PERCEPTION: GESTALT APPROACH, ASSOCIATIONISTIC APPROACH, AND STABILIZED IMAGES

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Supplement to the Video-Taped Program Produced
in Fulfilment of the Requirements for the
Degree of Master of Arts at
Sir George Williams University
Montreal Canada
April, 1971

ABSTRACT

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The television program is recorded on an IVC one-inch video tape and it is 27 minutes 40 seconds in length.

The program is conceived of as one of a series in (perception) for college students who have taken introductory courses in Psychology.

The subject matter of this television program is mainly about a psychological experiment of stabilized images and a consideration of the implication of the experiment. It also incorporates two major theoretical approaches to perception. The experiment is important because it has produced evidence to sustain both gestalt and associationistic approaches in visual perception. The purpose, method and findings of the experiment are examined. The fundamental concepts of gestalt and associationistic approaches are introduced. There is also a discussion of the theoretical implications of the experiment in the program.

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GESTALT APPROACH TO PERCEPTION

The most concise way to characterize gestalt psychology is to say that it deals with wholes and that its given data are what have been called phenomena. The gestalt psychologists believe that the word gestalt carries both these implications, in part because they are convinced that it is really always wholes that are given in experience to conscious man. It is also because of their strong phenomenological orientation. In perceiving a melody one gets the melodic form, not a string of notes, a unitary whole that is something more than the total list of its parts or even the serial pattern of them. This is the way experience comes to man, organizing in significant structured forms, gestalten.

It was Koffka (1935) who asked, 'Why do things look as they do?', and he argued as follows: Things look as they do, not because the proximal stimuli (microscopic stimuli) make them look so, for if this were the case, then it would follow that, (a) any change in the proximal stimuli would produce a change in the appearance of the objects, and, (b) no change in the appearance of objects would occur without a corresponding change in the proximal stimuli. However, neither of these two consequences is true. That (a) is not the case is evident from the phenomena of subliminal proximal stimulation

which have been demonstrated by psychophysics: the range of the variation of the stimulus dimension extends considerably beyond the range of variation of the perceptual dimension. That (b) is not the case is evident from the phenomena of perceptual inconstancies (e.g. variations of optical illusions) which indicate changes in the appearance of objects without a corresponding change in the proximal stimuli. The conclusion, arrived by Koffka (1935), was that things look as they do because the distal stimuli (macroscopic stimuli) make them look so. And since the distal stimuli correspond, roughly speaking, to 'perceptual gestalten', the gestalt psychologists proposed that the study of 'gestalten' must be given the central place in the psychology of perception.

A gestalt (configuration) is to be described as a psychological structure, being constituted out of a set of elements and relations, and displaying a quality not possessed by its constituents. The formula is that the whole is something more than the additive aggregate of its elements (parts and relations). What is more consists of the emergence of a new quality (in the case of the perceptual gestalten). The main trait of perceptual gestalt is that it possesses at least one property which is not possessed distributively by its parts and relations. The property is the psychologically emergent property. The class of phi-phenomena constitutes the illustration of the

perceptual gestalten: For example, the phenomenon of apparent movement demonstrated by Wertheimer (1912) and the phenomenon of the gamma movement (Ellis 1938). If a fixed short line of light a is very briefly shown and then a similar fixed line b is briefly shown a short distance away or in a rotated position and following (a) very closely in time (say by 1/30 second), the two stimuli will appear as two and as simultaneous. If the interval between the two exposures is relatively long (1/5 second), a and b are again seen as two, but as successive. At some interval whose duration is between these two intervals an appearance of movement is seen. The optimal interval for this effect is about 1/16 second. One sees, in this case, a single line of light moving from the position of stimulus a to that of stimulus b. This experience of movement has emerged from a whole and does not refer to any basic constituents. Gamma movement refers to an apparent motion which appears in an object when tachistoscopically exposed. The evident expasion of electric light bulb when the current is suddenly switched on is a special case of this effect; similarly, when the object disappears there is a definite contraction observable with the movement of the contours directed toward the center. Lindemann (1922) found that various geometrical figures presented in different ways behaved differently. In the case of a circle, the gamma movement was most pronounced along the horizontal direction, and the same held for an ellipse whether resting upon its

long or short axis. A square resting upon one of its sides as a base also showed its maximum motion laterally; however, when it is stood on all four corners, it moved energetically in and out. This observation has suggested that the experiences of form and movement must be closely related.

Gestalt theory suggests that the gap between the sensation and the perception is the product of the intervention of the psychological framework of the subject during the interval between the sensation and the perception. As a psychological process this intervention consists of the construction of the percept out of the elements of the sensation in the form of a perceptual gestalt. The proximal stimulus is thus transformed into the distal stimulus in the subject; and the subject in turn always responds to the latter but not the former. For instance, one sees houses, trees and sky in a landscape but not the amount of brightness and the nuances of colour (Ellis 1938).

The process of perceptual gestalt-formation is generally regulated by the principles of figural organization (notably, the principles of proximity, similarity, continuity and frame of reference). In viewing dots arranged on a page in clusters one sees every cluster together, as a unit; one tends to group the dots which are closer together. If dots of various colours are scattered on a page, but there are a number of them of the same colour, these dots of the same

colour tend to group themselves and may form a distinct pattern. The principle of continuity can be illustrated by Köhler's demonstration of a sweeping scroll-like curve in which there is a slight hump or irregularity. There is a strong tendency to push this irregular part in or out to make it follow the continuation of the curve. The principle of frame of reference may be illustrated by the induced movement (Dunker 1929). An example of the induced movement is that when one is sitting in a railway coach and a nearby train moves, it seems for a time as if one's own train were moving in the opposite direction. The direction of the perceptual process is regulated by the principle of prägnanz, according to which every configuration, given its relative level of equilibrium, tends to attain a constant degree of equilibrium. The principle of prägnanz has innumerable manifestations. To give an example, suppose one is looking at a circle composed of dots with one dot slightly out of line. The tendency is for the dot to appear pulled back into the circle. The nature of the configuration tends toward as 'good a figure' as the circumstances will permit.

According to the gestalt theory, since the gestalt-formation consists of a psychological transformation of sensation into perception, the essential factor is the 'synthetic relationship' which constitutes the determining principle of the combinatorial possibilities of the elements and their elementary relations. The result of this synthetic

transformation is the emergence of a gestalt quality not possessed by the elements analytically considered. Since this gestalt and its quality is a function of the given elements and also the psychological framework of the subject, the variations of gestalt-formation may be explained with reference to the ramifications of the psychological framework of the subject. For instance, dark cloud in the sky might appear 'soft' to one person, and 'hard' to other.

The discovery of 'physical gestalten', analogous to the 'psychological gestalten', is the contribution of Kohler. It was suggested that, not merely are psychological configurations not identical with the additive aggregate of their physical components, but even in the realm of physical systems the properties of organized entities can not be adequately described in terms of their constituent elements alone. Consequently, at the physical level as well as at the biological level, the class of 'functional wholes' is to be distinguished from the class of 'summative wholes'. The former, unlike the latter, are not susceptible to analysis from the 'additive point of view' because of their integrative gestalt quality. Of the whole class of 'physical gestalten', one may consider the illustration provided by electric field effects. Thus, for example, a typical electric conductor maintains a specific density of electric charge, which is not evenly distributed at all points of its surface. As a rule, the

density of the charge will be greatest at the points of the greatest curvature of the conductor. This case of the surface distribution of the electric charge, being independent of the intensity of the total charge, is a function of the physical configuration of the conductor itself. There is an analogous phenomenon in chemistry (which might be called 'chemical gestalt'): This is the phenomenon of isomorphism, where, the elementary contents of the compound being constant, the variation of the chemical structure of the compound results in the modification of its physical properties.

A thesis was developed by the gestalt psychologist (Allport, 1955) that whatever happens on the phenomenological side is mirrored by a corresponding process, like it in all the gestalt properties of organization, in the brain. The gestalt psychologists incorporated the postulate of isomorphism and field effect as a basic part of their physiological explanation of perception. Köhler has pointed out the tendency of electrostatic charges always distribute or 'shape' in a way that would product an equilibrium over the surface of a conductor. Mach's dictum was cited to the effect that macroscopic physical states tend to develop in the direction of maximum regularity and simplicity and to become as stable as possible because in such distributions forces balance one another more exactly then in regular patterns (Allport, 1955).

It had been early proved that as impulses reach autonomic nerve endings a chemical substance is secreted into the surrounding medium between the end of the nerve fibre and the muscle fibre which it activates. Assuming this same condition to hold within the ganglionic layers of the brain, Köhler envisaged in the cortex similar stationary chemical states maintained by the cumulative action of sensory nerve-impulses as these impulses come to the cortex in waves along the afferent neurons. These states will depend for their intensity upon the intensity of this chemical activity, which in turn depends upon the intensity of the stimulation. Thus, in the case of a white square seen on a gray background, the activity will be more intense in that cortical area represented by the square than in the part represented by the ground. Since ions are involved in chemical processes we may assume a concentration of ions inside the figure different from that in the ground outside as these parts are represented in the cortex. Since ions diffuse from regions of higher concentration into those of lower, one of these areas will become electrostatic potential, which constitutes an electromotive force, a current is set up. The current passes circularly from the cortical region of the figure through that of the ground in the surrounding tissues, and back into the figure again. The self-distribution of electrostatic potential in the field, arising originally from optical sources and neural transmission to the brain,

thus 'segregates' the figure from its ground and give it unity and homogeniety. Inside the figure, where the current is more restricted, it is more dense; while outside the figure it spreads more widely. Hence the ground, phenomenologically, is less vivid than the figure. The cortical field theory, thus, offers a parallel explanation of the phenomena of configuration.

As the study of perceptual phenomena, gestalt psychology is successful and influential. The gestalt approach is a systematic orientation to psychology having a strong philosophical (phenomenological) theme and a set of apt and coherent formulations, rather than a basic explanation established by reference to a rigorously tested model.

ASSOCIATIONISTIC APPROACH TO PERCEPTION

Hebb tried to answer the perceptual question, 'Why do things look as they do?' with a theory that follows the associative tradition and attempts to explain the matter by joining of specific elements, one-to-one, into neurophysiological combinations.

Hebb (1949) claims that the perception of simple outline figures means much more than the experience of segregation, unity, good figure, and the like, upon which the gestaltists had based their theory. He recognized at the start the feature of 'primitive unity', a purely sensorily determined wholeness and its segregation from the surroundings. Figure and ground belong to this class of properties of the percept; and this aspect of perceptual experience is native to the individual. In addition to primitive unity there is another 'non-sensory', aspect of figures in which prior experience plays an important role. This phase is seen, for example, in the fact that in concealed figures, though the organization of the whole conceals the part, one can perceive the part independently if past experience gives one a clue as to what to look for. Finally, there is in figure perception also the aspect of 'identity'. A figure seen can be later recognized and can be made the basis of an experience of selective similarity and generalization upon which a class-

concept can be developed. Identity also means that the figure can be associated with other ideas or action; it can also be named.

The primitive unity of a figure (i.e., seeing it as one segregated whole against a background) is readily attained not only by any normal person, but also by those who, having been congenitally blind through cataract, see by means of an operation for the first time. However, the perception of identity is by no means given at the start as an immediate, organized whole; it has to be gradually acquired. Citing the work of Senden and of Riesen, Hebb pointed out that the newly seeing human being (after congenital cataract removal) and chimpanzees reared in darkness, though they readily discriminate two figures when both are given together, and though they perceive unity in the primitive sense, are amazingly poor in perception of figures or objects. They have great difficulty in recognizing figures and in having, with regard to them, an experience of identity. A course of patient learning is required to bring out the potentialities of the way things look. The human learner under these conditions goes through a process of separate attention to each part of the figure and gradually arrives at an identification of the figure as a whole. Trained to discriminate a square from a triangle over a period of thirteen days, one patient still could not report their forms correctly without counting the corners. Without an

extended learning period, generalization of perception can not be accomplished. Objects, also, whose names have been learned may fail to be recognized, i.e., names, when their previous surroundings have been changed.

It is possible, Hebb reasons, that a normal human infant goes through the same process. The immediate correctness and apparent simplicity of adult perception of objects and patterns may be misleading as a guide to the genesis and physiological basis of these perceptions. Very early in life, there may have been the piecemeal, repetitive, and summative process, demanding eye movements and many separate visual fixations; so that adults are able to perceive a square at a glance only by virtue of this earlier complex learning.

Motor aspects in the form of eye movements play an important role in Hebb's theory. Various lines of evidence support the view that perception involves a motor as well as a sensory activity. Though tachistoscopic speeds at which objects can be perceived seem to rule out eye movements as a means of the ordinary perceiving of objects, eye movements nevertheless facilitate definiteness and stability of perceptual experiences and images, as they clearly did in the case of the newly seeing patients to whom they were necessary for learning to perceive. Hebb argues that the capacity for recognizing patterns without eye movement is

possible only as a result of prolonged visual training and improvement that goes on during every moment that the eyes are open from birth until adulthood is approached. Tachistoscopic studies of the process of reading show a piecing together, bit by bit, of elements already familiar, a filling in of the gaps by residues of earlier experiences, and an arriving at an end result consisting of combination of familiar things, a reconstruction on the basis of experience. Hebb believes that perception is an additive, serial reconstruction (rapid and unconscious for the normal adult) and that the perception of identity, that is, of distinctive wholes, depends upon a series of excitations from the parts of the stimulus figure. For example, a triangle is simply perceived as having three angles and three sides and is recognized and identified for what it is. The perception of a distinctive triangle is the association of the discrete sides and angles perceived.

Hebb was more impressed by clinical, physiological and behavioural data than by direct introspection. Though he regarded wholes as significant, he insisted on seeing them as built up from the activities of parts. Naturally, his postulate of percept is that of the individual element, and his associationistic model is built from microscopic neurological units.

Since learning must be involved in the perceptual process,

a 'dual trace mechanism' is postulated whereby the effects of short-lived reverberating circuits known to occur in the cortex can sustain a connection between neurons long enough to permit a lasting association to occur. This more permanent connecting process is described as follows: 'When an axone of cell A is near enough to excite a cell B and repeatedly or persistently takes part in firing it, some growth process or metabolic change takes place in one or both cells such that A's efficiency, as one of the cells firing B, is increased'. This is probably brought about by the development of 'synaptic knobs' on terminal fiber of the axone, increasing the area of contact and thus decreasing the resistance of the gap between the fibers. Hebb also mentioned metabolic changes and neurobiotaxis as possibilities. Typical transmission includes the convergence of two or more afferents upon the dendrites of an efferent, and extends from the sensory projection areas of the cortex into neighbouring association areas. A group of cortical neurons functionally associated in this manner and involving sensory to sensory, as well as sensory to motor, connections is called cell assembly. The cell assembly is conceived as a three-demensional latticework, and in it there are frequently alternate pathways converging upon a single synapse, thus giving a certain amount of equipotentiality in case some of the pathways are out of action.

A simple percept corresponds to a simple cell assembly. More complex percepts then correspond to compounds of interfacilitated cell assemblies. According to this model, perception of a triangle could consist of the following phases:

The fixation of angle A brings about cell assembly a. This assembly incorporates motor neurons which cause the eye to shift from angle A to B (or C). This shift results in assembly b (or C). The shifting from angle to angle is called a phase sequence. There need not be any regularity in phase sequences. Typical sequences may be a-c-b-a-a-c-a-a-b-a-c, etc. Phase sequences involving over time more and more new cells and exhibiting more and more facilitation, build up a compound system, called assembly 't'. 't' is an interfacilitated group of cell assemblies corresponding to the perception of the triangle as a whole. Finally the perception of identity has been acquired. 't' does not replace the assemblies, a,b, and c. It intervenes in a phase sequence, e.g., in the following manner: a-c-t-a-c-t-b-t, etc. This means that perception of the whole alternates constantly with perception of the parts.

What Hebb has done is to reject the picture of behaviour and of its cortical segment as a process having a 'determinative' whole character. He has substituted for this the idea of an 'aggregate of elements' joining together

and operating together under certain physiological laws. The joining of the elements may take time; and repeated excitations of the elements may be needed throughout the early years or even later. If the aggregating occurs at a later period and takes an appreciable time and many trials, it is recognized as 'learning'. If it has occurred extremely early, or it now occurs very quickly, that is, under conditions in which its repetitive or trial-and-error aspect cannot be observed, it is recognized as perception.

THE EXPERIMENT OF STABILIZED IMAGES

It has been known for some time that the eye is constantly in motion. Even under conditions when steady fixation is attempted, small, involuntary movements of the eyes are always present. Knowledge of these movements has generated considerable experimentation in an attempt to understand their role in perception. Ratliff, Riggs and Ditchburn have studied at length the nature and the extent of these involuntary movements (Pritchard, 1961). Their results indicate that the involuntary movements consist of: a slow drift of the eye; a rapid, jerking movement; and a small, rapid tremor superimposed on the drift. The findings of the nature of involuntary movements have lead to further investigation of what happens when the involuntary movements are reduced or stopped.

One method of producing a stabilized image on the retina would be simply to stop the movements of the eye. However, the resulting discomfort and possible harmful consequences to the subject makes the method unpractical.

Ditchburn and Pritchard (1956) placed a calcite crystal, six millimeters in diameter, between two polaroid sheets and attached this to a stalk mounted on a contact lens. As the eye of the subject engaged in its involuntary movements,

the targets, being attached to the eye by means of the contact lens, moved with it, thus producing a stabilized image on the retina. Pritchard (1961) later presented a design which offered a great improvement. A miniature light collimator was constructed and attached to a stalk on the contact lens. A target was inserted in the end of the collimator and was illuminated by a tiny bulb. The contact lens moved with the movement of the eye and as a result the target image was kept fixed at one point on the retina. The convex lens focused parallel rays of light on the retina, so the target was viewed by the subject as if it were at an infinite distance. The target can be changed during the experiment by unscrewing the top of the collimator assembly and replacing it by another.

Some findings of interest are the observations (Pritchard, Heron, & Hebb, 1960 and Pritchard 1961) that the part of the image to which the subject's attention is directed remains in view longer than other parts, and that stimulation of other sensory modalities causes regeneration of an image that has disappeared. Several variables have been investigated in an attempt to discover the causal factors of these phenomena. During the course of these studies, it was observed that not only the disappearance and fragmentation occur, but they occur in what seems to be an orderly fashion. For instance, when a vertical line was viewed, the line not only disappeared, but it disappeared

as a unit. The line did not gradually fade with some parts disappearing and then others, but rather it followed an 'all-or-none' principle - that is, it was either wholly visible or wholly invisible. It was found that it seems the length of time that a target remains visible is partly a function of the complexity of the figure. (Complexity here refers to an increase in the number of elements or an increase in 'meaningfulness'.) A single target such as a straight line may be visible only 10% of the total viewing time while a more complex figure such as a triangle might be visible 80% of the total viewing time. Secondly, a simple line vanishes completely as a unit and reappears in the same way while the lines comprising a more complex figure such as a triangle behave independently of each other.

There are other rules which the activity of the figures seems to follow. In a Necker cube, lines defining a plane usually operate together, leaving parallel planes intact. The profile of a face (a meaningul figure) will remain visible longer than an irregularly shaped curved line (less meaningful). If the profile is viewed alone, certain parts of the face appear and disappear as a unit; that is the front of the face or the top of the head may remain visible while the rest disappears. A letter of which a jagged line has been superimposed will act independently of the jagged line in its disappearance, and will remain visible longer. While viewing a square, a common perception is one in which either

the two horizontal or the two vertical lines appear and disappear together. Another aspect of the importance of linear organization can be seen while viewing a matrix of squares arranged in rows and columns. Whole rows or columns act together. Thus the entire matrix may disappear leaving a single row, column, or diagonal of squares remaining in view. Another illustration is the superiority of smooth, rounded figure (the 'good' figure of Gestalt) over jagged, irregular figure in maintaining visibility. A word such as 'beer' when viewed may, due to the fragmentation of the image, be seen as other words such as 'peep', 'peer', 'be', or 'beep'. It has also been found that while viewing a triangle and a circle placed side by side, the parts of the triangle and circle nearest to each remain visible while the other parts disappear; or, if some other side of the triangle remains visible, an arc portion of the circle which is approximately parallel to that side also remains visible. Finally, it was observed that when a blackened square was presented as a stabilized image, the disappearance of the square is gradual rather than sudden. The center portion of one of the sides will begin to fade with the fade-out spreading first toward the middle of the figure and then outwards toward the other side.

Some qualitative studies of stabilized image were conducted (Evans, 1965). It was shown that different targets generated significantly different disappearance rates, and that it was

the configuration of the target that was of primary importance in determining the extent and direction of these differences. It was found that when a straight line is part of a more complex pattern there is a very high probability that this line will disappear or remain as a unit. It was also shown that a circle has a very high unitary disappearance value; a circle has higher resistance to disappear than an ellipse, however, when it vanishes, it does as a whole more often than ellipse.

An explanation of the phenomena observed with stabilized images has been suggested in terms of events occurring at the retinal receptors (Barlow, 1963). Barlow has found that the contact lens technique eliminates only partially the effects on involuntary movements since even a well-fitting contact lens can slip relative to the corneal surface. The phenomena observed may simply reflect variations in the degree of receptor adaptation or fatique which occur from the failure to achieve complete stabilization.

After considering Barlow's critique of contact lens slippage, the disappearance and reappearance of targets were studied by examining the phenomenon of after-images. And after-image can be obtained by showing the subject a target illuminated by a photographic flash bulb set in a reflector behind the target. The targets are usually drawn up on black paper out of which the outline shape of the required pattern is cut.

The after-image may remain about ten minutes and is clear enough to allow observation for at least five minutes (Bennet-Clark and Evans, 1963). The advantage of studying the disappearance and reappearance of targets by the after-image method is that the after-image is perfectly stabilized and that the physical contact of apparatus with the eye is avoided.

Simple observational studies made it clear that patterns such as squares, triangles and circles with two cross-bars could be clearly seen for an appreciable time when viewed as strong after-images, and could be seen to fragment in the same fashion reported when the contact lens stabilization technique is used. In the observation made by Bennet-Clark and Evans (1963), it was shown that the after-image appeared and reappeared, sometimes in whole, sometimes in part. After fading, the image would reappear to its original state as a complete pattern. It was also found that there was a strong tendency for the straight lines of which a target was composed to fade as units. It was suggested that the partial and structured reappearances of images can not be attributed solely to contact lens slip.

The disappearance of targets was also studied when a subject fixated steadily on targets under conditions of low illumination. The target could be painted with luminous

paint on dark paper and presented in a completely darkened room. Because the simplicity of applying luminous paint, the experiment is straightforward. The problem of this method is that the eye-movements are not controlled. Nevertheless, it was considered useful to compare the findings with those obtained by other methods. Five luminous designs fixated on by the subjects were studied (Makenney, 1963). It was observed that the results were strikingly similar to those obtained by Pritchard, Heron, & Hebb in their studies on stabilized images. Recently, an outline figure of a square was studied while viewed as a stabilized image by contact lens technique, as a steadily fixated figure, and as a prolonged after-image (MacKinon, Forde, & Piggins, 1969). It was found that the phenomena observed under the three viewing conditions were highly similar. The suggestion was that a common process in perception probably underlies the phenomena observed under these three viewing conditions. It was found that the lines comprising the square or the entire square itself disappeared and reappeared generally in all-or-none fashion, only occasionally did the lines fragment gradually. It was also found that the combinations of two and three lines fragmented together less frequently than an independent hypothesis (Pritchard, Heron & Hebb, 1960) would predict. Since the target studies was a square, the findings do not invalidate the claim that lines behave independently in a complex figure except in a square (Pritchard, Heron & Hebb, 1960).

THEORETICAL IMPLICATIONS

The perceptual effects associated with the stabilized image phenomenon have important consequences for some general theories of perception.

There are some general results reported consistently in almost all the studies of stabilized image. For instance, there is an all-or-none disappearance of the image; the pattern of disappearance and framentation is orderly or non-random; and the pattern (fragmentation and duration of visibility) also depends upon the complexity and quality of the image.

Hebb argues that the all-or-none disappearance of the image makes unlikely any explanation by fatigue in independently functioning cells. Equally unlikely are explanation involving local areas of satiation, or those based upon an inhibition process. Fatigue or inhibition within the cells would require a precise coordination in time of thousands of cells to yield the sudden cesation of activity. Satiation effects would produce a fading of an image rather than abrupt disappearance. (Hebb 1963)

Pritchard, Heron, and Hebb (1960) discussed as another unlikely explanation the idea of random fluctuation of

thresholds in various parts of the visual field. Such random fluctuation can not account for the orderly activity which has been observed.

Two major theories that receive considerable support from the stabilized image phenomenon are gestalt and Hebbian theories. In gestalt theory, the notion of field effects can be applied to some of the organized activity which has been observed, such as the activity of adjacent figure (Pritchard, Heron, & Hebb, 1960). The holistic approach of gestalt psychology is also supported by the principles of closure, continuity and similarity which seem to be present in the organization of the disappearance of the stabilized image. Figures judged to be 'good' in terms of gestalt theory have been proved significantly more stable than 'less good' figures in all the relevant studies. On the other hand, cell-assembly theory find support in the sudden, all-or-none kind of disappearance of separate elements, and also in the differential activity in meaningful versus less meaningful figure. These observations make tenable the idea of specific assemblies of cells acting as perceptual elements that operate as a unit or not at all, and the idea that complex (i.e. meaningful) assemblies can remain active longer than less complex (i.e. less meaningful) assemblies. The observations also give new support to the view that some innate organization seems to be present but this organization is modifiable as

a result of experience.

Both of these theories, however, have difficulty in explaining some effects. For instance, it is difficult for gestalt theory to explain the apparent independent action of parts forming an organized whole. Likewise, cell-assembly theory can not account for the completion noted in incomplete figures and for the gradual disappearance of solid figures (Hebb, 1966).

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