

A RE-EXAMINATION OF RUBIN'S FIGURAL AFTEREFFECT

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There are very few experiments which unequivocally show form perception to be determined by specific past experience, if by form perception we mean the experience of shape as such. By this definition we mean to rule out influences of past experience which lead to recognition of a form (familiarity) and meaning, which obviously do occur. Leeper's experiment showing a role of past experience in the correct organization of Street Figures does seem to be a case of past experience influencing form perception (4). Another is the Schafer and Murphy experiment (8), although it now is not certain under what conditions their results can be reproduced [(6) but see also (3) and (9)²]. But perhaps the clearest example of a reported influence of this kind is Rubin's famous figural aftereffect (7). Rubin first showed Ss ambiguous figure-ground patterns, instructing them to see each in a certain way. Subsequently these figures were exposed again briefly with instructions to report what was

seen. He found a beyond-chance tendency for Ss to organize the figures in the way they had seen them previously. This past-experience effect on figure-ground perception is not to be confused with the other fact reported by Rubin, namely that recognition of these figures depends upon whether or not they are seen in the same way when re-exposed. We are here concerned only with the first effect.

There is a logical reason, however, why past experience should not determine form perception as here defined. Insofar as past experience with specific shapes is preserved via memory traces, to say that such past experience can determine form is to say that the relevant trace can enter into the process which organizes the percept. But we assume that ordinarily the relevant trace is aroused *after* the form is perceived, that it is selected in some way by virtue of the similarity of the present perceptual process to the trace and that this leads to recognition (10). Before the form is perceived what reason is there for any particular trace to play a determining role, particularly in the light of the fact that the image of the form will rarely fall again in the same place on the retina? This reasoning applies to Rubin's experiment because here a past-experience effect means that the trace (or traces) of any given figure seen in training must make its

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²Recently Prentice and Taylor repeated Smith and Hochberg's experiment with negative results (5).

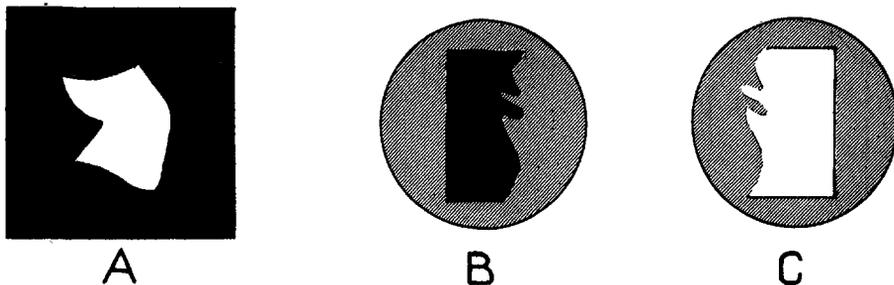


FIG. 1. (A) One of Rubin's figures; the surrounded part was green. (B) The black training figure corresponding to Test Figure 13. (C) The white training figure corresponding to Test Figure 13.

influence felt *before* the ambiguous stimulus is seen one way or the other in the test, which means before one region or the other emerges as the shaped figure. Hence if such effects do occur one has the problem of explaining how they are possible.

In reading carefully Rubin's procedure, however, it was concluded that it contained many serious flaws so that one could not really have confidence that the figural aftereffect actually occurs. Gottschaldt repeated Rubin's experiment and reported that unless Ss expect a test and are set to look for familiar figures during the test, the effect does not occur (2). Since in Rubin's procedure these attitudes were undoubtedly present it might be argued that without them he too would have obtained negative results. But in any case Gottschaldt followed Rubin's procedure in all other respects so that it was still considered advisable to repeat it in such a way as to remove the questionable aspects of the procedure and to give the effect optimum conditions under which to show itself.

Rubin's procedure will be outlined and the questionable features indicated. He used irregular forms of the kind shown in Fig. 1A, in which the surrounded figure was cut out of cardboard and measured about 1.5 cm. square. When placed before a lantern with a green glass plate interposed they were projected on a screen and could be seen as surrounded green shapes or

surrounding black shapes. Two sizes of projected figures were used, either true size 1.5 cm. square or enlarged size 7.5 cm. square (.6 in. square and 3 in. square, respectively). The S sat at a distance of 60 cm. in front of the screen with the projection apparatus behind it.

Rubin worked with three Ss over a period of seven days. Each day S was first presented with a *training series* consisting of two divisions of nine figures each, in one of the sizes employed. In the case of one division, S was instructed to try to see the enclosed portion of each card as figure; for the other, he was instructed to see the surrounding portion of each as figure. The nine figures of each division were shown for 4 sec. each, and the series was presented four times over. Following this, the entire procedure was repeated for the other size figures employed, thus making a total of 36 training figures shown per day, each for a total of 16 sec. From day to day each S was given new figures in the same way.

Following a 30- to 45-min. intermission a *test* was given each day. Rubín shuffled the 36 training figures with 18 new ones and presented them in random order. The Ss were instructed to remain passive and to report whether the enclosed or the surrounding portion appeared as figure and also whether or not the figure seemed familiar (by adding these instructions, Rubín was able to obtain data concerning the recognition effect). In the test, S was given a ready signal and the lantern was uncovered briefly for each exposure; it was covered again as soon as S responded.

The following features of this procedure seem questionable from the point of view of testing the hypothesis under consideration. As Gottschaldt subsequently pointed out, Rubín's Ss undoubtedly expected that the test figures would contain the training figures because they were asked to report not only which figures they saw but whether they appeared familiar. The latter instructions may even have led Ss to believe that

they were *supposed* to see familiar figures. In addition, the use of so many figures per day was inadvisable because, even without such instructions, *S* might begin to recognize figures after a good number had been shown, so that for the remaining ones he might develop a similar expectation. Worse still is the use of *S* for seven days of experimentation; after the first day he is completely sophisticated concerning the entire procedure. In fact it is not clear from Rubin's description whether the *Ss* were initially naïve concerning the hypothesis. Obviously, it would be preferable to use many *Ss*, each for one cycle of training and test, instead of a few for many such cycles.

Another shortcoming of Rubin's procedure is that his figures were not truly ambiguous, the enclosed portions being slightly favored. His results for the 18 new figures shown during the test each day reveal a dominance of enclosed portion over surrounding portion of about 60:40. However in a repetition of this experiment dealing only with the recognition effect, Dutton and Traill (1) found that most *Ss* experienced great difficulty in seeing the surrounding portion as figure. It would therefore have been of interest to have control data from *Ss* without any previous training with the critical test figures.

Still another major weakness of Rubin's procedure stems from the manner in which *S* obtained experience with the training figures. The *S* was told to see the figures as instructed but he did not always succeed in doing so. Rubin, therefore, distinguishes "obedient" cases where *S* did succeed from "disobedient" ones

where he did not. This difficulty may actually be unfavorable from the standpoint of obtaining the effect because not all of the time allotted to each training figure is necessarily spent perceiving the intended organization. In any case it is unsatisfactory not to be sure what *S* will see in training.

Finally, Rubin apparently did not control exposure time during the critical test. One would judge that the time interval was not too short because it ceased only when *S* responded. This is a serious objection because if this is the case *S* may have had time to reverse the figure.

METHOD

In general, changes were introduced either because it was thought they would facilitate the aftereffect or because they were deemed necessary to make sure that the effect, if obtained, could be attributed to the spontaneous influence of past experience on figure-ground organization.

After exploratory experimentation, 18 ambiguous black-white figures plus one additional sample were prepared (see Fig. 2). They were 2 in. square, mounted on neutral gray cardboards (TV illustration board No. 350), $5\frac{1}{2}$ in. \times $6\frac{1}{2}$ in. A thin border line of black extended around the white fields. This center-contour type of figure-ground pattern was selected because it is more genuinely reversible. The white field on one side could easily be seen as figure against the gray ground and the black field on the other side could also easily be seen as figure against the gray ground. Of the 18

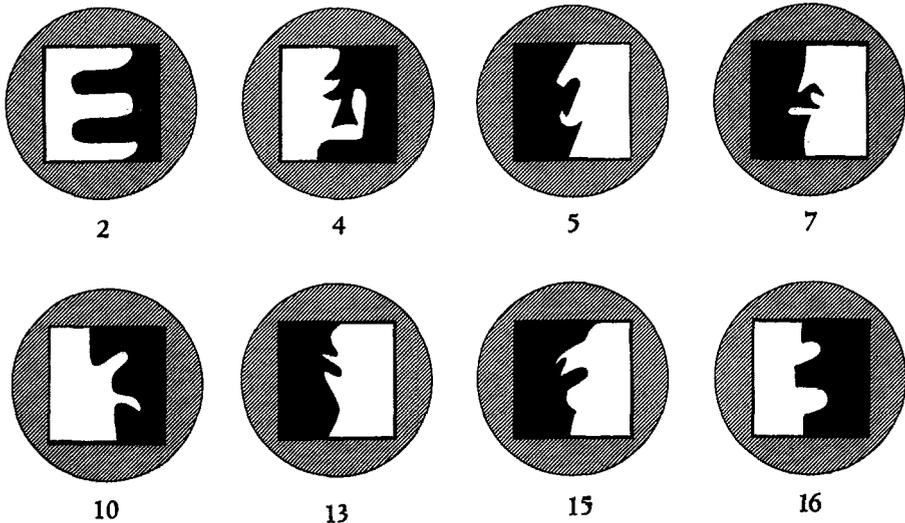


FIG. 2. The eight critical test figures.

figures, 9 had black fields on the left and 9 had black fields on the right. All were nonsense figures.

Eight figures, those which yielded a fairly even division of black and white responses when shown to a control group, were selected for use as critical test figures. From these, eight training figures were prepared for Group A consisting of only one-half of the original figures (Set A). They were thus unambiguous white or black figures on the same gray ground as were the test figures (see Fig. 1 B and C). Four were black and four were white, with two of the black having the contour on the left, two having it on the right, and similarly for white. The complementary halves of the test figures were prepared as training figures for Group B (Set B). This type of training figure was used so that there would be no doubt that *S* experienced just the half of the critical figure intended during training. Only eight critical figures were used, separated in the test by completely new ones, in order to prevent *S* from becoming aware, soon enough for it to influence the results, that previously seen training figures were being shown in a new setting.

The apparatus consisted of a modified Dodge Tachistoscope, the arms of which measured 38 in. With *S*'s head resting against the apparatus so that he was looking down one of the arms and the figure placed in a slot at the other end, *S* was 38 in. from the figure. A variable shutter was placed inside one of the arms with a plunger extending outside. It was connected to the light sources in each of the two arms. A cardboard with a circular opening equal in size to the shutter opening was placed in the other arm at the same distance from the corner mirror so as to coincide exactly with the shutter opening. The experimental room was kept in semi-darkness.

When the shutter was closed *S* saw through the circular opening of the cardboard a portion of the homogeneous gray surface of a 5 × 7 in. cardboard inserted at the end of one arm. This served as the pre- and postexposure field. It was matched in hue and brightness to the exposure field itself. When the plunger was depressed, part of the exposure field (a 5 × 7-in. gray cardboard) containing the 2-in. square figure inserted at the end of the other arm, was seen within the circular opening of the shutter. The *S* used one eye to eliminate double imagery of the shutter opening.

Training.—To allow the experience with the half-figures to be acquired without disclosing the purpose of the experiment, *Ss* were led to believe they were participating in an experiment on extrasensory perception. They were told to look at each figure for as long as it was ex-

posed and attempt to "project its image to another person in another room." The eight training figures were then each exposed for 2 sec., eight times over, the order being randomized for each complete presentation.

Intermission.—In order to prevent any expectation of a test from developing, *Ss* were then asked to construct a design from little colored pegs for the next 5 min.

Test.—The eight critical test figures were presented together with 10 new figures of the same type (5 black on right, 5 black on left). The order of the 18 cards was arranged in such a way that any two critical cards were always separated by at least one new one. The eight critical figures were so arranged that a figure for which the training figure had been white was followed by one for which it had been black, etc. The color arrangement of each figure (i.e., whether black or white is on the left side) was alternated from figure to figure from the first to the eighteenth.

Each card was exposed for 1 sec., this exposure time being selected after an initial failure to obtain the effect with shorter exposures. It was decided to allow 1 sec. inasmuch as Rubin did not control his time interval and it may have been that long. A ready signal was given prior to each exposure.

The *S* was first given a brief explanation of figure-ground perception by means of a sample figure. He was made to understand that each test figure could be seen in either of two ways and that *E* was interested in knowing whether in any given card the black or the white portion appeared to him as the figure. No request was made to report whether a figure appeared familiar. The *S* was also required to indicate the side on which he saw the figure. This served as a rough check that *S* had responded with the color he had in fact seen as figure. In this respect there were virtually no errors among all *Ss* in all the variations performed. The *S* was also given the option of reporting "neither" or "both."

Also, a recognition test was introduced in order to demonstrate that the training with the unambiguous half-figures had indeed been effective. At the end of the test the critical figures were presented again (but now not tachistoscopically, in order to allow time to examine the two alternatives) and *S* was asked to identify the half of each figure which looked familiar. Evidence of retention would require more correct recognitions than could be expected to occur by chance. To prove the effectiveness of learning in this way may be considered gratuitous since the only purpose of the training was the establishment of past experience with the half-figures. It may be assumed that these

were perceived, leaving traces of themselves, and that this is sufficient for an influence on later perception even if subsequently they cannot be consciously identified. Nevertheless, the objection might be raised, and this would apply to Rubin's experiment as well, that the training had not been sufficiently extensive to expect such a past-experience effect to occur. This objection is met if the training was sufficient to enable Ss to identify the training figures even after the critical test.

Control group.—These Ss were given 1-sec. exposures of the 18 figures in the test series without any prior training and in exactly the same way as the experimental Ss. This provided data concerning the way the critical figures tended to be organized without prior experience with either half of the figure-ground patterns.

Subjects.—An approximately equal number of male and female undergraduate students were used in all groups. There were 15 Ss in Group A, 15 in Group B, and 20 in the control group.

To summarize, the present experimental procedure differed from Rubin's in the following ways: (a) The figures differed in the direction of being more genuinely reversible. They were the center-contour type of ambiguous figure. (b) The training figures were half-figures which insured that the experience was with the half intended. Rubin used ambiguous figures with instructions to see each in a particular way. (c) The figures were 2 in. square at a distance of 38 in. from S. Rubin's figures were either .6 in. square or 3 in. square at a distance of 60 cm.

(24 in.) from S. (d) The projection apparatus differed primarily in that it provided a pre- and postexposure field while Rubin's did not. (e) In several ways the procedure eliminated expectation of a test which might lead Ss to look for familiar figures: the instructions deleted the request to report whether a figure appeared familiar; naïve Ss were used for only one cycle each rather than a few Ss used for a complete cycle of the experiment on seven successive days; the training session was disguised as an extra-sensory perception experiment. Considerably fewer figures were used than in Rubin's experiment. (f) Exposure time was limited to 1 sec. by tachistoscopic presentation. (g) Training consisted of eight 2-sec. exposures of each figure rather than of four 4-sec. exposures. (h) The intermission period was shortened to 5 min. (i) A control group was included. (j) A recognition test was introduced following the main test.

RESULTS

Of the 18 figures shown to the control group, the black and white halves were seen about equally frequently in eight. Consequently these were selected as critical figures. Four had black on the left and four had black on the right. For these eight critical figures there were altogether 76 responses to Set A halves and 71 responses to Set B halves (Table 1).

TABLE 1
RESPONSES TO THE CRITICAL FIGURES

Critical Figure	Group					
	Control (N=20)		A (N=15)		B (N=15)	
	Set A	Set B	Training Half (Set A)	Non-Training Half (Set B)	Training Half (Set B)	Non-Training Half (Set A)
2	11 (B)	9 (W)	12	2	6	7
4	10 (W)	10 (B)	5	8	11	4
5	10 (B)	8 (W)	7	5	10	4
7	10 (W)	10 (B)	6	8	7	8
10	8 (B)	9 (W)	7	7	6	8
13	8 (W)	8 (B)	9	6	6	6
15	9 (B)	9 (W)	4	9	10	5
16	10 (W)	8 (B)	6	6	7	6
Sum*	76	71	56	51	63	48

* "Neither" and "both" responses are not included.

The mean number of correct identifications obtained in the recognition test for the 30 Ss of Groups A and B was 6.0 with an *SD* of 1.3 (the mean for incorrect identifications was 1.5 since *S* did not make a choice in every case). This value differs significantly from chance at the .001 level. The experience with the training figures was sufficient to allow for subsequent recognition. It seems, therefore, that this training should be sufficient to allow for a past-experience effect on figure-ground organization if there is such an effect.

As shown in Table 1, in the critical test Group A gave 56 responses to Set A halves and 51 responses to Set B halves, and Group B gave 63 responses to Set B halves and 48 responses to Set A halves. As one can see by inspection, the differences between the distribution of results for Group A and the 76:71 distribution for the control group is not significant. Nor is the difference between the distribution of results for Group B and the 71:76 distribution for the control group significant ($\chi^2 = 1.6$, $P < .3$ for 1 *df*). Comparison of the total responses to those figures seen in training (119) and those not seen in training (99) for both experimental groups combined, also reveals no significant effect ($\chi^2 = 1.8$, $P < .2$ for 1 *df*).

The following variants of the analysis of these data were used, always with the conclusion that no significant effect resulted from the training: (a) consideration of the results only for Ss having very high recognition scores; (b) elimination of the results of the few Ss who responded with what appeared to be either positional sets or color sets; (c) comparison of the results in terms of the number of Ss seeing more training than nontraining against the number

seeing more nontraining than training halves; (d) determination of whether the number of Ss who do seem to show the effect are in excess of chance.

The results reported above duplicate findings obtained in an earlier version of this experiment, the procedure of which differed in the following respects. A projection-type of tachistoscope was used which cast an image $9\frac{1}{2}$ in. square on a screen 84 in. from *S*. The critical test figures were not selected on the basis of the control data. The eight training figures were each exposed for 4 sec., four times over. The intermission lasted 10 min. during which time *S* identified Street Figures. A recognition test was not included. The results of this experiment with 30 Ss also did not reveal an effect of past experience.

DISCUSSION

Although negative results were obtained, it is impossible to establish conclusively that an effect such as this cannot be obtained under *any* circumstances. On the other hand, it seems correct to say that the failure to duplicate Rubin's results shows that the type of past-experience effect he had in mind does not occur with a procedure designed to reveal it. If the effect requires very special conditions to show itself then this necessitates a drastic change in the evaluation of its significance.

It is not known whether an effect of past experience would have been obtained if the present procedure were modified by giving *S* the additional instruction to report whether a figure appeared familiar. But an effect which requires a set such as would no doubt be induced by these instructions could not be regarded as evidence of a spontaneous influence of past experience on figure-ground perception. Under the influence of such a set Ss might tend to look for the familiar half. Even in a fairly brief exposure there would be time to organize first one and then the other half as figure. The one recognized would probably then be reported. This would be evidence of an effect of past experience on recognition but not on perception.

It may be objected that the use of the unambiguous halves of the ambiguous figures in training, rather than the ambiguous figures themselves under instructions to see them in a particular way, changes the *kind* of past experience *S* gets. In Rubin's procedure *S* sees an *ambiguous* training figure in a particular way and the question is, will he tend to see it again in the same way? In the present procedure, *S* sees an *unambiguous* training figure and the question is, will he tend to see this figure when an ambiguous pattern, containing it as one possibility, is shown? A first answer to this objection is that there seems to be no practical way of using an ambiguous figure in training while guaranteeing that *S* will see it in the desired way, and only in this way, each time it is shown. A second answer is that the organized percept is presumably identical whether one sees an unambiguous figure or whether one sees as figure that same geometrical shape in an ambiguous figure-ground pattern.

In a repetition of the Schafer and Murphy experiment by Rock and Fleck it was pointed out that for many *Ss* the training faces appeared somewhat different when seen in the ambiguous test pattern (6, p. 774). In the present experiment, however, there was no evidence of this, and there is the excellent recognition test results as proof that experience with the half-figure sufficed for recognition of it when the full figure was exposed.

The results of this experiment can also be viewed in relation to the problem of the influence of motivation on perception. It is likely that if motivation influences perception it does so through the influence of traces representing the need-related objects (10). Consider the Schafer and Murphy experiment which structurally is very much like Rubin's experiment. In the former, there are also two alternatives in the ambiguous figure-ground test situation. The perception of one has been previously

rewarded and the other punished. If, however, reward and punishment is to have an effect, it can only be via the traces of these training figures. One might say, for example, that the trace of the previously rewarded figure is somehow stronger or more strongly cathected or dominant in some way in comparison with the trace of the previously punished figure. Thus the rewarded traces can be expected to be more effective than the punished ones. But in the Rubin experiment the demands made for the appearance of the effect are simpler. Here there is a trace for one alternative and *none* for the other. If the effect does not occur in the trace vs. no-trace situation why should it be expected to occur in the cathected vs. noncathected trace situation? Hence if this effect is confirmed in subsequent investigations (in view of the contradictory results with differing conditions thus far) we will be faced by a puzzling problem of interpretation.

SUMMARY

Rubin's experiment showing a tendency to organize ambiguous figure-ground patterns in accordance with past experience was repeated with certain modifications. Questionable features of the original procedure were eliminated. The effect was not obtained.

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