AN EXPERIMENTAL STUDY OF SCHIZOPHRENIC THOUGHT DISORDER*

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Historical Introduction

For many years, schizophrenic thought disorder has been regarded as being due to an abnormality of concept formation of some sort. However, there has not been general agreement about the nature of this abnormality. Kurt Goldstein and his followers (9, 32, 33) have argued that schizophrenics are abnormally "concrete". That is to say, they are unable to perform inductive reasoning, since they are unable to make an abstract generalization. Norman Cameron (11, 12, 13, 14, 15, 16, 17, 18, 19) on the other hand argues that in one sense at least, schizophrenic concepts are over-generalized. He believes that the concepts formed by schizophrenics are "over-inclusive". They are unable to maintain the normal conceptual boundaries, and incorporate into their concept elements (some of them personal) which are merely associated with the concept, but are not an essential part of it. This makes their thinking both over-general, and less precise than normal. A large number of studies have been carried out to test both these hypotheses.

Studies of "Concreteness" of Thinking

Bolles and Goldstein (9) first attempted to demonstrate abnormal "concreteness" of thinking by using the Goldstein-Scheerer (34) battery of tests for concept formation with a group of 16 schizophrenics. While they were reported as "concrete" according to the scoring criteria used, no control group was tested.

Rapaport *et al.* (65), using an object sorting test similar to Goldstein's, found that a group of schizophrenics were no more "concrete" than normals. However, the concepts they evolved were unusual, and the term "syncretistic" was used to describe them.

McGaughran (58, 59) and McGaughran and Moran (60) report an interesting series of studies with the Goldstein object sorting test. They scored the sorting behaviour along two dimensions. The first was called "conceptual

* The senior author is responsible for the review of the literature, the experimental design and analysis of data, the theoretical formulation and writing up the results. Dr. Mattussek and Dr. George gave the tests during the course of a stay at the Institute of Psychiatry. Dr. Mattussek also assisted in the selection of the cases.

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freedom" or "open-closed", which they identify with "concreteness". It is assessed by the number of objects the concept covers (the degree of generality). The second was called a "public-private" dimension and was a rating of the extent to which the concept formed was usual or unusual. They found that, far from being "concrete", schizophrenics formed slightly more extensive concepts than normals. Their concepts, however, tended to be "private" or unusual.

Another group of studies has made use of the Vigotsky (74) test for concept formation, which, unlike the Goldstein tests, requires the subject to form only one concept, the score being a function of the speed with which this is done. Kasanin and Hanfmann (50, 51), Hanfmann and Kasanin (38, 39) and Kasanin (49) report several studies using this test with schizophrenics. They demonstrated that the score was probably related to educational level, but that even when this is controlled, schizophrenics do worse than normals. However, these results are not unambiguous, since poor scores on this test could be purely a function of mental slowness, or a tendency to produce unusual generalizations. They do not necessarily indicate an inability to generalize. Indeed, Fisher (28), using the Vigotsky test material as a sorting test to determine how many different sortings could be achieved, found that 20 schizophrenics and 20 hysterics were not differentiated (although 20 normals who were younger and brighter than either group, did better).

Studies by Rashkis, Cushman and Landis (67) and Rashkis (66), using a rather different type of word sorting and number sorting test, produced very similar results inasmuch as schizophrenics were inferior in their performance, not because they could not generalize, but because they produced very unusual generalizations.

Feldman and Drasgow (26) developed a test of concept formation using pictures on cards. On each card were four pictures, and on each two different groupings of three objects each were possible. While schizophrenics were inferior to normals on this test, it is possible that this is because they think of unusual generalizations, and not because they are "concrete".

Thus the studies using "sorting" tests of concept formation have produced more or less consistent results. Schizophrenics cannot be regarded as "concrete" in the sense of being unable to generalize at all. Rather, they tend to produce unusual generalizations.

Another different technique for studying the ability to form concepts, consists in asking the subjects to sort a long series of cards into two groups, correcting the subject when an error is made. The principle of sorting is not explained beforehand, but must be *learned* during the course of the experiment. This technique was used by Heidbreder (41, 42, 43, 44, 45, 46, 47, 48) for the study of concept formation in normal people. The Wisconsin Sorting Test (8, 36, 37) makes use of a similar technique. During the course of the test, concepts must be learned, and several times the principle of sorting is changed, to force the subject to learn a new concept. Fey (27) used the test with a schizophrenic and a normal group, and found that the schizophrenics were inferior, possibly not because they were unable to learn the concept, but, having learned it, they had ". . . difficulty in holding the correct set . . .".

The remaining group of studies of "concreteness" attempt to assess it by rating the quality of definitions given to words or the explanations of proverbs. The results have been consistent and these studies all report schizophrenics as being more "concrete". For example Flavell (29) gave a multiple choice vocabulary test to 24 schizophrenics and reported that they chose more

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"concrete" definitions than did normals. Proverbs have been used in studies by Wegrocki (76), Benjamin (7), Becker (6) and Gorham (35). Gorham (35) reports two very large studies, one using a matched group of 100 normals and 100 schizophrenics. He used both the ordinary form of the proverbs test, and a multiple choice version. Schizophrenics consistently gave more "concrete" interpretations.

In the light of the earlier studies discussed, these consistent findings with the proverbs test cannot be regarded as unambiguous. There is no doubt that schizophrenics tend to define words and interpret proverbs peculiarly. However this is not necessarily due to an inability to generalize. It is possible that unusual generalizations given in response to proverbs are often labelled "concrete". It is also conceivable that, just as they tend to use and define words peculiarly, some schizophrenics may interpret words they hear unusually. Some, for example, may interpret the instructions of the proverbs test as allowing either a general statement of the principle illustrated *or* the use of an apt concrete illustration of the meaning it has for them. These studies have apparently not established what generalizations these schizophrenics might have produced, had they been encouraged to continue talking long enough.

It is perhaps not unfair to conclude that the studies of "concreteness" so far carried out, have not succeeded in demonstrating that schizophrenics are unable to make abstract generalizations, although there is ample evidence that the generalizations they do make tend to be unusual.

Studies of "Over-inclusive" Concept Formation

Norman Cameron (11, 12, 13, 14, 15, 16, 19) was one of the first to explain much of the thought disorder in schizophrenia in terms of over-inclusive concept formation, although Schilder (70) and Bychowski (10) among others have described a similar type of thinking disturbance. More recently Angyal (1) and Lovibond (56) have reformulated this theory.

Cameron first used the theory to account for the performance of small groups of deteriorated schizophrenic patients on the Vigotsky test, and on a sentence completion test. He reported that the schizophrenics were unable to preserve the "conceptual boundaries" of the task. In solving a problem the schizophrenics ". . . included such a variety of categories at one time that the specific problems became too extensive and too complex for a solution to be reached . . .". Not only are their concepts "over-inclusive" but their thinking is disturbed by the "interpenetration of personal themes", although this might be regarded as one aspect of the general disorder of "over-inclusion".

A surprising number of studies have been conducted to investigate "over-inclusive" thinking in schizophrenia. The results consistently support the theory. Shneidman (73) developed a modification of the Thematic Apperception Test in which the subject selects from a large group of different human figures, those he believes suited to each background scene, makes up a picture, and then tells a story about it. As predicted from Cameron's theory, schizophrenics' stories were "over-inclusive" in several aspects. For example, they chose significantly more figures as relevant to each background, than did normals.

Zaslow (78) developed a simple test of over-inclusion in concept formation, which consisted of a series of 14 cards, each containing a drawing which gradually progressed from an equilateral triangle to a perfect circle. Various methods were used to determine how many cards the subjects would incorporate into the concepts "triangle" and "circle". As predicted, schizophrenics included significantly more cards than normals. However Kugelmass and

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Fondeur (54) were unable to repeat these results at an acceptable level of significance, probably because of the unreliability of the test.

White (77), testing a matched schizophrenic and normal group, asked his subjects to group 15 cards with a word printed on each, in any way they liked. The schizophrenics tended to form very large, vague categories, forming concepts such as "suspicion" or "having to do with God".

Daston, King and Armitage (23) read two short stories aloud to 25 paranoid schizophrenics and 27 matched normals. Afterwards the subjects were given a check list of 36 positive and 36 negative statements about the characters in the stories. The schizophrenic group checked off significantly more adjectives than the normals.

Moran (61) tested several deductions from Cameron's theory with a group of 40 schizophrenics and 40 matched normals. The subjects were first given 25 words to define. There were no differences in the "conceptual level" of the definitions given, thus not supporting the hypothesis that schizophrenics are "concrete". The subjects were then asked to give as many synonyms as possible for each word. As predicted, the schizophrenics' synonyms were less precise. When asked to free associate to the words, the schizophrenics produced more "distant" associations. When asked to incorporate the words into a sentence, their sentences were unclear, contradictory and ungrammatical. The subjects were also given a test in which each word (printed on a page) was followed by 8 response words, including neologisms. They were asked to underline each word which they regarded as an essential part of the concept denoted by the stimulus word. As predicted, the schizophrenics did not underline significantly fewer correct words, but did underline significantly more of the distantly related words. Epstein (24) developed a very similar test, and obtained the same results with a schizophrenic and a normal group.

Lovibond (56) using the Goldstein Object Sorting test, with schizophrenics and normals, employed a rating system to assess the amount of "over-inclusion" in sorting behaviour. Schizophrenics were rated as more over-inclusive.

Chapman (21) and Chapman and Taylor (22) report a series of interesting experiments which have also confirmed the theory of over-inclusion. They made use of card sorting tests of different types, and found that, when asked to sort according to a specific concept (e.g. "fruit"), schizophrenics tended to include in this category similar cards (e.g. cards with the names of vegetables), but not completely dissimilar cards. Normals did not do this. In another experiment, they presented the subjects with cards containing four pictures, some of which illustrated a concept. The subjects were asked to sort the cards according to a concept, but to disregard all the pictures on the cards except the picture in the lower right hand corner. As predicted, the schizophrenics were influenced by the irrelevant "distractor" items, whereas the normals were not. There was no evidence of "concreteness", or inability to sort at all, since the number of errors made varied directly with the number of distractor items, there being no significant difference between normals and schizophrenics when these distractor items were not present.

It must be concluded from these studies that Cameron's theory of over-inclusion has received strong support from the experiments so far performed.

Theoretical Formulation

It is possible to reformulate Cameron's theory of over-inclusion in a slightly more general way so that a number of predictions follow from it.

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Concept formation can be regarded as largely the result of discrimination learning. When a child first hears a word in a certain context, the word is associated with the entire situation (stimulus compound). As the word is heard again and again, only certain aspects of the stimulus compound are reinforced. Gradually the extraneous elements cease to evoke the response (the word), having become "inhibited" through lack of "reinforcement". This "inhibition" is in some sense an active process, as it suppresses a response which was formerly evoked by the stimulus. "Over-inclusive thinking" may be the result of a disorder of the process whereby "inhibition" is built up to "circumscribe" and "define" the learned response (the word or "concept"). In short, it could be an extreme degree of "stimulus generalization".

The same theory can be expressed in different terms. All purposeful behaviour depends for its success on the fact that some stimuli are "attended to" and some other stimuli are ignored. It is a well-known fact that when concentrating on one task, normal people are quite unaware of most stimuli irrelevant to the task. It is as if some "filter mechanism" cuts out or inhibits the stimuli, both internal and external, which are irrelevant to the task in hand, to allow the most efficient "processing" of incoming information. Over-inclusive thinking might be only one aspect of a general breakdown of this "filter mechanism".

It was the purpose of the present series of experiments, to test a fairly large number of predictions from this general theory, on a small group of schizophrenic patients, using a group of neurotic patients as controls.

The Experimental Subjects

All the subjects tested were in-patients of the Maudsley Hospital.

The experimental group consisted of 18 schizophrenic patients, 12 males and 6 females. These were selected as being typical of this diagnostic category by the psychiatrist in charge of the case. They were seen independently by a second psychiatrist (Dr. Mattussek) who rejected any doubtful cases. Six were labelled "paranoid schizophrenia", one was labelled "paraphrenic schizophrenia", one "acute schizophrenia", one "simple schizophrenia" and the remainder were merely labelled "schizophrenia". None of the patients were regarded as chronic, although many had had previous admissions with the same illness. Needless to say, all were sufficiently well to co-operate in the rather lengthy and exacting testing programme involved.

The control group consisted of 16 neurotic patients, 7 males and 9 females. These patients were selected from the in-patient neurotic population in the same way. Neurotics thought to have some psychotic features were rejected. The diagnoses which had been given them were as follows: reactive depression 4; anxiety state 6; obsessional neurosis 2; anxiety hysteria 1; hysteria 1; psychogenic eczema 1; immature personality 1. Neurotic patients were used as a control group as they are not thought to suffer from thought disorder, and the factor of length of hospitalization was thus roughly controlled.

Table I compares the groups with respect to age and general intelligence.

It can be seen that the two groups are fairly well matched on all these variables. It is surprising that, while the schizophrenics are a trifle duller than the neurotics on the Mill Hill Vocabulary test (68) they are a trifle brighter on the Nufferno Level Test (31), a "speed free" non-verbal test of "general intelligence". This is not consistent with the findings usually reported, that schizophrenics show a "vocabulary-G" discrepancy consistent with some

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TABLE I

Age and General Intellectual Status of the Two Groups

		Schizophrenics (N=18)	Neurotics (N=16)
Age	Mean	28·83	31·69
	Standard deviation	8·37	9·53
	Range	21–47	18–48
	Significance of difference	Not significant (t=0·30)	
Mill Hill Vocabulary raw scores	Mean	56·58	58·36
	Standard deviation	9·42	9·76
	Range	36–71	41–73
	Significance of difference	Not significant (t=0·47)	
Matrices raw scores	Mean	42·43	46·07
	Standard deviation	9·60	11·32
	Range	22–53	10–57
	Significance of difference	Not significant (t=0·91)	
Nufferno Level Test raw scores	Mean	315·12	308·66
	Standard deviation	165·22	140·54
	Range	100–633	133–533
	Significance of difference	Not significant (t=0·11)	

measure of general deterioration. It must be pointed out however, that the schizophrenics in the present study cannot be regarded as chronic cases, and on clinical grounds were not judged to have deteriorated.

The two groups were also fairly well matched for educational attainment. Six of the 16 neurotics had attended grammar school, while 7 of the 18 schizophrenics had attended grammar school. The remaining subjects had received elementary only, or elementary and/or "secondary modern" education.

INVESTIGATION OF INTELLECTUAL SPEED

It is a fairly well established finding that schizophrenics are unusually slow at problem solving (2, 3, 4, 20, 40, 52, 62, 71, 72). Several of these studies (40, 62, 72) have made use of the Nufferno Speed Tests (30). These tests consist of Thurstone type letter series items, and the solution speed for each individual item is obtained separately, the incorrect answers being excluded. It seems possible that "over-inclusion" may be the fundamental cause of intellectual slowness in schizophrenia. Normal people, when solving a letter series problem, consider only a limited range of possible solutions. Indeed, they regard only the sequence of the letters as being relevant to the task. It is possible that schizophrenics do not exclude other aspects of the letter series items in considering possible solutions. For example they might also take into account their associations to the letters. This, in itself, would not necessarily produce an incorrect answer, since any answer, whatever aspect of the material it is based on, must explain the letter series given in the question. Solutions based on irrelevant aspects of the material might be considered by schizophrenics, but rejected if they did not "fit". In short, it is possible that schizophrenics are slower on letter series items merely because for them, the difficulty level is increased, there being more items of information to take into account. In other words, over-inclusion would lead to a larger pool of possible (but incorrect) solutions to be considered for each item. This would not necessarily lead to an increase in the number of errors made, since they might be recognized as wrong.

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It would however produce on the *average* a slower solution time per item. It should *also* lead to increased variability of solution times.

If this were the case, slowness could not be regarded as a fundamental disorder in schizophrenia (as Babcock regarded it) but rather as a secondary disorder. It was predicted therefore, that tests of intellectual slowness would discriminate between the groups less well than direct measures of "over-inclusion".

Three forms of the Nufferno speed tests (30) were used in the present study. Test A1 consists of a group of easy items of homogeneous difficulty level. It was given individually under "unstressed" conditions. That is, the subjects were told to work at their own rate, and they were unaware that they were being timed. Test A2 is identical to test A1, and is of the same level of difficulty. However it was given under "stressed" conditions. That is to say, the subjects were told to work as quickly as possible, and were aware that they were being timed. (The "individual" method of giving the test was still used.) Test B1 is similar to the other tests, but consists of a homogeneous set of more difficult items. It was also given individually under "stressed" conditions. The scores obtained are "mean log time" scores (i.e. the average of the logarithm of the solution time for each item solved correctly). The results are presented in Table II.

TABLE II

Nufferno Speed Test Scores for the Two Groups

		Schizophrenics	Neurotics
Speed test A1 Individual unstressed	Mean	1·0991	1·0584
	Standard deviation	0·1608	0·1748
	Range	0·7805–1·4881	0·8200–1·4600
	Significance of difference	Not significant (t=0·63)	
Speed test A2 Individual stressed	Mean	1·0545	0·9197
	Standard deviation	0·2529	0·1412
	Range	0·6238–1·5885	0·6442–1·1119
	Significance of difference	Significant at 5 per cent. level (1 tail test) (t=1·70)	
Speed test B1 Individual stressed	Mean	1·2851	1·2000
	Standard deviation	0·2501	0·2297
	Range	0·8834–1·6755	0·7643–1·6692
	Significance of difference	Not significant (t=0·93)	

These results are consistent with previous findings in that the schizophrenics are slower than the neurotics on each test. However the mean differences achieve statistical significance for only one test (A2), and then only at the 5 per cent. level by a "one-tail" test. As will be seen later, direct measures of over-inclusion differentiate the groups at a very high level of significance, so that the prediction that tests of intellectual speed will differentiate the groups less well, is substantiated.

While intellectual speed tests themselves do not differentiate well, it is possible that some measure of the individual's slowness relative to his general intellectual level might differentiate better. In order to examine this possibility, "speed-level" discrepancy scores were calculated for all the subjects. This score was obtained by converting each subject's level score into a standard score on the basis of Furneaux's published norms. The speed score obtained on test B1 was also transformed into a standard score. (In this calculation, the signs were

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reversed, so that a high speed standard score represents a fast performance.) The discrepancy score is merely the level standard score minus the speed standard score, plus 5·000. This constant was added to eliminate negative numbers (subjects whose speed scores were better than their level scores). The results are presented in Table III.

TABLE III

Speed-Level Discrepancy Scores for the Two Groups

		Schizophrenics	Neurotics
Speed-level discrepancy score	Mean	5·3710	4·7694
	Standard deviation	2·1214	1·9230
	Range	1·307–8·193	0·530–7·726
	Significance of difference	Not significant (t=0·93)	

This table suggests that, on the average, the schizophrenics obtain a level score 0·37 standard deviations higher than their speed score (in terms of Furneaux's norms). They are therefore rather slow in comparison with the level they attain. The neurotics on the other hand are slightly quicker than their level score would suggest, since on the average their speed score is 0·23 standard deviations higher (i.e. better) than their level score. Due to the wide variability however, the difference between the groups is not statistically significant. In fact the speed scores differentiate just as well as the discrepancy score.

If schizophrenics tend to be somewhat slow intellectually, it is possible that they tend to compensate for this by working at their maximum rate most of the time. Thus, when asked to speed up and work as quickly as possible, very little change should occur. The *stress gain* score, was used as a measure of the extent to which the subjects were able to speed up when asked to. This is merely the mean log time for test A1 (given "unstressed") minus the mean log time for test A2 (given "stressed"). A constant of 0·200 was added to eliminate negative scores. Table IV gives the results obtained.

TABLE IV

"Stress-Gain" Scores for the Two Groups

	Schizophrenics	Neurotics
Mean	0·2668	0·3386
Standard deviation	0·1463	0·1292
Range	0·0064–0·6262	0·1789–0·5481
Significance of difference	Significant at 5 per cent. level (1 tail test) (t=1·70)	

The differences are in the expected direction. Neurotics are able to speed up to a greater extent than schizophrenics when asked to work as quickly as possible. However the differences are small, attaining the 5 per cent. level of significance only on a "one tail" test.

If schizophrenics are slow thinkers, it is possible that they might compensate for this by a greater degree of persistence. Indeed, Furneaux (31) has shown that scores on the level test are a function of speed, "error" and persistence. Two attempts were made to assess the persistence of the subjects on intellectual tasks. Both were unsatisfactory. The subjects were first given an insoluble but simple-looking intellectual task. Unfortunately, in spite of warnings not to do so, the patients discussed it among themselves on the wards, arriving at the joint conclusion that the task was insoluble. This experiment was thus abandoned. The second measure used was the sum of the two longest

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times (in seconds) spent during the level test on items which were subsequently abandoned or solved incorrectly. Since this measure was only introduced after the first had failed, measurements were not obtained for all the subjects. The results obtained are given in Table V.

TABLE V

Persistence Scores for the Groups

	Schizophrenics (N=10)	Neurotics (N=8)
Mean	137·40	132·38
Standard deviation	89·09	71·94
Range	32–303	72–273
Significance of difference	Not significant (t=0·13)	

These results are in the expected direction, but not significant statistically.

SUMMARY AND CONCLUSIONS OF EXPERIMENTS ON INTELLECTUAL SPEED

The results suggest that slowness of problem solving is not an important intellectual defect in schizophrenia. This is not consistent with Babcock's hypothesis that intellectual slowness is of fundamental importance in schizophrenic thought disorder. The findings are consistent with the hypothesis that slowness of problem solving in schizophrenia is a by-product of the more fundamental disorder of "over-inclusive" thinking.

INVESTIGATION OF MOTOR SPEED

A number of previous studies (2, 3, 5, 72) have found schizophrenics to be unusually slow at extremely simple psychomotor tasks, such as the speed of writing from dictation, or even the speed of writing one's own name. It is difficult to see how this type of slowness can be explained in terms of "over-inclusive" thinking, since these tasks would seem to require very little thought indeed.

In order to see whether these findings characterized the present group, four subtests from the Babcock-Levy test (5) were used. These were:

1. The speed of writing "the United States of America". The score was merely the number of seconds required.
2. The speed of writing one's own name. The score was the number of seconds required.
3. The speed of writing a simple sentence from dictation. The sentence used, from Babcock's battery (item 12 mc) was "I hope to leave here very soon".
4. The Babcock-Levy "substitution" test (test 7 in Babcock's battery) was the final item. This test merely requires the subject to write the appropriate number (from 1 to 5) in a symbol, using a key provided. The test would appear to be a function of simple perceptual and motor speed, although some rote learning is probably also involved. Babcock's scores were not followed. The score used in the present study was merely the average time in seconds required to complete each line of the test, there being five lines in all.

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The results obtained are given in Table VI.

TABLE VI

Simple Psycho-Motor Speed Test Scores for the Two Groups

		Schizophrenics	Neurotics
Speed of writing U.S.A.	Mean	13·95	11·08
	Standard deviation	10·53	2·73
	Range	7·5–51·0	6·5–15·0
	Significance of difference	Not significant (t=0·92)	
Speed of writing own name	Mean	10·47	8·08
	Standard deviation	4·56	2·88
	Range	5·5–24	4·5–14
	Significance of difference	Not significant (t=1·65)	
Speed of writing a sentence	Mean	13·27	11·00
	Standard deviation	6·63	2·07
	Range	8–35	7·5–14
	Significance of difference	Not significant (t=1·14)	
Babcock-Levy substitution test	Mean	19·34	16·41
	Standard deviation	6·22	4·29
	Range	9·2–33·2	9·0–24·0
	Significance of difference	Not significant (t=1·37)	

All the mean differences are consistent, in that the schizophrenics were slightly slower. However none are large enough to reach statistical significance. These tests differentiate even less well than do the tests of intellectual speed.

SUMMARY AND CONCLUSIONS OF EXPERIMENT ON MOTOR SPEED

There is no evidence that psychomotor retardation is an important aspect of the psychological abnormalities of the schizophrenic patients in the present study.

INVESTIGATION OF "CONCRETENESS"

(a) *Results Using the Goldstein-Scheerer Tests*

Previous studies suggest that schizophrenics are "concrete" in their performance on these tests, if Goldstein and Scheerer's scoring (34) criteria are used. If the tests are scored in this way however, the result will be ambiguous. Goldstein and Scheerer do not distinguish between what might be called a "bizarre" sorting, and a failure to sort at all. Both performances are rated as "concrete". If the theory of "over-inclusion" is correct, and schizophrenics perceive more aspects of the test material as relevant to the task than do normals, they will have more data on which to base possible sortings. If they base their sorting on what normal people would regard as irrelevant aspects of the material, the sorting will be judged to be bizarre, or at least unusual. However, if the schizophrenic does not distinguish between a "bizarre" sorting and a normal "abstract" sorting, which type of response occurs first will be completely random. If Goldstein's method of administration is followed, and the initial solution is an unusual one (e.g. "patterning"), the subject's performance will be rated as "concrete". Furthermore, the subsequent test procedure will be altered, and in many cases the subject will not be allowed to continue to sort the material, and it will not be possible to determine whether or not he will later produce spontaneously an "abstract" solution.

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It was therefore predicted from the theory of over-inclusion, that, if Goldstein and Scheerer's scoring system were followed, the schizophrenics would be significantly more "concrete" than the neurotics, by virtue of their "over-inclusive" tendencies. However these tests should not differentiate as well as tests specifically designed to measure "over-inclusive" thinking.

Only two tests in the Goldstein-Scheerer battery were used, the "colour-form" test, and the "object sorting test". These were administered in accordance with the instructions in the manual. Unfortunately, although the authors give a detailed description of the types of "concrete" responses to these tests, they do not give a system of scoring them. A five-point rating scale for "concreteness" was therefore used for each test. A score of 1 indicates a completely "abstract" performance, while a score of 5 indicates a completely "concrete" performance. These rating scales were very carefully constructed on the basis of the criteria laid down in the manual, and each level of performance was defined as precisely as possible. For example, rating "3" on the colour-form test was defined as follows: "Correct sorting for one principle (colour or shape), but inability to shift spontaneously. However, immediate success with the assistance of (*a*) the white sides turned up, if appropriate, or (*b*) immediate recognition and acceptance of the sorting presented by the examiner *and* an acceptable definition at either (*a*) a completely 'abstract' level, e.g. 'I have sorted for shape' or (*b*) a slightly 'concrete' level, e.g. 'these are all round, these all square, etc.' "

The results obtained are presented in Table VII.

TABLE VII

Ratings of "Concreteness" on the Goldstein-Scheerer Sorting Test

		Schizophrenics	Neurotics
Colour-Form Test	Mean	2·57	1·64
	Standard deviation	1·79	1·15
	Range	1–5	1–4
	Significance of difference	Not significant (t=1·64)	
Object-Sorting Test	Mean	4·21	2·79
	Standard deviation	0·80	1·25
	Range	2–5	1–5
	Significance of difference	Significant beyond 0·1 per cent. level (t=3·60)	

These results are more or less as expected. The colour-form test just fails to produce a difference significant at the 5 per cent. level (1 tail test), but is in the expected direction. On the other hand the object sorting test produces a highly significant difference (beyond the ·001 level on a two tail test). This is probably because the object sorting test material, being extremely heterogeneous, provides more scope for the schizophrenics to produce "over-inclusive" or unusual sortings of the type that are sometimes labelled "concrete" when the scoring criteria are applied. (Evidence that this is the case will be presented later in connection with a similar test.)

It is of interest that, if the performance of the neurotic group is taken as a criterion, the object sorting test is more difficult than the colour-form test. Indeed, according to the rating scale used, the average neurotic performance on the object sorting test would be judged as definitely "concrete". Only two neurotic subjects gave a perfectly "abstract" performance according to Goldstein and Scheerer's criteria (i.e. getting a rating of "1"). On the other

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hand, only four members of the neurotic group (and 8 members of the schizophrenic group) failed to perform perfectly on the colour-form test (i.e. getting a rating of "1").

(b) *Results Using Benjamin's Proverbs Test*

It has already been argued that, although schizophrenics are consistently reported as being "concrete" in their explanations of proverbs, that these findings could also be interpreted as being due to over-inclusive thinking. Benjamin's proverbs test was given to the present group, in order to demonstrate that, when scored in the traditional way, the schizophrenic group will be moderately "concrete", but that this score will not differentiate as well as a direct measure of "over-inclusive" thinking.

Benjamin's (7) list of 14 proverbs was used. Since there appears to be no standard way of administering this test, it is worth recording the precise instructions which were used in the present study. They were as follows: "I am going to read a few proverbs and what I want you to do is simply give the meaning of each one as simply as you can. Let me give you an example 'Too many cooks spoil the broth'. This means that when too many people are concerned in a task, they are likely to be less efficient than a single person would be. Now I am going to read some more proverbs and I want you to explain what they mean. Also tell me when you have finished." (The proverbs were then read one at a time and the answers recorded verbatim, no other instructions being given.)

The answer to each proverb was merely rated "abstract" or "concrete" according to Benjamin's general criteria. The score was the total number of abstract answers given. If, however, no answer at all was given, that particular proverb was not counted (e.g. some subjects claimed not to have heard of some of the proverbs, and these were excluded). When proverbs were omitted in this way, the score obtained was pro-rated so as to be a proportion of 14 (the highest possible score).

The results are given in Table VIII.

TABLE VIII

Number of "Abstract" Answers Given to Benjamin's Proverbs

	Schizophrenics	Neurotics
Mean	7·33	9·43
Standard deviation	4·20	2·79
Range	0–14	3–13
Significance of difference	Not significant (t = 1·57)	

These results are in the direction of those reported in the literature, but just fail to achieve statistical significance at the 5 per cent. level (one tail test).

(c) *Results Using a Concept Formation Test Modified from Feldman and Drasgow*

Feldman and Drasgow (26) devised a simple test for concept formation which they found differentiated between schizophrenics and normal subjects. The details of their test were not reported, but a test constructed on similar principles was employed in the present study.

This test of concept formation is simpler than the methods previously described. The subjects were presented with four objects drawn on a card. For example, Card 1 contains four circles. One of the circles is smaller than the

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other three, but one of the large circles is coloured black. In each card it is possible to group three of the objects together for one reason, but another three of the objects can be grouped together for a different reason. For example, in Card 1, the three white circles can be grouped together, or alternatively, the three large circles can be grouped together. The test contained 20 cards. For each card the subject was asked to say which three objects could be grouped together, and why, and then to discover an alternative method of grouping another three objects together. Some of the cards contained simple geometrical designs, but most of them depicted everyday objects (e.g. a banana, an orange, a rubber ball and an apple—three are edible and three are round).

It seemed that this test would be less likely to be influenced by over-inclusive thinking than the sorting tests already discussed, as the material is less complex, and would therefore be a better measure of the ability to abstract, uncontaminated by other factors.

The test was given without a time limit, but a record was taken of the performance for each card within the first minute. Thus two scores were possible, one based on no time limit, and one on the first minute's performance. This was done because Feldman and Drasgow had given the test with a time limit of 1 minute per item, and the effect of imposing such a time limit could thus be observed.

The "total abstraction" score used in the present study was merely the total number of correctly identified concepts (the total possible score is 40 as there are two concepts per card).

The results are given in Table IX.

TABLE IX

"Total Abstraction" Scores for the Two Groups

		Schizophrenics	Neurotics
Within the first minute	Mean	30·00	32·46
	Standard deviation	4·91	4·70
	Range	21–38	23–39
	Significance of difference	Not significant (t=1·33)	
With no time limit	Mean	31·14	33·15
	Standard deviation	4·67	4·18
	Range	24–39	25–39
	Significance of difference	Not significant (t=1·18)	

There is no evidence that a time limit of one minute per card has any appreciable effect on the scores of the two groups. Under neither condition is the difference significant. There is thus no evidence in the present study that schizophrenics are "concrete" on this test.

Goldstein and Scheerer (34) identify "concreteness" and "rigidity". They maintain that people who have difficulty in making an abstract generalization are rigid in that, having once produced one type of abstract classification, they have extreme difficulty in producing an alternative generalization for the same material. More evidence will be presented later that schizophrenics are not rigid in this sense. However, the present test provides a method for assessing this type of rigidity. On each card, there are two different ways of grouping the objects. Rigid people, having grouped them in one way, should find it extremely difficult to find the alternative grouping. In other words, they should have a low proportion of "double concepts" (cards in which both groups are obtained). The rigidity score used was merely the number of "double concepts"

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obtained, expressed as a proportion of the "total abstraction" score. A high score suggests flexibility, a low score, rigidity. The results with and without time limit are presented in Table X.

TABLE X

"Rigidity" Scores for the Two Groups

		Schizophrenics	Neurotics
Within the first minute	Mean	0·343	0·406
	Standard deviation	0·084	0·084
	Range	0·19–0·47	0·24–0·50
	Significance of difference	Significant at 5 per cent. level (1 tail test) (t=1·97)	
With no time limit	Mean	0·364	0·409
	Standard deviation	0·071	0·082
	Range	0·24–0·49	0·24–0·50
	Significance of difference	Not significant (t=1·52)	

It can be seen that the differences are in the direction to be expected from Goldstein's theory, as schizophrenics are more "rigid". The difference only reaches significance when the test is given with a one minute time limit per card, and then the difference is not large. It is worth noting that a similar difference would tend to occur if schizophrenics have a higher proportion of incorrect answers (due to "over-inclusion") than neurotics, as the probability would then be that one of their two answers for any card would be "wrong" and thus not counted.

SUMMARY AND CONCLUSIONS OF EXPERIMENTS ON "CONCRETENESS"

Of the five measures of "concreteness" examined, only one differentiated the groups significantly. This was the concreteness rating based on the Goldstein Scheerer Object Sorting test. This test probably provides more scope than the others for unusual responses due to "over-inclusive" thinking, some of which are scored "concrete" if Goldstein's criteria are used. Evidence will be presented that schizophrenics do tend to produce some unusual responses on tests of this sort.

"Rigidity" has been identified with "concreteness" by Goldstein and Scheerer, but significant differences on a rigidity score only occurred when a time limit was imposed. It has been pointed out that "over-inclusive" thinking could have produced this difference equally well.

The results are at least consistent with theory that schizophrenics are not "concrete", but that they can produce "concrete" responses on some tests, if some unusual methods of dealing with the material are classified as "concrete". Since the theory of "over-inclusion" accounts for the production of unusual responses of all sorts, it is believed to offer a more useful explanation of the performance of schizophrenics on sorting tests.

INVESTIGATION OF "OVER-INCLUSION"

(a) *Results Using the Benjamin Proverbs Test*

If the concepts formed by schizophrenics are abnormally broad, it is possible that to them, a single proverb means more than it does to normal people. Thus the concept it illustrates will be more difficult to define. Several predictions can thus be made. First, before they start to answer, they will need a longer time to prepare what they are going to say. They should thus have an

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increased "reaction time", if this is defined as the time elapsing between the presentation of the proverb by the examiner, and the first word spoken by the subject in answering. Second, their explanation should itself require longer to give, since it should be more complicated (more difficult), require more thought, and involve the use of more words.

The results with respect to the two time measures, are presented in Table XI.

TABLE XI

Time Scores (in Seconds) for the Benjamin Proverbs

		Schizophrenics	Neurotics
"Reaction Time"	Mean	26·73	10·93
	Standard deviation	19·40	6·50
	Range	5–86	4–26
	Significance of difference	Significant at 1 per cent. level (2 tail test) (t=2·90)	
Total time required to give answer	Mean	68·73	38·29
	Standard deviation	28·60	14·13
	Range	33–121	22–55
	Significance of difference	Significant at 1 per cent. level (2 tail test) (t=3·60)	

Both these time measures differentiate at a high level of significance. Six of the 18 schizophrenics obtain reaction time scores in excess of 26 seconds, and are thus completely outside the neurotic range. Ten of the 18 schizophrenics require more than 55 seconds to give their answer, once started, and are completely outside the neurotic range. These differences are unlikely to be the result of any general intellectual slowness, since none of the other speed scores differentiated so well.

The average number of words used in answering each proverb, is given in Table XII.

TABLE XII

Average Number of Words Used in Answering Benjamin's Proverbs

	Schizophrenics	Neurotics
Mean	20·93	18·07
Standard deviation	7·30	7·56
Range	12–36	13–42
Significance of difference	Not significant (t=1·04)	

This difference, while in the expected direction, is not significant. It is possible that these estimates were not very reliably ascertained. It is extremely difficult, when copying down patients' answers, to avoid paraphrasing them and condensing them. This tends to occur more with people who speak at length, than those who answer briefly. It is possible that, had the answers been recorded on a tape recorder and scored later, both groups would have been found to use more words, and the differences might have been larger.

(b) *Results Using the Goldstein-Scheerer Object Sorting Test*

During the first stage of the administration of this test (the "Handing Over" experiment), the subjects are asked to select one of the objects on the table. The subjects are then asked to hand over to the examiner all the objects which might be grouped together with this object. As each is handed over, it is

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placed out of sight by the examiner. This experiment thus requires the subject to build up a concept around the initial object. If schizophrenics tend to form over-inclusive concepts, they should select significantly more objects as belonging together during this part of the experiment.

Although Goldstein and Scheerer allow the subjects to select their own objects as starting points in this stage of the experiment, it was thought desirable to standardize this aspect of the test. In the present experiment, the "handing over" procedure was performed four times. On the first trial, the subject was allowed to select his own object. For the remaining three trials the examiner selected the object which was to be the "point of departure". The objects were always the red plate, the box of matches and the bicycle bell in that order. (Note that all subjects were given the "male" set of objects described in the manual, regardless of sex.) The over-inclusion score used was merely the average number of objects grouped together with the four objects used as "points of departure".

The results are given in Table XIII.

TABLE XIII

Average Number of Objects Grouped together during the "Handing Over" Experiment

	Schizophrenics	Neurotics
Mean	11·33	5·86
Standard deviation	8·44	1·66
Range	5–32	4–11
Significance of difference	Significant beyond 2 per cent. level (2 tail test) (t=2·46)	

The results are in the predicted direction, and attain an acceptable level of statistical significance.

(c) *Results Using an "Object Classification Test"*

This test was originally designed to provide an easier and more objective method of measuring "concreteness" in sorting behaviour, as defined by Goldstein. The aim was to incorporate all the features of the three Goldstein-Scheerer sorting tests in one test.

The test consists of 12 small objects: four triangles, four squares and four circles. The objects vary in weight, thickness, size, material, and the hue and brightness of the colours which they are painted. There are intended to be ten different ways of grouping the objects, as follows: (1) By shape (3 groups—square, circle and triangle). (2) By size (2 groups. Some are large and some small). (3) By thickness (2 groups—half the objects are twice as thick as the others). (4) By surface area (6 groups—those of the same shape and surface size have an identical surface area). (5) Presence or absence of curved edges or corners (2 groups). (6) By weight (at least 3 groups. This sorting must be independent of density). (7) By material (3 groups—some are metal, some wood, and some a light plastic). (8) By colour (8 groups—those of precisely the same colour are grouped together). (9) By hue (four groups—some are red, some blue, some green and some yellow). (10) By saturation of colour (2 groups—some colours are highly saturated and "bright" looking, some are unsaturated and "dull" looking).

The instructions used with the test were very simple, and were as follows: "Do you see these objects on the table? I want you to sort them out into groups. Put them in some sort of order. Put those together which you think belong

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together." (When S has performed one of the 10 sortings say:) "Good—Why did you do it that way?" (If the subject's explanation is correct, proceed with the test. Note that the explanation need not be completely "abstract" in Goldstein's sense, just sufficiently clear to be sure the subject has really perceived that particular sorting method. If the subject cannot explain his grouping, or if he cannot group at all, the examiner demonstrates the "shape" sorting, but does not subsequently credit it. Otherwise the initial sorting is credited. The final instructions are as follows): "Now there are other ways of sorting this material. I want you to sort the objects in as many other simple ways as you can. Arrange the objects into groups as you have just done, so that there is a single simple reason for each grouping. Each time you sort them, I want you to tell me why you have sorted them in that way." (No further instructions are given at all, but each explanation is recorded. There is no time limit. The first time the subject spontaneously says he can do no more, encourage him to continue. End the test when he gives up a second time.)

In an earlier study in which this test was used with 100 normal subjects (64) it was found that normal people are able to perceive all ten methods of sorting (although no subject saw all ten), but very seldom produce any other methods of sorting the material.

If it is true that schizophrenics are not "concrete", but are "over-inclusive", a number of predictions can be made concerning their sorting behaviour on this test. Since schizophrenics will perceive more aspects of the material as being relevant to the task than will normal people, they will be able to elaborate many more methods of sorting. These extra methods of sorting would not be considered by normal people, because they ignore the aspects of the material on which they are based (e.g. the shadows cast by the objects on the table, slight scratches on the objects, personal associations to the objects, and so on). In other words, schizophrenics have more data to work with. They should therefore take longer to do the test, because they think of more solutions. They should not distinguish between "normal" and "unusual" solutions, and should therefore produce both types of sorting in a random order. If there were no time limit to the test, there should be no reason why they should not produce as many "abstract" or "normal" methods of sorting as normal people do, although these would be interspersed among the other solutions. In practice, of course, all the subjects will tend to give up the test after working on it for a period of time, so that it would not be surprising to discover that, while schizophrenics produced many more solutions, they nevertheless produced slightly fewer "abstract" or "unusual" solutions than normal people before they gave up.

The scoring system used was simple. A "correct" response (an "A" response) was merely defined as one of the ten groupings intended in the construction of the test. Any other method of sorting (including a repetition of a previously given "A" response) was scored "Non-A".

The results obtained are given in Table XIV.

The results are as predicted. The schizophrenics obtain significantly fewer "A" scores, presumably because they "give up" the test before they have exhausted all the possibilities it has for them. On the other hand, the schizophrenics obtain significantly more "Non-A" or "unusual" sortings. Indeed 9 out of the 18 schizophrenics produced more than 8 "Non-A" sortings, the highest score for a neurotic subject.

The schizophrenics produced an average of 11·66 different methods of sorting (taking all kinds into account), while the neurotics only produced an

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TABLE XIV

Results Using the Object Classification Test

		Schizophrenics	Neurotics
Number of "A" sortings	Mean	2·13	4·86
	Standard deviation	1·77	1·23
	Range	0–6	3–7
	Significance of difference	Significant beyond 0·1 per cent. level (2 tail test) (t=4·78)	
Number of "non-A" sortings	Mean	9·53	2·21
	Standard deviation	3·68	2·01
	Range	3–17	0–8
	Significance of difference	Significant beyond 0·1 per cent. level (2 tail test) (t=6·58)	

average of 7·07 different methods of sorting. These data appear to support the theory of "over-inclusion". They certainly provide no evidence that schizophrenics are "rigid" or unable to generalize.

(d) *Results Using Epstein's Test for Over-inclusive Concept Formation*

This test was developed by Seymour Epstein (24) as a direct measure of "over-inclusion" in concept formation as defined by Cameron. The test consists of a list of 50 words printed on two pages. Following each stimulus word, there are 6 response words (including the word "none"). The subject is merely asked to underline all those response words which are an essential part of the concept denoted by the stimulus word. Epstein predicted from Cameron's theory that schizophrenics would underline more response words than normals, as their concepts would be more over-inclusive. This was, in fact, the case in his initial study.

Two scores were used in the present study. The "over-inclusion" score is based on those words which tended not to be underlined by normal people in Epstein's study. It was scored according to Epstein's own procedure so as to make the present results comparable with his.

The test also includes neologisms. Five of the 50 stimulus words are neologisms, as are 5 of the response words. A "neologism" score was calculated which was merely the total number of words (other than the word "none") underlined in response to a neologism, plus the number of neologisms underlined as responses.

It was also predicted, that, as the task would be more complicated for the schizophrenics by virtue of their more extensive and presumably more complex concepts, that they should take longer to do the test. The results obtained are given in Table XV.

The results are all highly significant, and in accordance with the predictions. It is interesting that the "over-inclusion" score appears to differentiate much better in the present study than it did in Epstein's original study. Epstein found normals to have a mean over-inclusion score of 12·49, while schizophrenics he found to have a mean of 20·92, significantly higher. The schizophrenics in the present study have a mean score over twice this size, while the neurotics score only slightly in excess of Epstein's normal group

The "neologism" score was not used by Epstein. The significant difference on this score suggests that the over-inclusive concepts formed by schizo-

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TABLE XV

Scores Obtained from the Epstein Test of "Over-inclusion"

		Schizophrenics	Neurotics
Over-inclusion score	Mean	56·93	16·64
	Standard deviation	51·21	16·90
	Range	3–157	1–47
	Significance of difference	Significant beyond 1 per cent. level (2 tail test) (t=2·80)	
Neologism score	Mean	6·00	1·87
	Standard deviation	5·05	1·75
	Range	0–17	0–5
	Significance of difference	Significant beyond 1 per cent. level (2 tail test) (t=2·97)	
No. of seconds required to complete the test	Mean	1161·07	761·92
	Standard deviation	415·12	209·96
	Range	632–1,930	484–1,105
	Significance of difference	Significant beyond 1 per cent. level (2 tail test) (t=3·01)	

phrenics can incorporate words which are meaningless, but which have features in common with everyday words.

As expected, schizophrenics are significantly slower at doing the test. Again this difference cannot be explained in terms of their general intellectual slowness, since other speed scores produced very small differences.

(c) *Results Using the Leiter-Partington Pathways*

It was hypothesized that "over-inclusion" is due to an abnormally flat "stimulus generalization gradient" in schizophrenics. This would make discrimination learning more difficult for schizophrenics. "Set" of the "Einstellung" type can be regarded as nothing more than a special case of discrimination learning. For example, in the typical "Einstellung" rigidity test (e.g. Luchins "water jar" test (57)), in the course of a series of problems, a specific type of complicated solution is consistently "reinforced", simpler methods not being found to work. Later, when this "set" has been learned (discrimination learning) it is found that even when a simpler type of solution is possible, normal people continue to use the complex method due to their "set". If the theory is true, schizophrenic patients should *not* readily be able to learn a "set" of this type. Indeed they should not be susceptible to "Einstellung" rigidity. This lack of "set" should be an advantage in some types of tasks, and a disadvantage in others. It has already been demonstrated that schizophrenics can think of more solutions to a sorting test. In this sense they are less "rigid" and more "creative". The purpose of the present experiment was to demonstrate how this lack of "rigidity" or "set" can also be a disadvantage.

In the Leiter-Partington Pathways Test (55), the subject is presented with a series of circles randomly drawn on a piece of paper, and randomly numbered from 1 to 10. Without giving verbal instructions, the examiner with his pencil connects the circles in numerical order. The subject is then motioned (without verbal instructions) to do the same, on an identical sheet of paper. If he succeeds (as nearly all subjects do), he is motioned to do the same with a second sheet of paper (the test proper) containing many more numbered circles in a different arrangement. The authors of the test found that normal people almost never make errors on this test, and indeed they use it as an error free speed test. In

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the second part of the test, the material and procedure are identical, excepting that the circles have to be connected in the order 1, A, 2, B, etc.—numbers and letters alternating.

The success of this test with normal people almost certainly depends upon the fact that when they perceive numbers being connected in order (or numbers and letters being connected), they immediately assume that the essence of the test is to connect the circles in numerical (or numerical-alphabetical) order. Presumably this strong "numerical set" has been built up through past experience. They ignore the spatial juxtaposition of the circles on the paper, and the direction of the movements the examiner makes, as they believe those to be irrelevant. However, if schizophrenics do not adopt such a normal "set", they might well perceive these other aspects of the examiner's performance, and elaborate some much more complex hypothesis about what the examiner is doing, involving all these aspects. However when they are given the proper test sheet, it includes many more items, and the spatial juxtaposition of the circles is now quite different. Any complex hypothesis involving both numerical arrangement *and* spatial arrangement would no longer work, since these aspects would now be in conflict. Indeed anything more elaborate than a simple numerical sequence would not be correct. It was predicted, that, if schizophrenics do form over-elaborate hypotheses for these reasons, when they tried to apply them to the test proper, they would find it very difficult. Furthermore, the conflicts produced by an elaborate hypothesis which no longer fits would lead to errors. It was thus predicted that the schizophrenics would be significantly slower, and make significantly more errors than the neurotics.

The results obtained are presented in Table XVI.

TABLE XVI

Results from the Leiter-Partington Pathways Test

		Schizophrenics	Neurotics
Errors made on Pathway 1 (numbers only)	Mean	0	0
	Standard deviation	0	0
	Range	0–0	0–0
	Significance of difference	Not significant (t=0)	
Time in seconds for Pathway 1	Mean	75·20	69·29
	Standard deviation	29·64	30·86
	Range	50–172	34–140
	Significance of difference	Not significant (t=0·53)	
Errors made on Pathway 2 (letters and numbers)	Mean	7·00	1·86
	Standard deviation	9·75	3·76
	Range	0–25	0–13
	Significance of difference	Significant at 5 per cent. level (1 tail test) (t=1·90)	
Time in seconds for Pathway 2	Mean	123·15	97·00
	Standard deviation	62·16	45·34
	Range	69–248	51–197
	Significance of difference	Not significant (t=1·24)	

It is clear that pathway 1 did not differentiate the groups either with respect to error or time taken. This is possibly because the tests are too simple. None of the subjects made any errors at all. The time score on pathway 2 produced differences in the predicted direction, but not significant. However,

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the errors on the second pathway differentiated as predicted, although only at the 5 per cent. level (1 tail test) of significance.

Summary and Conclusions of Experiments on "Over-inclusion"

For the most part, the groups were very significantly different on the measures of over-inclusion, as predicted. Of the 13 scores examined, 7 differentiated at well beyond the 1 per cent. level, while only 4 scores produced statistically insignificant differences. All the differences were in the expected direction. Individual "over-inclusion" scores differentiate the groups much better than any tests previously discussed. The results are therefore regarded as supporting the theory advanced.

Some Possible Consequences of "Over-inclusive" Thinking

Of all the standard cognitive tests, it was thought that the "Picture Arrangement" type of test would be most likely to be influenced by "over-inclusive" thought disorder. This test requires the subject first to perform "inductive" reasoning, and formulate some story which could account for all the pictures, before arranging them in their proper order. It was thought likely that "over-inclusive" subjects would make up over-elaborate and rather unusual stories, and thus obtain poor scores.

The test given was the Wechsler Picture Arrangement sub-test (75), and the score used was the "weighted sub-test" score. The results are given in Table XVII.

Table XVII

Wechsler Picture Arrangement Scores for the Two Groups

	Schizophrenics	Neurotics
Mean	9·20	10·30
Standard deviation	2·86	3·45
Range	5–14	6–17
Significance of difference	Not significant (t=0·93)	

Although the results are in the expected direction, they are not statistically significant.

Rodnick and Shakow (69) have reported that schizophrenic patients are both slower and more variable in a reaction time experiment. They have explained this finding by postulating that schizophrenics are defective in maintaining a "set". This would be consistent with the theory elaborated in the present paper. Presumably schizophrenics are unable to "filter" out irrelevant incoming stimuli, and become distracted by these, making a simple reaction time task into a discrimination reaction time situation. It was proposed to investigate this theory in the present study, and an experiment designed to decrease the amount of hypothesized distraction in a normal reaction time experiment, was performed. Unfortunately any results were nullified by the initial finding. In the present group, in a simple visual reaction time experiment with no warning stimulus, the schizophrenics were slightly faster, and less variable than were the neurotics. The results are given in Table XVIII. The reaction time (expressed in tenths of a second) is the average of 10 trials, following a warm-up period of 5 trials. The variability measure used is the standard deviation of these 10 trials for each individual.

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TABLE XVIII

Reaction Time and Variability Measures for the Two Groups

		Schizophrenics	Neurotics
Reaction Time	Mean	2·46	2·953
	Standard deviation	0·39	0·77
	Range	1·77–3·20	1·67–4·21
	Significance of difference	Significant at 5 per cent. level (2 tail test) (t=2·19)	
Variability of Reaction Time	Mean	0·463	0·795
	Standard deviation	0·200	0·450
	Range	0·15–0·90	0·23–1·72
	Significance of difference	Significant at 2 per cent. level (2 tail test) (t=2·58)	

These findings are not consistent with Rodnick and Shakow's (69) findings that schizophrenics tend to be slower and more variable in reaction time. The fact that the present group contains no chronic cases could account for this discrepancy. However, it has been demonstrated on a number of tests that the schizophrenics in this study are "over-inclusive". The fact that they are faster than neurotics in their reaction time suggests that there may be no relationship between slowness in reaction time, and over-inclusive thinking. In other words, slowness in reaction time may have nothing to do with the inability to develop a "set".

AN INVESTIGATION OF ONE POSSIBLE EXPLANATION OF "OVER-INCLUSION"

It was postulated that "over-inclusive thinking" is due to a defect in some central "filter" which is responsible for screening out stimuli, both internal and external, which are irrelevant to the task in hand. This "filter" presumably operates by "inhibiting" these irrelevant stimuli possibly by some process similar to that described by Pavlov (63), and usually referred to as "negative induction". It is conceivable that schizophrenics are abnormal in that they do not readily develop any type of cortical inhibition. If this were the case, they should also develop "reactive inhibition" more slowly than normal people.

Eysenck (25) regards "satiation" as a special case of reactive inhibition; and has used a test devised by Klein and Krech (53) as a measure of it. This test has been described in detail elsewhere (25, 53). Briefly, it consists of a long wooden board, wide at one end and narrow at the other, which is marked off in units representing its width at that point. The subject is blindfolded and given a small block of wood to feel. His task is to estimate its width, by feeling it with his left hand, and then moving his right hand up (or down) the large board until he reaches that point at which he judges the board to be the same width as the test object. A series of 4 judgments is made initially, the score being the average. The subject is then presented with a block of wood similar to the test object, but wider. He is required to place his left hand over it, and rub it up and down for 15 seconds. This is thought to produce a "satiation" effect, so that when the subject now judges the width of the narrow test object, "displacement" will have occurred, and it will seem even narrower. If "satiation" and "reactive inhibition" are the same process, the greater the displacement effect, the more "reactive inhibition" can be assumed to have been generated. Thus the subject is asked to assess the width of the test object four times following the 15 seconds of satiation, the score being the average judgment

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The subject is then required to "satiate" himself for a further 30 second period, and four more judgments are made of the width of the test object. Again more displacement should occur. Finally the subject is given a ten-minute rest, during which the "inhibition" should have dissipated. Four final judgments are taken, and the measurement of subjective width should now return to its original level.

This test was given to the two groups, and the results are presented in Table XIX.

TABLE XIX

Results from the Klein and Krech Figural After-Effect Test

		Schizophrenics	Neurotics
Initial judgment of width	Mean	10·65	10·73
	Standard deviation	2·08	2·07
	Range	6·50–14·00	7·75–15·00
	Significance of difference	Not significant (t=0·11)	
Judgment after 15 seconds of satiation	Mean	9·52	8·41
	Standard deviation	1·78	1·54
	Range	6·75–13·25	6·25–11·00
	Significance of difference	Significant at 5 per cent. level (1 tail test) (t=1·78)	
Judgment after a further 30 seconds of satiation	Mean	8·15	7·84
	Standard deviation	1·66	1·52
	Range	5·75–10·50	5·25–10·00
	Significance of difference	Not significant (t=0·52)	
Judgment after a 10-minute rest period	Mean	10·76	10·66
	Standard deviation	1·98	1·29
	Range	8·50–14·25	8·25–13·00
	Significance of difference	Not significant (t=0·17)	

The results are consistent with the theory of figural after-effects, in that, following the two satiation periods, the estimated size goes down in each group, presumably due to "displacement" effects. Following a ten-minute rest, the judgments return exactly to their pre-satiation level.

As expected, the schizophrenics consistently show smaller satiation effect than the neurotics, suggesting that they develop less inhibition. However, this difference only reaches significance after the first satiation period, and then only at the 5 per cent. level by a "one tail" test of significance.

These results are not regarded as providing unambiguous support for the theory, in that the measure of "inhibition" used makes several assumptions which may not be valid. Even if it were a valid measure of "reactive inhibition", there is no guarantee that "reactive inhibition" is related to the type of "inhibition" which the theory postulates that schizophrenics lack. Nevertheless they suggest that this aspect of the theory might profitably be investigated further.

SUMMARY

1. A review of the literature suggests that there is no conclusive evidence in support of the theory that schizophrenics are abnormally "concrete". On the other hand, a number of studies have clearly supported Cameron's theory that schizophrenics are "over-inclusive". No study appears to have been carried out to determine what the result would be if measures of "concreteness" and "over-inclusion" were given to the same schizophrenic group. The present study investigated this.

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2. The theory of "over-inclusion" was reformulated, and a number of predictions were made from it.

3. A large battery of tests was given to 16 neurotics and 18 schizophrenics matched for age, educational attainment, Mill Hill Vocabulary Score, Progressive Matrices score and Nufferno "Level" score. The group contained no chronic schizophrenic patients.

4. Three Nufferno intellectual speed tests (A1, A2, and B1) were given under various conditions. Measures of "speed-level" discrepancy, "stress gain" and "persistence" were also obtained. Only two measures differentiated the groups significantly at the 5 per cent. level, and it was concluded that intellectual slowness is not an important aspect of schizophrenic thought disorder. It was hypothesized that intellectual slowness is a by-product of "over-inclusive" thinking in schizophrenics.

5. Four of the Babcock psychomotor speed tests failed to differentiate the groups significantly. It was concluded that motor retardation is not an important characteristic of the present schizophrenic group.

6. The following measures of "concreteness" were given: the Goldstein Scheerer Colour-Form test, the Goldstein Scheerer Object sorting test, Benjamin's proverbs test, and a test of concept formation modified from Feldman and Drasgow's test. Of five measures of "concreteness" used, only one (based on the Object Sorting test) differentiated the groups significantly. It was concluded that this result was due to the heterogeneous nature of the material, which favoured the production of unusual, "over-inclusive" responses, some of which are labelled "concrete" when Goldstein's criteria are applied.

7. "Over-inclusion" measures were obtained from the following tests: the Benjamin Proverbs, the Goldstein Scheerer Object Sorting Test, a specially designed "Object Classification Test", the Epstein test for "over-inclusion", and the Leiter-Parting pathways test. Of 13 different "over-inclusion" scores used, 7 differentiated at well beyond the 1 per cent. level of significance. Only 4 scores failed to achieve significance, but these produced differences in the predicted direction. It was concluded that these results support the theory that "over-inclusion" is a fundamental aspect of schizophrenic thought disorder.

8. There was no evidence that "over-inclusive" thinking significantly affects performance on the Wechsler picture-arrangement subtest, although this had been thought likely.

9. There was no evidence that "over-inclusion", which could produce a defect in "set", can account for slowness of simple reaction time in schizophrenia. Indeed the present group of schizophrenics surprisingly were significantly faster and less variable than the neurotics in reaction time.

10. An experiment with the Klein and Krech "figural after-effect" test produced slight evidence (significant at the 5 per cent. level) that schizophrenics show less "satiation" effect. This was related to the theory of "over-inclusion" although the results were not thought to be unambiguous.

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