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FIGURE-GROUND IN VISUAL PERCEPTION.

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INJURY TO THE NERVOUS SYSTEM CAN RESULT IN DEFECTS OF FIGURE FORMATION SUCH AS LACK OF PRECISION OF FIGURE AND UNCERTAINTY AS TO WHICH IS FIGURE AND WHICH IS GROUND. IMPAIRMENT OF FIGURE GROUND PROCESSES MAY BE LIMITED TO ONE AREA OF THE NERVOUS SYSTEM FUNCTION. DISTURBANCE IN FIGURE FORMATION MAY NOT RESULT IN PERCEPTION DISTURBANCES, DEPENDING ON THE EXACT LOCATION OF THE INJURY. FOR EDUCATIONAL USEFULNESS, A CATEGORIZATION OF SOME OF THE FIGURE-GROUND CHARACTERISTICS AND POSSIBLE DEFECTS ARISING FROM NERVOUS IMPAIRMENT IS NEEDED. THIS LISTING COULD INCLUDE DIFFERENTIATION OF INTERSECTING FIGURES, PERCEPTION OF A COMPEX FIGURE AS A WHOLE, ABILITY TO WITHSTAND DISTRACTION BY OTHER STIMULI, AND INSTABILITY OF FIGURE. THOUGH THESE CATEGORIES ARE RELATED, THEY MAY BE INDEPENDENT. TWO TYPES OF REMEDIAL TECHNIQUES ARE AVAILABLE--(1) CIRCUMVENTION OF THE PROBLEM, AND (2) DIRECT IMPROVEMENT OF THE PERCEPTUAL ABILITY. REMEDIATION OF A PERCEPTUAL DISORDER MAY NOT RESULT IN ACADEMIC IMPROVEMENT. NINE REFERENCES ARE INCLUDED. THIS PAPER WAS PRESENTED AT THE INTERNATIONAL READING ASSOCIATION CONFERENCE (BOSTON, APRIL 24-27, 1968). (WL)

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Figure-Ground in Visual Perception

In this paper I shall trace the development of the figure-ground concept in educational writing, enumerate the aspects of the figure-ground problem that have emerged, establish criteria with which to judge procedures for identifying deficits in figure formation and for improving visual perdeption, and discuss several techniques that have been suggested for improving figure formation in visual perception. (1,8)

The Classical Concept

The classical concept of figure-ground in visual perception found in experimental psychology is concerned with why we see things and not the spaces between them. Several physiological factors play a role in the perception of three-dimensional objects. These include visual accomodation to the object making it clear, whereas other objects in the visual field are unclear, out of focus, and double images. (8)

The phenomenal laws of grouping contribute to figure formation of both three-dimensional and two-dimensional forms. These are the laws of nearness, similarity, contrast, continuity, and closure. Figure is more easily formed if the elements of that figure are nearer to each other, the elements making the figure are similar, greater contrast exists between figure elements and ground elements, elements follow a continuous direction, and the elements form closed spaces.(8).

Several phenomenal qualities distinguish figure and ground. Figure has the character of an object; ground is formless. Figure seems nearer in space. Ground appears to extend continuously behind the figure. Contours are perceived as belonging to the figure. Figure is definitely localized in space and has surface texture; ground is poorly localized and has filmy texture.(8).

Goldstein's Interpretation

The interpretation of figure-ground by Kurt Goldstein is the source of this topic's important status in current educational thinking. In the classical figure-ground concept an attempt is made to describe phenomena and explain them with phenomenological laws. In contrast to this phenomenological approach, Goldstein treats figure-ground as a function of the organism. Excitation of that part of an organism that receives stimulation is accompanied by a state of excitation in the rest of the nervous system. The reaction at one point of the system is more precise the more it stands in contrast to the rest of the system. Goldstein illustrates this conception with examples from motor activity as well as from perception. Movement of one's arm, for example, stands as figure in contrast to the change in posture of the remainder of the body, the background. When the figure arises in the perceptual field, the field changes to support the perception of the figure. Goldstein considers the figure-ground relation a basic form of functioning of the nervous system (6).

Damage to the nervous system affects the excitation process by directly modifying the functioning of the damaged part itself, and by isolating the part from the rest of the nervous system. This injury will result in defects of figure formation, as Goldstein uses the term, of the parts affected. Defects in figure formation manifest themselves in several ways. Among those described by Goldstein are: leveling of differences between figure and ground, and lack of precision of the figure; uncertainty as to which is figure and which is ground; formation of simpler figures impoverished in content; instability of the figure and tendency for figure and ground to alternate; excessive time for a perception to be consolidated; upon accomplishing a figure formation, an inability to form a new figure, as in a tendency to perseverate old performance. (6)

Goldstein's concept of figure-ground is, then, far broader than the classical concept. Even with respect to visual perception, Goldstein does not limit figure-ground to seeing objects rather than the holes between objects. His concept subsumes many additional phenomena. Educational thinking that derives from Goldstein's view treats figure-ground in visual perception in this broader way. If Goldstein's theory of the functioning of the nervous system is correct, then there is something in common about those reactions which he labels figure-ground reactions. His use of the term figure-ground is not merely metaphorical.

Despite the commonality of figure-ground reactions, they may function independently of one-another. Impairment in figure-ground processes may be limited to one area of nervous system functioning or may arise in several areas. Disturbances of figure formation in motor functioning may or may not be accompanied by disturbances in perception. This would depend upon where the injury to the nervous system was sustained.

Even within one area of functioning, say visual perception, functions subsumed under figure-ground are apt to be independent of one-another. This has been demonstrated in factor analytic studies. (3) Hence, in visual perception, impairment in one figure-ground function may not be accompanied by impairment in another.

Accepting Goldstein's concept of figure-ground and his categories of impairment in figure formation, other persons investigated figure-ground impairments of specific types within several populations.

Investigations of Deficits

Strauss and Lehtinen, using the marble board, found that non-brain-injured, mentally retarded children were able to duplicate a figure of marbles located at discrete points, whereas brain-injured mentally retarded children found it difficult to focus upon the organization of marbles. They hypothesized that the background of holes was distracting. To test this, they employed new marble boards with deliberately structured backgrounds of configurations that differed from the patterns formed by the marbles. The brain-injured retarded children were unable to withstand the attraction of this background and produced a pattern of marbles that was modified to conform to the background structure. (9)

In my opinion this result raises more issues than it resolves. Since the background consisted of discrete points (the holes in the board) and the subjects' errors corresponded to the background structure, the brain-injured retarded children evidently were able to perceive this structure, that is, they were able to form a continuous pattern from elements that were discrete. How then can poor performance on the simply and complexly structured marble boards be explained? In both cases, the patterns to be perceived by the child were the models displayed by the examiner. The breakdown of performance may have been in the process of remembering and visualizing the pattern on the subjects' empty board. Interfering with this attempt to visualize the pattern were the already present holes on the board, simply structured in one case and complexly structured in the other. The figure presented by the holes distracted the subject in his attempt to superimpose a visualized figure and to construct such a figure. This explanation, if correct, suggests that the subject was able to perceive the figure formed by the marbles on the model. To test this, one could have the subject select the same figure as the model from among several displayed marble boards. In this study by Strauss and Lehtinen then, the figure formation task was to superimpose and reconstruct a visualized figure on a structured ground, not merely to perceive a figure of discrete points on a structured ground.

Strauss and Lehtinen, reasoning that injury to the brain could create a figure-ground problem of a general kind, sought evidence that the same type of deficiency existed in both the visual and tactual areas. Using boards on which were figures constructed of semispherical tacks placed at discrete points against a background of flat thumbtacks, they found that the brain-injured mentally retarded children were clearly affected by the strong tactual background. They found these children had no difficulty with the same figures presented as solid forms on a smooth background, indicating that the children could perceive and draw these figures. This study supported their view that a figure-ground problem caused by brain injury can be a general problem and that the same kind of disturbance can arise in several sensory fields. (9) Yet it also showed that not all kinds of functioning subsumed under figure-ground are necessarily affected. Difficulty in forming a figure of discrete points on a structured ground was not accompanied by difficulty in perceiving the shapes of solid forms. Had Strauss and Lehtinen asked the subjects to color what they had drawn, it might be possible to say whether the subjects perceived the figure-ground relation in the classical sense, that is, whether the subjects assigned the contours-- the lines of their drawings-- to the objects or to the backgrounds.

In a study of the performance of cerebral palsied children with approximately normal intelligence, Cruickshank used a series of pictures embedded in a structured background. These pictures were flashed on a screen, and the subject was asked to indicate what he saw. The slides differentiated between normal, athetoid, and spastic groups (2). Although the slides were intended to test one's ability to discern an obscured figure, I thought, after examining pictures of these slides, that in some instances the background stimuli were highly structured and so closely resembled objects that they could readily be named. On one slide, the only clear, unobscured stimulus was a word, and this counted as part of the background. It appeared that the major criterion the experimenter used in deciding what was to be considered figure was the position of the figure in the center of the slide. If the cerebral palsied children had diffuculty fixating on the center of the screen, this alone would have caused them to perform more poorly than normal children. This possibility should be investigated.

Another test of figure-ground is the subtest of intersecting figures on the Frostig Test (5). Finally, Kephart's Visual Achievement Forms requires that the child copy several geometric forms. Kephart suggests that copying the form as a whole rather than part at a time is an aspect of figure formation (7).

Aspects of Figure-Ground

From the procedures employed in the studies and tests I have summarized, we can see that figure-ground, as used in educational studies, is a broader concept than the classical concept found in perception theory. Unfortunately, it may become too broad to be useful. Probably it would be best to subsume certain performances under other categories. Also, aspects of performance that may have been measured unintentionally, such as ability to fixate on the center of the screen, should not be thought of as aspects of figure-ground.

The following, then, may be listed as aspects of the figure-ground problem as the term is used in educational writing: classical figure-ground formation; differentiation of intersecting figures; perception of one figure hidden in a complex figure; perception of a complex figure as a whole rather than perception of a part as figure and the remainder, temporarily, as ground; ability to withstand distraction by other stimuli in the visual field; and ability to superimpose and reconstruct a visualized figure formed of discrete points against a structured ground. Defects in figure formation would include defects in the aspects listed and: retarded responsiveness; instability of figure; perseveration of a figure that has been formed; and formation or a simpler figure from a complex stimulus.

Criteria

When considering possible procedures for improving figure formation in visual perception, several words of caution are necessary. Because the term figure-ground is employed with respect to all the aspects listed, we may be tempted to assume they are all one thing. Even within the area of visual perception, the functions listed may be independent of one-another. An impairment in one does not signify an impairment in another. Poor performance on the Frostig figure-ground subtest may indicate that the child has difficulty in identifying intersecting figures. It does not indicate a problem in figure formation in the classical sense. An impaired function in the visual field does not mean the same function will be impaired in auditory or in motor functioning. Therefore, an impaired function may not be helped by remedial training on another function or on the same function in another area.

The existence of an impairment must be clearly demonstrated. Poor performance on a test designed to identify an impaired function may result from problems unrelated to the function. A child may do poorly on timed exposures of intersecting figures if he fails to fixate on the center of the screen. A teacher may interpret inattention as distractibility caused by other visual or auditory stimuli when, in fact, the inattention may be due to intrusions of the child's own thoughts and worries. Moreover, a cluster of impaired functions could be assumed to exist because of the presence of several behavioral characteristics that lead us to place the child in a handy category of children that are supposed to manifest these impaired functions.

If a deficiency in perception is to be remedied, the validity of the remedial procedure must be demonstrated. Considerable published material and many procedures have been offered for improving perception. The validity of these materials and procedures often has never been demonstrated.

The occurrence of a perceptual deficit concurrently with an academic deficiency need not mean that remediation of the perceptual deficit will contribute to improvement in the academic area, for one deficit may not be the cause of the other. Even if a cause-effect relation exists, it may be more helpful to train pupils directly on the perceptual skill within the academic area, such as the identification of syllables within words, than to train them on a related skill using, say geometric forms.

Remedial Techniques

Remedial techniques proposed for perceptual difficulties are of two types. First, techniques that lead to improvement of functioning by circumventing the problem. These include using a non-distracting environment for a distractible child, and employing a device for exposing one line of print for the child who cannot read without interference from the other words on the page. The second type includes techniques for improving perceptual ability. The Frostig program for the development of visual perception falls into this category. (4) Some techniques used for circumventing the problem may help to improve perceptual ability as well. All these techniques must be viewed against the criteria and limitations enumerated earlier.

Specific techniques tried by several educators include the following. Strauss and Lehtinen recommend that a minimum of visual materials be displayed in classrooms for brain-injured children. Presumably, other distractible children could profit from this procedure. Other procedures for controlling distractibility include removing or covering borders or pictures from textbooks and other materials. If the child has difficulty maintaining the stability of a figure, outlining it with a colored or a heavy black line is suggested. Another suggestion is to provide motor activity to hold the child's attention on the task. (9)

Cruickshank found that, for cerebral palsied children, the stimulus value of material was increased by using color. He suggests that three-dimensional teaching materials might be used before two-dimensional materials (2). This would support the use of three-dimensional alphabet letters and objects before using printed letters and pictures. Whether it is necessary to employ such a procedure with normal children has not been demonstrated. Cruickshank concludes that the optimum visual material to use with spastic children would include a large figure on a large background combined with color in three-dimensions and presented without time limitations.(2). He would then gradually move to more standard materials. Since we cannot generalize to normal children, such a procedure may not be necessary, but it probably would do no harm.

Bibliography

1. Allport, Floyd H. Theories of Perception and the Concept of Structure. New York: John Wiley & Sons, 1955.

2. Cruickshank, William M., Bice, Harry V., Wallen, Norman E., and Lynch, Karen S. Perception and Cerebral Palsy: Studies in Figure-Background Relationships. Syracuse, New York: Syracuse University Press, 1965.

3. French, John W., Ekstrom, Ruth B., and Price, Leighton A. Manual for Kit of Reference Tests for Cognitive Factors (Revised 1963). Princeton, New Jersey: Educational Testing Service, 1963.

4. Frostig, Marianne, and Horne, David. The Frostig Program for the Development of Visual Perception: Teacher's Guide. Chicago: Follett Publishing Co., 1964.

5. Frostig, Marianne, Maslow, Phyllis, Lefever, D. Welty, and Whittlesey, John R.B. The Marianne Frostig Developmental Test of Visual Perception: 1963 Standardization. Palo Alto, California: Consulting Psychologists Press, 1964.

6. Goldstein, Kurt. The Organism. Boston: Beacon Press, 1963.

7. Kephart, Newell C. The Slow Learner in the Classroom. Columbus, Ohio: Charles E. Merrill, 1960.

8. Osgood, Charles E. Method and Theory in Experimental Psychology. New York: Oxford University Press, 1953.

9. Strauss, Alfred A., and Lehtinen, Laura E. Psychopathology and Education of the Brain-Injured Child. New York: Grune and Stratton, 1947.