

# SIZE CONSTANCY AND ABSTRACT THINKING IN SCHIZOPHRENIC PATIENTS\*

By

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## INTRODUCTION

FOR many years both clinicians and researchers have been interested in the thought disorders found in schizophrenic patients. Bleuler (4) believed that "weakness" or "looseness" of association was the primary disorder in schizophrenia. However his views were based on the associationist approach to the theory of thinking, which was buried a long time ago by the advent of Gestalt psychology, and even before that by the work of the "Denkpsychologie" school of Würzburg. The founders of the Würzburg School, Külpe, Ach, Watt and Marbe (31, 1, 56, 34) showed conclusively that the thinking process cannot be reduced to association of ideas and they introduced the concepts of "aufgabe" and of "einstellung", which represented some kind of imageless directional and selective influences in the thought process. A suggestion was made by Paul Schilder (47) that it was this super-ordinate directionality and selectivity of thought process which was affected in schizophrenia. An attempt to apply the principles of formal Aristotelian logic to schizophrenic thinking was made by Von Domarus (17) who found that schizophrenics tended in their propositions to identify the subject with the predicate.

During the past thirty years the main interest as far as schizophrenic thinking is concerned has centred on concept formation. The pioneering work of Vigotsky (55) in Russia was continued in America by Hanfmann and Kasanin (22) and also by Rapaport (39) who investigated the performance of schizophrenic patients in object sorting tests. Benjamin (3) found that schizophrenic patients interpreted proverbs "literally" and that they could not generalize from them. Although it is widely accepted that the ability to form "abstract" concepts is impaired in schizophrenic patients, that their thinking is "concrete", there is no consensus of opinion in the matter. By and large there are three schools of thought. The first is represented by the views of such workers as Vigotsky, Kasanin, Hanfmann, Goldstein, Bolles, Storch, Zeigarnik, Babcock and Rapaport. This school maintains that the essence of the schizophrenic thought disorder is an inability to form abstract concepts. Schizophrenic thinking is concrete and is similar to the disorder of thought occurring in patients with organic brain damage. "Concrete-abstract" is the most important dimension used in the description of concept formation by this school.

\* Approved by the Saskatchewan Committee on Schizophrenia Research.

The most representative of the second school of thought are the views of Norman Cameron (12, 13), Stack Sullivan (51) and, more recently, Whiteman (60). These authors maintain that schizophrenics are as abstract in their thinking as are normals and that the peculiarity of their concept formation is due to their autism, lack of "publicness", as it were, in their thinking; schizophrenics do not use the social standards in their concept formation, they do not monitor their thinking from the point of view of the outside society and do not shape it according to the social norms. It is the interpersonal relations, the "role taking" to use G. H. Mead's term, the communication which suffer, but not the ability to abstract. "Private (autistic)-public (social)" is the most important dimension used by this school in description of schizophrenic concept formation. The psycho-analytical views on schizophrenic thinking, which stress the "ego weakness", the "narcissism", the "primary process", and the lack of "reality testing", can be classified as belonging to this school.

The third school of thought is represented by such workers as Paul Schilder (47) and Chapman (14, 15) who stress over-inclusiveness of schizophrenic concepts and also distractability by irrelevant stimuli. According to these workers schizophrenics tend to form very wide, over-inclusive, too general, poorly delineated concepts. These concepts include irrelevant material. "Span" or "range" of concepts is the most important dimension stressed by this school.

Both the first and the third school of thought presuppose an impairment of cognitive functioning in schizophrenic patients. An assumption of impairment of cognitive functioning brings in the question whether the general level of intelligence is impaired in schizophrenic illness.

One can ask, for instance, how the ability to abstract could be separated from the general level of intelligence or intellectual functioning. If one accepts the multi-factorial theory of intelligence, ability to abstract will be one of the factors. If one accepts the uni-factorial theory of intelligence there is a great likelihood that the ability to abstract will be highly correlated with or saturated by the general factor—Spearman's "g". Another factor which influences concept formation is that of language. As Sapir (45) and Whorf (61) pointed out, language is a mould which categorizes and classifies the surrounding world. In many schizophrenics the use of verbal tags and associations may mask an inability to abstract and categorize. These considerations point on the one hand to the difficulties confronting any study of the thought processes in schizophrenics and, on the other, to the need for a broader theory of cognition which would take into account the complexity of the relationships.

Perceptual processes in schizophrenic patients in contrast to thought processes have raised, until recently, rather limited interest. This was due to several factors: Kraepelin and his pupils could not find any major sensory changes in schizophrenic patients when they applied experimental techniques developed in Wundt's laboratory. They followed Wundt and understood by "perception" elementary sensory processes, such as sensory thresholds, and classified more complicated perceptual processes involving "meaning" as "apperception". As the result of these studies Kraepelin concluded "that there are no perceptual changes in dementia praecox". Kraepelin's authoritative statement was soon afterwards bolstered by Bleuler's statement about the "clear sensorium" of schizophrenics. This was incorporated into all textbooks of psychiatry and was accepted by two generations of psychiatrists. Investigation of sensation and perception by laboratory methods ceased to be in

vogue, as the main interest turned towards emotional factors propounded by the "Depth Psychologies".

However, the last twenty years or so have seen a tremendous upsurge of interest in the study of perception. Due to the writings of the Gestalt school of psychology, perception acquired much wider connotations; it came to denote those processes classified by Wundt as "apperception". This broadening of the concept of perception gave impetus to the "New Look" movement in perceptual research, which tried to understand perceptual processes in terms of needs, emotions, personality traits, and so on. Soon "higher" cognitive processes began to be approached through the study of perception. The Gestalt school approached the problems of thinking and learning through perception. Goldstein and his followers explained concept formation or "categorical attitude" in terms of the ability to break down "gestalts" and to form new "gestalts"; and also the ability to perceive and differentiate clearly between figure and ground (20). In more recent years, Michotte (35), Piaget (37, 38), Ames (2), Brunswik (10), Bruner and Postman (8) and Gibson (19) have approached problems of cognition through perception. At the same time Phenomenological and Existentialist schools in psychiatry became interested in the perceived and "experienced" world of mental patients. All these indicate a revived interest in the perception of mental patients.\*

Constancy of perception is an aspect of perception which has very broad connotations for the cognitive process as a whole. It is one of the basic mechanisms of adjustment to the environment. It allows the subject to perceive stable objects in the external world instead of an ever-changing flux of stimulation. Within wide limits, it maintains the perceived environment constant, thus it is a homeostatic mechanism of great importance for the biological adaptation of the organism. It allows one to perceive and to "know" the environment in terms of stable and probable "things". Various workers commented on the similarity between classifying a percept as representing an object and classifying an object as representing a certain conceptual category. Thus for Klüver (28) these are special cases of "stimulus equivalence". It can be regarded as the ability to recognize certain "situations" or "things" as identical. Piaget (37, 38) compares this tendency to the conservation of energy in physics. Michotte (36) talks about the tendency to identify a "cachet spécifique" or essential quality as being basic in both perception and in thinking. Bruner, Goodnow and Austin (7) state that "categorization at the perceptual level consists of the process of identification, literally an act of placing a stimulus input by virtue of its defining attributes into a certain class . . . The act of identification involves a 'fit' between the properties of a stimulus input and the specification of a category. Categorization of conceptual objects also involves the fit of a set of objects or instances to the specification of a category." Constancy of perception is a very important mechanism serving this perceptual categorization. It enables one to perceive a "thing" of a certain size, shape and colour at a certain distance, at a definite place in the three-dimensional space, thus having an identity and continuity.

Recent research has shown that constancy of perception is poorer in schizophrenics. Size constancy† in these patients has been investigated by

\* Witness recent monograph by Eysenck, Granger and Bregelmann (18).

† Size constancy is that characteristic of perception which allows one to perceive, within certain limits, an object as being the same size independently of its distance. Thus it enables one to perceive according to the "real", physical size of an object and not according to the visual angle.

Raush (40), Weckowicz (57) and Crookes (16). Raush found that paranoid schizophrenics had increased size constancy compared with normals and other schizophrenics. He predicted that in other types of schizophrenia size constancy might be poorer than in normals. However the difference found by him was not statistically significant. Weckowicz found that chronic hospitalized schizophrenics had poorer size constancy than other hospitalized patients and normals. He also found that during each individual size constancy experiment the performance of individual schizophrenics was significantly more variable than that of normals and non-schizophrenics. (The intra-individual variance was higher.) Crookes came to the same conclusion regarding poor size constancy in schizophrenic patients. He also found that in these patients there was a positive correlation between poor size constancy and "literal" responses to the Rorschach ink blots. By "literal", he meant responses in which ink blots were perceived as ink blots, patches of paint, clouds, and so on, which was not far from their real nature. Weckowicz, Sommer and Hall (58) have reported that chronic schizophrenic patients show poor distance constancy and that this is related to the poor size constancy in these patients. These investigators concluded that schizophrenic patients live in a "visual world" which is lacking in depth ("three dimensionality") and the perception of these patients is more "literal" and less related to the "third dimension" than the perception of normals. Weckowicz (57) also reported that although on average size and distance constancies in schizophrenics are significantly lower than in non-schizophrenics, yet the variation from subject to subject was in these patients greater than in the controls. While most schizophrenics showed low size constancy, some of them deviated in the opposite direction and showed extremely high size constancy. Paranoid schizophrenics with comparatively little thought disorder seemed to have high size constancy, while hebephrenics with much thought disorder showed low size constancy.

#### PRELIMINARY INVESTIGATION

A pilot study was conducted on 20 schizophrenic patients to whom were administered: a simple sentence completion test (sentences describing well-structured situations such as "John looks out of . . ."), the Similarities and Comprehension Scales of the Wechsler-Bellevue and the interpretation of three proverbs. The patients were ranked purely impressionistically from the test protocols according to the amount of what was considered to be "schizophrenic disorder of thought". The same patients were given a test of size constancy and ranked according to the results. Rank-difference Spearman correlations were for 7.5 m. distance  $\rho = .31$  ( $p = 0.05$ ), and for 15 m. distance  $\rho = .41$  ( $0.05 > p > 0.01$ ). These correlations were in the expected direction and significant. They showed that there was a positive correlation between thought disorder and low size constancy. (This applied to the similarities, comprehension and proverb tests, but not to the sentence completion test.) However the method of assessment of thought disorder was impressionistic and its reliability had not been established. It was therefore decided to carry out another experiment with a larger sample, more clearly defined criteria of schizophrenic thought disorder and measures whose reliability would be ascertained. After reviewing the literature the decision was made to limit the study of schizophrenic disorder of thought to that aspect which is concerned with concept formation.

## GENERAL HYPOTHESES

The experiment reported in this paper was conducted primarily to test the hypothesis that there is a positive correlation in schizophrenic patients between size constancy and ability to form concepts. To put it in more general terms there is a positive correlation between constancy of perception and capacity for abstract thinking. However to explain a relationship between constancy of perception and concept formation, a more general cognitive hypothesis was required which would include both the phenomenon described as constancy of perception and the phenomenon described as concept formation. As it was mentioned in the introduction, there are three schools of thought in contemporary clinical psychology with regard to the theories of impaired concept formation in schizophrenic patients. The first stresses the impaired ability to "abstract". The second implicates "autism" and social "disarticulation". The third emphasizes the "over-inclusiveness" of schizophrenic concepts believed to be due to "distractability" by irrelevant stimuli, mainly internal. Therefore this last group of theories considers that the disorders of concept formation are secondary to those of attention.

Accordingly, three general hypotheses were formulated as follows:

1. There is a redundancy of information in the sensory input from the environment to the organism. The "cognitive process" is to a great extent concerned with reduction of this redundancy and with "selection" or "abstraction" of some information according to certain principles and suppression of all other information. In the perceptual process it will manifest itself in the ability to perceive stable "things" or objects, in spite of a constant change in the sensory input—the ability which is usually described as "constancy of perception". It will also manifest itself in more artificial perceptual tasks such as the ability to "break down gestalts" (e.g. tasks using embedded figures). The rationale for this is as follows: constancy of perception depends on selecting certain cues and rejecting other cues. Therefore it could be related to the ability to break down gestalts, if, by gestalts, are understood primary and total configurations of visual cues, which are perceived "literally", as a pattern of light and not as denoting certain objects. Crookes' finding mentioned before is relevant here that in schizophrenics, poor size constancy correlates highly with "literalness" of the Rorschach responses. In the thought process this selectivity will manifest itself in the ability to form stable "classes" of "things" or objects, which is the essence of concept formation.

Thus there is a common factor involved in constancy of perception—ability to "break down" gestalts and capacity for abstract thinking. If this factor is affected by schizophrenic illness there should be a positive correlation between constancy of perception, ability to break down "gestalts" and capacity for abstract thinking. In the special case of the experiments reported in this paper there should be a positive correlation between poor size constancy, impaired ability to see embedded figures and impaired ability to form concepts.

2. Both perception and thinking are determined by social learning and therefore by the habits of perceiving and thinking existing in a given social group as a part of its cultural pattern. Constancy of perception is related to the ability to "recognize" culturally familiar objects. Concept formation is determined by the "give and take" of social inter-communication in the context of a linguistic pattern. In schizophrenic patients both perceptual and thought disorders are due to an estrangement from society. Thus poor constancy of perception should correlate positively with "bizarreness" and

“autism” of schizophrenic thought. (It is a well-known fact that some products of schizophrenic thinking process are quite “abstract”, but according to the social standards very unusual.) If this hypothesis is true, then in the experiments with schizophrenic patients reported in this paper, poor size constancy should correlate positively with “bizarreness” of schizophrenic concepts rather than with their “abstractness”. There should be no correlation of either to the performance on an embedded figure test.

3. Both disorders of perception and thinking in schizophrenic patients are secondary to a disorder of the span of attention, which can be too broad or too narrow, or may alternate between the two. Constancy of perception, and in this particular case, size constancy, depends on the ability to perceive a thing in its context, a figure together with its background, or to take into the account all the “cues” existing in the whole perceptual field. Thus it is related to “broadness” of attention. “Over-inclusiveness” or wide span of schizophrenic concepts is related also to “over-broadness” of their attention, which makes them incapable of excluding irrelevant stimuli. On the other hand, the ability to perceive embedded figures is related to “narrowness” of attention which causes the distracting, embedded figure to be excluded. Therefore if this hypothesis is true in schizophrenic patients, “over-inclusiveness” or over-wide range of concepts should be positively correlated with good size constancy and negatively with poor size constancy. Size constancy and concept range should correlate positively with the number of objects sorted in the Active part of the Goldstein Scheerer Object Sorting Test. The performance on the embedded figures tasks should be negatively correlated with good size constancy, positively correlated with poor size constancy and negatively correlated with “over-inclusiveness” or wideness of concept range.\*

As one can see, these theories are logically not mutually exclusive, but stress different aspects of cognitive process.†

Since it is commonly believed that personality and thinking process are usually better preserved in paranoid schizophrenia than in other types of schizophrenia and since this may be related to the selectivity function investigated in this study, the following additional hypothesis was tested: Paranoid schizophrenics show better size constancy and better preserved ability to form concepts than patients suffering from other types of schizophrenia.

#### SAMPLE

Forty chronic schizophrenics were used as subjects. In all cases the diagnosis of schizophrenia had been firmly established by all the psychiatrists who had examined them. There were 30 males and 10 females. Fifteen patients were diagnosed as paranoid, 12 as hebephrenic, 3 as simple, 4 as catatonic and 6 as undifferentiated schizophrenics. However, the clinical picture frequently did not correspond to the original diagnosis. The mean age of the subjects was 38 years (S.D.=8.7 years). The average length of stay in the hospital was 7 years, 8 months (S.D.=6.12 years). No patient in whose case there was a

\* This theory was put forward by E. Calloway (11) in his work on the influence of sympathicomimetic drugs on perceptual and thinking process in normal subjects.

† Both first and third hypotheses may be called “attention” hypotheses. They deal with two different aspects of attention. The first hypothesis deals with the ability to attend selectively, to control attention, and to resist distraction; the second hypothesis deals with the “span” of attention. Because of the introspective connotations of the concept of attention going back to the Titchenerian concept of “attensity”, the authors prefer more functional concepts of “set” or “selectivity” for the first hypothesis and “the span of the cognitive field” for the third hypothesis.

possibility of mental deficiency or organic brain disease was included. No patient undergoing insulin or electric shock treatment was included. Only patients who would co-operate in the experiment were included in the sample. All the subjects had visual acuity 20/20, corrected or uncorrected.

#### METHOD

##### *Tests*

A. The following tests were chosen to assess the capacity to form concepts or abstractness of level of thinking:

1. Similarities Test from Wechsler-Bellevue.
2. Benjamin's Proverb Test.
3. Goldstein-Scheerer Object Sorting Test
  - (a) Active form.
  - (b) Passive form.
4. Goldstein-Scheerer Colour-form Sorting Test.\*

B. Two tests were used to test the ability to break down gestalts:

1. Letter Finding Test.
2. Gottschaldt's Figures.

C. The Stroop Test was used to test the ability to attend selectively and to resist distraction.

D. In addition, two other subtests from Wechsler-Bellevue were used to assess the level of general intelligence in our subjects.

1. Vocabulary scale. It was thought that this test would give a measure of the level of intelligence before the onset of the illness.
2. Comprehension scale. This test was also used as a measure of intelligence, reflecting the present level of functioning.

E. Size constancy was measured in the following way: the apparatus consisted of a white painted box standing on a white painted table with a white screen behind it. There was a black rod (0.5 cm. in diameter) in the top of the box, which could be adjusted to different heights (0–20 cm.) from behind the screen.

Another white painted screen in front of the box could be removed and put back again. There was another table painted white, of the same size and shape as the first table, to which was attached a white box the same size and shape as the first box with a black rod which could be adjusted to different heights (0–20 cm.) by pushing a handle behind the box. On the other side of the table was fixed a chin support.

A long corridor was used which was lit with electric lights. All external light was carefully excluded. Care was taken to maintain a standard arrangement of objects, so that visual cues would not change. The subject sat behind the second table with his chin on the chin support and his hand on the handle for adjusting the rod on the top of the box 44 cm. in front of him. The other table was placed at a distance from the subject. Two distances were used for each subject, the first 7.5 mm., the second 15 m. The experimenter sat behind the screen. The subject was told to adjust the black rod on the top of the white

\* Goldstein-Scheerer Colour-Form Test taps two functions: (1) ability to abstract; (2) ability to shift from one conceptual framework to another.

box in front of him to the same size as the black rod which he saw at a distance. He was told to use both eyes and to make matches of the real, not the apparent size. The experimenter showed the sizes of the rod in a standard order, different for 7.5 m. distance and 15 m. distance. Twenty standard sizes were shown at either distance. Each time the size of the rod was being changed, the white screen was put in front of the box, thus preventing the subject from seeing the movement of the rod.

The adjustments of the rod made by the subject were read and recorded by an assistant. Each adjustment was recorded in centimetres as an error, either plus or minus from the standard size displayed to the subject from the distance. (The accuracy was to one decimal point.) These errors were added up and the average error was calculated, which became the score of size constancy for each subject. In addition, standard deviation of individual errors from the average error of each subject was calculated which became the measure of the variability of the performance of each individual.

These tests were administered on the same day.

### *Scoring*

As far as scoring was concerned the main difficulty was to evolve a reasonably reliable measure of the quality of functioning independent of the general level of functioning, which is measured by I.Q. In measuring the quality of functioning, it was important to keep as much as possible "concreteness" separate from "autism".

Two scores of I.Q. were obtained. First the Vocabulary and Comprehension tests from the Wechsler-Bellevue were scored according to the Wechsler-Bellevue scoring method. As was mentioned before, it was believed that the Vocabulary Test would give the most dependable measure of I.Q. before the onset of illness. However it was felt that if this test was scored strictly according to Wechsler-Bellevue standards, the original I.Q. of the subjects would be underestimated, as many bizarre answers, indicating that the subject knew the meaning of the word, could not be given even half a credit. Therefore it was decided to use a more lenient score and give half a credit to an answer which indicated that the subject knew the general meaning of the word. For instance, if the subject, asked to explain the meaning of the word "belfry", answered, "Hell's bells", it was assumed that the subject originally knew the meaning of the word and he was given half a credit for such an answer. To establish the reliability of this procedure, corrections of the standard score were made by two authors independently of each other. Pearson's product moment correlation between two sets of scores was  $r = .63$ . The corrections were discussed again and finally a set of corrections was arrived at to which both authors agreed. From the corrected vocabulary score the I.Q. was derived by the standard method. This I.Q. was believed to be the measure of the level of intelligence before the onset of illness. It will be referred to in the rest of the paper as I.Q. "A".

The second measure of I.Q. was derived from the Vocabulary and Comprehension subtests of Wechsler-Bellevue by the standard procedure. This I.Q. was the measure of the present level of intelligence and was usually lower than the I.Q. which measured the premorbid level of intelligence. It will be referred to in the rest of the paper as I.Q. "B".

Pearson's product moment correlation between these two measures of I.Q. in the subjects was  $r = .85$ . (The Similarities subtest was not included in



the measure of I.Q. because it was used for measuring the level of abstractness.)

So much for the level of functioning. In order to assess the quality of functioning, the responses of the subjects on the Wechsler-Bellevue Similarities subtest, Benjamin's Proverb Test and Goldstein-Scheerer's Object Sorting Test: (a) active, (b) passive forms were taken down verbatim. They were rated independently by two judges on the following dimensions: (1) "Abstract Concrete"; (2) "Public-private (autistic)"; (3) "Span of concept"—(wide-narrow). In the "abstract-concrete" dimension Rapaport's (39) criteria for conceptual level were used. The concept was rated as "abstract" when a generic term describing a class was used. It was rated as "functional" when the common denominator of a concept was a common function and finally it was rated as "concrete" when a concrete attribute of a thing was used for concept formation. When the generic term used was unusually wide, the concept was classified as being "over-abstract". This four-point rating scale was used for each response: "over-abstract", "abstract", "functional" and "concrete".

In rating concepts on the "Public-private" (autistic) dimension, another four-point rating scale was used: from completely public (obvious to everybody in our culture) to completely autistic (completely incomprehensible). The autistic way of categorizing may occur when the common denominator of a concept is a common affect or feeling tone. Bruner *et al.* (8) and also Schachtel (46) and McClelland (32) suggested that affective categories are the most primitive categories, that they go back to early childhood, and may resist conscious verbal insight by virtue of having been established before the full development of language. In that case, "Public-private (autistic)" is not an independent dimension from "abstract-concrete" dimension and "private" (autistic) concepts are examples of the "affective" type of concepts and should be regarded as being on the same or lower level as "concrete" concepts. However some "autistic" "bizarre" concepts appear to be "very abstract" and it was considered profitable to keep the two dimensions independent. "Range" or "span" of concepts was also rated on a four-point rating scale (from very wide to very narrow).

Some additional comment is necessary with regard to Benjamin's Proverb Test. The responses on Benjamin's Proverbs were rated only on "Abstract-concrete" and "Public-private (autistic)" dimensions. Two parts of the answer corresponding to two parts of each proverb were rated separately. Benjamin's (3) method of scoring was adapted to the rating scale, used in conjunction with other tests. The "literalness" of his rating scale was equated with the concreteness of our rating scale, and the "false de-symbolization" and "false abstraction" of his rating scale with the "privateness" or "autism" of our rating scale.

Regarding the special categories of concepts used by Rapaport, concepts which would be scored by his method as "Syncretistic" were scored as "concrete" on the "concrete-abstract" scale and as very wide on the concept "span" scale. Concepts which would be scored according to his method, as "Fabulated" were scored as "concrete" and "private (autistic)". Concepts which would be scored as "Symbolic" were scored as "private (autistic)" but "abstract" and so on. These special classes of concepts could be placed on our scale. Each answer in the Similarities, Proverbs Tests and Active and Passive parts of the Goldstein-Scheerer Object Sorting Test was scored on three independent rating scales. In each test the scores were added up and divided by the number of answers and the resulting figures constituted the score in the given test of Level of Abstraction (Abstract-Concrete), Autism (Public-private)

and Concept Span. In this way subjects who gave only few answers were not penalized and this method of scoring brought forth quality of functioning rather than level of functioning.

For the purpose of calculating correlations, combined scores were derived from "Abstraction Level" and for "Autism". (The concept range rating was found to be unreliable and was discarded.) The scores for Abstraction Level for each test were added up. (Benjamin's Proverb Test was given only half weight because in this test the answer to each proverb had a double score for each of the two parts of the proverb, and otherwise it would have influenced the combined score more than other tests.) This constituted the "Combined Abstraction Level Score". Exactly the same procedure was applied to "Autism" scores on individual tests to derive the "Combined Autism Score".

To have more reliable measures it was decided to use also another method of scoring at least in some of the tests. McGaughran and Moran (33) developed a scoring method of concept formation in object sorting behaviour. These authors modified Rapaport's "conceptual level", they used what they called "conceptual area" in their analysis of object sorting behaviour of schizophrenic patients. Similar to our rating scale, they used also two independent dimensions: "Open-closed", which corresponded roughly to the "abstract-concrete" dimension and "private-public" dimension which was almost identical with the "public-private (autistic)" dimension of our scale. According to these authors "open" concepts are concepts where only one particular characteristic determines membership in a class. For instance if we choose the colour red as our concept, all the objects in the universe which have some red colour can be classified together and at the same time be members of different classes, if classificatory criteria are changed, as these objects can also be wooden and round and what not. Closed concepts are concepts where several characteristics determine class membership, e.g. all red, wooden, round objects with bits of metal in them. In open concepts only one or few "degrees of freedom", as it were, are used, and many left unused; in closed concepts many "degrees of freedom", as it were, are used and few left unused. The limiting case is when one object is equated with one concept because all its characteristics are used to define the concept. It is a case of extreme concreteness.\*

This approach to categories is identical with that of Boolean Algebra with its "primary", "secondary", "tertiary" and so on, classes.

The "Private-public" dimension measures conformity of the conceptual categories to the socially acceptable or understandable norms. In their method of scoring McGaughran and Moran do not use continuous variables, but four discrete categories. They use a fourfold scheme and classify each response according to strictly prescribed criteria as (1) Public-Open ("M"), (2) Public-Closed ("H"), (3) Private-Open ("A"), and (4) Private-Closed ("I"). Those interested in further detail are referred to the original articles.

It was decided to use McGaughran and Moran's method of scoring in the Goldstein-Scheerer Object Sorting Test independently from the ratings of "Abstraction Level" and "Autism", described before. Although McGaughran and Moran established the reliability of their method of scoring, in view of our lack of experience with their scoring method it was decided to establish the reliability of this method independently. Accordingly the protocols of the Goldstein-Scheerer Object Sorting Test of our subjects were scored by two independent judges using McGaughran's method.

\* These "degrees of freedom" can be also called "cognitive valances". A smaller number of "Cognitive valances" is used up in an "open" concept than in a "closed" concept.

The Goldstein-Scheerer Colour-Form Test was scored in the following way: Complete failure—1, success with colours or shapes—2, success with colours and shapes after help\*—3, success with colours and shapes after 30-second delay—4, immediate success with shapes and colours—5.

The two perceptual tests which tested the ability to break down "gestalts" were scored in the following way:

1. Gottschaldt's figures. In this test, described first by Gottschaldt (21) the subject is presented with a series of simple geometrical figures some of which are embedded in a more complex figure. He has to identify the appropriate figure and to trace it in the more complex figure. In scoring it was decided to eliminate the factor of time in order not to penalize lethargic schizophrenics. The score was the total number of successfully identified figures.
2. Letter Finding Test which was described by Sherman (50) who showed that schizophrenic patients gave inferior performance on this test in comparison with controls. In this test the principle of embedded figures is used. The subject has to find letters which are embedded in larger gestalts. He is presented with ten figures which can be broken into an almost unlimited number of letters. The total number of letters found is the score.

The last test used was the Stroop Test. This test measures the ability to attend selectively and not be distracted by irrelevant stimuli. The subject is first presented with a card on which are printed names of colours in black and white. He has to read them as fast as he can. Next he is presented with another card with coloured dots. He has to name the colours of the dots as fast as he can. Last he is presented with still another card where names of colours are printed in "wrong" colours. He has to name the colours in which the words are printed as fast as he can. On these tasks he is timed. It takes longer to read the colours of the words which name "wrong" colours, than to name the colours of the dots. The difference between the times required by the two tasks is the measure of the ability to resist the interference by the meaning of the words when naming the colours in which these words are printed.

The smaller the difference the better the performance. The method of scoring which was used was based on the per cent. increment of time taken for reading coloured words as compared with coloured dots. The formula used was

$$\frac{C-B}{B} \times 100$$

The procedure by which size constancy was measured has already been described. In statistical analysis four scores were used: (1) Average error at 7.5 m. distance, (2) Average error at 15 m. distance. These were the scores of size constancy. Two other scores were the Standard Deviations from the average errors of the twenty readings at 7.5 m. and at 15 m. distances of each subject.

\* If a subject had a difficulty with switching from the classification according to colour to the classification according to form, the usual technique of turning over the figures to the other side, which was of the same white colour, was used. If a subject had difficulty with switching from the classification according to form to that of colour, a modification of the standard Goldstein-Scheerer technique was introduced: the three squares and the three triangles were substituted by six circles, bringing the number of circles to nine and presenting the subjects with three sets of circles of different colour.

## RELIABILITY

Two independent judges rated the responses in Similarities, Proverbs and Object Sorting Tests independently on three dimensions: (1) Abstract-concrete, (2) Public-private (autistic), (3) Concept Span (range), and also scored the responses in Object Sorting Test according to the McGaughran procedure. Pearson's product moment correlations were calculated as reproduced in Table I.

TABLE I

Tests	Dimensions		
	Abstract-Concrete	Public-Private (Autistic)	Concept-Span
Similarities .. ..	.86	.88	.18
Proverbs .. ..	.79	.79	—
Object sorting (active) ..	.73	.83	.13
Object sorting (passive) ..	.72	.90	.31

The reliability of McGaughran's scoring categories was calculated in the following way: the number of agreements and number of disagreements as to McGaughran's categories were counted. Remembering that agreement could occur by chance in 1 in 4 instances, Chi-squares were calculated.

These were:

1. For Object Sorting Test active form:

$$\chi^2 = 232.96$$

(Contingency coefficient  $C = .64$ )

2. For Object Sorting passive form:

$$\chi^2 = 614.10$$

(Contingency coefficient  $C = .71$ )

One can see that the reliability of the "concept span" ratings was too low to be satisfactory. Therefore these ratings were dropped from the further analysis of data. In the case of other scores a satisfactory reliability has been established. Reliability of the correction of the estimation of the premorbid level of I.Q. had been dealt with already, and reliability of size constancy measurement had been investigated before and had been found satisfactory (55).

## RESULTS

At this point it is appropriate to derive special hypotheses from the general hypotheses formulated before and to predict on their basis the expected correlations between size constancy measurements and the measurements obtained in various tests.

Because concept span could not be measured reliably the third general hypothesis which relates concept span and size constancy cannot be considered here. The issue therefore will be between the first general hypothesis which can be called the "selectivity hypothesis" and the second hypothesis which can be called the "autism hypothesis".

A. The "selectivity hypothesis" is that constancy of perception and abstract thinking are due to the common factor of cognitive selectivity. If this general hypothesis is true, these two variables should correlate positively

together and also correlate positively with the ability to break down gestalts. The specific sub-hypotheses derived from this are:

1. A positive correlation between the level of abstraction (abstract-concrete) dimension and size constancy.
2. A positive correlation between McGaughran's score of "Openness" of concepts and size constancy.
3. A negative correlation between McGaughran's score of "Closedness" of concepts and size constancy.
4. A positive correlation between the two tests (Gottschaldt's figures and Letter Finding Test) for the ability to break down gestalts on the one hand and size constancy on the other.
5. A positive correlation between the scores on Goldstein-Scheerer colour form sorting test and size constancy.
6. A negative correlation between the score on the Stroop Test and size constancy. (As it was mentioned before, the high score on the Stroop Test means a large difference between the time used for reading the words in colours and the time used for reading the colour dots, therefore it signifies a poor performance. A poor performance on this test can be explained as due to inability to maintain a set.)
7. No correlation between size constancy and "Public-private" (autistic) dimension, provided the latter is not correlated (is orthogonal) to the "Abstract-concrete" dimension.
8. No correlation between size constancy and McGaughran's score on "Public-private" dimension.
9. A positive correlation between the level of abstraction ("Abstract-Concrete") dimension and the two tests of the ability to break down gestalts.
10. A positive correlation between McGaughran's score of "Openness" of concept and the ability to break down gestalts.  
As was mentioned before, "selectivity" means selection according to a certain principle or a set. Therefore, if poor size constancy is due to a fault in a mechanism of selectivity, it should correlate positively with variability of performance.
11. Average size constancy scores for each individual should correlate negatively with the scatter of the individual responses from which the average score was derived.
12. There should be a negative correlation between the scatter of individual responses in size constancy experiment and "Abstraction" level (abstract-concrete dimension).
13. There should be a negative correlation between size constancy scatter (intra-individual) variability and McGaughran's "Openness" of concepts score.

Some of these variables may correlate with I.Q., which should be partialled out from those correlations relevant to the major hypothesis.

*B.* If the second hypothesis is true that constancy of perception is related to the learned cultural factors, that it is due to the way a given culture teaches one to perceive the world, then high score on "Publicness" of responses would be related to high size constancy and "Privateness" of "Autism" to low size

constancy; other correlations should be zero, providing, of course, there is no correlation between the dimensions "abstract-concrete" and "public-private".\*

1. Size constancy is positively correlated with "Publicness" (Public-private (autistic) dimension), scored by the method developed by the authors.
2. Size constancy is positively correlated with "Publicness" (Public-private (autistic) dimension), scored according to McGaughran's method.

Before presenting the evidence from correlations in support of these theories, it is necessary to examine the inter-correlation between the tests, which were assumed to measure the same dimension when two measures were obtained under different conditions or two different tests were used to measure the same thing.

These correlations are summarized in Table II.

Size constancy	Measured at 7.5 m. distance	vs.	Measured at 15 m. distance	.64
Intra-individual variability of performance in size constancy	Intra-individual S.D. at 7.5 m. distance	vs.	Intra-individual S.D. at 15 m. distance	.64
Capacity for abstraction	Abstract level Combined score	vs.	"Openness" score according to McGaughran's procedure	.52
Autism	Public-private (autistic) combined, scored according to authors	vs.	"Public-private" scored according to McGaughran's procedure	.89
Ability to break down Gestalts	Gottschaldt's Figures Test	vs.	Letter Finding Test	.33
Intelligence	I.Q. "A" based on vocabulary corrected (supposed to measure pre-morbid I.Q.)	vs.	I.Q. "B" based on vocabulary standard procedure plus comprehension (present I.Q.)	.85

From the Table it can be seen that apart from the correlation between the performance on Gottschaldt's Figure Test and that on the Letter Finding Test, all correlations are quite high. The two tests measuring the ability to break down gestalts are correlated at a significant level ( $p < .05$ ), but it is obvious that these tests measure also some other important factors which are different.

The correlations which are relevant to the "Selectivity Hypothesis" are presented in Table III and Table IV.

Table III presents the correlations between Size Constancy scores and scores of intra-individual variability in size constancy experiment on the one hand and the other tests on the other hand. Table IV presents the correlation between Abstraction Level Combined ("Abstract-concrete") dimension and McGaughran's "Openness" of concepts scores on the one hand and the other tests on the other hand.

It can be seen from the Tables that all the correlations are in expected directions and of the total number of 36, 13 are statistically significant at 1 per cent. or 5 per cent. levels. This proportion of significant correlations is very

\* An experiment with size constancy of familiar and unfamiliar objects would be very important in connection with this hypothesis.

TABLE III

TEST	TEST						
	Abstraction Level Combined ("Abstract-concrete" Dimension)	McGaughran Score of "Openness"	McGaughran Score of "Closedness"	Letter Finding Test	Gottschaldt's Figures <sup>1</sup>	Stroop Test	Goldstein Scheerer Colour/Form Test <sup>2</sup>
Size constancy, distance 7.5 m.	.33**	.43**	.38*	.25	.01 b.s.	-.11	.07
Size constancy, distance 15 m.	.46***	.31*	.33*	.20	.19	-.06	.02
S.D. at 7.5 m. distance (intra-individual variability)	-.29	-.14	.17	-.25	-.32* b.s.	.24	-.56**
S.D. at 15 m. distance (intra-individual variability)	-.17	-.16	.20	-.05	-.16 b.s.	.21	-.75**

<sup>1</sup> Gottschaldt's Figures scores were converted to square roots to normalize a negative skewness of distribution.

<sup>2</sup> On account of "J" shaped distribution of Goldstein Scheerer's Colour Form Test, biserial correlations were calculated.

<sup>3</sup> One asterisk denotes significance at 5 per cent. level and two asterisks at 1 per cent. level. In testing the significance of these correlations two-tail test was used.

<sup>4</sup> The Abstraction Level ("Abstract-concrete" scores) correlations with size constancy for individual tests are as follows:

Distance 7.5 m.: Object Sorting Active .47, Object Sorting Passive .22, Similarities .10, Proverbs .09.  
Distance 15 m.: Object Sorting Active .47, Object Sorting Passive .27, Similarities .29, Proverbs .30.  
Thus Active part of the Object Sorting Test correlates most significantly with size constancy.

TABLE IV

TEST	TEST <sup>1</sup>			
	Letter Finding Test	Gottschaldt's <sup>2</sup> Figures	Stroop Test	Goldstein <sup>3</sup> Scheerer Colour/Form Test
Abstraction level combined ("abstract-concrete" dimension) score .. ..	.52***	.33*	-.20	.49** b.s.
McGaughran "Openness" of concepts score .. ..	.51**	.15	-.27	.01 b.s.

<sup>1</sup> Correlations between Abstraction Level and McGaughran's "Openness" scores on the one hand and size constancy and intra-individual variability of performance in size constancy experiment on the other hand were presented in the previous Table.

<sup>2</sup> Gottschaldt's Figures scores were converted to square roots to normalize distribution.

<sup>3</sup> On account of "J" shaped distribution of the Goldstein Scheerer Colour/Form Test, biserial correlations were calculated.

<sup>4</sup> One asterisk denotes significance at 5 per cent. level and two asterisks at 1 per cent. level. In testing the significance of these correlations two-tail test was used.

unlikely to be obtained by chance. It can be also seen that all correlations between the size constancy measurements and the measurements of the capacity to form concepts are in the expected direction and statistically significant.

It is important to find out whether these correlations are not spurious on account of their being correlated positively with intelligence. In order to do so the two measures of "I.Q." described previously were correlated with the scores

on the tests dealing with Size Constancy, Concept Formation and Ability to break down gestalts.

The results are presented in Table V.

TABLE V

TEST	TEST									
	Size Constancy, Distance 7.5 m.	Size Constancy, Distance 15 m.	Intra-individual Variability S.D. Distance 7.5 m.	Intra-individual Variability S.D. Distance 15 m.	Abstraction Level Combined ("Abstrac- tion-concrete") Score	McGaughran's "Openness" of Concepts Score	Letter Finding Test	Gotteschaldt's Figures	Stroop Test	Goldstein Scheerer Colour/Form Test
I.Q. "A" (I.Q. based on the corrected vocabulary score and assumed to represent the pre- morbid level of intelligence)	.01	-.04	-.23	-.31*	.40** <sup>1</sup>	-.07	.06	.04	-.16	.24
I.Q. "B" (I.Q. based on the standard vocabulary score plus comprehen- sion and repre- senting present level of intelligence)	-.22	.07	-.25	-.22	.50**	.12	.27	.03	-.27	.89**

<sup>1</sup> One asterisk denotes 5 per cent. level of significance, two asterisks 1 per cent. level of significance (two-tail test).

As could be expected, Level of Abstraction-Combined ("Abstract-Concrete" dimension) correlates positively with intelligence. However the correlations between McGaughran's score for "Openness" of concepts and both estimations of I.Q. are not significant. There are negative correlations between the intra-individual variability of performance and the I.Q. measures and positive correlations between I.Q. measures and Goldstein-Scheerer Colour/Form Test. The correlations between size constancy measures are insignificant with two of them being negative, thus confirming N. Jenkin and Morse's (27) finding in mental defectives that size constancy is not related to intelligence.\*

These correlations with I.Q. were partialled out from the correlations presented in Tables III and IV. The correlations corrected for intelligence are presented in Tables VI and VII.

Partialling out intelligence did not substantially change the correlations. It increased almost all the correlations between the size constancy measurements and the ability to form concept measures. Thus it may be concluded that the relationship between size constancy and concept formation in schizophrenic patients has been established. As far as the other correlations predicted by the "Selectivity" hypothesis are concerned, there is a definite positive and significant correlation between ability to form concepts and ability to break down gestalts. The other correlations are in the predicted direction, but in most of the cases do not reach the level of significance. Thus the relationship between the size constancy measurements and the ability to break down gestalts is rather tenuous.

Two additional correlations which are important from the point of view of "Selectivity" theory are that between the size constancy measurements and

\* Thouless (52) has found a small negative, nevertheless significant, correlation between constancy of perception and intelligence.



TABLE VI<sup>1</sup>

TEST	I.Q.	Abstraction Level Combined Score ("Abstract-concrete" Dimension)	TEST			
			McGaughran "Openness" of Concepts Score	Letter Finding Test	Gottschaldt's Figures	Stroop Test
Size constancy distance 7.5 m. ..	I.Q. "A" <sup>2</sup>	.36**	-.44**	.25	.01	-.114
	I.Q. "B"	.53**	-.47**	.33*	.02	-.05
Size constancy distance 15 m. ..	I.Q. "A"	.48**	-.31*	.21	.19	-.06
	I.Q. "B"	.49**	-.31*	.20	.19	-.04
S.D. at 7.5 m. distance (intra-individual variability)	I.Q. "A"	-.22	-.16	-.24	-.32*	.21
	I.Q. "B"	-.20	-.12	-.20	-.33*	.19
S.D. at 15 m. distance (intra-individual variability)	I.Q. "A"	-.05	-.19	-.03	-.15	.17
	I.Q. "B"	-.07	-.13	.01	-.16	.16

<sup>1</sup> I.Q. was not partialled out from the Goldstein Scheerer Colour/Form Test correlations, because these correlations were biserial. The McGaughran "Closedness" of concepts score correlations has also been omitted on account of its high negative correlation with the McGaughran "Openness" score.

<sup>2</sup> I.Q. "A" and I.Q. "B" were partialled out and the partial correlations appropriate to these I.Q.s are in the corresponding rows.

<sup>3</sup> One asterisk denotes 5 per cent. level of significance and two asterisks 1 per cent. level of significance (two-tail test of significance was used).

TABLE VII<sup>1</sup>

TEST	I.Q.	TEST		
		Letter Finding Test	Gottschaldt's Figures	Stroop Test
Abstraction level combined ("abstract-concrete" dimension score) .. .. .	I.Q. "A" <sup>2</sup>	.54**	.35*	-.15
	I.Q. "B"	.47***	.37*	-.07
McGaughran "openness" of concepts scores .. .. .	I.Q. "A"	.52**	.15	-.29
	I.Q. "B"	.50**	.14	-.25

<sup>1</sup> I.Q. was not partialled out from the Goldstein Scheerer Colour/Form Test correlation because these correlations were biserial.

<sup>2</sup> I.Q. "A" and I.Q. "B" were partialled out and the partial correlations appropriate to these I.Q.s are in the corresponding rows.

<sup>3</sup> One asterisk denotes 5 per cent. level of significance and two asterisks 1 per cent. level of significance (two-tail test of significance was used).

the measurements of intra-individual variability of performance in size constancy experiment. After average errors for each subject were correlated with the standard deviations of individual responses in each subject from these average errors, the following correlations were obtained:

$$\begin{aligned} \text{Distance 7.5 m.} & \dots \dots r = .03 \\ \text{Distance 15 m.} & \dots \dots r = -.41 \end{aligned}$$

The first correlation is not in the expected direction and insignificant, the second is in the expected direction and significant at 1 per cent. level. So much for the evidence in favour of the "Selectivity" hypothesis.

On the basis of the second hypothesis the "Autism" hypothesis, the prediction was made that the size constancy scores will correlate with the combined "Autism" ("Public-private" dimension) scores and with the McGaughran "Public" scores.

These correlations and also the correlations with intra-individual variables of performance in size constancy experiment are presented in Table VIII.

TABLE VIII

TEST	TEST			
	Size Constancy Measures		Intra-individual Variability of Performance Measures (S.D.)	
	7.5 m. Distance	15 m. Distance	7.5 m. Distance	15 m. Distance
"Autism" <sup>1</sup> ("public-private" dimension)	.11	.20	-.49***	-.25
McGaughran <sup>2</sup> "public" scores	.10	.22	-.36*	-.15

<sup>1</sup> The correlations of the scores in the individual tests on "Autism" ("Public-private" dimension) with size constancy are as follows:

Distance 7.5 m.	Object Sorting Active $r = .12$
	Object Sorting Passive $r = .14$
	Similarities $r = .10$
	Proverbs $r = .02$
Distance 15 m.	Object Sorting Active $r = .25$
	Object Sorting Passive $r = .21$
	Similarities $r = .15$
	Proverbs $r = .07$

<sup>2</sup> A high correspondence between correlations with "Autism" scores and with McGaughran "Public" scores can be predicted from the fact that these two variables correlate highly ( $r = .89$ ).

<sup>3</sup> One asterisk denotes 5 per cent. level of significance and two asterisks 1 per cent. level of significance (two-tail test of significance).

The correlations between size constancy and "Public-private dimension" score are positive, but insignificant. The correlations between Intra-individual variability of performance and "Public-private dimension" scores are negative, and the one for the distance 7.5 m. significant. However, as the latter was not predicted by the "Autism" hypothesis, it is difficult to interpret it. It was also found that the two dimensions "Abstract-concrete" and "Public-private (autistic)" are not orthogonal. The correlation between "Abstraction Level Combined" and "Autism Combined" scores  $r = .42$ . However the correlation between the McGaughran "Openness" of Concept scores and the McGaughran "Publicness" of Concept scores is almost zero,  $r = -.03$ . Thus there is a difference in orthogonality between McGaughran's dimensions and our dimensions and also while there is a high correlation between both "Public-private" dimensions, the correlation between both "Abstraction" dimensions is only .52. This may be due to the fact that two "Abstraction" dimensions differ in some important respect. A suggestion may be put forward that our dimension of "Abstraction" is much more related to verbal factors than McGaughran's dimension of "Abstraction". However the answer to this must await factorial analysis.\* So there is more evidence in the results of this study supporting "Selectivity" hypothesis than the "Autism" hypothesis.

The last hypothesis to be treated is that paranoid schizophrenics show better size constancy and better preserved ability to form concepts than other schizophrenic patients.

There were 15 patients diagnosed as paranoid schizophrenics and 25 as other types of schizophrenic. Point biserial correlations were calculated between paranoid schizophrenia vs. size constancy and ability to form concepts measures.

\* Factorial analysis of the material is being carried out at present and will be published in a subsequent paper.

Also the differences of the means were tested by the "t" tests between paranoid and other schizophrenics.

The following correlations and "t" values were obtained:

Size constancy distance 7.5 m.:

r p.b.i. = .25 (t = .194)

Size constancy distance 15 m.:

r p.b.i. = .28 (t = .313)

Intra-individual Variability in the performance in size constancy experiment—distance 7.5 m.:

r p.b.i. = -.09 (t = .193)

Intra-individual Variability in the performance in size constancy experiment—distance 15 m.:

r p.b.i. = -.23 (t = .510)

"Abstraction Level Combined" ("Abstract-concrete" dimension) scores:

r p.b.i. = .37 (t = .464)

The McGaughan "Openness" of concepts score:

r p.b.i. = .31 (t = .636)

These correlations and the differences are in the predicted direction, but they do not attain the significance level, thus leaving the hypothesis neither confirmed nor refuted.

In order to find out whether the variables investigated in this study are related to age and to the length of stay in the hospital, the age of the subjects and the length of their stay in the hospital was correlated with size constancy measurements, intra-individual variability of performance in size constancy experiment measurements, Combined Abstraction Level, McGaughan's "Openness" of Concepts, Letter Finding Test, and Gottschaldt's Figures. No correlation was significant and no trends were detected. However one has to bear in mind that our sample was relatively homogeneous as far as age and the length of hospitalization were concerned.

#### DISCUSSION

This study indicates that the abnormalities of thinking and perception in schizophrenic patients can be described as an inability to "attend selectively" or "to select relevant information". It has also been found that there may be a difference in this respect between paranoid schizophrenics and the other types of schizophrenics, with the latter being more affected than the former.

The inter-correlations of the performance scores of the subjects give more support to the "Selectivity" hypothesis than to the "Autism" hypothesis. However, these hypotheses are not mutually exclusive. The ability to conform to a social pattern presupposes some ability to "select" and to maintain a "set". The "Selectivity" hypothesis is more inclusive than the "Autism" hypothesis. The difference between the two theories lies in the stress they put on interpersonal relationships versus cognition. Most of the recent thinking about schizophrenia influenced by the psycho-analytical tradition has regarded the disorder of cognition as being secondary to that of motivation and interpersonal relations. One might argue that it is the other way round—that the emotional and interpersonal difficulties are caused by the disorders of perception and thinking. This position was taken by Bleuler (4) who regarded the "looseness" of association in the thinking of schizophrenic patients as primary to other disorders.

The authors feel that this may be a pseudo problem like the proverbial question, "Which came first—the chicken or the egg?" However the cognitive hypothesis of "Selectivity" is broader and more general than the "Autism" hypothesis. It deals with the subject's relationships to his total environment, both animate and inanimate.

It has been shown that in schizophrenic patients there is a definite relationship between constancy of perception and abstract thinking and also probable relationship between constancy of perception and the ability to break down gestalts. This finding, subsumed under the heading of "Selectivity" theory, can be related to the similar findings of other investigators in the field of perception. In his *Factorial Studies of Perception*, L. L. Thurstone (53) isolated among other factors: the factor "A" and the factor "E". The first factor represents the ability to "form perceptual closure against some distraction". The second factor is concerned with "the manipulation of the two configurations simultaneously or in succession". It denotes a freedom from what is called by Thurstone as "Gestaltbindung" and implies "flexibility in manipulating several more or less irrelevant or conflicting gestalts". This factor is related to the Reasoning (R) factor of intelligence. Both factor "A" and factor "E" are correlated with size constancy. The proposed factor of "Selectivity" may be related to Thurstone's factor "A" and factor "E".

The cognitive attitude of "Focusing vs. non-focusing" described by Schlesinger (48), which denotes the subject's ability to focus on the few relevant variables while excluding the influence of all others, is related to the factor of "Selectivity" put forward in this paper. Also Witkin's (62) finding is relevant here. This author has found that those subjects who perceive a position of their body or a position of a rod independently from the total perceptual field (or, to put it differently, who can perceive a part of a field independently of its surroundings) perform better on the Gottschaldt's figures. He also has found that children and schizophrenics are much more "field bound" than normal adults.\* Salzinger's (43) finding that in schizophrenic patients weight judgment is more affected by "Anchoring Stimuli", than in normal controls is also relevant to our findings, as it indicates that in schizophrenic patients there is an impairment of the ability to "shut out" disturbing background stimuli.

It remains to formalize these relationships, subsumed under the heading of "Selectivity" theory, in the terms of general psychological theory. Thinking and perception cannot be separated; they are aspects of the same cognitive process. This cognitive process can be described to use Bartlett's terminology, as an "effort after meaning". In perception this "effort after meaning" is the "effort to attain object", an attempt to perceive the world in terms of stable objects—objects situated in definite places in space and having a continuity in time. This is true whether from the metaphysical point of view one regards "objects", "space", and "time", as Kantian innate categories of "pure reason" or whether one follows the tradition of the English empiricists and regards them as characteristics of external reality learned by experience.

In thinking, this "effort after meaning" is an effort to attain a concept or to classify information into certain categories. We tend to perceive not only stable things, but also look upon them as representatives of classes and categories of things. The process which appears to be involved in both thinking and perception is abstraction. Abstraction can be simply described as paying attention to certain characteristics and disregarding others; or in more general

\* This was found in female schizophrenic patients, a small sample of paranoid schizophrenic male patients deviated in the opposite direction (62).

terms, abstraction can be described as selection of information—some information is used, other is suppressed.

How can the “selectivity” theory be applied to the problem of constancy of perception? If one takes as the point of departure some of the existing theories of constancy of perception, such as Brunswik’s “Probabilistic Functionalism” (9), Ames’s “Transactional Functionalism” (2), or Bruner and Postman’s “Hypothesis Theory” (8), one finds that all these theories offer more or less the following explanation of the phenomenon of constancy. A pattern of stimulation could give rise to unlimited numbers of hypotheses regarding the other patterns of stimulation, which are linked up with it in a meaningful, causal matrix (matrix of cause and effect), but only certain hypotheses are selected. For instance, if certain patterns of stimulation (a retinal image) is interpreted as a small object at a short distance, an extension of an arm and touching this object will give rise to another pattern of stimulation. These two patterns will be linked up in a causal way; they will form a closely knit sequence of patterns of stimulation. On the other hand, if the same pattern of stimulation—the same retinal image in our case, is interpreted as a large object at a long distance, then the walking towards this object with the size of the retinal image constantly increasing will give rise to a different sequence of patterns of stimulation linked up causally. These two sequences of closely knit patterns are clearly delineated; they form two distinct classes of phenomena. In this respect they are like logical classes of objects, or concepts.

What is important in both cases is the ability to select consistently certain cues or features and to disregard others. A pattern of stimulation presents unlimited numbers of cues: “a”, “b”, “c” . . . “n”. Only cue “a” is consistent with the hypothesis that this particular pattern of stimulation is a member of the sequence “A”. If this hypothesis is chosen, cue “a” is selected and cues “b”, “c” . . . “n” are disregarded. The same applies *mutatis mutandis* to cue “b” and hypothesis “B” and so on. The question why certain hypotheses about patterns of stimulation are selected and others rejected is a difficult one. If one knew the answer to this problem one would probably know the answer to most of the problems of human behaviour. There are various theories; some stress “probability of validation”, others the “directive state of the organism” or “particular set induced by the task”. However all the theories recognize the importance of set or “*einstellung*” which means that once a choice of hypothesis is made the subject selects certain cues consistently and rejects other cues until the hypothesis about the object is confirmed or refuted.

The same applies to concept formation or abstraction. An object has an unlimited number of characteristics: “a”, “b”, “c” . . . “n”. If it is being classified with some other objects only one or few characteristics of this object are relevant. For instance only the characteristic “a” is relevant if it is classified with all objects belonging to class “A”, only characteristic “b” is relevant if it is placed in class “B”. Other characteristics are disregarded. So attending selectively and consistently to certain cues or features and disregarding others is important in both perception and thinking. This selectivity has to be consistent, therefore it is important that only one set at a time or only one hypothesis at a time is maintained. There are probably the same basic mechanisms behind the perception of stable objects due to constancy of perception and behind the formation of concepts due to abstract thinking. These mechanisms reduce the flux of experience to a certain number of constants or stable constructs from which the “knowledge” of the environment is built.\* In terms of cybernetics,

\* Von Uexkull calls this subjectively constructed environment the “Umwelt” (54).

these mechanisms can be described as filtering or selective letting through some information and stopping other information. It is suggested that these mechanisms of "selectivity" are affected in schizophrenia.

There is also another interesting possibility which offers itself in connection with the time aspect of perceptual process. The process of selectivity and hypotheses testing must have a certain time duration.\* This development in time is quite obvious in thought process, but it is not so obvious in perception, which is usually regarded as being immediate. However the work of the Leipzig school with "Aktualgenese" (Sander (44), Krueger (30)) on perception and the more recent work of Kragh (29) indicate that perception is a process which develops in time. It develops in milliseconds from being global and undifferentiated to being precise and definite. Werner (59) showed that perception of small children, patients with brain injuries and schizophrenics is global, undifferentiated and "physiognomic". He assumed that in brain-injured patients and schizophrenics a regression takes place to childlike mode of perception. Thus it is very likely that in each act of perception the ontogenetic phases of perception are repeated and that in children, brain-injured patients and schizophrenics, perceptual development process stops at an earlier phase while in normal adults it progresses and elaborates the material further. If perception is not given in a point-like present, but each act of perception develops in time, it develops from a global undifferentiated percept to an analytical structured and differentiated percept, from a momentary configuration of visual stimuli to the percept of a definite object. In terms of Gestalt psychology each perceptual process involves breaking down immediately present gestalts and forming new gestalts. Thus a stimulus configuration forms a certain pattern or gestalt, a gestalt which is determined by such factors in figure-ground organization as "similarity", "proximity" and "good continuation" of the elements, described by the classical Gestalt psychology—factors which are given "here" and "now" and are independent of previous experience.† These primary gestalts have to be broken and the elements constituting them built into the percepts of an object in accordance with the hypothesis entertained at that moment by the perceiver. If these primary gestalts are very "strong", formation of percepts of objects may be well nigh impossible—the trick which is used in camouflage.

We have then much evidence that the perception of schizophrenics is more primitive, more global, less differentiated and structured, than that of normals. It appears that these patients have a greater difficulty in breaking "primary gestalts" and in forming percepts of objects, that their perception is more influenced by the "here" and "now" factors of the immediate situation and less by the experience of the past and the anticipation of the future. The perception of schizophrenics is more literal in the context of "here" and "now" and less oriented in the time continuum, than of normals. Their perception therefore is more in terms of the total momentary configurations of stimuli rather than in terms of objects having certain continuity in time with which it is possible to have certain "transactions". While in normals a selection takes

\* In terms of cybernetics the object and the perceptual response to it form a "feed back" system with earlier percepts corrected and changed to fit the "set" of the organism. This process takes time. In sensory deprivation experiments this process of selection and elaboration is artificially limited by the paucity of information and the percept does not develop beyond the early phase.

† These factors can be found in "pure culture" in congenitally blind people who have their vision restored later on in life by surgical operation and in animals reared in darkness when they have been exposed for the first time to visual stimuli (Seden (49), Rieson (41), Hebb (23, 24)).

place from these total momentary configurations in terms of the hypotheses about the perceived objects. The same lack of differentiation, the same globality and "literalness" or concreteness (boundness to "here" and "now") characterize the thinking process of schizophrenic patients (syncretistic thinking). At the same time one has to bear in mind that "globality" of perception and thinking cannot always be equated with "primitiveness" and immaturity. It occurs in the experiences of mystics whose experiences are holistic and global.

It is tempting to translate these ideas into neurophysiological terms and speculate on the nature of the disturbance in schizophrenics responsible for their inability to select relevant information which is used in attaining cognitive constructs and therefore in structuring a meaningful environment. There is some evidence that the reticular-activating system, or a similar system, which conditions or prepares the cortex for the reception of certain specific stimuli may play an important role in this process. As a speculation one may suggest that in certain types of schizophrenia, particularly in the acute phase of this illness, and also in L.S.D. and mescaline-induced psychosis, the reticular activating system is over-active; anyway, there is some change in filtering the stimulation. The gates are wide open, the cortex is flooded with irrelevant information, maintenance of set becomes difficult. The subject cannot attend selectively to certain cues and he interprets all the stimulations patterns literally because he attends to all the cues at the same time.\* He also thinks concretely because he attends to all the features of the object at the same time. This is in agreement with Rodnick and Shakow's (42) finding that schizophrenics are not capable to maintain a set when they perform a task. There are also some investigators who stressed the importance of the level of non-specific excitation of the brain for the selectivity in perception and motor behaviour. Thus Hebb (25) postulated an inverse "U" function for the relationship between the general excitation as mediated by the "reticular-activating" system and the efficiency of functioning of the "cell-assemblies" and "phase sequences" responsible for patterning of perception and motor behaviour. A certain level of general excitation is necessary to activate the "cell assemblies", however when the level of excitation is increased beyond certain limits, all the "cell-assemblies" reach the threshold of firing. There is the same probability for all of them to be fired and as a result the behaviour becomes disorganized. Hull's general equation  $E_r = f(H \times D)$  predicts the same (26). If "Drive" attains a certain magnitude of strength even the "weakest" habits reach the activation threshold, the hierarchy of the habits disappear, and the behaviour becomes disorganized. The Yerkes-Dodson law of the effect of the strength of motivation on the performance in learning has the same implications.

In other cases of schizophrenia where the mechanism responsible for selection of cues is not deranged, but the mechanism responsible for validating "hypotheses" is deranged, the subject will form hypotheses about the universe, but his hypotheses may be false because the validating mechanism, probably operating on the basis of theory of probability is at fault. One can very well imagine that certain paranoid schizophrenics with their rigid well-systematized delusions would fall into this category. In these patients abstract thinking and constancy of perception may be well preserved, but they lead to wrong conclusions. The picture presented in this paper is an over-simplification of a very complicated entity, which is schizophrenia. However it may serve as a scientific model in the psychological approach to the problem till a better one is found.

\* Bruner in a recent paper has stressed the importance of the principle of selectivity in the neural mechanisms of perception (6).

## SUMMARY

1. The relationship between Size Constancy and Concept Formation in schizophrenic patients has been investigated.
2. A technique has been developed for measuring "Abstractness vs. Concreteness" of concepts and "Publicness vs. Privatness (Autism) of concepts".
3. It was found that there is a positive correlation between poor size constancy and impaired ability for abstract thinking in schizophrenic patients.
4. It was found that both size constancy and abstract thinking are related to the ability to "break down" *gestalts*.
5. A cognitive theory—"Selectivity" theory—has been proposed as an explanation of these relationships.
6. The theoretical implications of the "Selectivity" theory have been discussed.

## ACKNOWLEDGMENTS

This work was carried out using funds provided by Rockefeller's Foundation and a National Health grant. We would like to express our thanks to Dr. H. F. Osmond, the Superintendent of the Saskatchewan Hospital, Weyburn, Dr. A. Hoffer, the Director of Psychiatric Research in Saskatchewan and Dr. R. Sommer, the Research Psychologist at the Saskatchewan Hospital, Weyburn, for their help, encouragement and criticism. We would also like to thank Mr. R. Hall, the Research Nurse at the Saskatchewan Hospital, Weyburn, for his technical assistance.

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