Offprinted from THE AMERICAN JOURNAL OF PSYCHOLOGY
September 1956, Vol. 69, No. 3, pp. 345-358

# THE PERCEPTUAL ELABORATION OF STROBOSCOPIC PRESENTATIONS

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The study here reported was designed to explore the visual perception of contiguous stimulus-patterns rapidly succeeding each other in time. In the case of two such consecutive patterns, it has been found that, under given conditions, the first exposed stimulus-figure may not be represented in the configuration that is perceived. The present study was designed to explore further conditions that elicit this response, and to gain qualitative data that could lead to hypotheses about underlying mechanisms.

This phenomenon in question has been recently described by Peter Scheffler.[1] In Scheffler's experiment a horizontal series of five adjacent squares was used. When the second and fourth of these squares were presented simultaneously, and were followed, 0.1 sec. later, by the first, third, and fifth squares, also flashed simultaneously, *only the last three squares were perceived.* Squares 2 and 4 always manifested themselves as dark intervals, especially if 1, 3 and 5 were fixated. Only if Squares 2 and 4 were attentively fixated and full concentration was applied to them. could an indication of light be perceived in them.

Scheffler found the interval of 0.1 sec. between the two exposures optimal for the effect. He also emphasized the importance of similarity of the squares. Lowering or raising the intensity of one of the banks relative to the other, for instance, could offset the phenomenon.

* Received for publication June 14, 1955. The study was supported under Contract N6onr27014b between Princeton University and the Office of Naval Research. It presents a summary of a dissertation submitted to Princeton University in fulfillment of a requirement for the Doctorate in Philosophy.

[1] Peter Scheffler, Versuche aus dem Institut für experimentelle Psychologie der Universität Innsbruk: Gestaltete Zeitwahrnehmung (manuscript). Also see Wie sehen wir Bewegung?, *Pyramide*, 10, 1951, 181-184.

Qualitative data showed that the lights in the first bank (2 and 4) were not totally eliminated from the percept. The visible squares looked different when Squares 2 and 4 were omitted from the stimulus-presentation. Small imperfections in the first squares communicated themselves to the three visible squares. On the whole, the nature of observations was subject to considerable variation, and it was even possible to see the three squares flashing twice. Apparent movement was sometimes reported.

The fact that the first of two adjacent and rapidly consecutive stimulus-presentations may not receive proportional representation in the percept has been known for some time. The principal heading under which this phenomenon has appeared in the literature is that of *metacontrast*. Metacontrast has been attributed to an inhibition-effect exercised by the second stimulus, and thus it is defined as "the depressing effect of the second of two brief adjacent asynchronous excitations on the sensory impression produced by the first."[2]

Metacontrast as such was first demonstrated by Stigler in 1910,[3] although precursors have been cited in Sherrington and McDougall.[4] Stigler found that in successively exposing two halves of a geometrical figure (such as a disk) the first half was almost imperceptible to observers, except for its outer border. Later investigators have used presentations in which the second stimulus bordered two sides of the first, and their experiments have determined the conditions optimal for the inhibition of the center flash by the two adjacent flashes following it. The most significant studies in this literature are those of Fry, Piéron, and more recently, Alpern, who has also reviewed earlier work.[5] The findings of these studies may be roughly summarized as follows: (1) The effect increases with the time-interval between 'a' and 'b' flashes, up to 100 m.sec. or 150 m.sec. after which it decreases to zero.[6] (2) The effect increases with the brightness or duration of the 'b' flashes, and decreases with increased brightness or duration of the first flash. (3) The effect takes place only with contiguity or near-contiguity of the flashes.

All the investigators cited have viewed metacontrast basically as a product of neural or chemical inhibition effects in the retina, although Piéron discussed secondary cortical elaborations, such as apparent movements and "eccentricity of rotation

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[2] Mathew Alpern, Metacontrast: Historical introduction, *Amer. J. Optom.* 29, 1952, 634.

[3] Robert Stigler, Chronophotische Studien über den Umgebungskontrast, *Arch. f. d. ges. Physiol.* 134, 1910, 365-435.

[4] Alpern, *op. cit.*, 631-646.

[5] Glen Fry, Depression of the activity aroused by a flash of light by applying a second flash immediately afterwards to adjacent areas of the retina, *Amer. J. Physiol.*, 108, 1934, 701-707; Mechanisms subserving simultaneous brightness contrast *Amer. J. Optom.*, 25, 1948, 162-178; Henri Piéron, Le processus du métacontraste, *J. psychol. norm. Path.*, 32, 1935, 1-24; Le métacontraste, *Ibid.*, 32, 1935, 651-652; Alpern, Metacontrast, *J. Opt. Soc. Amer.*, 43, 1953, 648-657; The effect of luminance of the contrast inducing flashes on the spatial range of metacontrast, *Amer. J. Optom.*, 31, 1954, 363-369; Alpern, *op. cit.*, *ibid.*, 29, 1952, 631-646.

[6] In discussions of stroboscopic experiments alphabetical order traditionally indicates flashing order. The positions of the letters with respect to each other represents the spatial arrangement of the figures.

of . . . the rings which one does see, which is due to the visual action of the inhibited or unrecognized stimulus."[7]

Research on metacontrast has traditionally been done monocularly. Stigler, however, investigated the possibility of binocular metacontrast using adjacent areas on different retinas. Although he claimed to have been successful he never published relevant data.[8] Baumgardt and Segal, in the course of a paper dealing with the physiology of inhibition and facilitation, also reported having obtained metacontrast across retinae.[9] A confirmation of this finding, needless to say, would make it difficult to think of metacontrast as purely a retinal inhibition.

Werner's *masking experiments* may also be regarded as related to the present study, since the effect obtained was precisely that of the first of two stroboscopically or tachistoscopically presented figures not being perceived.[10] The presentation consisted of two black-on-white figures, the first of which was a solid figure that fitted into the second, a frame for the first. With exposures of 12–15 m.sec., and intervals of 120–240 m.sec., the first figure, according to Werner, "will disappear." Werner regarded such effects as the result of "contour appropriation." According to this hypothesis structuration takes place toward the contour, and to follow up one figure with a frame deprives the first figure of its contour before the completion of structuration, and hence prevents the figure from being built up.[11]

A third type of experiment in which closely similar observations have been made is that of *apparent movement*. Wertheimer made mention of instances in which the first of two stimulus figures was not seen, and movement was observed in the "surviving" figure.[12] His emphasis on "pure phi" suggests the suppression of one or both terminal stages in the percept. More recently, Willey, in the course of experiments concerning combinations of apparent movements, states: "Sometimes there was movement from one member of the first pair of lights to both members of the second pair. *The other member of the first pair of lights was not seen at all.* or was seen as motionless and independent."[13]

A systematic study of apparent movement when alternative terminal stimuli are presented was conducted by Paul von Schiller.[14] His study dealt principally with the factors of time and distance set over against similarity of the initial and final stimuli. Under some circumstances Von Schiller found that the a-figure would be seen as moving to both b-figures, if necessary changing shape en route. This observed tendency of the a-figure to transform itself in every possible respect into the b-figure, Von Schiller called the tendency to total assimilation (*Tendenz zur*

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[7] Piéron, *op. cit., J. psychol. norm. Path.*, 32, 1935, 14-15. See also *ibid.*, 24 and 652.

[8] Cited by Alpern, *op. cit., Amer. J. Optom.*, 29, 1952, 631-646.

[9] Ernst Baumgardt and J. Segal, Facilitation et inhibition. Parametres de la fonction visuelle. *Année psychol.*, 43-44, 1942-1943, 54-103.

[10] Heinz Werner, Studies in contour: I. Qualitative analysis, this JOURNAL, 47, 1935, 40-64.

[11] Werner, *op. cit.*, 42.

[12] Max Wertheimer, Experimentelle Studien über das Sehen von Bewegung, *Z. Psychol.*, 61, 1912, 161-265, 217-218.

[13] C. F. Willey Directional variations of apparent movement. *J. exp. Psychol.*, 19, 1946, 656. Italics mine.

[14] Paul von Schiller, Stroboskopische Alternativversuche, *Psychol. Forsch.*, 17, 1933, 180-214.

*totalen Angleichung*). This is the tendency to become totally figure 'b,' irrespective of its formal constitution. In other words 'b evolves phenomenally from a.'[15]

## Apparatus and Procedure

The basic presentation in the present study consisted of a horizontal series of three adjacent squares, with the middle one flashed before the other two, which could then be flashed simultaneously. This basic presentation was subjected to controlled variations, and was susceptible of expansion through the addition of squares, or the introduction of figural content into squares.

*Apparatus.* An apparatus was constructed for these purposes that produced light flashes of constant duration and permitted the independent variation of flash intensity and the interval between flashes.[16] Two viewing units allowed for the presentation of figures made up out of 18 squares of light, and also provided facilities for the introduction of detailed figures within the squares.

The apparatus consisted of a timing unit, a set of two switchboards, and the two viewing units. A variac transformer supplied current to the viewing units.

The timing unit was a calibrated mechanical timer, which operated a set of relays. The current for the lights, after passing through the relays, was led to a variac transformer on the control table, the settings of which had been calibrated in terms of brightness of the light sources with a Macbeth illuminometer. The timer itself permitted the variation of the interval between flashes.

The brightness values used in the study ranged from 0.007 to 70 ml. Intervals between flashes, measured from the end of the first flash to the start of the second, ran from an overlap of — 20-200 m.sec. The flash duration was 50 m.sec.

The viewing units consisted of tin-partitioned, black painted compartments, faced by diffusing glass, each compartment containing a 7.5-W filament bulb. The larger unit allowed for the presentation of 2.5 × 2.5 in. squares in any desired pattern. This unit consisted of a honey-comb arrangement of 18 compartments. The smaller unit had three compartments (2.5 × 5 in.), each containing two bulbs and an extra pane of milk glass to increase diffusion. This unit had a space behind its glass front for the insertion of 8 × 10-in. photographic transparencies.

*O* was seated 7 ft. from the glass screens, on an oculist's chair.

*Procedure.* Eight *O*s were used for formal study.[17] All were young adults. Each indicated having normal vision, in two cases with corrective lenses. No test for visual acuity was administered.

Sessions lasted 2 hr. and took place in a completely darkened room. Each session was preceded by a 5-min. dark-adaptation period. Observation was free; *O* was simply instructed to report what he saw. The only exceptions to this rule were 'quantitative' sessions in which *O* was asked to note two specific aspects of the perceived configuration. Otherwise, a practice was made to supplement spontaneous

[15] *Ibid.*, 186, 213.

[16] For the design of the apparatus and the wiring of its electrical components, the author is indebted to W. H. Ittelson.

[17] A pilot study preceding formal experimentation was conducted with only one *O*. The investigator wishes to acknowledge, in this connection, the assistance of Edward Engel. One other *O* was tried and excluded from the experiment, since he succeeded in resolving the presentation into three squares under all conditions. The trial data for this *O* are not reported.

reports by questioning about unreported aspects of the experience. Whenever *O* indicated being unsure about an observation, the presentation was repeated.

Every presentation was run a minimum of 5 times at 2-sec. intervals to permit stabilization of the percept; whenever *O* was not satisfied that he could make a judgment after 5 presentations, the run was renewed until *O* reported being sure of what he saw. In the early experiments, each stimulus-condition was presented under a variety of brightness and at least two time-intervals. This practice was later discontinued as being too time consuming. It did not yield additional information. An interval of 40 m.sec. with flash-brightness of 12 ml. was chosen, and all patterns were subsequently presented with these conditions constant. Every pattern was repeated at least twice. If the two responses were not identical, the experiment was repeated until two consecutive reports were judged to be the same.

*Fixation.* The data were collected under conditions of free viewing. *O* was instructed to look at the presentation, and he was left free to attend to any of its aspects. Since fixation was omitted as an experimental variable, some control data were taken on two types of fixation.

The first type involved fixation of the center of the presentation (the locus of the 'a' square) without, however, a fixation-stimulus.[18] Incidental findings with such fixation confirmed Scheffler's observation that, under conditions other than optimal, fixation of the center space facilitated the perception of light there.

A case illustrating the effect of central fixation was that of a naïve *O* who in his first session never reported light between the two squares. In subsequent sessions, he began seeing light under some conditions, a fact he attributed to having "switched" to fixating the center of the presentation. It was his impression that he had initially "followed the two moving squares," and thus prevented himself from seeing anything between them.

Conversely, the protocols of the one *O* who was discarded because he reported the center square throughout, indicate that his performance was probably due to an analytic set, and an unusually careful fixation.[19]

A second type of fixation investigated was peripheral fixation. As a check on this, a fixation-lamp was constructed which could be placed anywhere in the experimental room. Three *Os* were used for one session each with this fixation-light. The light was placed some distance from the viewing unit, above it, below it, or to one side. *O* was instructed to fixate, and to watch the presentation without abandoning fixation. In all cases, and with all the presentations used, this results in the *Os* perceiving no center squares, but *not seeing any movement*. The squares were reported as simply "flashing on."[20]

[18] The use of a fixation-element is precluded by the fact that it would probably alter the nature of the presentation.

[19] It has been noted that 'analytic' set is unfavorable to apparent movement-perception also. Von Schiller, *op. cit.*, 180; G. M. Stratton, The psychology of change: How is the perception of movement related to that of succession?, *Psych. Rev.* 18, 1911, 262-293.

[20] This may be of relevance to apparent movement. As may be recalled, in apparent movement-situations, fixation to one side of a presentation favors movement to the fixated side. See H. G. Van der Waals and C. O. Roelofs, Optische Scheinbewegung. *Z. Psychol.*, 114, 1930, 241-288; 115, 1930, 91-190; Von Schiller, *loc. cit.*; Wertheimer, *loc. cit.*

## Experimental Conditions and Result

The 30 experimental conditions of the present study can be summarized under 3 headings.[21] (*a*) The first seven may be characterized as *basic patterns.* They were designed to explore the important features of the three-square arrangement. (*b*) The second heading comprised ten *figure-ground* conditions. They were so designated because the figural content was systematically introduced into the three-square presentation, which thus became ground. (*c*) The remaining conditions involved the formation of a sequence. Presentations of more than three squares were used here, in an effort to explore their differential perceptual elaboration.

(*a*) *Basic Patterns.* The procedure used in the first of these experiments was, Condition 1, to present the figure with instructions to "describe it in detail," and, Condition 2, to flash the figure on the same screen with a set of two 'b' squares alone, *i.e.* with an actual space between them. *O* was asked to specify differences, if any, between the two perceived configurations in Condition 1.

Three *O*s were used for the purpose of more closely specifying the effects of varying light-intensity and time-interval between exposures. They were presented with Condition 3, the figure over eight brightness-values (ranging from 0.007 to 70 ml.) and 11 time-intervals (— 10–160 m.sec.)[22] They were instructed to report (a) what, if anything, they saw in the center of the presentation; and (b) any movement they perceived. The whole series was carefully repeated with one *O*, both binocularly and monocularly, to determine intra-*O* reliability and monocular-binocular differences, if any. Intervals were used in random order, and intensities were randomized within intervals.

A Polaroid viewing unit was constructed with filters aligned so that the center square would be seen by one eye, and the outside squares by the other. This is called Condition 4, and was used to test the central as opposed to the peripheral locus of the intraction.

The effects of contiguity and figural similarity were explored with Conditions 5 to 7, which are shown in Fig. 1.

[21] Complete presentation of the full set of experimental conditions, and of the results obtained with each, may be found in Hans Toch, Perceptual elaboration of a stroboscopic presentation of three contiguous squares, Doctoral dissertation, Princeton Univ., 1955.

[22] The brightness-values used were .007, .05, .4, 5, 12, 19, 45 and 70 millilamberts. The intervals were — 10, 0, 10, 20, 40, 70, 100, 120, 130, 140, and 160 milliseconds.

The results were as follows:

*Results.* (1) The basic (three-square) figure was perceived by all *O*s as two squares, in most cases "moving away from the center," and otherwise "restless and vibrating."

(2) When compared with the set of 'b' squares in Condition 2, the

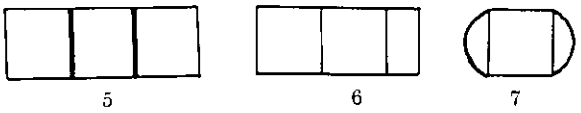



FIG. 1. GRAPHIC SUMMARY OF BASIC CONDITIONS 5-7

three-square presentation was found in all cases to differ in that it moved, "while the other squares were steady," and it was noticeably brighter than the comparison squares.

(3) The quantitative data for the one *O* with whom the series was repeated are plotted in Fig. 2. These data, and those obtained from the two other *O*s, can be summarized as indicating (a) that increasing brightness favored the perception of only two squares and the three squares tended

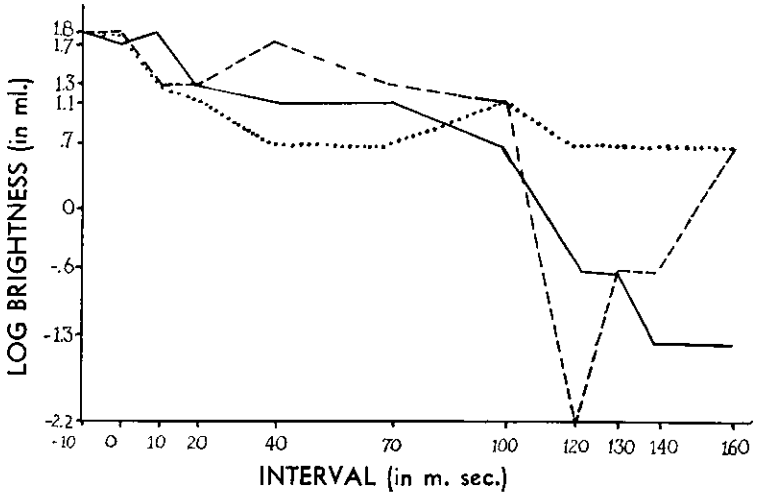



FIG. 2. PERCEPTION OF TWO SQUARES AROUND EMPTY SPACE AS A FUNCTION OF BRIGHTNESS OF FLASH AND INTERVAL BETWEEN FLASHES

Data for one *O*, three sessions, and one monocular and two binocular. The curves represent lower thresholds for 'complete disappearance.' At values below each curve light was perceived between the two squares. At values above the curves the space between squares was reported as empty. The solid line and the broken line represent the first and second binocular observations respectively. The dotted line represents monocular data.

to be perceived only at the lower intensities; and that (b) the brightness range within which only two squares were perceived increased with the interval up to the point where the effect was no longer operative. Reports of "some light" or "flash in the center" were obtained for intermediate conditions, between those favoring a two-square as against a three-square resolution. The perception of apparent movement was directly related to that of two squares. In every instance in which no movement was perceived, light was reported between the two squares. The thresholds of these two phenomenal results appeared to be closely linked. For the one *O* with whom conditions were repeated, observations proved highly reliable. In monocular observations the phenomenon appeared to be less favored by longer intervals than in binocular ones.

(4) Viewing through the Polaroid eye-piece did not result in reports differing from observations without it. In all cases, two squares were seen moving outward.

(5) Contiguity of the squares proved to be essential to the perception of only two squares. A ¼-in. strip between squares, Condition 5, enabled most *O*s to perceive a middle square, which was seen as dimmer or of shorter duration than its neighbors.

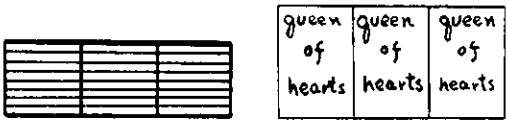
(6) There was also no difference between the perception of the 'basic' presentation and that in which one of the squares had been reduced to a rectangle. Nothing was distinguished in the center of this presentation.

(7) A curtailed middle square was also perceived with the presentation in which the 'b' squares had been converted into semi-circles, Condition 7. The semi-circles were seen as very bright, and moving away from a dim grey square linking them.

(*b*) *Figure-ground patterns.* Ten photographic slides were prepared featuring figural content in squares. These figures were varied in the relation of the figure to the square, and in complexity. They ranged from a small figure (a letter 'H') in the center of the middle square, to identical or different figures fully covering all three squares. The large figures included lines traversing the squares as crosses, verticals or horizontals, and color transparencies of playing cards. Samples of the figures used are shown in Fig. 3 and Fig. 4.

*Results.* Out of the 10 slides only 2 resulted in the perception of nothing in the center of the presentation. These are shown in Fig. 3. One of these featured horizontals running through the three squares, Condition 14; the other consisted of three identical playing cards, the queen of hearts. In all other cases, including a slide featuring vertical lines on all three squares,

Condition 15, and one containing playing cards in which the center card (a queen of hearts) was dissimilar from the other two (backs of playing cards), *the figures of the center square were perceived.* In the case of all




14 18

FIG. 3. CONDITIONS 14 AND 18

line drawings other than Condition 14, the figures were reported on a dark ground surrounded by a faint halo of light, just sufficient to make them perceptible.[23] Two squares were in each case seen to move away from

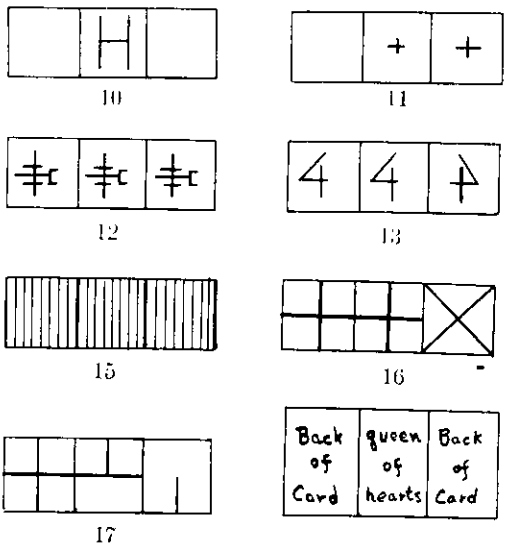



FIG. 4. CONDITIONS FEATURING RESIDUAL FIGURAL CONTENT

these residual figures. In the case of the dissimilar playing cards, the entire center card was perceived.

(*c*) *Conditions involving sequence.* In an attempt to investigate the

[23] The above was the case with binocular observation. Monocularly, there was a tendency not to perceive anything in the center. This fact may be accounted for by the residual figure's being monocularly mislocalized in these cases, and transferred, in apparent direction, into one of the 'b' squares in which it then appeared.

perceptual results of expanding the basic presentation, the latter was made a part of eleven different complex presentational arrangements. In each case, one or more squares were added, either in phase with the center 'a' square (20, 21 and 22, Fig. 5) or with the second 'b' squares (23 and

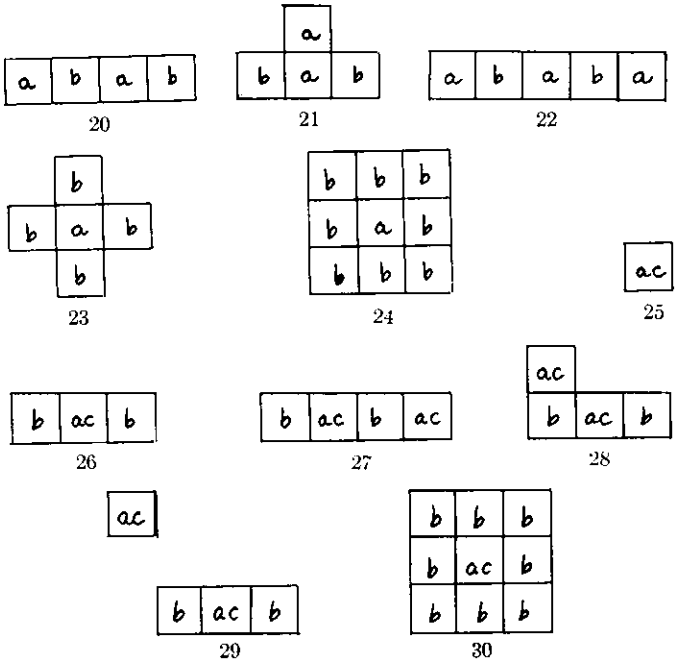



FIG. 5. GRAPHIC SUMMARY OF CONDITIONS INVOLVING SEQUENCE

24, Fig. 5). In five other conditions the 'a' square was flashed again after the 'b' squares (26-30, Fig. 5).

*Results.* The most general possible statement summarizing findings with these presentations is that the 'a' square was perceived in a variety of ways, depending on the nature of the sequence. Thus, (1) unidirectional arrangements (such as Condition 20) resulted in smooth unidirectional movement, with the 'a' square as a movement-terminal;[24] (2) centripetal sequences (such as Condition 22) tended to make the 'a' square perceived as a square; (3) total enclosure of the 'a' square (Conditions 23, 24) resulted, as a rule, in its perception as a flash of light; (4) in presentations

[24] Movement-terminals are the end-points of a movement percept, *i.e.*, the starting place and point of arrival of the moving object which is perceived.

in which the 'a' square was flashed again as a third bank, the 'b' squares were perceived as phases linking 'a' to 'c.' Thus, the 'b, ac, b' presentation (Condition 26) was most often reported as an outward-inward movement (predominantly inward) of dim light, which 'formed' a very bright center square. Similarly, an 'ac' square totally surrounded by (six) 'b' squares (Condition 30) was seen as a very dim reddish frame around a brilliantly bright center square which outlasted it. Although the 'ac' square alone (Condition 25) in all instances was reported as two distinct flashes, adjacent 'b' squares in all cases linked these into a smooth, continuous square. Occasionally 'b' squares were phenomenally totally absent, as in Condition 27, which was perceived as two squares oscillating a very small distance. The right hand 'b' squares in Conditions 28 and 29 also tended not to be perceived.

## Discussion

*Basic patterns.* From the present results it is clear that there is not an all-or-none inhibitory effect operating to suppress the center square in the 'bab' presentation. First, aspects of the perceived configuration (movement and increased brightness) were shown to be a function of the center square, since they did not occur in its absence. Secondly, under conditions of dissimilarity and near-contiguity a curtailed square could be perceived.

On the other hand, many of the findings of the present study are in line with those of the investigators of metacontrast, except that the latter usually make no mention of apparent movement. Increasing the interval between flashes, up to the longest value used, 160 m.sec., was found to decrease reports of a center square. Similarly, the finding that shorter intervals are effective only with increased brightness is in accord with data on metacontrast regarding the brightness of the second bank of lights. Given the fact that the second bank of lights (with double the area of the 'a' square) has twice the total light energy of the first, an increase in total brightness would preferentially favor the second bank. Another finding with regard to metacontrast, that of the vital role of contiguity, was confirmed.

In the present experiment it was found that the effect was not strikingly diminished when the first and second exposure were to opposite eyes. This is in line with findings concerning flicker fusion and apparent movement, both of which have been obtained across the two retinas.[25]

[25] Among the studies reporting flicker fusion across the two eyes, see F. Schwartz, Ueber die binokulare Summation von Flimmerlicht, *Z. Sinnesphysiol.*, 70, 1943,

*Figure-Ground conditions.* The perception of residual figures on barely perceptible ground in the empty space corresponding to the 'a' square, suggests that prior to elaboration of the figure it must have been divorced from the square that contained it, which was not itself elaborated. It becomes possible to think of some sort of classification or sorting process preceding actual perceptual structuration.

The question may be posed as to why horizontals extending throughout the presentation (Condition 14), and the three identical picture cards (Condition 18), are not subject to the same two-category sorting as other presentations. Why, in other words, is all of 'a' in these two cases unelaborated, in view of the fact that content is elaborated in comparable presentations?

In the case of the horizontals, it may be speculated that these are not perceived because they are perceptually incorporated into the lines which *are* perceived (those in the 'b' squares) of which they are in fact continuations. Similarly, it may be assumed that the identity of the three queens permits their perceptual identification, and hence the incorporation of the 'a' queen.

The fact that a whole queen is perceived when followed by two backs permits the hypothesis that the 'figure-ground phenomenon' in line figures is attributable to some sort of conceptual separability of figure and ground in these presentations.

*Spatio-temporal sequence.* It has recently been suggested that "the facts of (movement) experiments can be explained by the hypothesis that the retina responds to adjacent and successive order. . . . The stimulus for motion . . . may be *ordinal.*"[26] The indications provided by the 'sequence' conditions of the present study are that, as a descriptive statement, this may hold true of more than movement perception; characteristics of configurations perceived with rapid successive stimulation appear to be intimately linked to the ordinal aspect of the stimulus-situations. Qualities in the percept such as apparent brightness and perceived duration, for instance, are subject to variation by means of differential spatio-temporal arrangement in the presentation.

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22-29. G. J. Thomas has reviewed relevant literature in his study: The effects on critical flicker frequencies of interocular differences in intensity and in phase relations of flashes of light, cff, this JOURNAL, 67, 1954, 623f. With regard to apparent movement see K. R. Smith, Visual apparent movement in the absence of neural interaction, this JOURNAL, 61, 1948, 73-78, and H. S. Langfeld, Apparent visual movement with a stationary stimulus, this JOURNAL, 39, 1927, 343-355.

[26] J. J. Gibson, The visual perception of objective motion and subjective movement, *Psychol. Rev.*, 61, 1954, 310.

What are the dynamics of this relationship? It has been suggested, in another context, that movement perception results when stimulus-situations are interpreted in line with an unconscious generalization derived from early experiences with moving objects.[27] The common denominator in all such experiences (and hence, the basis of the generalization) would be the successive stimulation of adjacent portions of receptor surfaces. More specific situational denominators are, however, involved.

*Object connotation and sequence.* A moving object manifests itself as a unified experience. The movement of the object cannot be divorced from its other connotations in the percept. That this unity goes deeper is exemplified by the demonstration of the rotating trapezoidal window. The perception of this device as a rectangle in perspective involves seeing it in oscillatory movement, whereas its correct identification (as a trapezoid) shows it as rotating.[28] The stimulus-situation is here interpreted by the perceiver, *in toto*, and all the attributes of the percept arise from the meanings assigned to the whole.

The elaboration of a movement-configuration does not consist of separate processes making for 'object' and 'movement,' but of a single process culminating in the perception of an object-in-movement. The sequential aspects of this configuration are inseparable from its meaning aspects.

Thus, when the 'bab' presentation is reported seen as "two squares moving away from the center," the question "where is the third square?" does not arise. The configuration called for by the ordinal aspects of the stimulus condition is a centripetal one, culminating in two objects. Object characteristics are assigned to the presentation to achieve this phenomenal result. A center square would not make sense in this context, and hence is not elaborated into the configuration.

*Classification and disposition in sequences.* If configurations are structured in line with meanings assigned to presentations, it is important to inquire in what manner and on what basis meanings are assigned.

To formulate these questions, they have to be divorced from each other. Accordingly, perceptual elaboration may be conceived of as a two-stage process. The first stage would consist of *classification*[29] of the stimulus-condition (the assignment of meaning to it), and the second of the *disposition* of relevant perceptual data into a configuration.[30] By means of this distinction one avoids the confusion of product with determinants of processing which appears to underlie much of structuralist theorizing.

It would be the purpose of the perceptual classification process to determine the nature of configurations, by means of a rapid unconscious evaluation or physiological categorizing of perceptual data. Actual disposition would follow accordingly.

[27] H. H. Toch and W. H. Ittelson, The role of past experience in apparent movement, *Brit. J. Psychol.*, (publication pending).

[28] Adelbert Ames, Jr., Visual perception and the rotating trapezoidal window, *Psychol. Monogr.* 65, 1951, (No. 324), 1-32; F. P. Kilpatrick and W. H. Ittelson, Three demonstrations involving the visual perception of movement, *J. exp. Psychol.* 42, 1951, 394-402.

[29] The author wishes to acknowledge his indebtedness to Adelbert Ames, Jr., for the suggestion of this term.

[30] Processes being indivisible in fact, the order in which the above has been conceptualized is, of course, arbitrary. Classification would have to take place in terms of the disposition called for.

In conditions involving sequence, the nature of the classification clearly determines the character of the disposition. Identical physical conditions (classified differentially because they occur in different presentational sequences) may be elaborated as bright squares, dim squares, brief squares, squares of longer duration, amorphous flashes of light, movement terminals, vague feelings "that something might be there," or as nothing at all phenomenally isolable.

The concrete disposition is a function of the role assigned to impinging events in whatever sequence is meaningful to the perceiver. The overall attempt is to perceptually create a world which behaves reliably, despite constant and continuous flux.[31]

[31] This same point has been made by Ittelson in The constancies in perceptual theory, *Psychol. Rev.*, 58, 1951, 285-294.