lost to raccoons which repeatedly raided the live traps.

9. The radio frequency of the transmitters varied less than 200 kc/sec after implantation. Our receiver was a Commaire PT-27, Vocaline Co., Old Saybrook, Conn. (nominal sensitivity 0.1 μv increased with a 6-db gain preamplifier).
10. Supported by NSF grants RG 18106 and GB 2365 and by a grant from the faculty research funds of Swarthmore College. One of us (P.H.H.) was supported by the NSF undergraduate research participation program. D. R. Griffin, Harvard University, made available the field facilities and helped with the report.

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Luminous Figures: Factors Affecting the Reporting of Disappearances

Abstract. *Subjects fixated luminous figures in darkness and reported the parts, either points or lines, that disappeared. After carefully controlled instructions, almost half of the disappearances were of lines and less than 20 percent were of fixation points, thus refuting the argument that meaningful disappearances are artifacts of the manner of fixation.*

The extent of the influence of past experience upon perception is one of the classical psychological problems that continues to pose intriguing questions. Recently, McKinney (*1*) suggested a very simple new technique for studying some aspects of this problem.

When a person fixates on a luminous figure in a darkened room, the figure appears to fragment, with parts disappearing and reappearing rapidly. In his initial report of this effect, McKinney stated that whole lines tended to drop away, leaving meaningful perceptual units intact. One luminous figure, for example, included the letters "*HB*." When fixating on this design, some subjects reported that lines dropped away leaving only the letter *H*, then the letter *B*, or the number *3*, or the number *13*.

This result, so comparable to earlier outcomes with stabilized retinal images (*2*), was interpreted as a demonstration of the influence of past experience upon perceptual organization (*3*).

Such claims were disputed by Hart (*4*), however, who recorded the verbal reports of subjects as they viewed luminous figures like those illustrated in Fig. 1. He found that line disappearances constituted only a relatively small proportion of the total disappearances, and that usually the part which faded from sight was the viewer's fixation point. Because of this relation between the disappearance of a part and the point of fixation, Hart (*4*) concluded that the meaningfulness of fragmentation is probably due to the meaningful way a subject scans and fixates the design rather than to anything inherent in the perceptual process itself.

Upon our request, Hart sent us his raw data and a complete description of his procedure. Unfortunately, certain aspects of his method make an evaluation of his data difficult, since an opportunity for bias occurred in the instructions repeated to each subject before presentation of the test figure. Even though the comparison between disappearances of lines and points was crucial in Hart's study, these instructions contained the word "point" nine times, but the word "line" was never mentioned. Moreover, it is possible that Hart's procedure favored the reporting of points in yet another way by providing the subject with a convenient letter "name" for each point in the test figure but failing to provide equally convenient labels for the lines.

In our first study, all details of Hart's procedure were duplicated, but the data failed to show the preponderance of fixation-point disappearances that was obtained by Hart. In the second study, the procedure was modified in an effort to eliminate any factors that might bias the reporting of disappearances toward either points or lines. This modified procedure about doubled the proportion of lines reported and, once again, failed to show a preponderance of fixation-point disappearances. Twelve naive undergraduate subjects were used in the duplication of Hart's fixation condition. The figures (Fig. 1) were made up of lines, 2.5 cm wide and 15 cm long, painted in luminous paint (Craftint Nite-Brite) on black display board. The subject viewed the luminous figure at a distance of 2.7 m in a darkened room, and his reports of fragmentations were collected by tape recorder. In a practice session, each subject was told to report "any changes" he noticed in the sample figure (Fig. 1*A*). During this session, the experimenter used only verbatim phrases from Hart's instructions for prompting and correcting the subject's report. These included instructions to keep from blinking or moving the head, to make reports continuous and complete, to report disappearances seen anywhere on the figure, to distinguish dimmings and disappearances but to refrain from reporting apparent movement.

The subjects then viewed each of the two test figures (Fig. 1, *B* and *C*) for three 2½-minute periods, with instructions to fixate on a different point, either *a*, *b*, or *c*, during the three periods with each figure. The Hart replication is called group *R*.

Twenty-four additional subjects (group *M*) viewed the Hart figures under modified conditions. In the practice session, 12 of these subjects were shown the luminous sample figure and also a schematic diagram of it in which the lines were labeled with numbers and the end points and the point of intersection with letters (see Fig. 1*A*). The experimenter explained to the subject that he was to report all disappearances as accurately as possible, but that, since changes occur quite rapidly, labels were provided to make reporting easier. The subject was instructed to report the disappearance of a line or point by saying the appropriate letter or number. If the midpoint of a line dropped away, he was to say "Mid-___," filling in the proper number. If the entire figure disappeared, he was to say "all." After these instructions, the experimenter pointed with equal frequency to the various lines and points of the sample figure until the subject responded quickly and smoothly and without referring to the schematic diagram. This approach guaranteed the subject a readily available name for each kind of disappearance in Hart's scoring categories before the testing session began.

The same procedure preceded the viewing of each test figure. Labels for the test figures corresponded to those in Fig. 1, *B* and *C*. An identical procedure was used for the remaining 12 subjects with the single exception that the points were labeled with numbers and the lines with letters. In all other respects, the original Hart conditions were duplicated for all 24 subjects in the modified replication.

For both test figures, the proportion of disappearances reported by each subject was calculated for fixation points, nonfixation points, lines, and the entire figure. In the upper part of Fig. 2 are presented the mean proportions for test figure *B* along with the comparable proportions calculated from Hart's original data; in the lower part are presented the same data for test figure *C*. All statistical comparisons cited in this paper were *t*-tests; the tests involving mean proportions were calculated by means of arcsin transformations.

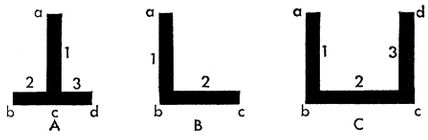

Fig. 1. Sample (*A*) and test figures (*B* and *C*). Lower-case letters identify end points and points of intersection. Numbers identify lines and were used only in the modified instructions condition—that is, group *M*.

Our guess that Hart's original procedure biased the subject against the reporting of line disappearances was clearly supported. For both test figures (whether the lines were labeled with numbers or letters), the modified instructions almost doubled the proportion of lines reported: the differences were significant ($p < .01$) for the comparison of group *M* both with group *R* and with Hart's original data.

The findings concerning point disappearances are not so easily interpreted, however. We were unable to reproduce Hart's data indicating a preponderance of fixation-point disappearances, even in group *R*, where every effort was made to duplicate his procedure. Group *R* and group *M* differed significantly ($p < .01$) from the original Hart data in the mean proportions for both fixation points and nonfixation points, and the order of these statistically reliable differences was comparable, once again, for both test figures. Instead of the preponderance of fixation-point disappearances found by Hart, our data suggest

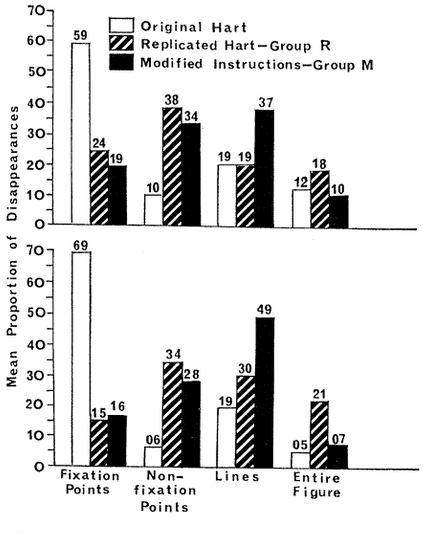

Fig. 2. The upper graph shows the mean proportions of disappearances reported by subjects viewing test figure *B*. The lower graph shows the same comparisons for test figure *C*. Decimal points have been omitted. For Hart's original data, see (*4*).

a relatively greater proportion of disappearances of nonfixation points. In group *M*, for instance, the mean proportion of fixation-point disappearances was only 0.19 for figure *B* and 0.16 for figure *C*.

The same pattern of results was obtained when the reported dimmings (rather than disappearances) were analyzed. In no category were the mean proportions for dimmings significantly different from those for disappearances.

Hart specifically noted that none of his subjects reported the disappearance of point *d*, one which was never fixated. In the present study, however, 7 of 12 subjects in group *R* and 15 of the 24 subjects in group *M* reported at least one disappearance of that point.

Even though our data for group *M* do not reveal a preponderance of fixation-point disappearances, a fixation-point effect is evident when only the disappearances of points *a*, *b*, and *c* are considered. When the proportion of fixation-point disappearances was calculated for each subject, only these three points being considered, the mean proportions were 0.54 for figure *B* and 0.60 for *C*. Both proportions are significantly greater ($p < .01$) than 0.33, the expected proportion under the assumption that the fixation point does not affect disappearances.

Our data also differed from Hart's in the frequency of reported disappearances. Considering only the total number of disappearances reported by each subject, the means for our replication were 17 for figure *B* and 20 for *C*, whereas the respective values calculated on Hart's original data were 35 and 30. Only if the reports of dimmings are pooled with those of disappearances do the values for group *R* compare to those of Hart. However, Hart's preponderance of fixation-point disappearances can not be related in any simple way to this difference in frequency, since the comparable values for our group *M* were 71 and 72, more than twice the values Hart obtained. Obviously, the modified instructions not only increased the proportion of lines reported, but also significantly ($p < .01$) increased the overall rate of reporting as well.

In general, our evidence supports McKinney (*5*) and Clarke and Evans (*6*) who suggested the possibility of two kinds of fragmentation: point-of-fixation disappearances related to receptor distribution on the retina, and more structured fragmentations having a central neural basis. Fixation-point disappearances are not the most likely to be reported, however, unless the experimenter inadvertently induces a response bias. Consequently, the fragmentation problem should continue to have important implications for current theories of perceptual organization.

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7. We thank J. T. Hart for his prompt and full reply to our requests for detailed information about his study and both Hart and J. P. McKinney for their suggestions concerning this report. This research was supported by grant GS-343 to Timothy C. Brock from NSF.

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Discriminative Avoidance Training of Rats

Hurwitz [*Science* **145**, 1070 (1964)] compares two methods for training rats to avoid shock in a lever-pressing apparatus. In both methods shock could be avoided by pressing the lever during the 7.5-sec interval between the onset of a light signal (conditioned stimulus) and the beginning of shock (unconditioned stimulus). In the first method failure to avoid resulted in a train of 0.2-sec shocks spaced at intervals averaging 13 sec. This shock was described as inescapable because a response made after the train of shocks had begun did not terminate a shock pulse if one happened to be on at the time, although it did terminate the series and turn off the light. In the second method, failure to avoid resulted in a continuous shock which had a maximum duration of 10 sec. This shock was described as escapable because a response during the shock terminated it and the light simultaneously. Hurwitz presents convincing evidence that the rats learned to avoid the inescapable but not the escapable shock. In attributing this result to the difference in escape contingency, the