1955

Color and form variables in relation to the Rorschach Test.

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Thesis Submitted in partial
fulfillment of the requirements
for the M.S. degree in
Psychology
University of Massachusetts, Amherst

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November 1955

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Historical Background

In the scoring and interpretation of the Rorschach, consideration is given the degree to which the subject responds to the form (i.e. outline appearances) and to the color in the blots. If the subject uses only form to determine his response, the response is scored "F" (e.g. "a bat because of the outline"). If the form is used primarily to determine the response, but color also enters, the response is scored "FC" (e.g. "a red flower mainly because of the color"). If color is the only determinant, the response is scored "C" (e.g. "a lake because it is blue"). The interpretative meaning of the relationship of color and form has been investigated by Beck (3,4) Klopfer et al, (17), and Rorschach (24) by comparing Rorschach protocols with the case histories of patients. They maintain that if a person is unable to control his emotional responsiveness, it will be revealed by such signs as pure color responses, color naming, (i.e. "red", "blue") color shock, (measured mainly by delay in reaction time) and differential productivity on the color and non-color cards. Fortier (11) accepts the above hypothesized relationship between color and emotional responsiveness as an established fact and attempts to account for it by postulating a relationship between color and ego functioning. He reviews two viewpoints, namely that of Schachtel (11), and Rickers-Ovsiankina (11), who believe in common with Fortier that the relationship between

color and emotionality is based on a more basic relationship of color and ego functioning. The first view postulated by Schachtel (11) maintains that the experience of color and the experience of affect have two important characteristics in common: (a) "passivity" of the subject, and (b) immediacy of the relation between object and subject. According to Schachtel, it is the ego that controls and directs the affective reactions. An individual of high ego strength would inhibit or delay his immediate reaction and thus would give "F" or "FC" responses on the Rorschach whereas an individual of low ego strength would not inhibit his immediate reaction and thus by responding to the most salient features of the blot, he would give pure "C" responses on the Rorschach. Therefore the degree of "passivity" exhibited by the individual would be a function of his amount of ego strength and the "immediacy of the relation between object and subject" would be exhibited by the amount of inhibition displayed by the individual in an "emotionally" toned situation. It should be remembered here however that this theory depends on the ability to measure ego functioning and as yet there is no valid measure of ego strength. The second view, postulated by Rickers-Ovsiankina (11), is a deductive theory inferred from genetic changes. She had observed that children from 3 to 4 years of age are interested in color and disregard form, and that children from 4 years of age and up are capable of integrating color and form. She then concluded that the younger children, having lower ego strength, respond to the immediate

or salient features such as colors, thus producing "pure" color responses on the Rorschach, whereas upon ageing, there is an increase in ego functioning which results in a decrease in color dominant responses on the Rorschach. She further contends that the degree of ego strength is not only related to individual capacity but also the individual's opportunity to learn. Therefore those individuals who exhibit little or no reaction to color: (a) have an inherently limited capacity for affective experience, (b) have repressed affective experience or, (c) may never have learned to express affective life on a conscious level.

The hypothesis that there is a relationship between color and emotionality poses two questions: (1) is there such a relationship existing and (2) if there is, what is the basis for the relationship? Fortier, Rickers-Ovsiankina and Schachtel (11) assume a positive answer to the first question and attempt to answer the second question by postulating that the relationship between color and emotionality is due to a more basic relationship between color and ego functioning. This however only poses another hypothesis to be confirmed, namely, the relationship between color and ego functioning. Keehn (16) in evaluating Fortier's article (11) in accord with experimental evidence (15, 19, 25) concluded that the majority of evidence cited by Fortier is irrelevant. He based this view on his own beliefs that the use of the results of Rorschach studies either to support or to refute the color-emotionality hypothesis has been invalidated by vague terminology, unjustified

comparisons due to different methods, and erroneous statistical methods.

In an effort to answer the question, "is there a relationship between color and emotionality?" several empirical studies have been performed. Sarason and Potter (26) upon giving the same group of children a Kohs and Binet test classified the children into two groups on the basis of the M.A. (mental age) received on both tests. The first group consisted of children who received a higher M.A. on the Kohs as compared to the Binet; the second group consisted of those children who received a higher M.A. on the Binet as compared to the Kohs. The Rorschach test was then administered and it was found that the children whose M.A. on the Kohs was below that of their M.A. on the Binet were unable to handle the color responses on the Rorschach intellectually or constructively. Further investigation revealed that these same children although they passed difficult items on the Kohs failed to pass the easy items. The authors arrived at two alternative explanations: (a) color brings up emotional reactions that interfere with intellectual functioning, and (b) color makes visual grasp of figure and ground relationships difficult thereby resulting in emotional reactions which make for inefficient intellectual functioning. It should be noted however that in drawing their conclusion, the authors <u>assumed</u> that it was the color in the Kohs blocks that made it more difficult than the Binet for some children. However, the difficulty may be attributed to some other features of the block,

i.e. the type of task-non verbal, requiring integrative ability. The only fair test of their hypothesis would be to compare Kohs blocks in color to Kohs blocks in black and white (instead of to Binet) as related to Rorschach color responses.

Kaslm (15), in administering a battery of nine color-form tests to psychotics, neurotics and normals found that schizophrenics reacted significantly more to color than did neurotics or normals. Normals and neurotics did not differ from each other in their reactions to color and manic-depressives reacted more to color only on the tachistoscopic presentation than did the other two groups. The author concluded that schizophrenics tend to react more to color than normals or neurotics. However, the author felt that the study did not justify any conclusions as to psychotics' reactions to color.

Eysenck (10) in relating emotionality to certain personality types, hypothesized that cyclothymes and pyknics would show a distinct tendency toward color reactivity whereas schizothymes and leptosomatics would lean toward form reactivity. Schell (16) in investigating this hypothesis, employed a tachistoscopic presentation of figures which Ss could respond to in terms of either color or form. His results uphold Eysenck's hypothesis; cyclothymes manifested a distinct tendency toward color reactivity whereas schizothymes responded primarily to form.

Clark (7) found that maladjustment on the M.M.P.I. correlated with higher sum color scores on the Rorschach and

concluded that a greater number of "CF" responses is linked with emotional responsiveness resulting in impulsive behavior and a lack of social consciousness.

Wishner (32) investigated the relationship of physiological and Rorschach measures in a group of normals and neurotics. The results revealed a different pattern between the neurotic group and the normal group but not at a significant level for the overall pattern. However the sum of weighted color responses on the Rorschach correlated significantly with the galvanic skin response and frontal muscle action potential, thus implying a relationship between emotionality and degree of color response.

In summary, the major conclusions (not all sould) relevant to emotionality and color responses on the Rorschach indicated by the above studies are that: (a) color elicits emotional reactions that interfere with intellectual functioning (questionable), (b) schizophrenics give more responses to color than do controls, (c) cyclothymes give more color dominant responses than do schizothymes (d) the relationship between a physiological and Rorschach measure differs between the neurotic group and the normal group and finally, (e) maladjustment on the M.M.P.I. is positively correlated with an increase of color dominant responses on the Rorschach. These conclusions are consistant with the theoretical view of Beck (4), Klopfer, et al. (17), and Rorschach (24) that color is related to emotionality. However, they indicate nothing about the nature of such a relationship.

To understand something about the meaning of color as related to behavior outside of the Rorschach, it would seem helpful to first investigate the influence of color within the Rorschach. In this connection, Siipola (27) found no difference in the reaction times to "emotional" responses (i.e. responses such as "blood", "fight", or "snake") as compared to non-emotional responses. She also found the same responses that were presumed to have been due to color in a chromatic version of the blots occured in an achromatic version of the blots. This led her to conclude that the effect of color in the Rorschach is probably due to the interaction of various color and form variables would be fruitful. Furthermore she found (28) that where color and form were incongruous (e.g. red tiger, blue bear) a longer reaction time resulted than where color and form were congruous (e.g. black bear). In a later study, Siipola (29) found that where the form is highly structured, the incongruent hue does not interfere, and the form exerts primary influence. Refining her theory, she hypothesized that where the form is unstructured and the hue incongruous with the form, the S will be in conflict thus effecting what she terms "color shock" (i.e. longer reaction time for chromatic cards). Siipola believes that when color is added to a form, the conceptual task becomes more difficult for the S. Under pressure conditions (responding within a limited time), she found that S's resorted to pure "C" responses where the form was unstructured or "vague",

whereas under free conditions (when the response can be delayed), the S's attempted to integrate form and color and gave pure "C" responses less frequently (29). Siipola concludes that the hue-form incongruity hypothesis is applicable only when operating under free conditions on the Rorschach.

Lazurus (18) investigating the influence of the color variable in the Rorschach used a standard set and an achromatic reproduction. In presenting both these sets to the same college population, Lazurus found that: (a) space responses (i.e. responding to the white parts in the blot) and F minus responses decreased nonsignificantly in the achromatic set, (b) color did not significantly affect the number of responses in any individual Rorschach scoring categories or the occurrence of "color shock", (c) the shapes of the chromatic slides in the standard set when reproduced in the achromatic set were more difficult to interpret than the shapes of the achromatic cards in the standard set. Lazurus concluded that structural features of the blots constitute the only determinant of "goodness" of responses. Lazurus interpreted his findings of no difference between the achromatic and chromatic cards in relation to "color shock" as an indication that hue-form incongruity is not a factor in the conceptual conflict which Siipola postulates.

Siipola has criticized Lazurus for failing to use the same procedure or method of analysis that she did. In response, Lazurus reanalyzed his data according to Siipola's standards. The results supported his previous findings. In addition, using

the usual details from the Rorschach blots in the same manner as did Stipola, Lazurus (19) made comparisons between congruous versus incongruous blots, chromatic versus achromatic blots and achromatic versus incongruous blots. Lazurus concluded that color plays a very minor role in determining reactions to ink-blots; the extent of the role varying directly as a function of the degree of structuredness (measured by the number of definite conceptual responses made to that blot) of the blots. He maintained that structural and other types of factors as well as personality variables should be investigated when experimentation is done with reactions to inkblots.

Sappenfield and Buker (25) performed an experiment employing the last three cards (the major color cards) on the Rorschach and their achromatic versions, in a manner similar to the study by Lazurus. They concluded, as did Lazurus, that color does not affect either individual scores or the occurrence of "color shock". They did not, however, find a decrease in F minus responses in the achromatic version nor any indication that the shape of the chromatic cards is more difficult to interpret than the shape of the achromatic cards on the Rorschach.

Berg and Polyot (5), in testing Stipola's hypotheses, concluded that degree of ambiguity, (measured by the amount of agreement in response) congruity, and presence of color were not significant factors in effecting a longer reaction time for response. They also contend that form factors are far more

significant in determining what is seen in a configuration than hue. Their results, however, are based on configurations taken from Mooney's "closure" test and not from the Rorschach blots, and therefore the validity of their conclusion in regard to the Rorschach is questionable.

In summary, the major conclusion from the above investigations in regard to the color and form variables are that:

(a) under non-pressure conditions where color and form are incongruous and the form is of a relatively unstructured nature, a longer reaction time will be elicited for the response.

(b) where the S is forced to respond under pressure conditions color will play an influential role in determining the response, (i.e. more indefinite color responses will be elicited).

(c) the appearance of color in a form tends to make the conceptual task in general a more difficult one as exhibited by a longer reaction time and increased productivity to the chromatic cards with a dominance of "C" or "CF" responses.

Contradictory to the above findings that color influences responses:

(d) color plays a very minor role in determining the response.

(e) hue-form incongruity is not a factor in the conceptual conflict.

(f) productivity to the last three cards in the Rorschach is not a function of color.

The above controversial evidence is indicative of uncertainty relating to characteristics of the color and form variables. Therefore it would seem that further investigation of the characteristics of the color and form variables would be a primary step, precluding any hypothesized color-emotionality, or color-ego-functioning relationship.

Statement of the Problem

It appears from the above findings that the difficulty in giving a response to an inkblot may be due to the degree of structuredness of the form of the inkblot. The degree of structuredness may be measured by the number of definite conceptual responses to the form. Thus those forms for which there is a high amount of agreement in definite conceptual responses may be found and considered to have a high degree of structuredness. In a similar manner, forms of medium structure and indefinite structure may be determined. However, the difficulty in developing a response to an inkblot may also be due to the interaction of color and form, color playing an influential role when form is relatively unstructured or when color and form are incongruous. An increase in reaction time would be expected in both circumstances.

Briefly, the present study involves an investigation of the following questions in regard to color and form:

(1) Is there a relationship between type of form (high, medium or indefinite degree of structure) and time it takes to give an adequate response (F plus, in

accord with Beck's scoring system) to the form?

(2) Are certain types of form (namely those of indefinite structure) influenced more by color than other types of form (i.e. highly structured forms)?

(3) Is reaction time to a colored form in which color and form are incongruous (e.g. red bear) longer than to a colored form in which color and form are congruous (e.g. grey bear) and is this related to the degree of structure of the form?

Predictions:

(1) Accurate responses will be given in less time to a highly structured form than to a form of indefinite structure.

(2) The presence of color will result in an increase in the time to give the first F plus response when the form is of an indefinite structure but will not influence those forms of definite structure.

(3) Where color and form are congruous, the reaction time for the first F plus will be less than when color and form are incongruous.

Other aspects of the color and form relationship, such as whether some colors have longer reaction times than others, are to be empirically investigated.

Experimental Method

Subjects

70 students from the course in introductory psychology at the University of Massachusetts served as Ss and were randomly assigned to one of 7 experimental conditions. Ten Ss, five males and five females, were assigned to each condition. Those students who knew they did not have normal color vision were asked to eliminate themselves.

Stimulus Materials and Apparatus

The forms employed were usual details from the Rorschach blots. The Rorschach cards were projected at varying distances onto a white paper in such a way that all the forms employed were individually traced on a white rectangle measuring 3 1/4 by 2 1/2 inches. In this way all forms were made of approximately equal area. After being traced, the forms were cut out and painted the appropriate color. The painted cutouts were then placed on white cards of the same size as those of the Rorschach and photographed. The slides were projected on a 5 x 7 ft. screen by means of a Keystone overhead projector with a Kapex shutter attachment calibrated from 1/400th's of a second to 1/10th of a second. The shutter when operated manually allowed for longer exposure times.

The forms were selected in three categories, (1) high degree of structure (2) medium degree of structure and (3) indefinite degree of structure or unstructured. The primary divisions based on Beck's scoring system and tables (3) were tentative until

the data from the present study could either support or refute them. Three popular forms were selected for the first category: card VIII;-D1, card X; D1, card VII; D9. The medium structured forms employed were those for which there was only a medium number of definite conceptual responses to the form on the Rorschach; the forms employed in this category were-D1, card IX, and D3, card III, (cf. figure 1).

The seven colors employed (red, green, orange, pink, blue, gray and black) were mixed in such a way that they approximated those colors that appear in the Rorschach cards. Therefore form A in pink, form B in green, form C in red, form D in orange, and form F in gray were cuplicates of those stimuli which appear in the Rorschach test. Each form appeared with each color thus allowing comparisons of: (a) all forms holding color constant, (b) all colors holding form constant, and (c) the interaction of colors and forms. A Graeco-latin square design was used in order to control for position effects (i.e. the same hue-form combination tending to fall consistently at the beginning or end of each presentation). Each of the 7 stimuli appeared only once in each of the 7 possible positions. In this way there were 7 sequential arrangements or experimental conditions (c.f. Table 1). Each S served as his own control. The seating was so arranged that the angle of vision ($22\frac{1}{2}^{o}$ on each side, perpendicular to center of screen) minimized the amount of perceptual distortion.

FIGURE


"A"
highly STRUCTURED
"B"
medium STRUCTURE
"C"
Medium STRUCTURE
"E"
INDEFINITE STRUCTURE
"F"
INDEFINITE STRUCTURE
"D"
highly STRUCTURED
"G"
HIGHLY STRUCTURED

Procedure

The testing was conducted in an experimental room where the seating had been prearranged so that there would be minimal perceptual distortion (cf. Materials and Apparatus). After the Ss had been seated and had read the instructions (cf. Appendix), all questions were answered and the overhead lights were turned off. The only remaining light, afforded by the projector, served to enable the Ss to record their responses. The lights were turned on after the completion of all seven trials. In order that all questions during experimentation might be answered with minimal interruption, an assistant to E remained in the experimental room to answer any questions that might arise.

The stimuli were presented tachistoscopically at a threshold above perception (first exposure was 1/2 second) and the length of the stimulus presentation increased on each succeeding trial. The Graeco-Latin square design was used in such a way as to allow presentation of all 7 stimuli at the same time interval. Thus on trial 1, seven different stimuli were presented each for 1/2 second. Trials 2, 3, 4, 5, 6, and 7 consisted of 1, 2, 4, 8, 16, and 32 seconds presentations respectively. The procedure can further be understood by referring to the instructions (cf. appendix, 12).

Table 1

Experimental Design

Group 1	G7	C3	D4	B2	E5	F6	A1
Group 2	D5	E6	G1	F7	C4	A2	B3
Group 3	F3	A5	E2	D1	B6	G4	C7
Group 4	B4	G2	A3	C5	F1	E7	D6
Group 5	C2	B1	F5	G6	A7	D3	E4
Group 6	E1	D7	C6	A4	G3	B5	F2
Group 7	A6	F4	B7	E3	D2	C1	G5

	1	2	3	4	5	6	7
colors	red	green	orange	pink	blue	black	light gray
Forms cf Fig. I	A	B	C	D	E	F	G

Scoring

The S's responses were scored F plus or F minus according to Beck's scoring method and norms (3). A response was scored as "indefinite" where the object described had no specific shape or where color appeared to be the only determinant of the response, (e.g. responses such as "blood" when the stimulus was red, "lake" when the stimulus was blue and "coal" when the stimulus was black). Those responses which were not listed in Beck were given to five graduate students of psychology who served as judges and independently scored each response either as an F plus or an F minus. The majority score was then given to the response. The major score recorded was the number of the trial in which the S gave an F plus response (i.e. if the S gave the first F plus response in trial 3, his score was 3 for that particular stimulus). Any S who consistently responded with an F minus score or who gave no response at all during the 7 trials received a recorded score of 8 on the assumption that if another sufficiently long trial had been allotted the S would have been able to eventually give an F plus response. The responses were also scored for "movement" and "content" (i.e. animal and human) on the basis of Beck's scoring system (3).

Results

Form

Table 2 summarizes the means and standard deviations of the time as measured by the number of the trial in which the S gave the first F plus. Analysis of variance (Lindquist type II design, (20) was used to test the hypothesis of no difference among these means. Because of marked heterogeneity of variance, a square-root transformation of the score plus .5 was undertaken. The F of 103.71 in table 3 indicates that form is a highly significant variable influencing reaction time, but that color (F = 4.5) is significant only in so far as it interacts with form (F = 4.07). That is, although color is significant as compared to the error term, it is not significant in relationship to the significant interaction.

Forms were grouped into categories of "structuredness" on the basis of the number of definite conceptual responses given to the form (cf. procedure). To determine the definiteness of the form, a count was made of the number of indefinite responses given each form on the S's first trial. The forms receiving the highest number of indefinite responses were considered forms of indefinite structure. It was found, (cf. table 4) that forms "L" and "F" were of relatively indefinite structure, forms "B" and "C" of medium definiteness in structure and forms "A", "D", and "G" of relatively definite structure. An analysis

Table 2

means and Standard Deviations of Reaction time based on the number of the trial in which the S gave the first F plus response to a particular stimulus blot.

Forms	Red		Green		Orange		Pink		Blue		Black		Gray		Mean	Mean S.D
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD		
A.	1.58	.28	2.00	1.11	1.20	.18	1.40	.49	1.40	.49	1.80	.84	1.50	.28	1.54	.52
B.	5.10	6.10	5.80	6.40	4.70	5.57	3.20	3.06	5.10	8.10	3.90	5.88	4.80	5.73	4.66	5.83
C.	4.20	3.73	3.60	1.38	5.60	7.37	4.80	6.84	3.60	5.60	3.70	5.34	5.90	4.32	4.48	4.94
D.	2.80	5.29	2.50	4.72	2.60	.93	1.80	1.73	2.80	4.18	2.00	.89	2.30	2.46	2.40	2.88
E.	6.20	3.96	5.90	4.32	6.20	3.28	5.90	3.43	4.60	7.16	4.70	4.90	4.50	5.38	5.43	4.63
F.	6.70	1.79	5.30	4.68	6.90	3.66	5.60	4.71	5.20	2.40	4.70	4.90	5.80	6.18	5.74	4.04
G.	1.80	1.96	1.40	1.60	2.70	7.34	1.40	.49	1.10	.10	1.10	.10	1.90	1.43	1.63	1.86
Mean	4.04	3.30	3.78	3.45	4.27	4.04	3.44	2.96	3.40	4.00	3.13	3.26	3.81	3.68		

*
Note-Entries are in terms of raw scores.

Table 3

Analysis of Variance of reaction time to first F plus.

(Transformed data)

Source	df	SS	ms	F
between S's	69	16.27	.24	
color-form(B)	6	1.43	.24	
error(B)	63	12.43	.20	
within S's	420	160.40	.38	
color	6	3.79	.63	4.5*
form	6	87.15	14.52	103.71*
color-form(w)	30	17.19	.57	4.07*
error(w)	378	52.26	.14	
total	489	176.67		

*Significant at .001 level

of variance was done to test the hypothesis of no difference among the means of those forms of "definite" structure as compared to "medium definite" or "indefinite" structure. As there were 7 forms in all and it was desirous to have the groups balanced (i.e. only two forms in a group) form "D", the most indefinite of the "definite" group was omitted. The F of 233.05 in table 5, significant at the .0001 level, is indicative of a relationship between the degree of structure of form and the time to respond accurately to that form. It was found that the more definite the form, the shorter the reaction time as measured by trial to the first F plus response. The significance ($F = 233.05$) is due mainly to the "definite" structured forms (i.e. form "A", mean = 1.54, and form "G", mean = 1.63) in contrast to both the "medium definite" (i.e. form "B", mean = 4.66, and form "C", mean = 4.48) and "indefinite" forms (form "E", mean = 5.43 and form "F", mean = 5.74) (cf. table 2).

Table 4

Number of Indefinite responses based on S's first association.

forms	RED	GREEN	ORANGE	PINK	BLUE	BLACK	GRAY	SUM
A.	0	0	0	0	0	0	0	0
B.	3	2	2	1	1	3	5	17
C.	4	4	3	2	4	2	1	20
D.	1	2	2	1	2	1	1	10
E.	7	3	7	5	7	4	6	39
F.	7	4	7	8	7	7	8	48
G.	1	1	4	1	0	0	2	9
Sum	23	16	25	18	21	17	23	

Table 5

Analysis of variance-relationship of reaction time and degree of structure of form.

Source	df	SS	ms	F
colors	6	3.75	.63	3.70
structuredness	2	79.25	39.62	233.05**
forms w/l structure	3	.22	.07	--
color x struc.	12	1.94	.16	--
color x form	18	4.65	.26	1.53
residual error	378	65.95	.17	
total	419	155.77		

*Significant at the .001 level

**Significant at the .0001 level

Color

The possibility that color tends to reduce the number of definite conceptual responses was investigated and it was found that although the colors red and orange tend to allow for more indefinite responses than do the other colors (cf. table 4) they do not differ significantly from the other colors. To investigate the possibility that some colors are more "salient" than others, a count was made of the number of individuals who arbitrarily named the color as part of their response (e.g. red bear) and those who used color as a determinant of the response (e.g. "blood" when the stimulus is red and "lake" when the stimulus is blue) at one time during the presentation of the stimuli (table 6). Chi squares were used to determine significant differences between colors. Here it was found that the color red was mentioned more than the other colors (differing significantly from blue and gray at the .02 level), and was also used as a determinant more than other colors (differing significantly from black at the .01 level). These findings suggest that red is a salient color which is more apt to be used as a determining factor in the response. Orange does not show this saliency, suggesting that other factors are operating. Furthermore, no significant difference was found in the number of responses using color in general, as a determinant in the first association (total of responses using color = 23) as compared to trial 7 (total of

Table 6

Number of individuals who named color with their response at one time during the presentation of trials 1 thru 7.

forms	red	green	orange	pink	blue	black	gray	sum
A.	2	3	1	0	1	1	2	10
B.	6	0	2	1	0	0	1	10
C.	1	5	0	2	0	0	0	8
D.	0	0	2	1	1	0	0	4
E.	0	0	3	5	1	3	0	12
F.	1	0	0	1	3	0	2	7
G.	5	1	1	1	0	3	0	11
Sum	15	9	9	11	5	7	5	

Number of individuals who used color as determinant of their response at one time during presentation of trials 1 thru 7.

forms	red	green	orange	pink	blue	black	gray	sum
A.	2	0	0	0	0	1	0	3
B.	4	1	2	2	0	0	0	9
C.	4	5	2	3	2	0	2	18
D.	0	3	4	4	1	1	3	16
E.	3	1	2	2	6	2	4	20
F.	3	0	1	1	3	2	1	11
G.	6	4	5	4	2	1	5	27
Sum	22	14	16	16	14	8	15	

responses using color = 19), thus indicating that "time to delay" does not influence the appearance of color as a determinant of the response. On "a priori" basis, it was believed that black differed significantly from gray due to the effect of contrast of the color relative to the background and that this effect might also explain why orange differed significantly from the other colors. To investigate the effect of contrast, 5 judges ranked the projected images (7 different colors appearing in the same form). The directions given to the judges were as follows:

> "7 images will be projected on the screen. You are to rank the colors according to their degree of contrast with the background. Write an "H" after the colors that have a high degree of contrast, an "M" after those of medium degree of contrast and an "L" after those of low degree of contrast. After you have done this, the images will be projected for a second time. However, this time you are to differentiate between the colors falling in the same "contrast" group by assigning a number from 1 to 7 for each color, number 7 being for the color with the lowest degree of contrast and number 1 for the color with the highest degree of contrast (e.g. if three colors are assigned an "H" value on the first showing, the number assigned them, 1, 2, or 3 on the second showing will

thus differentiate among them determining the "highest" among the "high" and so forth)."

The mean ranking of the colors were found to be: red 2.0, blue 2.2, black 2.4, green 3.6, pink 4.8, orange 6.4 and gray 6.6. A coefficient of concordance, used to determine how reliable these rankings are, was significant at the .01 level ($W_c = .821$). This then suggests that orange and gray may differ significantly from other colors due to their low degree of contrast with background.

Color x Form

The analysis of variance of reaction time to first F plus indicated that color was significant only so far as it interacted with form. In order to determine which forms accounted for the significant interaction, a separate analysis of variance was done for each form, (cf. table 7). Only for form "F" were the colors found to differ significantly (1% level). In order to determine which colors were responsible for the significance in form "F", comparisons were made by computing the critical difference (20) between the means of the transformed color scores (cf. table 8). It was found that red and orange differed significantly from all other colors and that in addition, black differed significantly from gray. Red and orange did not differ significantly from each other. However, it was seen that the significant interaction of color and form is not due to the degree of

Table 7

Summary of Separate Analyses of Variance for each Form.
Based on Reaction Time to First F plus

Form	Color mean square	Error mean square	F	Significance
A	.06	.08	.75	--
B	.37	.26	1.42	--
C	.46	.30	1.53	--
D	.11	.20	.55	--
E	.33	.22	1.50	--
F	.28	.05	5.60	.001
G	.22	.14	1.57	--

-- not significant

Note: degrees of freedom for color mean squares are 6.
degrees of freedom for all error mean squares are 63.

Table 8

Critical Difference, Form "F", based on reaction time to first F plus response

	red	green	orange	pink	blue	black	gray
red		-.30**	≠.03	-.25*	-.30**	-.44**	-.21*
green			≠.23**	≠.05	—	-.14	≠.09
orange				-.28*	-.33**	-.47**	-.24*
pink					-.05	-.19	≠.04
blue						-.14	≠.09
black							≠.23*

* significant at the .05 level

** significant at the .01 level

≠ = longer reaction time than color with which it is compared

\- = shorter reaction time than color to which it is compared

structure of the form (the r for the interaction of color x degree of structure of form being 1.53, which was not significant at the 5% level). This would indicate that forms of indefinite structure (such as "F") are not influenced more by color (as indicated by a longer reaction time), consequently, there must be some other factor to account for form "F" being the only form to be influenced by color.

To determine if the degree of incongruity between color and form exerts an influence on the reaction time (i.e. causes a longer reaction time where the color and form are highly incongruous - reaction time here does not refer to time to the first F/, but to any response) an incongruity index was derived (table 9) based on the procedure used by Siipola (27). The reaction time to the first association is measured by the number of the trial in which the subject gives his first response (i.e. if the S gives his first response on trial 2- his score will then be 2). The content elicited for the achromatic (gray) version of the blot on the first association was used to determine the degree of incongruity between the colors and the particular forms. For example, form "A" elicited 10 animal responses (such as "bear", "bat") when seen in gray on the first association. These responses in all chromatic versions of the form would be incongruous (e.g. green bear) therefore 10 out of 10 responses are incongrous with color resulting in 100% degree of

Table 9

Hue-form incongruity Index-based on content elicited by achromatic version.

Forms (content elicited) by		gray	red	green	orange	pink	blue	black
	(no. of) (R's)							
A. animal	10		i	i	i	i	i	c
degree of incongruity			100%	100	100	100	100	0
B. animal	4		i	i	i	i	i	c
map	2		c	c	c	c	c	c
island	1		i	c	i	i	i	c
lake	1		i	c	i	i	c	c
puzzle	1		c	c	c	c	c	c
degree of incongruity			66%	44	66	66	55	0
C. animal	3		i	i	i	i	i	c
human	1		c	c	c	c	c	c
cactus	1		i	c	i	i	i	i
instrument	1		i	i	i	i	i	c
musical	2		i	i	i	i	i	c
degree of incongruity			87%	62	87	87	87	12
D. animal	6		i	i	i	i	i	c
human	2		c	c	c	c	c	c
snowman	1		i	i	i	i	i	i
map	1		c	c	c	c	c	c
degree of incongruity			60%	60	60	60	70	10
E. animal	3		i	i	i	i	i	c
island	1		i	c	i	i	i	c
puddle	1		i	i	i	i	i	c
clay	1		c	c	c	c	c	c
map	1		c	c	c	c	c	c
lake	1		i	c	i	i	c	c
coal	1		i	i	i	i	i	c
violin	1		i	i	i	i	i	c
degree of incongruity			80%	60	80	80	70	0
F. animal	2		i	i	i	i	i	c
leaf	1		c	c	c	c	c	i
map	1		c	c	c	c	c	c
footprint	1		i	i	i	i	i	c
lake	1		i	c	i	i	c	c
island	1		i	c	i	i	c	c
stone	1		c	c	c	c	c	c
degree of incongruity			50%	30	50	50	40	10
G. animal	9		i	i	i	i	i	c
snowflake	1		i	i	i	i	i	i
degree of incongruity			100%	100	100	100	100	10

c-congruous
i-incongruous

incongruity (cf. table 9 - form "A"). In comparing the mean reaction time based on the first association of the color and form combinations, it was found that the degree of incongruity did not influence the reaction time (i.e. although form "A" was 100% incongruous in its chromatic versions, it elicited a shorter reaction time than form "B" which was less incongruous in its chromatic versions). Furthermore form "F" when shown in pink is incongruous 50% of the time. However, its mean reaction time (1.4) is not heightened relative to gray (mean reaction time = 1.4). In addition, form "F" when presented in green being incongruous 30% of the time, would be expected to elicit a shorter reaction time. However, the mean reaction time elicited is 1.8, thus in controversy with the hue-form incongruity hypothesis. In summary, the more incongruous color-form combinations do not appear to effect a longer reaction time, and furthermore the significant interaction in form "F" cannot be satisfactorily explained by the hue-form incongruity hypothesis as form "F" which was of medium incongruity should have precipitated a shorter reaction time than other forms with a high degree of incongruity, but this was not found to be the case.

In addition, an ambiguity index, (table 10) constructed after Berg and Polyot's procedure (5) and based on the percent of occurrence of the one most common response relative to all responses to the gray form (N = 10 Ss per form), was used in

Table 10

Ambiguity Index - determined by the percent of common response in content on the first association.

	Most common Form content elicited	red	green	orange	pink	blue	black	gray	Ambiguity category
"A"	animal	100	90	90	100	100	100	100	U
"B"	animal	40	40	50	50	40	10	50	M
	human	50	40	40	20	30	60	10	
"C"	animal	30	40	10	60	20	50	10	
	human	40	10	10	10	40	20	20	A
"D"	animal	10	100	10	0	0	0	0	
	human	70	90	90	90	90	100	80	U
"E"	animal	0	30	30	10	20	10	20	A
	human	20	30	10	30	50	50	0	
"F"	animal	0	40	20	10	20	10	50	M
	human	0	30	10	80	40	40	10	
"G"	animal	50	40	40	30	70	40	50	M
	human	20	0	0	30	0	30	0	

U - unambiguous
M - moderately ambiguous
A - ambiguous

order to determine if a relationship exists between degree of ambiguity of a form and reaction time to the first F plus response. For example, if a form elicited 9 out of 10 animal responses, the form was considered highly unambiguous. It can be seen in table 10 that forms "A" and "D" are relatively unambiguous, forms "B", "F", and "G" moderately ambiguous, and forms "C" and "E" are relatively ambiguous. On the assumption that the most ambiguous forms would elicit a longer mean reaction time, a comparison between mean reaction time of the forms (cf. table 2) and their degree of ambiguity (e.g. form "C" and "E") did not elicit a longer mean reaction time than forms of moderate ambiguity (e.g. form "F"). However, the least ambiguous forms (e.g. form "A" and "D") elicited the shortest reaction times.

In determining if there is a relationship between color and degree of ambiguity, it can be seen that ambiguity is not markedly different for the chromatic and achromatic cards by comparing the amount of agreement in response of the chromatic versions of the blot with the achromatic versions of the blot (table 10).

Several factors could have entered in determining the significant results in the analysis of variance of reaction time to the first F plus. The reaction time to first F plus might have reflected: (a) the reaction time to the first response apart from whether it was F plus, (b) the number of

rejections (i.e. the more rejections, the higher the score for the first F plus), (c) the number of F minus responses (i.e. the more F minus responses, the more the scores would indicate a high reaction time to F plus responses).

Using the transformed data, an analysis of variance of reaction time to first association was performed in order to determine if the results on first F plus could have been an outcome of this factor. An F of 2.22, significant at the .0001 level (table 11), indicated a significant interaction effect. To investigate this further, separate analyses of variance were done on each form (table 12). It was found that in only two forms, form "A" (F = 3.45 at .01 level) and form "G" (F = 2.5 at .05 level) was there a significant difference related to color. In order to determine which colors were responsible for the significance in forms "A" and "G", comparisons were made by computing the critical difference (table 13) between the means of the transformed color scores. It was revealed that in form "A", green differed significantly from all other colors as exhibited by a longer reaction time. In form "G", orange had a significantly longer reaction time than red, green and black, gray had a significantly longer reaction time than all colors other than orange, and black had a significantly shorter reaction time than orange and gray. Orange and gray, each of which presented little contrast did not differ from each other. Thus,

Table 11

Analysis of variance of reaction time to first association.

Source	df	SS	ms	F
Between S's	69	16.53	.24	
color-form (B)	6	1.91	.32	--
error (B)	63	14.62	.23	
Within S's	420	47.57	.11	
color	6	.70	.11	--
form	6	6.96	1.16	12.89*
color-form (W)	30	6.11	.20	2.22*
error (W)	378	33.80	.09	
total	489	64.10		

-- not significant

* significant at the .001 level

Table 12

Summary of Separate Analysis of Variance for each Form based on Reaction Time to First Association.

Form	Color mean square	Error mean square	F	Significance
A	.038	.011	3.45	.01
B	.26	.14	1.85	--
C	.32	.15	2.13	--
D	.12	.07	1.71	--
E	.33	.18	1.83	--
F	.33	.20	1.65	--
G	.05	.02	2.50	.05

-- Not significant

Note: degrees of freedom for all Color mean squares are 6, and for all Error mean squares 63.

Table 13

Critical Difference-Form "A" based on Reaction Time to first association

	red	green	orange	pink	blue	black	gray
red		≠.10*	-.07	0.00	-.07	-.07	0
green			-.17**	-.10*	-.17**	-.17**	-.10*
orange				≠.07	0.00	0	≠.07
pink					-.07	-.07	0
blue						0	≠.07
black							≠.07

Critical Difference-Form "C" based on Reaction Time to first association

	red	green	orange	pink	blue	black	gray
red		0	≠.14*	≠.04	≠.04	0	≠.17*
green			≠.14*	≠.04	≠.04	0	≠.17
orange				-.10	-.10	-.14*	.03
pink					0	-.04	≠.13*
blue						-.04	≠.13*
black							≠.17*

* significant at the .05 level

** significant at the .01 level

plus sign-longer reaction time than color with which it is compared

minus sign-shorter reaction time than color with which it is compared

it appears that the color red, although significant in form "F" when the reaction time is measured to the first F plus response, is not significant when the reaction time is measured by the first association. Orange and gray still however affect certain forms. It would appear that contrast but not saliency affects time to first response. The surprising significance of green in form "A" cannot be explained at the present time.

A count was made of the number of indefinite responses given each stimulus (cf. table 4). It was found that the colors red, orange and gray elicited more indefinite responses in general. Form "r" elicited more indefinite responses than any other form. There is the possibility that when a difficult form such as "F" is combined with difficult colors in that both are apt to elicit only indefinite responses under pressure, then a measurable degree of interference in time results for the first F plus response. However, the negative results in analysis of effect of structure (definiteness) indicate that indefiniteness is not the only critical variable: Form "A" elicited a high degree of indefinite first responses, yet was not affected by color in any of the measures. Indefiniteness may well be an important aspect of the form in determining whether color will exert an influence but other factors are also involved as not all indefinite forms (e.g. form "L") are so influenced.

A further tabulation, based on the first association, was made of the number of F plus responses, F minus responses,

"animal and human" responses and the number of rejects, (tables 14 - 16) in order to determine if color influenced responses in other ways. Here it was found that red and orange tended to elicit less F plus responses, possibly explained by the fact that they elicited more indefinite responses. It was also found that green tended to facilitate F minus responses. However, on inspection of table 15 this facilitation appears to be due to form "B" (i.e. it was found that the green form "B" elicited 7 F minus "frog" responses, whereas when presented in the other colors, it elicited only 1 or 2 F minus "frog" responses,. This suggests that when color fits the concept, the color can throw the balance to a form that suggests something poorly, resulting in an inaccurate response (i.e. color has a slight effect compared to form but it can be a decisive determinant under certain conditions). An inspection of the other tables revealed no distinct color trends.

Table 14

Number of F minus responses-based on first association.

forms	red	green	orange	pink	blue	black	gray	sum
A.	3	4	2	1	4	1	3	18
B.	4	8	3	1	6	4	1	27
C.	4	3	6	5	3	4	4	29
D.	2	1	2	2	0	1	3	11
E.	2	4	1	2	1	3	2	15
F.	1	2	1	0	2	1	0	7
G.	2	0	0	0	0	1	0	3
SUM	18	22	15	11	16	15	13	

Number of F plus responses-based on first association.

forms	red	green	orange	pink	blue	black	gray	sum
A.	7	6	8	9	6	9	7	52
B.	3	0	5	8	3	3	3	25
C.	2	3	1	3	3	4	3	19
D.	6	7	6	7	8	8	6	48
E.	1	2	2	3	2	3	2	15
F.	1	4	1	2	1	2	2	13
G.	7	9	6	9	10	9	3	58
SUM	27	31	29	41	33	38	31	

Table 15

Number of "animal" responses-based on the first association.

forms	red	green	orange	pink	blue	black	gray	sum
A.	9	10	10	10	10	10	9	68
B.	5	8	4	6	8	5	4	40
C.	3	2	2	6	2	3	3	21
D.	2	3	3	5	1	2	6	22
E.	2	2	3	1	0	0	3	11
F.	1	2	1	0	2	1	2	9
G.	9	9	6	9	10	10	9	62
sum	31	36	29	37	33	31	36	

Number of "human" responses-based on first association.

forms	red	green	orange	pink	blue	black	gray	sum
A.	1	0	0	0	0	0	0	1
B.	2	0	4	3	0	3	0	12
C.	1	1	0	0	1	1	1	5
D.	6	5	5	4	7	7	3	37
E.	0	1	0	3	2	2	0	8
F.	0	2	1	2	1	2	0	8
G.	0	0	0	0	0	0	0	0
sum	10	9	10	12	11	15	4	

Table 16

Number of rejects (no response given on trials 1 thru 7)

forms	red	green	orange	pink	blue	black	gray	sum
A.	-	-	-	-	-	-	-	0
B.	-	-	-	-	-	-	1	-
C.	-	-	-	-	-	-	2	2
D.	1	-	-	-	-	-	-	1
E.	-	1	-	-	-	-	-	1
F.	1	-	1	-	-	-	-	2
G.	-	-	-	-	-	-	-	0
SUM	2	1	1	0	0	0	3	

Discussion

This section is discussed in terms of the predictions in the section, Statement of the Problem.

It was predicted that accurate responses would be given in a shorter period of time to a highly structured form than to an unstructured form. This hypothesis was supported by the data. The relationship was found to be due to the highly structured forms (form "A" and "G") as compared to those of the medium structured and relatively unstructured groups.

Secondly, it was predicted that color would influence the time to give the first F plus response when the stimulus was one of a low degree of structure but not when it was one of a high degree of structure. This hypothesis was not supported by the data. No significant interaction was found between color and degree of structure. It was predicted that where color and form are congrucus, the reaction time for the first F plus will be less than where color and form are incongruous. The data did not, however, support this hypothesis. A comparison of the mean reaction time of the color form combinations (cf. table 2) with their degree of incongruity (cf. table 9) showed that the highly structured forms, although 100% incongruous, did not exhibit a longer reaction time for responses. Other forms that were congruous with color (e.g. form "F") did not precipitate a shorter reaction time when compared with their achromatic versions or

when compared with others in their same category (i.e. unstructured congruous compared to unstructured incongruous). The chromatic versions did not, in general, have a higher mean reaction time than the achromatic versions. Furthermore, there was no evidence that color "per se" influenced reaction time to the first F plus response. However, it was found that the color red, which was associated with an increased reaction time to the first F plus response, was more "salient" than the other colors. The color orange was also associated with a longer reaction time to the first F plus response, but this tendency was not a result of "saliency", but of a low degree of contrast. Similarly gray was associated with a significantly longer reaction time to first F plus than black, and this too indicates that contrast, apart from color, exerts an effect.

Siipola maintains (27) that when color is added to the form, the conceptual task becomes more difficult such that when the form is relatively low in structure and incongruous with the color a longer reaction time occurs if the test was administered under "free" conditions. As this study did not test the hue-form incongruity hypothesis under "free" conditions, it can neither support nor refute this hypothesis. However, Lazurus, (19) in a study which investigated the hue-form incongruity hypothesis, concluded that color plays a very minor role in determining group reactions to inkblots, thus supporting the findings of the

present study. Berg and Polyot (5), although employing figures from Mooney's "closure test", also concluded that the presence of color and the degree of congruity was not a significant factor in influencing reaction time. It may be concluded that Klopfer's hypotheses can not be rejected at present, but it is neither supported by this study or other studies. Probably degree of structure is of major importance in determining whether color will influence reaction time, but whether incongruity of color is a factor is questionable, at least in so far as the degree of incongruity investigated in the present study is concerned.

An ambiguity index was constructed and further investigation was performed in order to determine if (a) a relationship existed between degree of ambiguity and reaction time to the first F plus response, and (b) if the colors exerted a differential effect depending upon the ambiguity of the forms. The results indicated that the colors did not exert a differential effect according to ambiguity of the form, but, as might be expected, the reaction time to first F plus was lowest for the least ambiguous forms.

Due to the negative finding reviewed above, no explanation for the significant interaction between the colors red and orange and the form "F" is indicated. Although form "F" is the most difficult form (e.g. it has the longest reaction time to first F plus) and red and orange are the colors which produce the

most interference, form "E" is also difficult, but shows no interaction effect with red or orange. Thus difficulty, alone, is not a sufficient explanation. The fact that the interaction was not significant in the analysis of reaction time to first association might indicate that S, when given less time for a response, is not concerned with integrating form and color, but mainly uses one or the other as a determinant, thereby avoiding conflict. Orange, on the other hand, did not exhibit the "impressive" features of red. However, since it was found to be of particularly low contrast, it may be that this factor combined with above described characteristics of form "F" to make a good response difficult.

In addition, gray and orange (low contrast colors) interacted significantly with form "G" on the first association by raising the reaction time, which would indicate that certain structural forms under certain conditions are effected by colors exhibiting a low degree of contrast.

Due to the paucity of evidence bearing on the above possibilities, the need for further investigation of the nature of interactions between form characteristics and color is required.

Summary

The present study was designed to investigate the characteristics of the color and form variables, their interaction, and their relation to the Rorschach test. The main predictions

investigated in this study were:

(a) Accurate responses will be given in less time to a highly structured form than to a form of indefinite structure.

(b) The presence of color will result in an increase in the time to give the first F plus response when the form is of an indefinite structure but will not influence those forms of definite structure.

(c) When color and form are congruous, the reaction time for the first F plus will be less than when color and form are incongruous.

The subjects were 70 undergraduate students who had been drawn from introductory psychology courses and randomly assigned to one of seven experimental groups. The stimuli were 7 forms selected from the Rorschach cards combined with 7 colors (i.e. red, green, orange, blue, pink, black, and gray) which approximated the colors appearing in the Rorschach. A Graeco-Latin square design was used so that each form-color combination appeared once and only once in each possible position.

A Keystone overhead projector was used to project these stimuli on the screen in the experimental room. The stimuli were successively presented at increasing time intervals.

All blots in an experimental group were exposed on trial one for one half second, on the succeeding interval for twice the amount of the previous trial or 1 second, etc. The final trial, trial 7, involved an exposure of 32 seconds. Subjects were run in groups of ten, five males and five females composing one experimental group.

The subject's task was to write a response for each stimulus on each trial. The responses were scored according to Beck's scoring method (F plus, F minus, CF, etc).

Analysis of variance of time to the first F plus response (as measured by trial number) indicated that form was a much more decisive variable than color in determining time to F plus (i.e. the more highly structured the form, the shorter the reaction time). Color was significant only in interaction with a single form. Its effect could not be completely explained by ambiguity, incongruity or structuredness. Red, orange, and gray were associated with elevated reaction times on this form. These colors differed from the others in that red was more salient than all other colors, and orange and gray were lower in degree of contrast with background than all other colors.

An analysis of time to first association again revealed a significant interaction between color and form, but although two of the same colors were involved (i.e. orange and gray), the

same form was not. This finding indicated that the results on time to first F plus were not completely a function of a general increase in reaction time to all responses.

It was found that forms of a high degree of structure were associated with a shorter reaction time for an adequate response (F plus), thus supporting the first prediction. However, color did not appear to influence highly structured forms any differently from forms of low structure. Thus prediction (b) was not supported by the data.

It was found that color in general was not associated with an increase in reaction time to F plus. However, orange, red, and gray were associated with an increase in reaction time to first F plus. Red was found to be a particularly salient color, while orange and gray had a considerably lower degree of contrast with their background than the other colors. This suggests the manner in which color, at times, may function in the Rorschach.

In regard to the third prediction, there was no indication from the data that the degree of incongruity bore any relationship to reaction time. No relationship was found between a measure of the degree of ambiguity as related to the influence of color on reaction time to the first F plus response.

Due to the non-supportive data from this study for hypothesis (b) and (c), and an unanticipated interaction of

color and a particular form, further investigation of interactions between colors and forms varied according to known dimensions is required.

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Appendix

These instructions were mimeographed and given to each subject.

"In this study all you have to do is look at some slides which will be projected on the screen and then write what you see. Now the point about these slides is they are nothing more or less than reproductions of ink blots. Probably all of you at one time or another have shaken you pen on a piece of paper, caused a blot of ink, and on folding the paper produced a weird splotch which may or may not have resembled something you recognised. Now these slides are nothing more than reproductions of inkblots formed in this way."

"Your task is simply to write down what these splotches remind you of, resemble, or might be. You will see each of these slides for increasing time intervals and you may write your answers at you own time. If nothing occurs to you on a particular trial, make a dash on the appropriate line. It is not necessary to give the same response to the same slide when it appears on a later trial; if you care to, you may change your response on later trials."

"You will be given a booklet to write your responses in. Each page of the booklet is numbered and these numbers will correspond to "trials", (e.g. page 1 corresponds to trial 1, page 2 corresponds to trial 2). Each trial will consist of 7

stimuli or slides presented one at a time. After you have completed a trial (i.e. have seen 7 slides), or even from the instructions, you will turn the page and be ready for the next trial, (page 4, trial 2). Remember it is not necessary to be consistent, so do not refer to previous trials."

Acknowledgements

The writer wishes to express her appreciation to Dr. Seymour Epstein who served as her thesis advisor, and to Dr. C. C. Neet, Dr. Robert Feldman, Dr. Israel Rose, and Dr. Lawrence M. Bartlett who served as members of her thesis committee. She is also indebted to Dr. A. E. Goss for advice on the statistical analysis of the data. Gratitude is extended to Mr. Joseph Mach for his co-operation in setting up the apparatus and a word of thanks to all who gave moral support.

Approved

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Date 5/22/53