A DEVELOPMENTAL COMPARISON OF MODES OF PERCEPTUAL ADAPTATION TO AN ALTERED VISUAL-PROPRIOCEPTIVE TASK

A Thesis

Presented to

the Faculty of the Department of Psychology

University of Houston

In Partial Fulfillment

of the Requirements for the Degree

Master of Arts

By

James P. Thompson

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ABSTRACT

Following from a developmental hypothesis it was predicted that schizophrenics and normal children would adapt in a similar mode to an altered visual-proprioceptive task. Nine good premorbid schizophrenics, nine poor premorbid schizophrenics, nine normal children, and nine normal adults were tested for adaptation to a brief visual displacement of their hand images. The procedure involved the marking of a target design prior to and after exposure to a 20 diopter prism. The distance between preexposure and postexposure markings was measured for each subject. The schizophrenics and normal children showed significantly less compensatory, or adaptive, shift in their performances following the visual-displacement procedure. There was no relationship found between adaptive shift and I. Q. as measured by the Peabody Picture Vocabulary Test. The results lend support for the regression hypothesis for schizophrenics in terms of perceptual functioning.

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A DEVELOPMENTAL COMPARISON OF MODES OF PERCEPTUAL ADAPTATION TO AN ALTERED VISUAL-PROPRIOCEPTIVE TASK

In studies of adaptation one important area of research has been perceptual adaptive functioning. These types of adaptive skills are essential for adequate adjustment to the external environment. One key area of research (Ebner, Broekema & Ritzler, 1971; Harris, 1965; Held & Hein, 1958; Held & Gottlieb, 1958; Kohler, 1964) has been the investigation of the effects of experimentally altering patterns of perceptual input on adaptive organization. Recent studies (Comalli, 1973; Ebner et al., 1971) have focussed attention on comparing the adaptation of normals with schizophrenics on perceptual tasks. Their findings indicate schizophrenics manifest a deficit in their performance on tasks requiring adaptation to experimentally altered patterns of input.

Holzman (1969) defines perception as " a perceptual act that transforms a physical stimulus into psychological information. This transformation involves complex processes that include at least four stages: reception of the stimulus, registration, the processing of the registered information, and the checking of the information against the continued input. Sensory, cognitive, conceptual, conative, affective and motor processes are linked with each other in any perceptual act." (p. 145) He further notes that:

> Freud...relegated to perceptual acts a central role in the development of those modulatory and controlling structures he called the ego, for the perceptual act reflects the psychological point of

> contact between a person and his external and internal milieu. Its principal function is to convey information from this ambience for integration with other psychological functions such as memory, judgment, and anticipation. But it also receives and carries information about the nature and consequences of the perceiver's actions. Perception is thus a central ingredient in effective adaptation, in the 'fitting in' process between the person and his environment. (Holzman, 1969, p. 145)

By examining perceptual functioning one can gain a better understanding of the operation of ego functions mediating the person's contact with the physical as well as psychological environment. The purpose of this study is to investigate some of the perceptual-cognitive anomalies occurring in two subtypes (good and poor premorbid adjustment patterns) of schizophrenia and to compare these with the functioning of normal children and normal adults. Another important aspect of this research will be to attempt to make intergroup comparisons within a developmental framework.

The literature review which follows will consider several areas related to this research. First will be considered the general issue of psychological deficit in schizophrenia, followed by: developmental views of psychopathology, the body percept and sensory-tonic field theory of perception, and perceptual adaptation.

Psychological Deficit

Hunt & Cofer (1944) point out that "some loss of efficiency" is a common result of mental disorders. They object to the use of the term "regression" to describe the lowered mental efficiency in mental disorders because of the confusion over its meaning. In their classic paper they propose the use of the term "psychological deficit" to describe the mental condition in various forms of psychopathology. Psychological

deficit is a neutral term and may be used as an operational concept. This term applies "when any person performs in some situation at a level of efficiency below that expected from comparison with typical individuals or from some indicator in his present or past behaviour, that person manifests a deficit." (Hunt & Cofer, 1944, p. 971)

Hunt & Cofer (1944) further lament the lack of a unifying theoretical framework and the rarity of consistent programs of research to investigate the psychological condition of the various psychopathological states. this article revolutionized research in the area of psychopathology, and since its publication several such programs of research have emerged.

Developmental Views of Psychopathology

One means of investigating psychological deficit has been the comparative-developmental approach of Heinz Werner and Seymour Wapner (Werner, 1973; Wapner, 1964; Wapner & Werner, 1957; Wapner & Werner, 1965; Werner & Wapner, 1949). By comparing psychopathological groups with developmentally mature and developmentally immature groups, one can better understand the differences in developmental level which differentiate these various groups. Experimental research as well as clinical experience clearly indicates certain psychopathological groups, particularly psychotics, function at a developmental level which is lower or earlier than "normal" adults. Werner's (1973) work centered upon perceptual deficits as a result of psychopathology and developmental organization. He viewed psychopathological phenomena as stemming from a decrease in differentiation and hierarchic integration. Goldman (1962) and Buss (1966) believe that in the area of perception one may most easily and clearly

examine the sequence from diffuseness to differentiation to hierarchic organization. Pathological perceptual functioning may be seen as a combination of genetically early and genetically late aspects with the genetically mature features being less dominant. Werner's conceptualization of development, in its progressive as well as regressive sense, may be used to account for certain anomalies in the realm of perception. This conceptualization of developmental lines parallels Piaget's work on the stages of mental development.

Werner (1973) maintained that the various schizophrenic spheres of reality are different from those of normal persons in that they are "marked by a lack of differentiation between subjective and objective content." A primitive world is constructed out of this egocentrism, autism and the "nearness of the ego to the external world." In the schizophrenic world of perception there is a marked participation of subjective factors in the process of configuration. Reality, for the schizophrenic, is known from a highly egocentric standpoint; "the outer world stands in a peculiarly intimate contact with the ego." This 'peculiarly intimate contact' refers to a lack of differentiation, merging or fused relationship between the two.

The schizophrenic's world of fantasy resembles the child's play reality in that it has the value of the real, not because things appear true to nature, but because strong affects bring them to life. Schizophrenic spheres of reality, however closely they resemble those of primitive types, e.g. children, are fundamentally different in that they are pathological. The invasion of subjective forms of reality into objective reality is experienced not as an enrichment, as with normal primitive types, but rather as an impoverishment. This is in agreement with Arieti's

(1974) notion that although schizophrenics regress, they fail to integrate at the lower levels to which they descend.

Werner's (1973) developmental theory is fundamental to the understanding of the notion of perceptual regression. One key principle of Werner's theory is the "orthogenetic law." It states "wherever development occurs, it proceeds from a state of relative globality and lack of differentiation to a state of increasing differentiation, articulation, and hierarchic integration." (Wolff, 1960, p. 31-32) The concepts "relative globality" and "lack of differentiation" are important characteristics of the egocentric state. As normal development proceeds, there is a gradual progression to higher levels of organization relative to the diffuse, poorly organized, disintegrated nature of the egocentric state. Goldman (1962) recognizes the meaning of the term "regression" in Werner's usage differs significantly from the psychoanalytic notion of regression. In psychoanalytic terminology, regression "focusses on impulses and the methods by which these are gratified and controlled." In contrast to the psychoanalytic emphasis on function and content of psychopathology, the developmental approach considers only the formal structure of psychopathological processes. The advantages of the structural approach include its utility in describing developmental phenomena within a consistent framework. It can also serve as a "gauge by which psychopathological states and modifications in those states may be assessed and understood in terms of developmental criteria." (Goldman, 1962)

Several investigators (Comalli, 1973; Dworetzki, 1939; Fine & Zimet, 1959; Phillips, 1959) have proceeded to explore the notion of perceptual regression in schizophrenia. The Rorschach technique is one particularly

useful means of assessing perceptual functioning. The stimulus conditions allow freedom for diversity in responses, yet these responses may fairly easily be ordered into formal categories on a wide range of characteristics. Its applicability to a wide variety of populations makes it particularly appropriate to a developmental approach.

Dworetzki (1939) and Meli-Dworetzki (1956), in a classic study, devised a scoring procedure for the genetic ordering of Rorschach test responses and applied these measures of perceptual functioning to studies of normal children, retarded children, educated and uneducated adults, and schizophrenics. The responses of normal children approached those of normal adults with increasing age.

Friedman (1952) capitalized on Dworetzki's findings and modified and quantified her scoring system, drawing upon the work of Rapaport (1976) and Beck (1949). He restricted his measures to location scores, which he felt were the best representatives of the formal or structural aspects of perceptual functioning. Proceeding from Werner's developmental theory, he postulated that "schizophrenic patients, in the structural aspects of their perception, function at a genetically lower level, similar to, but not identical with, that of young children." (Friedman, 1952, p. 94) He construed this phenomenon, in all its vicissitudes, as indicating regression.

Friedman's concept of regression followed from that of Werner. Friedman (1952) viewed regression as:

> ...the relative accentuation of genetically lower levels within the individual as the higher and more recently developed levels, the result of a steadily increasing differentiation and hierarchic integration, become less dominant. However, 'just as any developmental stage preserves vestiges of the earlier stages from which it has emerged, so will any degeneration bear signs of the higher level from which it retrogressed.' Thus, it is a case of similarity rather than identity in comparisons of children and

schizophrenics. (p. 64)

Friedman concluded from his findings that:

> 1. Schizophrenics, as a group, exhibit a regression in the structural aspects of their perceptual functioning. Like children, and unlike adults, their perceptual functioning is predominantly of a global, diffuse, syncretic, rigid and labile nature, and marked by relative lack of differentiation and hierarchic integration.
> 2. This functional regression is not total; the schizophrenic's perceptual functioning cannot be conceived as being identical with that of the child; vestiges remain which reveal the efficacy of the individual's past, i.e., the previous functioning on a higher developmental level. This is most clearly observed in the survival of a perceptual discreteness and plasticity of an order not attained by children, and in the variety of responses which point to a wider acquaintance with environmental stimuli. (p. 96)

Hemmendinger (1953) found that higher scoring, developmentally considered, on Friedman's indices parallels increasing chronological age. Proceeding from a "microgenetic" approach, Framo (1952) (cited in Phillips, 1959, and Phillips & Framo, 1954) tachistoscopically administered the Rorschach with gradually increasing exposure time to normal adults. His findings indicated that genetically higher types of responses become more frequent with increased exposure time, the tendency being toward more maturity of the percept and integration of the blot areas. Phillips & Framo (1954) note that: "Structurally, at the shortest exposure time their performance was not grossly different from that of the normal adults, but as exposure time was increased these schizophrenics increasingly lagged behind in the development of perceptually mature responses." (p. 471) His conclusion was that the schizophrenics failed to utilize increases in exposure time to improve their perceptual adequacy and integration. Phillips & Framo further maintain Framo's and Freed's study support a developmental hypothesis. It was found that

young children, experimentally restricted normal adults and very severely impaired psychiatric groups give the genetically earliest responses to the Rorschach.

Siegel (1953), in an investigation in the same vein as those mentioned above, compared paranoid schizophrenics, hebephrenic schizophrenics, catatonic schizophrenics and normal children of various ages. He found that the perception of the paranoid is "more intact and closer to that of the normal adult than the catatonic and hebephrenic subjects. Another finding was that the perception of the paranoid was similar to that of the more differentiated but less integrated responses of children between six and ten years of age. The hebephrenics and catatonics, on the other hand, resembled the "global, amorphous, perceptual activity of three to five year old children." Siegel qualified his findings by pointing out that although there was a resemblance between the performance of the two groups, "paranoid perception is a combination of genetically early and genetically late characteristics."

Fine and Zimet (1959) investigated perceptual functioning in process and reactive schizophrenics using Friedman's technique. They point out that percepts scored as "immature and mature might also be regarded respectively as expressing primary and secondary levels of thinking." They found that process schizophrenics produce significantly more genetically lower responses than reactive schizophrenics. The reactive group scored at a more adequate and integrated level, whereas the process group showed more "perceptual immaturity." In a later investigation, Fine & Zimet (1965) found that process schizophrenics produce percepts which reflect more primary process characteristics than do those of reactive schizophrenics.

Buss (1966) recognizes that developmental researchers have made a

strong case for the regression hypothesis on the basis of Rorschach results. However, he argues there are some important methodological flaws with this research. He maintains that certain indicators have been chosen to the exclusion of others. On some structural characteristics of the Rorschach normal adults score at the same level as normal children. This could be interpreted as suggesting the normal adult shows as much regression as the schizophrenic. This is an important consideration and needs to be evaluated systematically. Wapner (1964) counters Buss' argument by asserting that "...the mature individual is assumed to have at his disposal the early as well as the late appearing functions. From this one can expect there will be certain formal aspects to be found in the Rorschach protocols of normal adults which will resemble those of young children.

The Body Percept and Sensory-Tonic Field Theory of Perception

An important area of consideration for developmental investigators has been that of the "body percept." This area is particularly pertinent to research with schizophrenics. There is well-documented clinical evidence that distortions in the perception of the body are frequent occurrences in schizophrenic pathological states (Fisher & Cleveland, 1968). Much work has been provided by the psychoanalytic literature of which Federn is a major contributor. Federn (1952) views the schizophrenic process as beginning with the loss of the ego's actual function of separating "external reality and inside mentality." If the person loses the ability to differentiate and integrate logically, then the person's cognitive processes cannot stabilize and adapt to the environment. The person may retain the ability to differentiate and integrate, but it will be on an illogical, infantile level.

Federn (1952) maintains that regression to an infantile level results in an entirely different conception of the outside world. The individual may undertake this retrograde process partially or totally to such an extent that a narcissistic level is reached in which ego and outside world are not separated. This schizophrenic regression is viewed as a dynamic, fluctuating process, and may suddenly cease or be reversed.

One of the most dramatic and frequently reported results of the schizophrenic process occurs in the area of perception of one's body. When one part of the body takes on an unusual valuation for the person, the self perception of one's body is changed. Federn (1952) points out that when the body loses its value in the person's conception of himself, very unusual distortions of self perception of the body result. Often fear and alienation may be coupled with an uncanny feeling of one's body. Fisher & Cleveland (1968) note that alterations in the body image occur frequently in various psychopathological groups. These alterations seem to manifest themselves as a lessening of the definiteness of the body boundaries. As a result, the boundaries between the self and the outer world become diffuse and permeable.

Wapner (1964) and Wapner & Werner (1957) review some important features of the organismic-developmental approach which underlies much of the research conducted in their laboratory at Clark University. They maintain that behaviour occurs in the context of the gestalt of organismic activity. This has clear implication for understanding the way in which a person processes information, particularly perceptual input, about his body. Werner's sensory-tonic field theory of perception adumbrates this

relationship between the body and the environment and places it within a developmental perspective. This theory posits that "perception is a reflection of a relation between sensory input (proximal stimulation) and ongoing organismic states." (Wapner, 1964, p. 198) Perceptual experience is viewed as continually changing in correspondence with variations in the relationship between object-stimuli and the current momentary state of the organism. Sensory-tonic field theory lends a conceptual framework for stabilization tendencies of the organism. It proposes that "given an unchanging stimulus which is in an unstable relation to the existing organismic state, there is a tendency of the organism to change its state toward a more stable relationship." (Wapner & Werner, 1957, p. 2)

Allport (1955) notes some of the implications of the sensory-tonic field theory for organism-object interactions. External object stimuli may disrupt the organismic state or they may not. If incoming stimulation interferes with the organismic state, a tendency emerges in which the organism may change its state in the direction toward establishment of equilibrium between body and object. The person may reestablish balance by changing the position of the object. Allport (1955) notes that:

> The perception, in its spatial aspects, is thus the result of an equilibrative tendency set up between the effects of stimulation from the object and the organismic state at the moment; and this tendency also represents an adjustment in the relationship between body and object—an attained equilibrium in the field that is composed of these two parts. (p. 196)

One might hypothesize on the basis of the primitive organismic state of the schizophrenic that conpensatory organizations may occur which will differ substabtially from that of normals. Howard & Templeton (1966) define egocentric orientation as implying "the positioning of an object

or of a part of the body with respect to some axis or plane defined entirely with respect to the body or some part of the body of the observer. There is no reference to any other point or plane outside the observer." (p. 272) Consequently it is to be expected that in light of the schizophrenic's egocentric orientation anomalies in their perceptual performance may be predicted from this theoretical framework.

Wapner & Werner (1965) embarked on a program of research with the intention of applying the developmental approach to the characteristics of the relationship between one's own body and environmental objects. The first group of studies involves an experimental paradigm similar to that employed in studies of perception of verticality. The procedure is described as follows:

> The person, seated in a tilting chair in a darkened room, is required to carry out two tasks which he is tilted: (1) In the first task a luminous rod is adjusted to that physical position in which it appears vertical—in this way we obtain a measure of the changes in apparent position of an object 'out there'; (2) in the second task the luminous rod is adjusted to the physical position in which the subject experiences the longitudinal axis of his body to be located--here, we obtain a measure of the way in which he perceives the position of his own body in space. (Wapner & Werner, 1965, p. 12)

In one study the findings indicated that for older adolescent and normal adult subjects the apparent vertical was judged as being rotated opposite to the direction of body tilt. The polarity between self and object space is thought to be reflected in the angular discrepancy between apparent vertical and apparent body position. The results for children were different in that the angular discrepancy was less, yet increases with age. The angular discrepancy between apparent verticality and apparent body position is smaller for younger children. A detailed analysis revealed that the

angular discrepancy does not change gradually, but there is a "sudden discontinuous increase in disparity around the thirteen to fifteen year age level." (Wapner & Werner, 1965, p. 16) The authors point out that such changes have been observed to occur in other areas of psychological functioning during development. Studies with schizophrenics show "a similar shrinkage of the angular discrepancy between apparent object and apparent body position." (Wapner & Werner, 1965, p. 16)

A second group of studies (Wapner & Werner, 1965) investigated the effect of variation of size of the surrounding space on apparent size of body parts using two procedures. In the first study "the subject is placed with arms stretched forward so that one arm is outstretched toward a wall; the other two control conditions have extended space or a wall in front of both arms...The task for the subject is to examine visually the spatial context in which he is located, then to close his eyes and judge which arm appears longer." (Wapner & Werner, 1965, p. 17) Generally, the arm outstretched toward open-extended space is perceived as longer. A second study was concerned with a similar problem using apparent head width instead of arm length. This study utilized a technique as follows: "With eyes closed the subject indicates the apparent width of his head at the cheekbones by the use of his index fingers with arms extended in front of him...This task is carried out in two spatial contexts: in one, the walls on left and right are very close on both sides of the subject; in the other condition, the walls are relatively far away." (Wapner & Werner, 1965, p. 17-18) Here, results showed that apparent head width is narrower in the close-confined spatial context as compared with the open extended spatial context. Studies utilizing these procedures were

also conducted with children, schizophrenics and normals under the influence of LSD, i.e. developmentally lower subjects. For these groups it was found that apparent head width is relatively larger.

Comalli (1973) in a study designed to test the regression hypothesis for schizophrenics, utilized a technique devised by Wapner & Werner (1957). He investigated the effects of body tilt and starting position in the perception of verticality in schizophrenics. He found support for the regression hypothesis in that the schizophrenic's performance was the reverse of the normal adult's performance. This reversal in the tilt relation of body and rod was interpreted as evidence for a return to a more egocentric organization of space, i.e. the object world is reliant upon the self as referent. This result was also seen as supporting the notion of de-differentiation. Comalli found an important difference between the schizophrenic's performance and the performance of children in earlier studies. Children typically are thought to be "stimulus bound"—a characteristic which reveals itself in this task as a large starting position effect. This effect was not seen in the schizophrenic's performance in this study. The reversal of the body tilt effect (seen in normal adults) is similar for schizophrenics and young children.

Perceptual Adaptation

Another group of studies have been conducted with the purpose of investigating perceptual adaptation (Ebner, et al., 1971; Gibson, 1966; Held & Hein, 1958; Howard & Templeton, 1966; Kohler, 1964; Teuber, 1960). These studies have focussed upon the ability to adapt to or compensate for experimentally disrupted relations between external input and movement produced sensory feedback. Harris (1965) interprets adaptation as

consisting "of changes in the position sense for various parts of the body." Harris (1965) terms changes in the position sense as referring to "proprioceptive changes." Ebner, et al. (1971) notes that although there are individual differences "the general finding seems to be that the affected individual adapts to the sensory disarrangement through compensatory perceptual changes which help restore perceptual order and stability." (p. 367) These findings clearly follow from sensori-tonic theory, particularly the postulate dealing with stabilization tendencies. One would expect nonclinical adult populations to attempt to make perceptual adjustments to compensate for disarranged sensory coordination. The case for certain clinical populations is somewhat different, however. On the basis of Werner's developmental theory and the data supporting it, one might expect individuals falling on the lower end of the developmental continuum to manifest deficits in their performance in such a task. Ebner, et al. (1971) was one of the first studies to examine systematically a clinical group using this type of task.

Ebner, Broekema, and Ritzler (1971) utilized Held and Hein's (1958) technique in a comparison of schizophrenics and normal adults in an optical displacement procedure. The technique allows for a brief visual displacement of the hand image in a psychomotor task. This procedure is generically similar to that of Comalli (1973) in that a disequilibrium is introduced in the person's perceptual field. In both procedures the person is required to make a perceptual adaptation in order to adjust to the alteration in the environment. The person is required to compensate in a similar fashion. The findings of Ebner, et al. (1971) indicate the

schizophrenic group "showed significantly less compensatory, or adaptive shift in their performance following the optical displacement procedure." They interpreted these findings as support for "previous work which appears to indicate that schizophrenics are deficient in integrating proprioceptive and visual information under conditions in which the neural patterning among sense modalities is disrupted." (p. 367) These data may also be interpreted as evidence supporting Werner's developmental theory. Ebner, et al. (1971) findings seem to reflect an egocentric orientation in that the schizophrenic is unable to adapt to alterations in his perceptual field by utilizing cues from the external environment as to orientation. This finding seems consistent with Howard & Templeton's (1966) notion of "egocentric orientation."

One important area for investigation would be to determine if the schizophrenic's performance is similar to individuals at early developmental levels, i.e. children, and to determine if their performance is different from normal adults. Another important area for research would be to compare schizophrenics who are at different developmental levels. This study addresses both of these questions. It is concerned with comparing four experimental groups (normal adults, normal children, good premorbid schizophrenics and poor premorbid schizophrenics) to see if a developmental pattern can be identified. Following from Werner's theory and Ebner's results one would predict an adaptive shift score for the normal adults which would be significantly different in the positive direction from a zero shift. One would further expect the normal adults to show a significantly greater shift than the other groups as a whole. Hopefully this information will provide guidelines for differentiating between

populations at different developmental levels and point to areas for further research.

Method

Subjects Eighteen adult schizophrenic subjects were selected from inpatients in the Houston Veteran's Administration Hospital. These patients were all housed in locked wards, although each had privileges to leave and return to the ward at will. Patients were included only if they met the following criteria: 1) An admitting diagnosis of schizophrenia by two staff clinicians 2) A criterion score on the Research Diagnostic Criteria (RDC) (Spitzer, Endicott & Robins, 1975) 3) No history of neurological impairment or head injury 4) An age range of 18-55 years 5) normal intelligence as measured by the Peabody Picture Vocabulary Test (I.Q. above 75) 6) at least eighth grade education or its equivalent, e.g. G.E.D.) 7) Adequate visual acuity to be able to perceive and correctly identify or describe the image of the target design.

Each schizophrenic subject was identified with respect to premorbid adjustment (process-reactive). Case history, the examiner's judgment and the Phillips rating scale (Phillips, 1953) were utilized to make these determinations. The eighteen schizophrenics were selected in order that two groups of nine patients could be formed according to premorbid adjustment rating. Each of the two groups were composed of nine schizophrenic subjects. All patients were receiving antipsychotic medication in moderate doses at the time of testing.

A control group of nine normal adult subjects were selected from Texas Research Institute of Mental Science's personnel volunteers. These subjects were included only if they met criteria 3, 4, 5, 6, 7 listed above for the schizophrenic subjects. Subjects who reported any personal

history of psychiatric illness were excluded from this group. Subjects reporting the use of hallucinogenic drugs (e.g. L.S.D., mescaline) in the past year were excluded from this group. Subjects receiving medication of any kind at the time of the experiment were excluded from this group.

A second comparison group of nine normal children were selected from volunteers. These subjects were included if and only if they met criterion 3 above and these additional criteria: 1) maximum age of 9.5 years 2) normal intelligence as measured by the Peabody Picture Vocabulary Test (I.Q. above 75) 3) not receiving medication 4) no severe behaviour problems as reported by the family. The mean and ranges for I.Q. scores and ages of each group is provided in Table 1.

AGES AND I.Q.S OF SUBJECTS BY GROUPS

TABLE 1

roup	Mean Age (years)	Age Range	Mean I.Q.	I.Q. Range
ormal Adults	25.60	22 to 29.7	123.9	100 to 138
hildren	7.95	6.25 to 9.5	115.3	76 to 139
ood Premorbid Schizophrenics	35.13	21.2 to 53.3	109.7	97 to 141
oor Premorbid Schizophrenics	36.14	22.2 to 53.7	98.7	81 to 128

All subjects were informed of the nature and purpose of the study and the confidentiality of individual results for this study was explained.

The children were advised that they would receive a toy of their choice when they were through if they "work hard." All children received a toy when the experimental session was over.

Procedure Three tests were administered to all subjects: 1) A technique designed for studying adaptation to disarranged hand-eye coordination described below. 2) The Beck administration of the Rorschach test (the results of this test will not be analyzed for this study) 3) The Peabody Picture Vocabulary Test. In addition a modified version of the Phillips rating scale and Research Diagnostic Criteria were administered to each schizophrenic subject.

The optical displacement apparatus conformed to specifications described elsewhere (Held & Gottlieb, 1958; Ebner, Broekema & Ritzler, 1971). This investigation utilized the experimental task described earlier (Ebner, Broekema & Ritzler, 1971). The subject was seated in front of the device into which he was instructed to look monocularly through a small aperture. He was instructed to rest his forehead against a cushion which was located directly above the aperture.

INSERT FIGURE 1 ABOUT HERE

The target design (Figure 1, T) consisted of a tick-tack-toe square, and was mounted on the far wall of the box. A mirror (Figure 1, M) attached to a movable track was located 13 cm under the viewing aperture so that light was reflected from the target to the subject's eye. The aperture limited the field of vision so that the subject was not able to see the edges of the mirror or the far wall of the box. The subject was able to see only the reflected image (Figure 1, T') of the target design which

appeared to be located on the bottom horizontal surface of the box.

All subjects were asked to look through the aperture and tell the experimenter what they saw. If the subject could not name the design, a description was requested. If the subject could not describe it, a drawing was requested. If the subject was unable to name, describe or draw the target design the task was discontinued because this was considered sufficient evidence that the subject either: 1) lacked sufficient visual acuity to be able to perceive the figure or 2) could not comprehend the task or 3) would not cooperate. If the subject passed this initial screening test, the instructions were given to look at the design and to mark with a pen the four points at which the lines forming the target design intersected ("the points where the lines crossed or came together") The information was given that neither the person's hand nor his/her markings would be visible. Instead the person was told to go by the "felt position" of the hand in relation to the visual image. After each trial the subject was instructed to remove the hand from the box. While the subject marked the points on the paper, the experimenter marked the paper for each trial by drawing a line along the edge of the box. This allowed the experimenter to return the paper to precisely the spot where each trial took place. The marking paper roller (Figure 1, R) was then rolled forward for the next trial. When the first ten marking trials were completed, the subject was told to close his/her eyes. At this point the mirror under the aperture was replaced by a 20-diopter wedge prism (Figure 1, B). The orientation (baseleft or base right) of the prism was randomly selected for each subject and the orientation selected was noted. The subject then viewed his/her hand on the bottom horizontal surface of the box which was a distance of approx-

imately 15 cm from the prism (Figure 1, B). When viewed through the prism at this distance, the image of the subject's hand was laterally displaced approximately 7.96 cm to the left or right depending on the orientation of the prism. This prism viewing period lasted for two minutes. The subject was instructed to move his/her arm laterally back and forth at an approximate rate of 60 movements per minute. The subject was instructed to keep the hand continuously in view as it was moved.

The subject was asked to close both eyes following the two minute prism exposure. The prism was removed and the mirror repositioned under the aperture. The paper was rolled back so that the paper was in precisely the same position as when it was marked for the first trial. The subject was requested to repeat the target marking for ten trials, exactly as before the prism exposure period.

Results

The datum of particular interest was the difference in location of the target marking made before and after the period in which the subject viewed the prism. A shift score was computed for each subject indicating the mean difference in mm between the pre-exposure and post-exposure markings for each point on the target. A positive numerical score indicated that post-exposure markings were shifted in the expected direction (i.e. the markings should shift in the direction opposite to that in which the hand image was displaced). A negative score indicated a shift in the post-exposure markings in the same direction as the optical displacement. The data was also analyzed to determine if any significant vertical displacement occurs following prism exposure.

Table 2 presents the mean difference scores in mm for each group for the preexposure and postexposure trials.

TABLE 2

Mean Difference Scores for Groups in mm

Group	Horizontal Shift	Vertical Shift
Normal Adults	9.65	-8.01
Children	2.61	8.71
Good Premorbid Schizophrenics	-0.12	-8.01
Poor Premorbid Schizophrenics	-7.76	-9.6

Table 3 presents the median difference scores in mm for each group for the preexposure and postexposure trials.

TABLE 3

Median Scores for Groups in mm

Group	Horizontal Shift	Vertical Shift
Normal Adults	9.5	-0.5
Children	10.0	11.5

TABLE 3 (con'd)

Group	Horizontal Shift	Vertical Shift
Good Premorbid Schizophrenics	3.5	-4.5
Poor Premorbid Schizophrenics	-1.5	-11.5

Shift scores were analyzed for each group by means of t tests to determine if any group manifested a shift score significantly different from a zero shift. The normal adult group was the only group to reveal a significant shift ($t = 3.99$, $df = 8$, $p < 0.005$). Analyses of the other groups using t tests failed to show any significant difference from a zero shift. The results of these t tests are presented in Table 4.

TABLE 4

Individual Group Shift Scores Compared with Zero Shift by t tests

Group	df	t	p
Normal Adults	8	3.99*	.005
Normal Children	8	0.55	NS
Good Premorbid Schizophrenics	8	-0.02	NS
Poor Premorbid Schizophrenics	8	1.93	NS

For a more detailed discussion of the median shift scores please see Appendix A.

Analyses of variance were performed for vertical and horizontal shift scores, and summaries are presented in Table 5 and 6.

TABLE 5

Summary of 2 X 2 Analysis of Variance for Horizontal Shift Scores for Groups and Prism Orientation

Source of Variance	df	MS	F
A (Prism Orientation)	1	152.3	0.99
B (Diagnosis)	3	121.05	0.79
A X B	3	41.6	0.27
Error Within Cells	25	153.0	

TABLE 6

Summary of 2 X 2 Analysis of Variance for Vertical Shift Scores for Groups and Prism Orientation

Source of Variance	df	MS	F
A (Prism Orientation)	1	433.4	1.27
B (Diagnosis)	3	627.2	1.84
A X B	3	184.9	0.54
Error Within Cells	25	340.9	

These analyses divided each of the four groups into two groups: one group receiving the condition in which the prism was oriented base right. The other group received the condition in which the prism was oriented base left. The analyses revealed no significant difference in shift scores across diagnostic groups, no significant difference for prism orientation, and there was no statistically significant interaction between prism base orientation and subject group.

Results of the t tests and mean difference scores indicated that a more detailed analysis was warranted. These results indicated a significant shift for the normal adults in the expected direction and a shift approaching significance for the poor premorbid schizophrenics in a direction opposite to the expected direction. It was expected that the two-way analysis of variance (see table 5 and 6) would fail to reveal a significant difference for diagnostic groups, because the number of subjects percell was radically reduced. The important result of this test was finding no significant difference for prism orientation. A one-way analysis of variance was performed for horizontal and vertical shift score. This increased cell size for each diagnostic group and provided a more powerful test of the question regarding differences in diagnostic groups. The results of these analyses are displayed in Tables 7 and 8.

TABLE 7

Summary of One-Way Analysis of Variance for Horizontal Shift Scores for Groups

Source of Variance	df	MS	F
Between Group	3	466.33	3.02*

Source of Variance	df	MS	F
Within Group	32	154.37	

* $p < 0.05$

TABLE 8

Summary of One-Way Analysis of Variance for Vertical Shift Score for Groups

Source of Variance	df	MS	F
Between Group	3	674.8	1.898 NS
Within Group	32	355.6	

NS = Nonsignificant

The prism orientation dimension was collapsed for this one-way analysis of variance. These analyses revealed the mean horizontal shift scores for the groups (normal adults, children, good premorbid schizophrenics, and poor premorbid schizophrenics) were significantly different from each other ($\underline{F} = 3.02$, $\underline{df} = 1/32$, $p < 0.05$). There was no significant difference found across groups for vertical shift.

In order to follow up the differences found for diagnostic groups, planned comparisons were undertaken to examine differences in individual comparisons of groups. These data are summarized in Table 9.

TABLE 9

Table of Planned Comparisons for Horizontal Shift Scores

Comparison	t value	p value
I - II, III, IV	2.39	0.05*
II - III, IV	1.55	0.1
I - II	1.2	0.2
I - III, IV	2.68	0.02*
III - IV	1.3	0.2
II - III	0.46	0.5
II - IV	1.76	0.1
I - III	1.66	0.1
I - IV	2.97	0.01*

I = normal adults

II = normal children

III = good premorbid schizophrenics

IV = poor premorbid schizophrenics

* = significant

These planned comparisons indicated significant differences are present in comparisons of normal adults with the developmentally lower groups

combined ($t = 2.39$, $p < 0.05$) and in comparisons of normal adults with the schizophrenic groups combined ($t = 2.68$, $p < 0.02$) and in comparisons of normal adults with poor premorbid schizophrenics ($t = 2.97$, $p < 0.01$).

Analyses of Peabody Picture Vocabulary I.Q. scores by a one way analysis of variance revealed a significant difference across groups. ($F = 3.9$, $p < 0.025$). In order to determine if I.Q. was related to horizontal shift score, Pearson product moment correlations were calculated for each group. The data revealed no statistically significant correlation between I.Q. and shift score and these data are presented in Table 10.

TABLE 10

Pearson Correlations for I.Q. by Groups for Horizontal and Vertical Shift Scores

Group	Horizontal Shift	Vertical Shift
Normal Adults	-0.38	-0.09
Children	0.002	-0.5
Good Premorbid Schizophrenics	-0.11	-0.04
Poor Premorbid Schizophrenics	0.60	0.25
Overall	0.28	-0.05

N = 9 for each group
Significant r ($p < 0.05$) = 0.666

Discussion

The most significant finding of this research is that the children and both groups of schizophrenics, i.e., the developmentally lower groups,

showed significantly less compensatory, or adaptive, shift in their performance following visual displacement of their hand image. These findings parallel the results of Ebner, et al. (1971) for schizophrenics and help to fit this study into a developmental perspective. The failure of the schizophrenics and the children to make the adaptive shift did not seem to be due to confusion or impaired attention during the experimental procedure. Comprehension of instructions seemed adequate and subjects seemed involved in the task. The subject's markings were not randomly scattered on the marking paper but fell in a reasonably uniform pattern which mirrored the target design. This further supports the impression of the examiner that the subjects were adequately motivated and were able to comprehend and follow the instructions of the task. Further evidence supporting the interpretation that the performance of the children and schizophrenics may be validly attributed to the influence of the experimental procedure was provided in that there was an absence of any difference across groups in vertical displacement.

Further examination of the results reveals some interesting findings. When one considers the mean difference scores in tandem with the results of the *t* tests, the one-way analysis of variance and the planned comparisons one sees the emergence of a developmental progression. The normal adult group was the only group to show a compensatory or adaptive shift. The developmentally lower groups, i.e. children and schizophrenics, failed to compensate for the alteration in their visual field and showed no significant change in the location of their post exposure as compared with their preexposure markings. These findings lend support for the regression hypothesis in perceptual functioning. This follows from the developmental principle of increasing differentiation and the notion of

dedifferentiation in schizophrenia. The absence of a significant shift score for the developmentally lower groups indicates a more egocentric organization of space, i.e. the object world is dependent upon the self as referent. This is consistent with Howard & Templeton's (1966) notion of "egocentric orientation."

It appears evident that the disruption in schizophrenia of the integrative mechanisms linking proprioceptive and visual input (Ebner, et al., 1971) results in a more "primitive" organization of space. This primitive organization of space refers to the egocentric orientation of the schizophrenic group's markings. This results in a perceptual deficit for the schizophrenic in that he is less adequate in adapting to the changing environmental situation. This may be viewed as the schizophrenic's mode of adaptation to a malfunctioning information processing system. The information processing system fails to provide the person with the information needed to make an adequate adaptation, and therefore the individual is forced to attempt to organize perceptually at a level which can process the input from the external environment.

There are a number of methodological difficulties which occurred in this study. One limitation in conducting physiological or perceptual research with schizophrenics is the possibility of a drug related effect. Almost all inpatient schizophrenics receive antipsychotic medication as part of their treatment plan. Taking them off medication for research interferes with their medical regimen and raises ethical issues. Unfortunately, this means the majority of perceptual research with schizophrenics must be conducted with patients who are receiving medication. This introduces a confounding variable in that it can be argued that it is

possible the differences found may be due to a drug effect. Future research might deal with this problem through a number of methodological alterations, all of which involve severe logistic problems.

One strategy would be to introduce a control group composed of normals who are receiving antipsychotic medication. This would result in obvious complications which would make it difficult to find subjects willing to participate. This strategy also has drawbacks because it could be argued that the possibility exists that the perceptual system interacts with the medication differently for normals than for schizophrenics.

Another alternative for dealing with this problem would be to test the patient immediately upon admission into the hospital before he receives any medication. This presents several difficulties as well. Patients are not very accessible at this time and tend to be upset, uncooperative, sometimes violent and are usually restricted to the ward until they are stabilized on medication. Also, a complete and reasonably accurate diagnosis may not be made until after the patient is on medication. Utilization of this strategy would require careful coordination with hospital personnel and a great deal of patience.

The relationship between I.Q. and performance on this task was also considered as a possible confounding variable. Evaluation by means of an analysis of variance revealed a significant difference in I.Q. across groups so that it became necessary to test to see if any relationship existed. Pearson product moment correlations revealed no statistically significant correlation between I.Q. and shift score for any group individually or across all groups. This indicates no meaningful relationship between I.Q. and shift score exists except in cases of severe

mental deficiency. Mental deficiency is usually accompanied by some rather gross, diffuse perceptual deficits.

Another difficulty with this particular study was the low number of subjects. The number of subjects was decreased because of time limitations. Future research should include larger cell sizes.

One factor taken into consideration was that of visual acuity. When the subject indicated he/she could recognize the reflection of the target design, this meant he/she had a visual acuity score of at least 20/400 (Borish, 1970). This criterion was felt to be necessary for adequate performance on this particular task.

Implications for future research in this area would include examining correlations between these results and other areas of cognitive functioning. These areas might include: language, primary and secondary thought processes, eye movement patterns, evoked potentials, perception of one's body image, and the developmental level of perception as evidenced in the Rorschach.

The results of this research provide supporting evidence for a developmental view of psychopathology. The schizophrenics adapted in a mode different from normal adults yet similar to young children in a basic perceptual process. This lowered efficiency in compensating for alterations in the external environment may result in an exacerbation of feelings of disorientation in schizophrenics. This would be another important area of research. Attempts could be made to develop techniques for studying the relationship between this adaptive mechanism and unusual body experiences.

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APPENDIX A

Some Further Statistical Considerations

In light of the large variability in difference scores, further statistical tests were performed in order to determine if there were other systematic effects. The large mean values for the vertical shift scores were of particular concern (see Table 2). T-tests were performed comparing the first five trials to the second five trials using mean scores for each group. No significant differences were found for any of the groups for the horizontal shift scores. A significant difference was found for the vertical shift scores for the poor premorbid schizophrenic group only ($t=2.72$, $p<.01$). A two by four repeated measures analysis of variance was performed on the vertical shift mean scores for diagnostic groups and first five trials versus second five trials. No significant difference was found for diagnostic groups. A significant difference was found when the first five trials were compared with the second five trials ($F=4.27$, $df=1/32$, $p<.05$) across all diagnostic categories. No interaction effects were found for this analysis.

Median shift scores were computed for all groups, since these scores are not as subject to variability as means (see Table 3). These results parallelled the results of the mean scores with one exception. The median of the median shift scores for normal children was in a direction opposite to that found in the mean shift scores, i.e. the median for children was greater in value than the median shift for normal adults. This is contrary to what one would expect on the basis

of developmental theory. These median shift scores indicate that one should consider the results of the mean shift scores cautiously. These results are merely tentative. Further research is needed with a larger sample size in order to provide evidence which would allow one to draw valid conclusions about this theory on the basis of experimental findings. What appears to be thrown into doubt at this point is the relative adaptive functioning of the children. Is their functioning on this task similar in nature to the schizophrenic or the normal adult group? We have some evidence that their functioning is closer to that of the schizophrenic groups(the mean shift scores). On the other hand, we have evidence that the children's functioning is more similar to that of the normal adults (the median shift).

In addition, t-tests were performed for all groups comparing the first five trials and the second five trials using median scores. No significant differences were found for any group for either vertical or horizontal shift scores. These data lend support to the interpretation that the large mean differences found for the vertical shift scores was due to the large variability in scores and not to real preexisting differences in the groups tested.

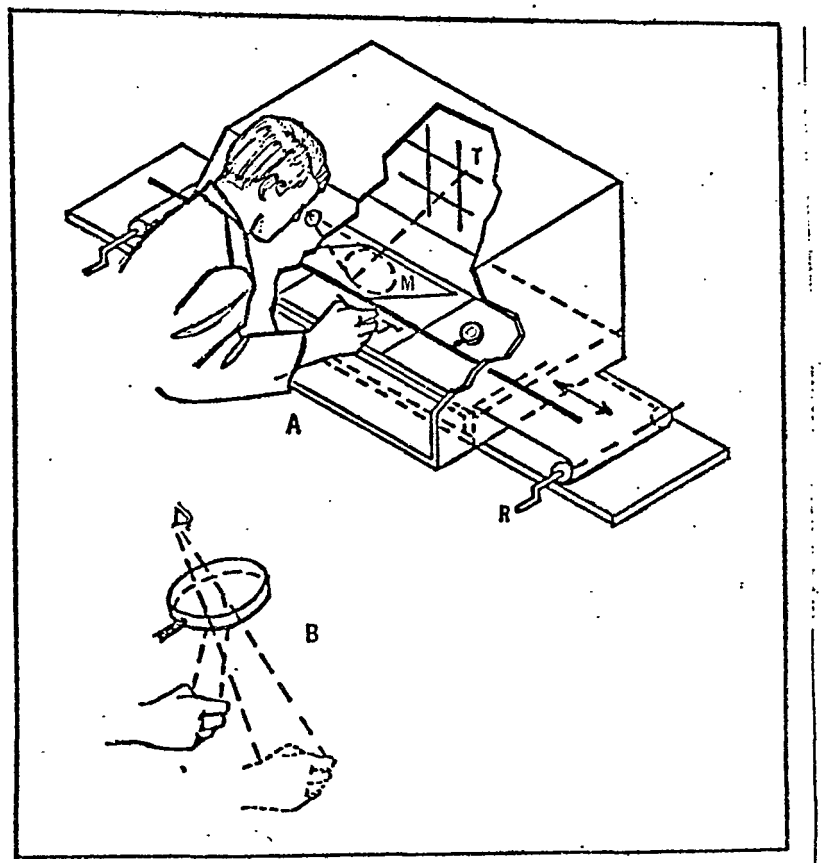

DIAGRAM OF OPTICAL DISPLACEMENT APPARATUS (AFTER HELD AND GOTTLIEB, 1958)

FIGURE I