by a loss of efficient functioning and temporary startle effect in the Rorschach test. It is concluded that the results of Experiment II offer independent experimental evidence in support of the assumption. The impairment of intellectual functioning of neurotics in the Rorschach test when stimulated by color and the apparent lack of it in normals does not seem to be a phenomenon peculiar
to that test alone.

**Summary.** 1. Impairment of intellectual functioning of neurotic subjects is not restricted to the Rorschach test situation as far as responsiveness to color is concerned.

2. Normals tend to be stimulated to a better performance by color in intellectual tasks while neurotics are impaired in their performance by color. The reaction to color stimulation of each of these groups appears to be consistent with their respective ways of dealing with everyday situations of tension and stress.

3. Whatever the stress associated with color may be attributed to, it appeared to be temporary and mild. It was independent of the particular type of task used and cannot be attributed to anxiety about the test situation as a whole.

4. While a transition from achromatic to chromatic materials appeared necessary for stress to be evidenced, transition from any one stimulus to another was not a sufficient condition generally. Since the transition to color was the sufficient condition for eliciting stress-like behavior in these groups, it is considered that there are properties of color itself under these conditions which accounted, on the stimulus side of the bipolar perceptual field, for the differences between the normals and neurotics.

5. The presence or absence of neurotic conflict
appeared to be the major factor, on the personality side of the bipolar perceptual process, accounting for the differences in the reactions of these groups to color stimulation.

6. Sufficient evidence has been offered to verify the proposition that color as a stimulus, independent of the Rorschach test, modifies intellectual functions. The properties of color-in stimulus-field which may explain stress-like behavior should be the subject of serious research study.
CHAPTER V

CORRELATION OF RORSCHACH AND PERFORMANCE TESTS
COLOR SCORES

The two previous experiments have dealt mainly with differences in the reactions of groups to color stimulus. In terms of group averages there appears to be strong evidence for the proposition that color modifies intellectual functioning. The problem of individual differences is the concern of the last part of this study.

Correlations were run between the Picture Completion test color scores and ten Rorschach color factors in an attempt to determine the nature and degree of relationships in the reactions of the neurotic subject to color in these two separate tests.

Only the sixteen neurotics who took the Picture Completion test first in order were used, although it had been originally planned to use all subjects and all tests. However, the first tests in order were found to be the only ones in which color made a significant difference. The neurotic subjects who took the Block Design test first in order were not included because their color scores ran considerably higher on the average than those on Picture Completion and the range of individual differences was slight.
It seemed probable that merging the two groups for correlation purposes would be pooling non-equivalent scores.

The Picture Completion score was the individual's score on the chromatic version of the test subtracted from the score on the achromatic version, the same C-A score used in Experiment II. The higher the color score the higher the performance on the chromatic test version compared with the achromatic test version.

The Rorschach scores were obtained by the formula $S(C-A) - E(C-A)$ for each individual. Subtracting the score on the Experimental series from the similarly derived score on the Standard series yielded a single score reflecting the amount of change in a particular factor in the presence of color. The higher the Rorschach color score the more of that factor appeared in the presence of color. Special scores are defined in Table XVIII.

Considering the small size of the sample, the coefficients shown in Table XVIII for five factors are so small that no relationship is suggested between the Rorschach color scores and the performance test color scores. These factors are, T 1/R, POP, Cont, REJ, and Form-color integration.

Increased responsiveness to the colored cards (#R), especially the multicolored cards (8-10%), may be associated with decreased efficiency on the performance test with color. As previously discussed, this may be a function of
TABLE XVIII
CORRELATION OF RORSCHACH AND PICTURE COMPLETION
COLOR SCORES

<table>
<thead>
<tr>
<th>Rorschach Factor</th>
<th>r</th>
<th>Method</th>
<th>r Required for .05 Level of Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>#R</td>
<td>-.20</td>
<td>Product Moment</td>
<td>.49</td>
</tr>
<tr>
<td>8-10%</td>
<td>-.34</td>
<td>&quot;</td>
<td>.49</td>
</tr>
<tr>
<td>T 1/R</td>
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<td>&quot;</td>
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</tr>
<tr>
<td>F/%</td>
<td>.21</td>
<td>&quot;</td>
<td>.49</td>
</tr>
<tr>
<td>REJ</td>
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<td>Biserial</td>
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</tr>
<tr>
<td>POP</td>
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<td>&quot;</td>
<td>.56</td>
</tr>
<tr>
<td>CONT</td>
<td>-.08</td>
<td>&quot;</td>
<td>.56</td>
</tr>
<tr>
<td>FC INTEGA</td>
<td>-.08</td>
<td>&quot;</td>
<td>.50</td>
</tr>
<tr>
<td>FC INTEGB VAR.</td>
<td>-.48</td>
<td>&quot;</td>
<td>.50</td>
</tr>
<tr>
<td>F/% Var.</td>
<td>-.36</td>
<td>Product Moment</td>
<td>.49</td>
</tr>
</tbody>
</table>

a. The form-color integration score was the sum of the weighted color scores (FC .5, CF 1.0, C 1.5) divided by the total number of responses involving the color determinant.

b. The form-color integration scores were used. Those in the upper and lower quartiles (I and IV) were pooled in one group, and those in the two middle quartiles (II and III) were pooled to dichotomize the total group for biserial computation of FC variability.

c. The F/% variability score was the regular color score, S(C-A) - E(C-A), with plus or minus signs disregarded.
this particular group of neurotic patients, but the sug-
gested relationship with an outside criteria is consistent
with the assumption that increased responsiveness to color
may represent an impairment in intellectual control.

Some relationship may also obtain between poorer
form perception (F/%) in response to color on the Rorschach
and impaired performance with color on the performance test.

On the basis of the inter-Rorschach correlations in
Experiment I it was proposed that deviation of a color
shock index in either direction, increase or decrease, when
chromatic cards are compared with achromatic, could be ex-
pected in a neurotic group. With an independent criteria
of intellectual performance with color available, it was
decided to test the assumption that deviations in either
direction might mean impairment of intellectual functioning.
Accordingly, the color shock index most representative of
intellectual control, F/%, was correlated with the inde-
pendent criteria by using a variability scale. This scale
had at one end the F/% scores which varied to either ex-
treme the most in reaction to color on the Rorschach test,
and at the other end the scores which changed little if any.

The form-level variability correlation with the per-
formance test color scores was -.36, short of the .05 level
of significance, but an increase over the regular form-level
correlation which was .21. The form-level variability corre-
lation suggests that marked increase or decrease of form-level
may both be associated with impairment of efficient performance when color is present.

The Form-color integration variability scores were correlated with the outside criteria for a purpose similar to that in relation to the form-level variability correlation. Many neurotics give form responses that are color dominated but some neurotics avoid color. The regular form-color integration scores, when correlated with the outside criteria, showed no relationship to impairment of intellectual functioning on an independent performance. The form-color variability correlation with the outside criteria was just short of the .05 level of significance. This strongly suggests that extreme avoidance of color or extreme use of color in the Rorschach test may both be associated with impairment of performance in the presence of color.

In summary, an attempt was made to ascertain what relationships exist between color reactions on the Rorschach test and color reactions on an intellectual performance test.

There appeared to be no relationship between the color shock indices, as traditionally thought of, with the possible exception of impaired form-level and greater responsiveness which may be associated with a less efficient performance on independent intellectual tasks with color.
Two factors which were considered to most reliably reflect the influence of color on the Rorschach test were selected, and the degree of variability in them correlated with the outside criteria. The results suggested that both extreme constriction, as measured by higher form level and avoidance of color, and extreme impulsivity, as measured by lowered form-level and extreme use of color, are associated with impaired intellectual performance on an independent task involving color.

It is concluded that, as reflected in the small sample of sixteen neurotic subjects, there is little evidence that the usual color shock indices represent generalized reactions to color. There is evidence, however, suggesting that wide deviation, either high or low, in form-level in response to color and in the degree of use of color in the Rorschach test indicate, and are associated with, impaired intellectual efficiency in the presence of color.
CHAPTER VI

SUMMARY AND CONCLUSION

The most general assumption of Rorschach color theory is that the nature of reactions to the stimulus of color is representative of the balance between intellectual and affective or emotionally expressive personality processes. The nature of this balance in turn is a major determinant of the adaptive capacity of the individual.

In scoring of the Rorschach color response both variables are represented, intellect in the extent to which perceptual interpretations of the blots utilize form, and affect in the extent to which interpretations utilize color. This form-color score has been validated in clinical research with different diagnostic groups, and in experimental work involving stress situations.

Color reactions do not seem to be specific to the Rorschach test. In experiments correlating color reactions on the Rorschach with color reactions in other situations and tests, it was found that people tend consistently to prefer and select either color or form. Those who are color dominant are apt to be less critical and more impulsive.

The concept of a color reaction continuum was used for a summary representation of that part of Rorschach
color theory which involves the form-color score. Extreme lack of control of affect is represented by the pure color response which is found in the disabled psychotic subject who has a liability for marked impulsive outbursts. Extreme control of affect by intellect is represented by the avoidance of color which is found in restrained, inhibited and depressed subjects whose critical, rational functions constrict adaptive expression. In the middle is discriminating control of affective expression, represented by the form dominated color response, which is characteristic of normals who have achieved a balanced integration. Marginal control is represented by tendencies to the extremes as found in neurotics, commensurate with their partial disability.

The theory which relates color to affect and assumes that the state of balance between intellectual and emotional processes in personality is represented in the scoring of form-color balance appeared adequately verified. The specific part of the theory which assumes that the balance of these processes is disturbed in neurotics at the time they perceive the color stimulus during the test administration is controversial, however. This is the concept of color shock which assumes that the color stimulus itself constitutes a stress. In dealing with it neurotic subjects presumably are upset as reflected by disturbances in the interpretive process. These disturbances are measured by specific
indices, usually apart from the scored color response.

The personality variables involved in the color shock assumption are the same as those in the scored color response. Since the shock is supposed to represent a temporary change in intellectual functioning due to the arousal of affect in the test situation itself, somewhat different experimental methods are required for verifying its existence, however. Because Rorschach color shock theory assumes that reactions to color change the balance of intellectual and emotional processes in personality, different reactions to color would be expected in different population samples. Thus the population sampled assumes much larger importance in experiments with the Rorschach test than with many other tests.

With few exceptions previous experimental work on the color shock concept has been done with samples of the normal population, yet in theory the phenomenon is assumed to be characteristic of neurotics. Thus the common conclusion of these investigators, that there is little evidence for the existence of the phenomena, and the conclusion of several that the concept is not valid, does not seem justified. The problem of testing the color shock concept with neurotics remained.

The attempt in this research was to so define the major dimensions of Rorschach color theory, within an adequate framework of personality theory, as to delineate clearly the
specific nature of color shock. This led to a proposition so stated that it could be tested not only in the Rorschach test but in independent experimental settings.

Personality was viewed as a concept which stands for the functioning organism as it structures, and is structured by, the environment. Much of Rorschach's thinking anticipated current theories of perception in personality so the representation of perceptual activity as a bipolar process in personality seemed appropriate and adequate for a general setting of the processes involved in the test. Responses to any stimulation could be thought of as emerging from the interaction of the preestablished inner structure of the perceiver's personality with the various aspects of the outer structure or environmental stimulus field.

In relation to the perceptual activity of individuals on the Rorschach test and color shock theory the following proposition seemed testable: color as a stimulus in visual perception may modify or impair intellectual functioning and mental control. In the functioning individual there is a total configuration of interactive forces and adaptive processes. It was assumed that intellectual and affective processes are so functionally related that a change in one would accompany a change in the other.

The term intellectual was used as referring to adaptive behavior commonly considered to include clarity of perception, analysis and organization of stimulation with associative
thought so that discriminative judgment integrates the requirements of a situation into an appropriate, adaptive response. The functioning of an individual at any given level of intelligence might be modified by the stress of color stimulation. According to Rorschach theory this could be seen in a number of indices reflecting either an increase in inhibitory control and blocking or in impulsive expression, characteristic of the neurotic. Neurotic disturbance in the presence of color is commonly measured by deviations of behavior on chromatic Rorschach cards in comparison with a base line of behavior on achromatic cards. Normals are presumed to show little change in behavior between the achromatic and chromatic cards.

In the two experiments of the present research the practice of comparing responses on achromatic materials with that on similar chromatic materials was maintained. In Experiment I color shock indices on the standard cards were compared with the same indices on an experimental set of cards in which color had been deleted by photographic reproduction of the chromatic cards. In an independent experiment (II) the same basic method was used. The performance of subjects on intellectual tasks from the Wechsler scales were compared for two equivalent test versions, one achromatic and one chromatic. This method yields a color score which measures the degree of deviation of responses to color from a base line of responses to similar materials without color.
The proposition that color stimulus may impair the intellectual functioning of neurotic subjects was confirmed in this research as measured by lowered form-level, the most important single index of intellectual control in the Rorschach test. It was confirmed also in the independent intellectual tasks where the performance of neurotics was impaired on chromatic test versions compared with achromatic versions of similar tests. The effect of color upon the response processes of neurotic subjects was not restricted to the Rorschach test.

Although the concept of color shock is not confirmed in all of its presumed manifestations, the proposition most fundamental to the concept is strongly supported in the present results as measured by the single index of form-level.

In the color experiment with intellectual tasks the performance of neurotic subjects was impaired and the performance of normal subjects was improved when stimulus color was present. The presence or absence of neurotic conflict seemed to be the major personality variable accounting for the differences in reactions of these two groups to color stimulation. Under the conditions of this experiment color appeared to constitute a stress. The behavior of each of these groups was consistent with their respective ways of dealing with everyday situations of tension and stress. The stress associated with color in the intellectual tasks was
temporary but it was not dependent on the type of task.

This study was not designed to ascertain why color might constitute a difficulty. Both experiments suggested, however, that when the achromatic materials were administered preceding the chromatic materials the influence of color was more marked than in the reverse administrative sequence. The discrepancy between the subject's expectations and set, based on previous experience with achromatic materials, and the immediate situation when chromatic materials were presented may have caused some stress. It is a common observation that many types of change, particularly the introduction of unexpected stimuli, may be upsetting and especially so for neurotics.

Even though the transition from non-color to color may be an important condition in which the effect of color is manifested, it was pointed out that the effects were probably not a function of change or transition per se. In these experiments change from color to non-color did not produce impairment on non-colored materials. In fact some impairment on colored materials was noted in each experiment with this sequence of presentation. It appeared to be the change to color or some properties of color-in-stimulus-material other than sequence per se that elicited stress-like reactions.

This is a problem for future investigation. The important point for diagnostic testing in relation to color
shock theory is that change involving the introduction of color, among other things, is an adequate stimulus condition for eliciting responses characteristic of the way subjects react to everyday situations of stress and change. It is this representativeness of reactions to color upon which Rorschach color theory rests and which is important for diagnostic work. The evidence of these experiments supports the general assumption that reactions to color are indicative of the state of balance between intellectual and affective processes in personality.

Color shock as formulated in the literature consists of blocking or constriction or impaired form perception. In the Rorschach experiment, in addition to lower form-quality (F%) which is consistent with the literature, color elicited more responses (#R) but fewer of the popular type and faster reaction times (T1/R). Color did not elicit more rejections. Thus the reactions of this particular sample of neurotics were inconsistent with the customary color shock assumptions in that there was no evidence of associative blocking and delay of responsiveness.

This may have been due to the small sample and its bias in the direction of the type of neurotic who attempts to master tension more by impulsive than by constrictive behavior. It was considered, however, that these effects might be fairly representative of neurotic reactions to color per se. This is possible because the experimental
measurement of color effect, while maintaining the clinical method of comparing responses to chromatic cards with responses to achromatic cards, cancelled out the differences between these cards due to form and configuration. In clinical practice comparison of these cards reflects the combined effects of differences in color, configuration, and form.

The effects of color stimulus in the Rorschach test which have been discussed above were experimentally determined to be over and above the differences between achromatic and chromatic cards due to the form, configuration and shading of the blots. Six out of ten indices tested did not appear influenced by color. With the exception of lower form-level, the greatest differences between the achromatic and chromatic cards were due to variables other than color. Cards 238910 differ significantly from cards 14567 in form, shading and particularly in greater dispersion of configurations, color aside. This finding is in accord with those of several other investigators.

In clinical work there is little opportunity to distinguish which differences may be due to form and configuration and which to color. Therefore clinicians should exercise caution in attributing all disturbances on chromatic cards to the color stimulus. As determined in this experiment, lowered form-level and decreased popular
responses are perhaps the most reliable indices of color disturbance in neurotics. Clinicians and students alike should consider the probability however that faster reaction times and greater productivity will be found among neurotic reactions to color.

With the possible exceptions of lower form-level and increased responsiveness, the usual Rorschach color shock indices were not associated with impaired intellectual functioning in the presence of color on the independent task. However, marked constriction, as measured by increased form-level and avoidance of color, on the one hand and marked impulsivity, as measured by impaired form-level and poor color integration, on the other hand were both associated with impaired intellectual performance in response to color in the independent criteria. In clinical practice it is assumed that marked deviation of the shock indices in either direction is indicative of pathology.

Little thought appeared to have been given to the relationships which might obtain between the various color shock indices and the personality variables they presumably measure. Clinical practice generally conforms to the statements in the literature that marked presence of one or two indices is indicative of shock. When correlations were made among seven color shock indices using experimentally derived color scores, a cluster of six correlations emerged. They suggested that impairment of intellectual control (F%),
faster reaction times (T 1/R), lack of blocking (RÆJ) and
greater productivity on the multi-colored cards were mod­
erately but rather consistently associated. It appears
that in response to color impulsivity, lack of discrim­
inating control, and expansive productivity, may be associ­
ated, as well as their opposites, blocking, excessive
control and constriction.

The cluster of relationships found among several of
the shock indices and the possibility that variation of
these indices in either direction may be indicative of per­
sonality disturbance in neurotics suggested a general dimen­
tion of neurotic color reactions. It would be similar to
the form-color continuum used to represent the color re­
sponse proper. The validity and adequacy of representing
neurotic color shock reaction on a continuum should be in­
vestigated. At one extreme would be the faster response,
lack of associative blocking and less accurate assessment
of the forms of the blots. At the other extreme would be
slower responses, blocking and accurate but constricted
form perception.

Should there be two general reactions types in re­
sponse to color in the neurotic population, an adequate
evaluation of the Rorschach test as an instrument for per­
sonality diagnosis is further complicated. For research
purposes general population samples of normals and
neurotics should be carefully selected as always but in
addition perhaps the types of neurotics should be carefully
chosen also. It is suggested that the selection of two groups of neurotics for a future Rorschach color study on the basis of personality characteristics markedly extreme with respect to impulsivity and constriction, as determined by independent criteria, might help clarify the concept of color shock.

On the basis of these results and within the limits of this experimental design, the following conclusions appear warranted:

1. Stimulus color interferes with the intellectual functioning and mental control of neurotic subjects as measured by lowered form-level on the Rorschach test. This effect is not limited to the Rorschach test but has been demonstrated in independent intellectual performance tasks.

2. With the exceptions of a decrease in form-level, in reaction times, in number of popular responses and possibly an increase in number of responses, stimulus color did not affect the response processes of this neurotic group. Six color shock indices appeared unaffected. The most extensive differences between achromatic and chromatic Rorschach cards are probably due to differences in variables other than color, form-level excepted.

3. On performance tests of the Wechsler-Bellevue intelligence scale, the performance of normal subjects improved with the use of color while the performance of neurotic subjects was impaired by color. The difference
between normals and neurotics was only significant when achromatic materials preceded chromatic materials in administrative sequence. In both the Rorschach and Wechsler experiments, however, there was evidence that there are probably some properties of color itself, aside from its role in sequence, that elicit stress-like reactions.

4. Evidence is offered to support the inference that, focusing on the stimulus end of organism-environment relationships, color constitutes a mild stress. Focusing on the personality end of the bipolar relationship, the presence or absence of neurotic conflict appears to be a major determinant of the nature of reactions to color. Color appears to be an adequate stimulus for eliciting behavior consistent with the ways in which normals and neurotics deal with environmental stress in everyday situations. Reactions to color appear to be characteristic of the balance between intellectual and affective processes.

5. There is little evidence supporting that aspect of traditional Rorschach color shock theory which assumes color shock is manifested in blocking and constriction. The tendency to impulsive reaction in this group may reflect a bias in the small sample of neurotic patients from a particular hospital or simply the pure effect of color distinguished from effects of form and other variables.

Various manifestations of disturbance due to color
are possibly evidenced in neurotics and several of these may be functionally related. In accordance with clinical practice, constriction and blocking may represent one extreme of neurotic reaction to color while impulsivity and uncritical responsiveness may represent another extreme. The possibility that these two extremes represent a continuum involving several color shock indices needs further experimental investigation.


14. Tables to be used in Scoring Responses to the Rorschach Ink-Blot Test. Western Reserve University, 1936. 160 pp.


APPENDIX
### TABLE OF MEAN WECHSLER WEIGHTED SCORES FOR FACTORS IN FIRST ANALYSIS OF VARIANCE

<table>
<thead>
<tr>
<th>FACTOR</th>
<th>MEAN</th>
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<tbody>
<tr>
<td>COLOR Achromatic</td>
<td>11.26</td>
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<tr>
<td>COLOR Chromatic</td>
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<tr>
<td>FORM Form I</td>
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<tr>
<td>FORM Form II</td>
<td>10.92</td>
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<td>PRACTICE 1st Version</td>
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<td>PRACTICE 2nd Version</td>
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<tr>
<td>GROUP Neurotics</td>
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</tr>
<tr>
<td>C x G Chromatic</td>
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</tr>
<tr>
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<tr>
<td>C x P x G Nu A2</td>
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ANALYSIS OF VARIANCE FOR COLOR SCORES (X) BY COVARIANCE ADJUSTMENT FOR INTELLIGENCE SCORES (Y)

<table>
<thead>
<tr>
<th></th>
<th>TOTAL</th>
<th>WITHIN</th>
<th>BETWEEN</th>
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</thead>
<tbody>
<tr>
<td>SUM OF SQUARES: Y</td>
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<td>1,588.00</td>
<td>216.00</td>
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<td>SUM OF SQUARES: X</td>
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</tr>
<tr>
<td>ADJUSTED SUM OF SQUARES: X</td>
<td>9,685.47</td>
<td>5,666.71</td>
<td>4,018.76</td>
</tr>
<tr>
<td>d.f.</td>
<td>10</td>
<td>9</td>
<td>1</td>
</tr>
<tr>
<td>CORRECTED VARIANCE ESTIMATE</td>
<td>----</td>
<td>629.63</td>
<td>4,018.76</td>
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\[
F = \frac{4,018.76}{629.63} = 6.38^* 
\]
Abstract of Dissertation

THE EFFECT OF COLOR IN THE RORSCHACH TEST
AND IN SELECTED INTELLECTUAL TASKS

by

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(A.B., Dartmouth College, 1940; A.M., Boston University, 1947)

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ABSTRACT

An important theoretical basis of the Rorschach test is the assumption that the subject's reactions to specific stimulus qualities of the ink blots, such as form and color, relate to specific personality variables. Our verified knowledge of the function of these various stimuli in perception has been limited. This may be due partly to the adequacy of validation studies which focus on overall interpretations of test results and partly to experimental difficulties in dealing with single variables out of their complex context.

The purpose of this study was to provide an experimental examination of the influence of color in the Rorschach test and in independent performance tasks.

Rorschach theory relates the subject's interpretation of color in the blots to affective components of personality and the interpretation of form to intellective components. It is assumed that the state of balance between intellectual and emotional processes in personality is represented in the form-color balance of the scored color response. This assumption appears to have been validated with different diagnostic groups and in experimental work involving laboratory stress situations. A liability for lack of emotional control is reflected in the pure color response where form
is disregarded, while excessive intellectual control of emotional expression is reflected in the avoidance of color and adherence to form.

Color shock is a specific part of Rorschach color theory which assumes that color constitutes a stress for neurotic subjects because it arouses emotions. Their relative difficulty in dealing with these emotions is presumably reflected in a less adequate interpretive performance on the chromatic cards than on the achromatic cards.

In diagnostic work, which conforms to theory, color shock is used to discriminate neurotics from normals on the one hand and from psychotics on the other hand. With few exceptions, however, previous experimental work on color shock has employed normal samples. Thus the common conclusion of the investigators that the existence of this specific influence of color is doubtful, and the conclusion of several that the concept is not valid, does not seem justified.

The problem of this research was to test the concept of color shock with a clearly neurotic sample and to determine whether response to color stimulus would differentiate the performance of normals and neurotics on tasks independent of the Rorschach test.

From an analysis of color shock theory the proposition was derived that color as a stimulus in visual perception may modify or impair intellectual functioning and mental control.
Consistent with current perceptual theory, for the purposes of this study, perceptual activity was represented as a bipolar process in personality. Response to stimulation was viewed as emerging from an interaction of the preestablished inner structure of the perceiver's personality with the various aspects of the outer stimulus field.

The term intellectual was used as referring to adaptive behavior. It was assumed that intellectual and affective processes are so functionally related and interdependent in the adapting individual that a change in the condition of one would accompany a change in the other.

According to Rorschach theory the disturbance of test functioning of neurotics due to color stimulation is seen in a number of indices which reflect blocking of associative thought, constriction of responsiveness, or a lack of discriminating perception. Ten of the common shock indices were used in this study. The usual Rorschach method of comparing behavior on chromatic materials with a base line of behavior on achromatic materials was maintained in both experiments which made up the research.

In Experiment I two Rorschach tests were individually administered to thirty-two hospitalized neurotic subjects. Within each test the scores for each index were obtained by subtracting scores on the achromatic cards from similar scores on the chromatic cards. These chromatic minus achromatic differences were computed separately for the standard
Rorschach series and for an experimental set of cards in which color had been deleted by photographic reproduction of the standard chromatic cards.

In Experiment II two forms of three Wechsler-Bellevue performance tests were administered to twenty-four normal subjects. Each subject received two versions of each test, one chromatic and one achromatic. This method permits the measurement of the degree of deviation of response to color from a base line of response to similar materials without color.

The results of Experiment I confirmed the proposition that color interferes with the intellectual functioning of neurotics on the Rorschach test. The most important single index of intellectual control, F%, was significantly lower when color was present in the blots. The proposition was also confirmed in the intellectual tasks where the performance of neurotics was impaired on chromatic versions of the tests compared with the achromatic. Thus a basic effect of color in the Rorschach test is not restricted to that test alone.

On the independent Wechsler tasks the performance of normal subjects improved with the use of color while that of neurotics was impaired. It was concluded that, focusing on the stimulus end of the organism-environment relationship, the color constituted a mild stress. Focusing on the personality end of the bipolar relationship, the presence or
absence of neurotic conflict appears to be a major determinant of the nature of reactions to color. Color, independent of its Rorschach setting, seems to be an adequate stimulus for eliciting behavior consistent with the general manner in which normals and neurotics respectively deal with environmental stress in everyday situations.

In both experiments results varied with the sequence in which chromatic and achromatic materials were administered. The most significant results were generally obtained when the achromatic material preceded the chromatic. However, in both experiments there was evidence that there are probably characteristics of the color stimulus aside from its role in sequence that elicit stress-like reactions.

In addition to lowered form-level, the influence of color on the Rorschach was to decrease reaction times and inhibit the perception of popular responses while increasing the number of responses of other types. Six of the ten shock indices appeared unaffected by the presence of color.

The two forms of the Wechsler performance tasks were well equated and showed the effects of color more simply and clearly than the Rorschach test where chromatic blots differ markedly in their forms and configurations from the achromatic blots, color aside. With the exception of the most extensive differences between chromatic and achromatic cards were found to be due to variables other than color, presumably differences in form and dispersion of
configurations.

The decrease of reaction times, increase of responsiveness and the lack of increased rejections with color was interpreted to mean that on the average this group of neurotics did not manifest the blocking and constriction, which is strongly emphasized in the literature, but were more impulsive and careless. It was pointed out that these results may have reflected either a bias in the small sample from a particular hospital or simply the effects of color per se as distinguished from the combined effects of form, configuration and color. In color shock, as clinically measured, these factors cannot easily be differentiated.

Correlations between the various color shock indices suggested that in the presence of color impairment of intellectual control \( F/\% \) was moderately but consistently associated with faster reaction times \( T_{1/R} \), a lack of blocking \( \text{REJECTIONS} \), and greater responsiveness to the multicolored cards \( 8-10\% \). Correlations between reactions to color on the Rorschach and reactions to color on the independent tasks showed little consistency or generality of individual differences in terms of the regular color shock indices. However, two correlations suggested that marked constriction, as measured by increased form-level and avoidance of using color, on the one hand and marked impulsivity, as measured by lowered form-level and poor form-color
integration, on the other were both associated with impaired intellectual performance when color was present in the independent tests.

On the basis of these correlations and the difference between the average group results and the usual concept of color shock, it was concluded that neurotic personality disturbance may be indicated by variation of the color shock indices in either direction, depending on the type of neurotic. To clarify the diverse effects of color stimulus it was suggested that in future research with the Rorschach two groups of neurotics be selected for study who are markedly extreme with respect to the two poles of impulsivity and constriction, as determined by independent clinical criteria.

The concept of color shock is difficult to deal with experimentally. It refers to one of a number of variables embedded in a complex stimulus field and implies the measurement of important personality variables which are modified during the test process. It seems clear that in the clinical comparison of chromatic and achromatic cards of the standard Rorschach, differences in form and configuration as well as in the color of the blots are reflected. The clinician is cautioned not to attribute disturbance on chromatic cards indiscriminately to color influence.

It appears quite certain, however, that color does have a disruptive effect upon the response processes of
neurotic subjects. This would be most obvious clinically in a marked drop in form-level and number of popular responses. The clinician is further advised to consider the probability that decrease in reaction times and increase of responses may be due to the influence of color.

Future experimental and theoretical attempts should be directed toward dealing with the tentative proposition that there may be a continuum of neurotic reactions to color (similar to that which is inherent in the scored color response) where at one extreme may be found critical inhibited, delaying reactions and at the other extreme may be found expansive, careless, hasty reactions.
AUTobiography

Richard H. York, the son of Marion Swasey York and the late George M. York, was born in Somerville, Massachusetts, June 12, 1918. He was graduated from Somerville High School in 1936. He majored in Sociology at Dartmouth College and received his Bachelor of Arts degree in 1940.

After two years employment in the sales department of the Lever Brothers Company, he served four years in the United States Navy as a line officer.

In 1947 he received the Master of Arts degree in Psychology from Boston University and continued graduate work there in Clinical Psychology.

He trained at Boston Psychopathic Hospital and at Massachusetts General Hospital. Through Boston University he entered the Veterans Administration training program for Clinical Psychology and is at Cushing Veterans Hospital.

He married Dolores Ann Zintz of East Aurora, New York. They have a son, Richard H. York, Jr. and reside in Natick, Massachusetts.