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Investigation of the brightness variable in figural after-effect

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AN
INVESTIGATION OF
THE BRIGHTNESS VARIABLE
IN
FIGURAL AFTER-EFFECT

by

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CHAPTER I

INTRODUCTION

This study is an investigation of an empirical variable affecting the occurrence and degree of the perceptual phenomena which have been termed figural after-effects by Köhler and Wallach (5). In a general statement of the effect, which was observed by Gibson (3) in 1933, Köhler and Wallach described the effect as an apparent displacement of a visual test-figure in a direction away from a previously viewed inspection figure.

Gibson's subjects reported that prolonged fixation of a curved line produced a transitory perception of a line curved in the opposite direction upon viewing an objectively straight line. An example follows to clarify the nature of the effect: assume that a subject fixates on a curved-line inspection-figure, as in part A of Figure 1, for a period of (say) five minutes; immediately following, he fixates on a straight-line test-figure, as in part B of Figure 1; then, the figural after-effect is seen in the momentary perception of the line in B as curved in the opposite direction, as shown in part C of Figure 1. This perception is usually rather transitory, although a majority of subjects report it with a minimum of training. This phenomenon appears with a variety of other inspection- and test-figures. The curved-line illustration, however, seems to be the simplest instance of its occurrence.

Recent interest and study of figural after-effect phen-

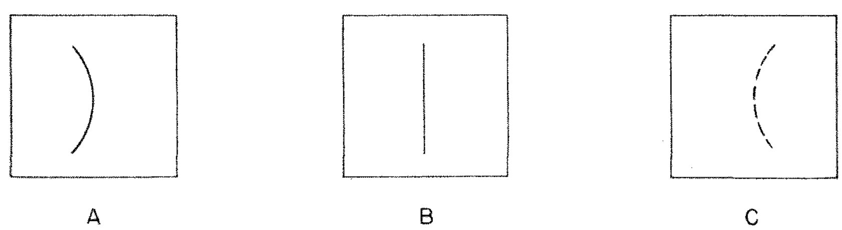

FIG. 1. GIBSON INSPECTION AND TEST FIGURES

(A, inspection-figure; B, test-figure; C, perceived test-fig.).

omena has been evidenced in studies by Hamilton and Freeburne (2), Bunch and Moyer (1), Hammer (4), and Marks (6,7). These studies have dealt with some of the quantitative relations between controlled variables and the amount and characteristics of displacement.

Hamilton and Freeburne postulated on the basis of incidental observations that figural after-effects will be perceived more frequently with stimulus-fields of low than of high brightness. Under the conditions of their study, however, the anticipated effects of brightness upon the incidence of perceived after-effects were not evidenced to a significant degree. Their results implied interaction among several variables, including brightness. Their implications for further research have been assumed in undertaking the present study.

The hypothesis for this experiment, then, is that an increase in brightness would be accompanied by an increase in the amount of effect induced. If this hypothesis were tenable, it would then follow that an optimal brightness relationship might be found.

CHAPTER II

METHOD

<u>Apparatus and procedure</u>. Two conventional slide-projectors were mounted side by side and placed at a fixed projection-distance from a viewing-screen. The projectors were fitted with an automatic timing device to insure proper sequence of presentation. One projector was used for the inspection-figure, and one for the test-figures. The sequence of presentation was so arranged that the test-figure appeared simultaneously as the inspection-figure flashed off the screen.

The test-figures consisted of a pair of squares symmetrically placed to the right and left of the center fixation-point "x." These squares varied in their size ratios, with the left-hand square being constant in size; the right-hand square being systematically larger or smaller than the left, as indicated in Figure 2. The constant square has a diagonal equal to the diameter of the circle of the inspection-figure (referred to as figure A). Figure A consisted of the circle to the left of a fixation-point identical with the fixation-points of the test-figures (the six test-figures are referred to as figure B). Figure A, then, is seen as a fixation-point with a circle to the left, and Figure B appears as fixation-point with squares to the right and left. Prior to each presentation of a set of figures, A and B were aligned at the screen so that the circle exactly circumscribed the constant square of figure A. This geometric relation has been shown by Köhler and Wallach to produce clear

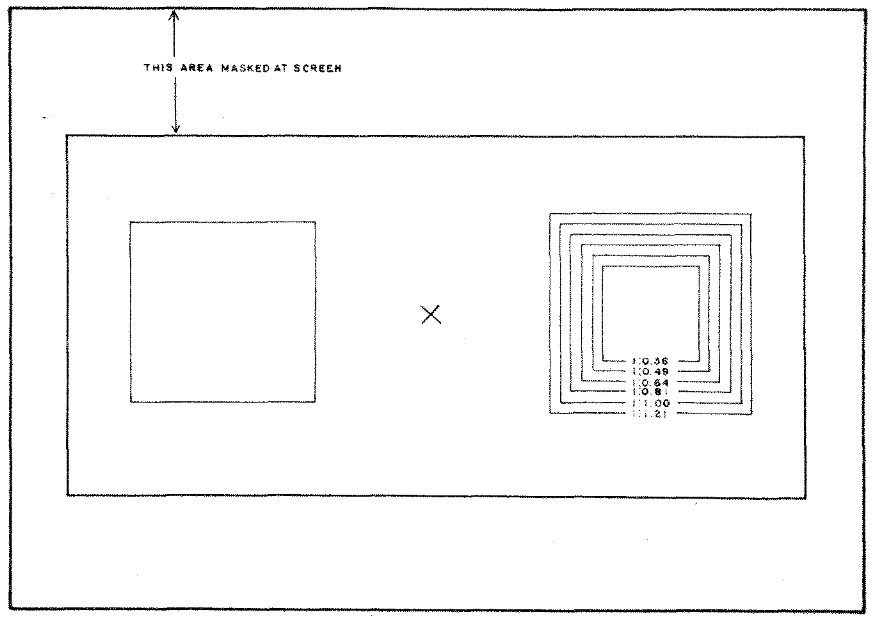

FIG. 2. TEST-FIGURES EMPLOYED IN THE EXPERIMENT

The circle of the inspection-figure circumscribed the left-hand, or constant square. The squares of the test-figures appeared in the objective proportions shown.

after-effect phenomena, so that left-hand square of the test-figure appears smaller, lighter, possibly more distant, after viewing the inspection-figure.

After each presentation of a pair of figures A and B, the screen was concealed from the subject while the next pair were aligned so that the subject need not alter his focus from the fixation-point of figure A in order to perceive the fixation-point of figure B upon its momentary presentation.

A translucent viewing-screen was constructed at the front of a darkened enclosure. A viewing aperture was placed at the far end of the enclosure, thereby maintaining a constant position and distance with respect to the screen for each subject. Thus the subject's visual field consisted only of the illuminated portion of the screen. The illuminated portion of the screen was masked so that no change or interruption could be perceived in the stimulus-field as figure A went off the screen and figure B was flashed on in its place. The stimulus-field extended horizontally six and one-quarter inches to either side of the fixation-point and vertically three and one-half inches above and below this point. The stimulus-field under these conditions subtended slightly less than twenty degrees of visual angle, well under any physiological limitations for this type of task.

Constancy of illumination was maintained by adjusting the power fed into the projectors through the use of variable transformers and checked at the screen by a Weston photometer at the beginning of each experimental session.

Forty subjects were employed in the experiment, and were obtained from an advanced class in Psychology. The subjects were divided at random into two experimental groups consisting of twenty subjects each. Group I is identified as the "high" brightness group and the figures for this group projected at an illumination value of 75 foot-candles. Group II is identified as the "low" brightness group and the figures projected at the discriminably lower value of 10 foot-candles. Twenty subjects from among those in group I or group II were utilized in a special control condition of the experiment which is to be described.

Groups I and II were presented figure A for a period of three minutes,[1] at the end of which figure B appeared for a period of

[1] This viewing-time was shown by Gibson (3) to be optimal in inducing figural after-effects.

one-tenth of a second. This exposure-time for figure B was determined to be of sufficient duration to minimize interfering after-images to the extent that they were not reported by the subjects of either group as a factor influencing the judgments called for. And, in accord with the experimental design, this exposure-time was not of a duration that would allow the subject to look away from the fixation-point in order to compare the squares of figure B.

As a measure in quantifying the amount of figural after-effect for each condition of brightness, the test-figure ratios shown in Figure 2 were selected so that the size relationship of the right- to left-hand squares ranged from a point at which the right-hand square would consistently be perceived as smaller than the left-hand square, to a point where the right-hand square was objectively larger. These ratios are recorded in terms of area, this being the criterion most reasonably employed by the subject in reporting his judgments of the left-hand square as larger, smaller, or equal in relation to the left-hand, or constant square. Consequently, average differences between experimental groups should indicate whether brightness of image is an effective variable in the amount of figural after-effect produced.

The subject made no adjustment to the apparatus, and in this experimental situation no training period was necessary.

Prior to each presentation of figure B the subject was given a verbal signal so that he would not miss its brief presentation. A rest interval of one minute followed before the subject again viewed figure A, during which time the eye-piece was covered and the projectors aligned at the screen for the next sequence of presentation so that the fixation-points of figures A and B exactly superimposed. Thus each subject appeared in the experimental situation for less than thirty minutes, a period not conducive to fatigue or loss of interest.

In the control situation, twenty of the original subjects appeared for a brief session in which they were shown the figure B-series of six test-figures alone, and their responses recorded without reference to figure A. These subjects entered the control situation a period of three to four weeks subsequent to their participation in the test situation, a period after which any effects of learning may be regarded as inoperative, considering that judgments were based upon momentary, vaguely-defined impressions.

Care was taken to avoid the arousal of any particular set on the part of the subject, and complete randomization precluded the possibility of any discernable pattern to the experimental sequence.

Since subjects were employed for the presentation of several sets of inspection- and test-figures, it was necessary to give instructions only at the beginning of the experiment. The subject was seated comfortably in front of the apparatus and the instructions given him as follows:

> "This is an experiment in which we are going to test an aspect of visual perception. Before you, you can see a screen. Behind the screen is a set of projectors which will throw some special pictures onto the screen so that you can see them. These pictures will always follow in a set order and will be controlled by the apparatus.
>
> "The first picture that you will see we will call figure A; the second figure will be figure B. While you are in the experiment you will see several pairs of these two figures. Figure A will always be the same, but figure B will vary from trial to trial. Now your task will be to look at figure A for a period of about three minutes, and then be prepared to make a judgment about figure B which will follow, but only for a very brief period. Figure B will appear exactly when figure A goes off the screen. I will now show you what figure A looks like (demonstrates). You will notice that at the center of the screen there is an "x."

This is the fixation-point. While you are looking at figure A, try to keep looking at the 'x' and not let your gaze wander over the screen. To the left of the 'x' there is a circle; pay no attention to the circle, but try to pay attention to the 'x'. Now this is figure B (demonstrates). Notice that there is an 'x' in the center of this picture also, and on either side of the 'x' there are two squares. When figure B comes on, look at the 'x' and not at the squares directly. After figure B has gone off the screen, I will ask you to say whether the right-hand square impressed you as larger, or smaller, or equal in size to the left-hand square. Figure B will not be on the screen long enough for you to look at each square to form this impression; if you look elsewhere it will be impossible to make the judgment asked.

"Figure B will sometimes have squares that appear to be equal in size, or sometimes the right-hand square will appear to be larger or smaller than the left-hand square; be sure to report your momentary impression as exactly as you can.

"After the first pair of these figures you will have a brief period in which to relax and then the second pair will be presented. There will be several such pairs. Near the end of the time that figure A is on each time I will give you a 'ready, Now!' signal so that you will be ready to focus on the 'x' of figure B when it flashes on. Are there any questions? Now we are ready for the first pair of figures. Remember, focus on the 'x'." (Starts timer).

Those subjects who later appeared in the control situation were instructed simply to view the test-figures and to compare the right- and left-hand squares on the basis of their momentary impression. For this purpose, a just-perceivable dot was placed on the center of the viewing-screen so that the subject could use this point as a substitute fixation-point for the "x" of figure A which had appeared in the experimental series. As soon as the subject reported that he had focused on the fixation-point, a signal was given and the test-figure flashed on the screen. Presentation of the test-slides was in a random order, as in the experimental series. The control group was added to the experimental design in order to determine whether the test-figures in themselves might give rise to subjective reports differing to any degree from objective reality.

CHAPTER III

RESULTS

Data. The principal data obtained in the experiment are presented in tables I - IV. Table I presents the judgments made by subjects under the condition of high brightness (Condition I); in this table, the columns are arranged in order of increasing ratio of the right-hand to left-hand square in the test-figures. The body of the table contains the judgments recorded from the subjects; these are recorded as L (larger), S (smaller), or E (equal). Table II presents the judgments made by subjects under the condition of low brightness (Condition II); the plan of this table is the same as for Table I. Table III, in the same manner, presents the judgments made by subjects under the control situation of the experiment. Table IV summarizes the information of the previous tables in terms of the frequencies of judgments of L, S, or E, for each of the test-figures under the two experimental conditions and the control situation.

Analysis of data. Differential effects of the brightness variable should reveal themselves if present in a comparison of the relative number of judgments of L, E, or S for the individual figures under the two experimental conditions. Inspection of the corresponding rows of sections I and II of Table IV (i.e., high and low brightness), fails to reveal any substantial

TABLE I

JUDGMENTS MADE BY SUBJECTS UNDER
THE CONDITION OF HIGH BRIGHTNESS (CONDITION I)

Subject	1:0.36	1:0.49	1:0.64	1:0.81	1:1.00	1:1.21
1	S	S	S	S	L	L
2	S	S	S	L	E	E
3	S	S	L	S	L	L
4	S	S	S	L	E	L
5	S	S	S	E	E	L
6	S	S	E	S	E	L
7	S	S	S	L	L	L
8	S	S	S	L	L	L
9	S	S	S	E	L	L
10	S	S	S	E	L	L
11	S	S	S	S	L	L
12	S	S	S	E	L	L
13	S	S	S	S	L	L
14	S	S	S	E	E	L
15	S	S	S	S	L	L
16	S	S	S	L	E	L
17	S	S	S	E	L	L
18	S	S	L	S	L	L
19	S	S	S	L	L	L
20	S	S	L	S	L	L

TABLE II

JUDGMENTS MADE BY SUBJECTS UNDER
THE CONDITION OF LOW BRIGHTNESS (CONDITION II)

Subject	1:0.36	1:0.49	1:0.64	1:0.81	1:1.00	1:1.21
1	S	S	S	S	L	L
2	S	S	L	L	L	L
3	S	S	E	E	L	L
4	S	S	S	S	E	L
5	S	S	S	E	E	L
6	S	S	L	E	L	L
7	S	S	S	S	E	E
8	S	S	E	S	L	L
9	S	S	S	S	L	L
10	S	S	S	S	L	E
11	S	S	S	L	L	L
12	S	E	S	S	E	L
13	S	S	S	L	L	L
14	S	S	S	L	L	L
15	S	S	S	S	L	L
16	S	S	S	L	L	L
17	S	S	S	S	L	L
18	S	S	S	S	E	L
19	S	S	S	S	L	L
20	S	S	S	S	L	L

TABLE III

JUDGMENTS MADE BY SUBJECTS UNDER THE CONTROL SITUATION

Subject	1:0.36	1:0.49	1:0.64	1:0.81	1:1.00	1:1.21
1	S	S	S	S	S	L
2	S	S	S	E	S	L
3	S	S	S	S	E	L
4	S	S	S	S	L	L
5	S	S	S	S	E	E
6	S	S	S	S	E	L
7	S	S	S	S	S	L
8	S	S	S	S	L	L
9	S	S	S	S	L	L
10	S	S	S	S	E	L
11	S	S	S	S	L	L
12	S	S	S	S	S	E
13	S	S	S	S	E	L
14	S	S	S	S	L	L
15	S	S	S	E	L	L
16	S	S	S	E	S	L
17	S	S	S	L	L	L
18	S	S	S	S	E	L
19	S	S	S	S	E	L
20	S	S	S	S	S	E

TABLE IV

TOTALS OF JUDGMENTS BY SUBJECTS UNDER EACH CONDITION OF BRIGHTNESS OF STIMULUS-FIGURE

Condition		Ratio 1:0.36	1:0.49	1:0.64	1:0.81	1:1.00	1:1.21	Means
	L			3	6	14	19	1.042
I	E			1	6	6	1	0.907
	S	20	20	16	8			0.526
	L			2	5	15	18	1.052
II	E		1	2	3	5	2	0.894
	S	20	19	16	12			0.544
	L			2.5	5.5	14.5	18.5	1.047
I & II	E		.5	1.5	4.5	5.5	1.5	0.901
	S	20	19.5	16	10			0.535
	L				1	7	17	1.140
Control	E				3	7	3	1.005
	S	20	20	20	16	6		0.595

differences in the frequencies of judgments for the figures under these two conditions. This finding is further emphasized when graphic representation is given to the data. In Figure 3, the frequency of judgments of L are presented as a function of the ratios of the squares employed in the test-figures; the two curves are representative of the high (solid line) and low (broken line) brightness conditions. It may be seen quite easily from this figure that the two conditions do not differ in results in any consistent degree. The question may be raised, however, as to whether these data, although not differential, present valid evidence favoring the Null hypothesis, i.e., no difference existed. For example, it might be argued that the procedure employed did not produce figural after-effect, hence the judgments under the experimental conditions probably would differ only by chance anyway. The row tabulating judgments of L for the test-figures for the control group (row L, section III, of Table IV), however, shows a different distribution of judgments than in the previous two rows considered. This comparison is emphasized graphically in Figure 6. In this figure, the solid line and open circles represent the averaged frequencies for the two test (experimental) groups, and the dashed line and closed circles represent the frequencies for the control group. As may be seen readily, the two curves are clearly distinguishable. Applying the Fisher "t" test to the mean frequencies for the high and low brightness experimental groups yields a value of "t" which cannot be considered significant,

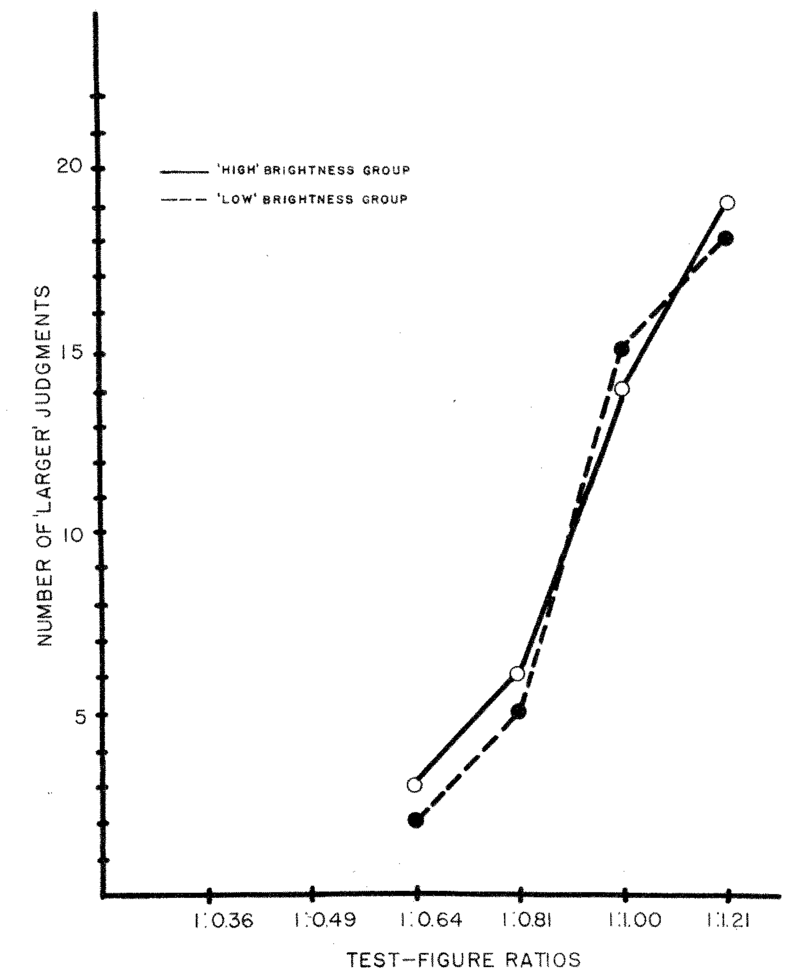

FIG. 3. FREQUENCIES OF JUDGMENTS OF LARGER IN THE TEST SITUATION

(The means of the distributions shown in Figs. 3 - 8 are given in Table IV).

as might be expected from inspecting the data; the same test applied to the mean frequencies of the combined experimental groups' data and the control group's data, however, yields a value of "t" equal to 2.05 which, with 5 degrees of freedom, is significant at the 10 per cent but not the 5 per cent level of confidence. In view of the "grossness" of the units employed in measurement (present experimental operations), this trend towards significance is striking; this finding is presumptive evidence for the conclusion that the experimental technique produced figural after-effect and that in terms of the judgments of larger the amount of after-effect produced was not differential between the two experimental conditions.

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[1] In this comparison and certain subsequent comparisons to be described, the "t" test was employed. To facilitate the presentation, the computed statistics for each of these comparisons are presented in Table V. In the present comparison, the values of "t" obtained are found in the first and third rows. It is recognized that the repeated computation of "t" in a series of comparisons over the same data--as at present--violates a basic assumption of independent random sampling. However, this violation is said to increase the likelihood of obtaining an apparently "significant" value of "t" and these spurious values should occur pretty much at random, increasing in frequency without predictability. In the present situation, it should be noted, it is specifically assumed from inspection of the data which "t" comparisons should be found to approach significance and which should not. Technically, analysis of variance (F) should be employed; this has not been done due to the fact that the additional assumptions required and complicated refinement introduced do not seem warranted by the degree of refinement of the present data--instead it seems evident that a reasonably straightforward analysis, utilizing as simple a statistic as possible, is more desirable.

TABLE V

ARRAY OF T RATIOS

Groups compared	Judgments compared	t-ratio obtained	Confidence level* Below	Above
I & II (Test)	Larger	1.247	30%	20%
	Equal	0.385	80%	70%
	Smaller	0.505	70%	60%
Test & Control	Larger	2.050	10%	5%
	Equal	0.310	80%	70%
	Smaller	2.254	10%	5%

* Significance of obtained t-values (5 degrees of freedom).

Similar comparisons may be made for the S judgments; these comparisons are presented graphically in Figures 4 and 7. Again, differences between the two experimental groups are negligible, and differences between the two experimental groups and the control group are marked. In this instance, as may be seen from Table V, "t" for the experimental comparison is not significant, but for the experimental-control comparison is 2.25 which, with 5 degrees of freedom, is again significant between and 10 and 5 per cent levels of confidence.

Finally, such comparisons may be made for the E judgments; these are presented graphically in Figures 5 and 8. In this instance, however, the differences between the experimental groups and the combined experimental group and control group are not as clearly of a different quality. In fact, the values of "t" for these comparisons shown in Table V are not significant in either case. Since the greatest proportions of judgments made by subjects under the various conditions falls in the categories of larger or smaller, it is not surprising that comparison of E judgments should show little real differentiation. In any event, the modal point of E judgments is the same but under the experimental conditions, subjects judged in some cases the right-hand square as small in ratio to the left-hand square as 0.64 to 1.00 <u>equal</u> to the left-hand square! This they never did under the control condition. It is evident that the judgments of equal do not present as unequivocal evidence for figural after-effects as the judgments of larger and smaller; this fact may be suggestive for the design of future experiments.

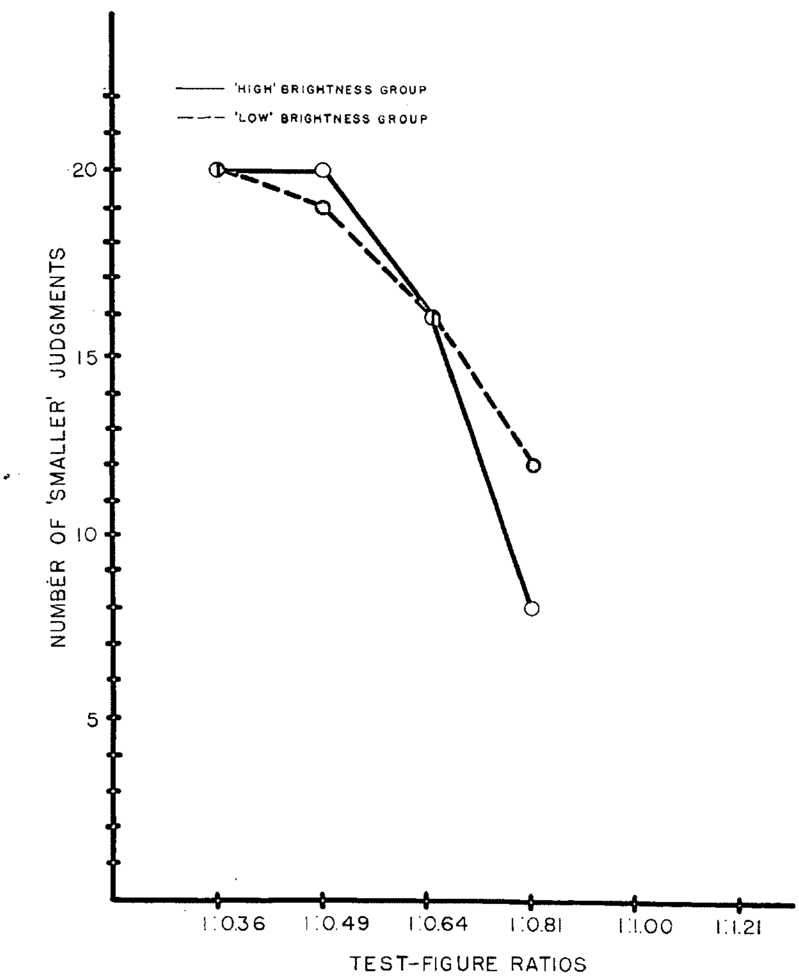

FIG. 4. FREQUENCIES OF JUDGMENTS OF SMALLER IN THE TEST SITUATION

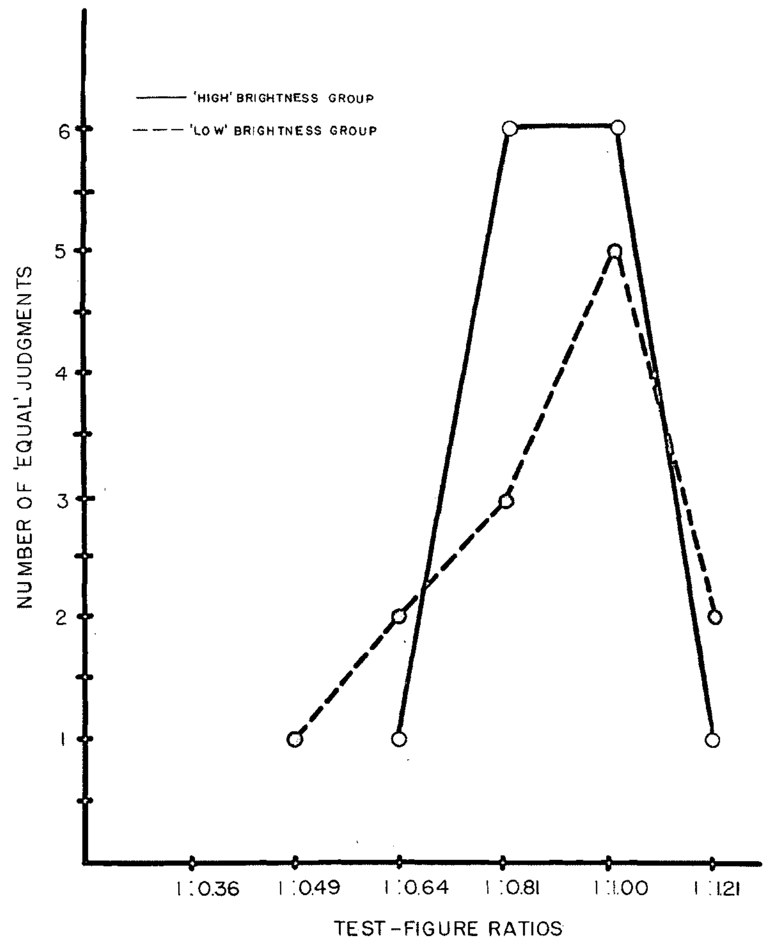

FIG. 5. FREQUENCIES OF JUDGMENTS OF EQUAL IN THE TEST SITUATION

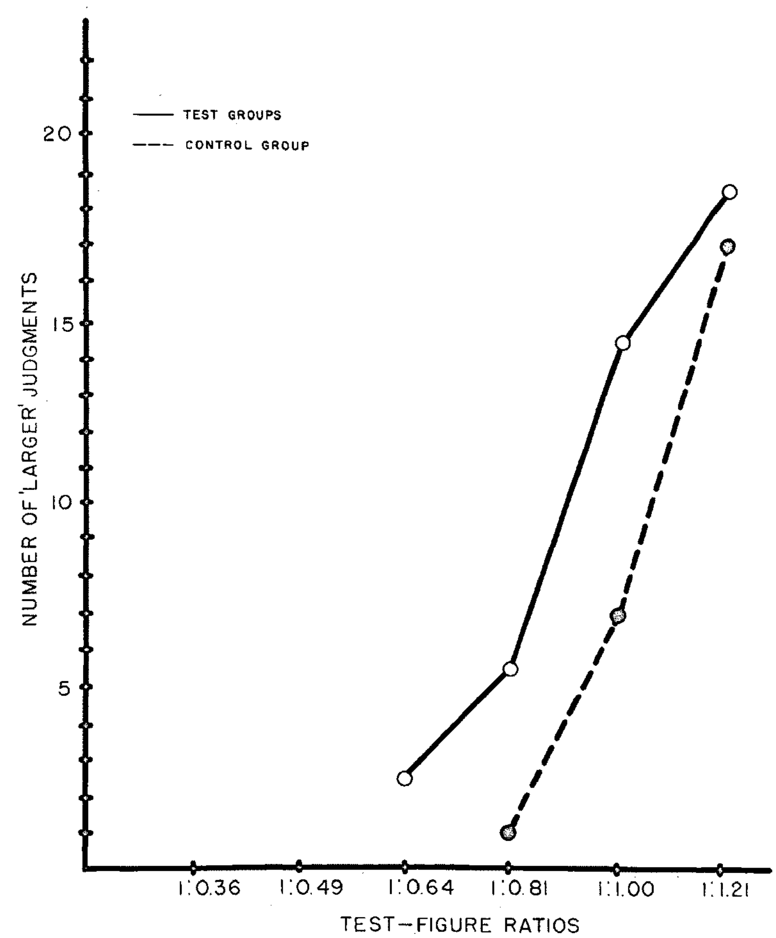

FIG. 6. FREQUENCIES OF JUDGMENTS OF LARGER IN THE CONTROL SITUATION

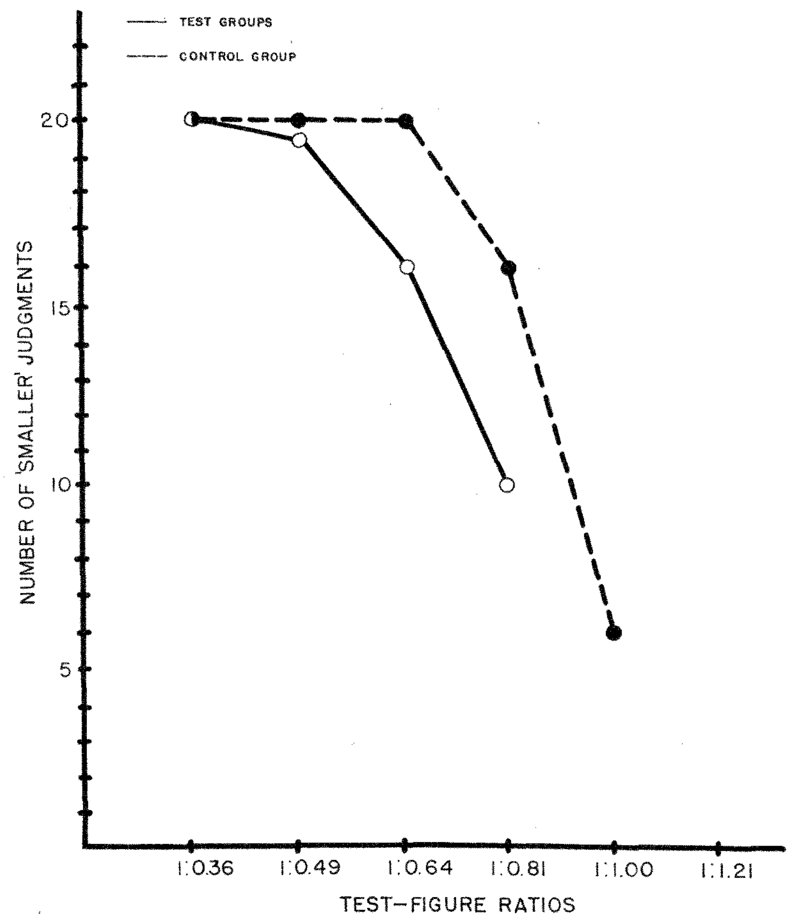

FIG. 7. FREQUENCIES OF JUDGMENTS OF SMALLER IN THE CONTROL SITUATION

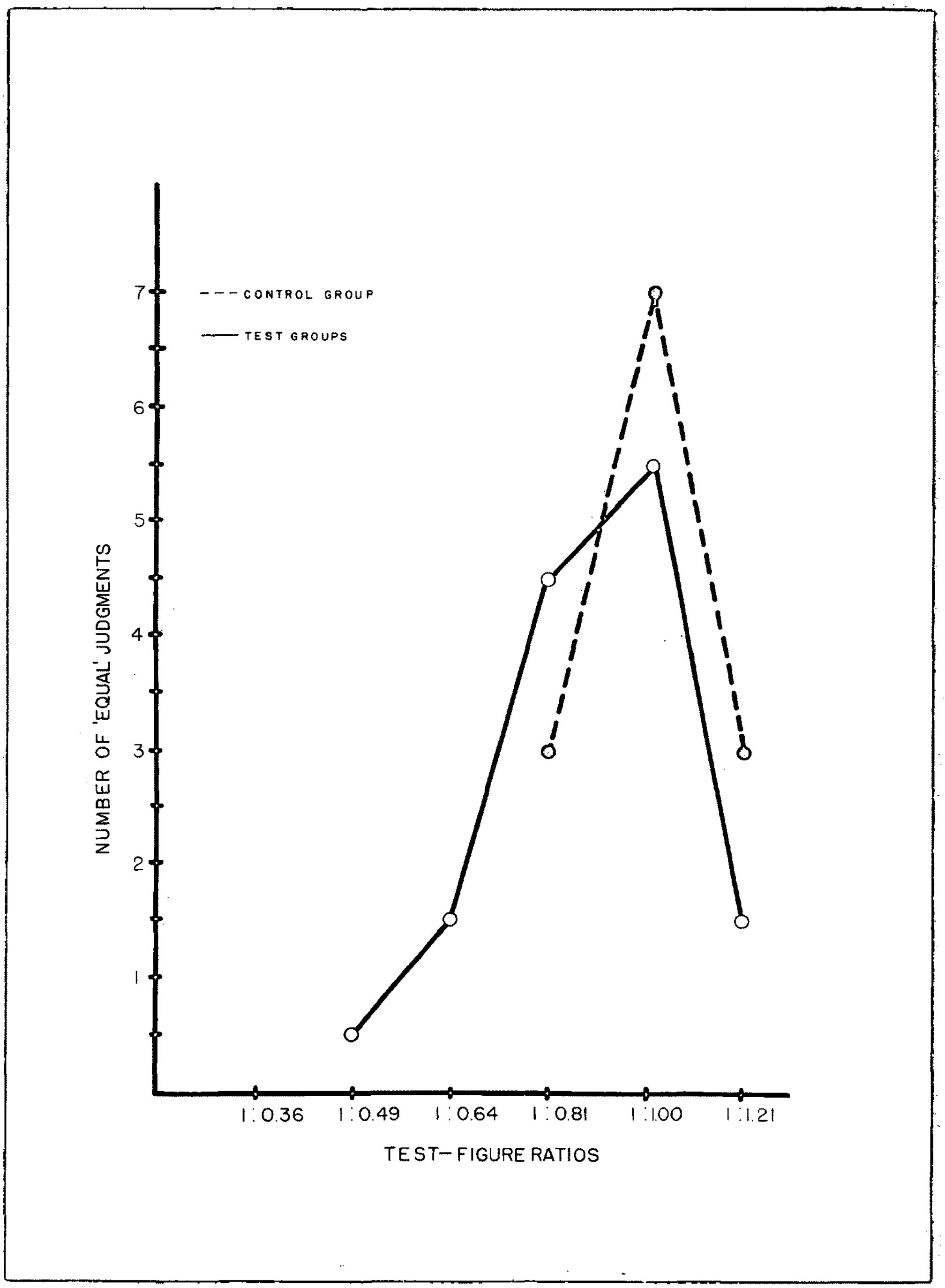

FIG 8. FREQUENCIES OF JUDGMENTS OF EQUAL IN THE CONTROL SITUATION

CHAPTER IV

DISCUSSION

The first point to be brought out in discussion may seem somewhat irrelevant. The problem of methodology is, however, of considerable incidental importance in the present considerations. The present experiment had as its aim, at least in part, a refinement of the techniques of obtaining and measuring induced figural after-effects. Previous investigations, while bearing fruitful results, have implied and demanded a more objective measure in determining the incidence of the effect. This investigation attempted to resolve this problem by means of placing the subject in the most objective situation possible. In the Hamilton and Freeburne experiment previously cited, the subjects were called upon to make subjective judgments of the character of the effects induced. These judgments were made upon presentation of a test-figure that appeared for about fifteen seconds, during which time the effect was undergoing change due to the fact that a decay of the induced effect proceeds rapidly subsequent to the presentation of the test-figure. Therefore it would be difficult to measure an effect while it is in the process of undergoing change, and where the subject was called upon to describe a phenomenon that might have been somewhat vague to him. Similar subjectivity was a part of the experimental design in the Marks study, where a similar situation was encountered. The subject, after viewing the inspection-figure, was shown the test-figure for a period of about 10 seconds, during which time it was similarly undergoing change as mentioned above; the subject was then called upon to make subjective reports in regard to the phenomenon observed. Other studies have had difficulties of the same nature compounded by the necessity of the subject's making adjustments to the test-figure, as in the Hammer study, where the subject was called upon to align parts of the test figure in order to gain a measure of the effect. In the experiment conducted by Bunch and Moyer (1), the Müller-Lyer figure was adjusted by the subject in quantifying the amount of figural after-effect; the Walthall experiment (8) involved the movement of a pointer in indicating the presence of the effect.

The present experiment was designed to eliminate the two classifications of procedure detrimental to the objective quantification of figural after-effects. These may be stated as (1) subjectivity of reports in a situation where the effect being measured is rapidly undergoing change, and (2) manipulation of the apparatus or of the test-figure, where the after-effect is very likely to be compounded as the subject manually attempts to adjust to a situation that has undergone radical change before and during the time that he identifies it.

To begin with, subjects in the present experiment were presented test-situations wherein they were not given the opportunity to make subjective estimates of the degree of the effect. These judgments, instead, were based upon momentary impressions of objective figures which were presented. Secondly, the subject was not called upon to make any kind of adjustment or alignment to any part of the test situation. Thus a measure of induced effects was obtained which may be regarded as real at the time that the measurement was taken. In other words, if the induced effect, which was in the direction of reducing the apparent size of the left-hand square of the test-figure, was sufficient the two squares would appear equal (the right-hand square not being in the visual area so affected), providing further, that the right-hand square was objectively smaller already than the left-hand square. Similarly, if the effect was less than this optimal amount, the left-hand square would appear larger than the right-hand; and, if more, smaller. Since the presentation of the test-figures was for an optimally brief period of time, the transitoriness of the effect could not be evident to the subjects; indeed, they could not know the objective comparison between the squares of the test-figures--only the apparent (affected) relationship! Hence, when a larger left-hand square would be judged equal in size to a smaller right-hand square, the objective difference in the two sizes could be interpreted as the amount of reduction in apparent size due to the induced effect from the inspection-figure; this feature provides the basis for the relatively more quantitative aspect of the present methodology as compared with previous methods employed.

In conclusion of a consideration of methodology, it may be stated that the method used in the present experiment will be useful as an improvement of the existing methods of testing other variables considered in the investigation of figural after-effect phenomena. Further, with additional refinements of design which readily suggest themselves, more subtle quantitative relationships between a variety of variables may be uncovered. Nothing in the present experiment suggests any limitations of the method _in general_ which need be noted. It might be suggested, however, that the _range_ of figure ratios be condensed somewhat without reduction of the _number_ of test-figures employed--possibly even an increase; this should result in a finer set of divisions on the scale measuring the amount of the after-effect. It must be admitted that the scale developed in the present set of operations is too coarse to yield much meaning. Further, it is quite obvious that sound experimental procedure would dictate many more sets of judgments for the various conditions employed. In defense of this latter point it can only be said that the design of this experiment included as many judgments as practical considerations allowed; in any event, the results are reasonably clear-cut and exact statistical procedures exist for small samples, as were used in this experiment.

It may be seen from the data which have been presented that under the conditions of this experiment measurable amounts of figural after-effect were produced. Brightness of image was found to have no differential significance in the amount of after-effect. This is under conditions where the absolute value of brightness was equal for the inspection- and test-figures at both the high and low settings. There are at least two possible reasons for the absence of differential after-effect as a function of brightness.

The first possibility concerns a feature of the apparatus and method. In this experiment, the two values of stimulus brightness used are reported as 75 foot-candles and 10 foot-candles measured at the screen. Technical shortcomings prevented the more pertinent measures of apparent brightness at the eye of the subject. Consequently, since it is obvious that the light measured at the screen would be reduced in being transmitted through the screen, and further reduced as it passes the additional distance to the subject, the brightness differential must be something less than 75 minus 10, or 65 foot-candles. Hence, it may be that within the range of brightnesses employed, brightness is not an effective variable; and, as a further implication, extending the range of the brightness to differences actually reaching or exceeding 65 foot-candles might show the variable to be effective beyond such range. However, it was observed during the course of the experiment that the images viewed from the screen side and from the subject's vantage point did not differ discriminably in their appearance of brightness. Consequently, the loss of light in transmission is probably slight although not measured in the present study.

The second possibility concerns a theoretical accounting of process underlying the phenomenon. This possibility seems more plausible to the writer.

A brain-field theory proposed by Köhler accounts for figural after-effects in terms of centrally-located processes of induced cortical resistance and conductivity so that satiation produced by the prolonged stimulation by an inspection-figure induces a perceived displacement in a subsequently-viewed test-figure. This is due to the cumulative, though temporary resistance to change in the cortical pattern that has been established. It may then follow from this brief reference to the brain-field theory that such a brightness relationship might be found.

Proceeding from this theoretical position to a consideration of the present study, it would be possible to predict post facto that no difference of significant proportion should be found as a function of a brightness when the brightness of the test and inspection figures are the same. This prediction follows from the additional assumption that the brain processes, whatever they may be, must occur in degree in some proportion to the strengths of the initiating stimuli. Nearly all the facts of nerve action in nerve trunks and the central nervous system support this contention--although the relation is not always one-to-one. Hence, if it is assumed that the inspection-figure initiates and builds up a brain process to some arbitrary strength A, and the test-figure--viewed alone--initiates and builds up a brain process to a strength B, then, the after-effect of the two viewed consecutively is the result of interaction of the residual, dying out process from strength A competing and modifying the new process building up to strength B_1.

[1] Support for the assumption of building up processes is found in Hammer's study (4) in which it was demonstrated that the amount of after-effect is a direct function of the duration of the inspection-figure.

Consequently, if the physical brightness values of the two figures are the same, the amount of after-effect ought to be relatively constant regardless of the absolute brightness values employed. That is to say, the amount of figural after-effect is a <u>difference</u> relation rather than an <u>absolute</u> relation and while a brighter inspection-figure might build up more potential effect, the equally bright test-figure would tend to overcome the residual effect more vigorously and readily.

The method used in this experiment could be utilized to resolve these possibilities. This line of reasoning carries with it very definite implications which can be subjected to experimental study. If this line of reasoning is correct, then holding the brightness of the inspection-figure constant and varying the brightness of the test-figure should be productive of differential amounts of after-effect in a predictable manner; the same conclusion applies to varying the brightness of the inspection-figure and holding the brightness of the test-figure constant, but in the opposite manner.

Thus an experiment is suggested in which figural after-effect would be adequately measured in relation to the brightness of the stimulus-figures. Three conditions of brightness would be tested by means of employing three experimental groups as follows:

Group I: In Group I, subjects would be shown the inspection-figure at an arbitrary intermediate brightness of (say) 50 foot-candles. The test-figures would then be shown at a discriminably higher absolute value of (say) 90 foot-candles.

Group II: Both the inspection- and test-figures would be shown at the intermediate brightness value of the inspection-figure of Group I.

Group III: The inspection-figure would be shown at the same intermediate brightness value as in Group II, and the test-figures presented at the discriminably lower brightness value of (say) 10 foot-candles.

The results obtained should reflect the greatest degree of figural after-effect for Group III, the least for Group I, and an intermediate amount for Group II.

CHAPTER V

SUMMARY AND CONCLUSIONS

(1) A visual phenomenon termed figural after-effect is described. The possibility that variation in the physical brightness of the stimuli used to produce this effect is shown to be pertinent.

(2) An experiment employing 40 subjects is described. In this experiment subjects of two groups of twenty subjects each reported the changed appearance of a stimulus figure due to figural after-effects, the differences between groups being principally a difference in brightness of the stimuli used.

(3) It was determined under the conditions of the present experiment that brightness of stimulus-figure is not an effective variable in altering the incidence of the effect. However, it is possible that some degree of difference might be found if a greater range of stimulus-intensities and a larger number of subjects had been attainable. The only trend shown by the data was that of no significant differences due to brightness under the conditions of the experiment.

(4) Refinements in the existing methods of gathering these data and in measuring their results are indicated.

(5) Significant differences in the amount of induced figural after-effects should be found upon alteration of the manner of presentation of the brightness variable so that the inspection- and test-figures are given at relative rather

than equal intensities.

An experiment is suggested in which differential measures of the effect of different brightness relationships should be obtained.

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