maining 18 animals in each of the "donor" groups were used to provide comparisons for the five experimental groups. At 18 hours after injections, all animals were given inhibitory avoidance training as described. The amount of time each animal stayed on the small platform before entering the darkened hole was recorded on each of two test trials. The latencies of the recipients of "trained" RNA did not differ significantly from those of animals in the other groups (Table 5). In contrast, it should be noted that with the exception of but one animal, those animals which were originally trained demonstrated criterion performance on the two retention tests.

In conclusion, the numerous variables which provided unsuccessful attempts to demonstrate "transfer of learning" should be summarized. First, several training and testing tasks have been used in both the preparation of the "donor" animals and the subsequent assay for "transfer of learning" effects. As may be judged from the number of trials required for original learning by "donor" animals, these tasks cover a wide range of relative difficulty. Spontaneous activity measures and response latency scores were included to provide an assay of more general transfer effects that might not necessarily be associated with learning. Motivational variables manipulated included foot shock, water deprivation, and cold-water immersion. Additional variables included the use of two species of animals, the degree of "donor" training, and the inclusion of testing intervals longer than those previously reported (*3, 6*). Under these diverse conditions, the results provided no evidence of "transfer of learning." The nucleic acid extraction and administration procedures were selected to minimize the possibility of losing any fraction that might be responsible for the "transfer of learning." Cold phenol extractions and precipitations with and without $MgCl_2$, as well as hot phenol extraction with SDS, failed to yield an "active" fraction of nucleic acid. Because of the lack of evidence that nucleic acid crosses the blood-brain barrier after I.P. administration, the nucleic acids were introduced directly into the brain by intraventricular injections. Yet, even under these conditions, there was no evidence for a "transfer" effect. Finally, the amount of total nucleic acid injected into the test animals was varied from the equivalence of nucleic acid from one brain to the equivalence from three brains. Still no "transfer" effect was found.

Although the training schedules and devices used have proven very effective in other studies of conditions affecting learning and memory, findings of "transfer of learning" via RNA reported by others (*3, 6*) were not corroborated in our laboratories. Rather detailed replications of those procedures originally reported as successful (*3*) have also failed to produce "transfer of learning" effects (*7*). Such negative findings suggest that the reported "transfer" effect, if it exists, is either a very limited phenomenon or a very difficult one to reproduce.

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Imagery: Effect of a Concealed Figure in a Stimulus

Abstract. *A concealed figure formed by the contours of a perceptually dominant figure influenced the content of viewers' subsequent imagery, although in describing the stimulus they showed no awareness of the concealed figure even after several exposures.*

In a common picture puzzle, the contours of a perceptually dominant figure conceal a recessive but independently identifiable shape. The concealed form is rarely spontaneously perceived. Normally, not until the viewer is told what to look for and where to look does he perceive the hidden figure.

What is the psychological status of such a concealed figure? According to the Gestalt point of view (*1*), it should have no independent status as a percept within the total configuration; only when the field is reorganized so that the concealed shape becomes figural ought it attain perceptual effectiveness.

Another view is that the stimulus potency of the concealed figure as meaningful content is not ruled out by its being experientially weak or never consciously perceived (*2*). One possibility is that some response evoked by a picture which contains a concealed figure will include content provoked by that figure. According to this view, the actually reportable percepts are only a segment, although the dominant one, of an ensemble of responses and associations activated by the entire configuration. The ensemble includes reported and unreported connotations of the dominant percept, and unperceived but nevertheless registered aspects of the picture array as well. These recessive particulars of the configuration are not likely to be evident in a direct report of perception but may emerge indirectly in freer, more open-ended modes of response, such as imagery. The present experiment was concerned with the question whether an unreported concealed figure will influence subsequent imagery.

The experimental stimulus, taken from Elkind *et al.* (*3*), was a picture containing two forms, a perceptually dominant tree and a perceptually recessive duck shaped by the branches of the tree; the control stimulus showed only the tree modified so as to eliminate the outlined duck (see Fig. 1). All subjects were instructed as follows: "A picture will flash on the screen three times. When the picture goes off, I want you to sit back, relax, close your eyes, and wait for an image of a *nature scene* to come to your mind's eye.

Fig. 1. The figure used as the experimental stimulus (right) contains a perceptually recessive duck, which is eliminated from the control stimulus (left).

When you get a visual image of a nature scene draw it on the paper in front of you." Imagery was restricted in this fashion because we believed that a task consonant with the theme "duck" might potentiate associated meanings of the concealed figure and thereby contribute to its stimulus potency.

The subjects were 310 male and female undergraduates of local universities, tested in seven classroom groups that varied in size from 18 to 94. In four of the groups, the tachistoscopic stimulus exposure was 1 second; in three it was 1/100th second. Subjects in each class were divided by rows or odd and even seats into an experimental and a control subgroup. The experimental subjects were asked to close their eyes and rest their heads on their desks. A 2-by-2 slide of the control stimulus (tree alone) was then exposed to the control subjects three times in succession by means of a tachistoscopic slide projector. Then the control subjects in their turn rested their heads on their desks while the experimental subjects were shown the tree-plus-duck stimulus three times. All subjects had the same task—imaging a nature scene and then drawing it. After the drawings were completed, the subjects were told to label the various parts. Their ability to recognize the presence of the duck form was then tested by a procedure to be described later in this report.

The rationale of the experiment was that if the hidden figure of the duck was effective as a stimulus, that is, if it registered, it would activate associations which would be discernible in the imaged nature scene. It was therefore necessary in advance of the experiment to discover the associations that are spontaneously elicited by the duck stimulus under normal viewing conditions. For this purpose, an independent sample of subjects similar to the subjects of the main study were shown a picture of the duck as a separate figure and asked to give a different verbal association after each of five presentations (*4*). The following responses were most frequent: "duck," "water," "birds," "feathers," "animals," "whiteness," "nest," "food," and "humans." In assessing the drawings of the control and experimental groups, the appearance of any of these items was scored as "duck-related" content. The drawings were coded and rated blind by two judges. Agreement between judges was perfect except for a few instances where subjects had neglected to label ambiguous parts of their drawings; these cases were resolved by discussion.

Analysis of the data may be focused in two ways: one, by comparing the number of subjects in the experimental and control conditions who had duck-related images; the other, by comparing the frequencies of duck associates in the images (an image could, of course, contain more than one such associate—for example, bird and water). The first comparison is more critical for this study, since the crucial question is whether or not the associative realm of the duck stimulus had been at all activated.

In each of the seven groups, a greater proportion of experimental than of control subjects had duck associations in their drawings. In the four 1-second-exposure groups combined, 46 of 91 control subjects (50 percent) and 56 of 81 experimental subjects (69 percent) had duck associates in their drawings ($Z = 2.48$, $P < .007$, one-tailed). In the groups with the 1/100-second exposures, the comparable figures were 35 of 71 (49 percent) for control subjects and 43 of 67 (64 percent) experimental subjects ($Z = 1.77$, $P < .04$, one-tailed).

With the 1-second exposure, the average frequencies of duck associates were also greater in the experimental group than in the control group (1.05 as against 0.73, $t = 2.39$, $df = 170$, $P < .01$, one-tailed). There was no significant difference in this respect, however, between experimental and control groups with the 1/100-second exposure (0.88 as against 0.72, $t = 1.00$, $df = 136$).

In order to determine whether differences among subjects in their capacity to perceive the camouflaged duck had anything to do with the likelihood of its intrusion upon the images, we tested their recognition thresholds as follows, after they had finished their drawings: For the 1-second-exposure groups, the tree-plus-duck stimulus was again presented in three 1-second exposures (step 1), and the subjects were asked to write a careful description of everything they saw. In step 2, the three 1-second exposures were repeated with the prior clue, "There is something in the picture in addition to the tree—what is it?" In step 3, this clue was repeated, and the stimulus was exposed for 30 seconds. In step 4, the stimulus was again exposed for 30 seconds with the prior statement, "There is a duck somewhere in the picture—find it." The subjects wrote their answers after each step. The 1/100-second-exposure groups went through the same procedure, except that the first exposure was 1/100 second as it had been in the experiment proper; this was followed by the four steps already described. Recognition was scored when a subject indicated he saw a duck, goose, swan, or, on the last trial, correctly indicated the location of the duck. A tally was made of the successful subjects at each step.

It should first be remarked that no subject spontaneously reported seeing the duck during the experiment proper. Of the 310 subjects, only one experimental and one control subject reported the duck on the first step—that is, after the same exposure as they had had in the experiment proper. Even at step 4, with a 30-second exposure and the information that "there is a duck somewhere in the picture," well over half the subjects failed to recognize the duck.

The presence of duck associates in the images was analyzed in relation to (i) the step at which the duck was recognized and (ii) recognition or failure to recognize the duck at any threshold step. In neither analysis did the chi-squares approach statistical significance. Thus it is evident that the ease or difficulty of recognizing the duck stimulus or, in fact, ability to recognize it at all had no bearing on the probability that duck associates would appear in the images.

It could be argued that subjects in fact consciously perceived partial cues (such as the duck's beak) from the hidden figure but did not report them, and that these cues would influence subsequent imagery. This argument cannot be entirely ruled out, but it is made less tenable by the fact that even after many exposures (six for the 1-second group and nine for the 1/100-second group) and the hint that "there is something in addition to the tree," only 9 of the 148 experimental subjects reported the presence of a duck, and no subject reported any partial cues related to duck. Nevertheless, the partial-cue argument is in a sense unanswerable, for it is always possible that unreported "fleeting" perceptions occurred. But perceptions too fleeting to be reported would seem to be operationally indistinguishable from stimulus registrations without awareness.

The fact that the 1-second exposure yielded a more clearcut effect than the shorter exposure suggests that greater opportunity to view the stimulus configuration is an important factor in obtaining the reported effects. Since the 1/100-second exposure allowed only a single fixation, it is likely that the subjects in that part of the experiment more often failed to view the background elements in the picture.

We propose the following hypothesis: The concealed duck registered, and it primed associations, that is, increased the probability of their occurrence (*5*). The nature of the task—that is, to form an image—allows the subject considerable latitude in the content of his responses. The emergence of particular contents associated with duck was encouraged by their congruence with the theme of a nature scene. Thus the instructions enabled the otherwise weak activations of the background stimulus to have some biasing effect. The experiments illustrate, then, a condition for the intrusion of a peripheral, concealed form: when both intended response and incidental activations are congruent in themes, and when the task is one that allows for a multiple response, there is created a setting favorable to intrusion of background, unattended elements of the stimulus into the stream of conscious thought.

Whether one conceptualizes the registration process of the concealed form as "fleeting" perception or discrimination without awareness, the results call into question the notion that a background form is a stimulus only insofar as it contributes to the perception of the phenomenally dominant figure, or becomes a dominant figure itself as a result of figure-ground reversal. Rather, the results suggest that the background can be independently registered, and that it is capable of influencing, under certain conditions, the subject's response to the total configuration.

Very likely the background form is only ground in regard to the perceptual experience of the dominant figure, as Gestalt psychology emphasized. We are suggesting, however, that connotative aspects of the ground, although apparently unperceived, may become manifest in nonperceptual response modes such as imagery. Thus, the figure–ground differentiation may be less relevant in accounting for the effects of registration than in accounting for the preferential selectivity of conscious perception.

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Computer Stereography

Finkle's letter about computer production of Lissajous figures [*Science* **148**, 1541 (1965)] and Knowlton's article "Computer-produced movies" [*ibid.* **150**, 1116 (1965)] lead us to report on work in which we use the computer to produce stereographic representations of mathematical functions and geometric objects.

Originally this work was directed toward the analysis of functions, and digital-computer contouring procedures were developed to study complicated functions associated with problems of optimal orbital transfer. This technique allowed one to contour a 20-by-20 array of data points in a few seconds using an IBM 7094 and a SC4020 CRT.

A contour map composed of straight line segments resulted from this procedure (Fig. 1). While such

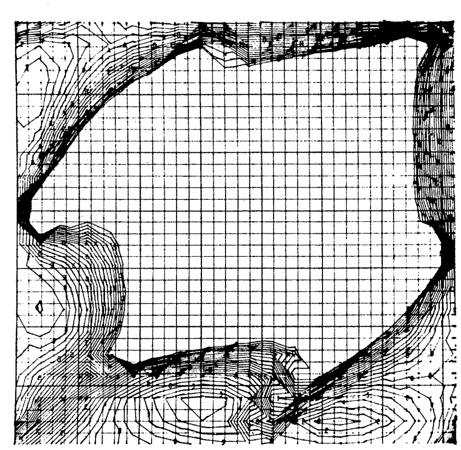

Fig. 1. Contour map of an optimum impulse function.