A COMPARATIVE STUDY OF CHRONIC SCHIZOPHRENICS AND NORMAL SUBJECTS ON A WORK TASK INVOLVING SEQUENTIAL OPERATIONS

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Statement of Purpose

This study is intended to yield information about the type of task that a chronic schizophrenic might be expected to succeed at and, conversely, the conditions under which their disabilities are magnified. The primary purpose is to obtain data to act as a guide in the design of work for such patients, and secondly to produce more general information about the differences between the normal person and the chronic schizophrenic on sequential operations. The task studied involved primarily both long and short-term memory functions, together with the associated processes of attention.

In this study, the patients are being compared with normals on a work task. The type of task to be studied has equivalents in industry, and to this extent can be used as a direct measure of employability.

Background of Research

This experiment is primarily empirical. The background events which led to the choosing of a sequential task for study came from the experience of the sheltered workshop. It was found that chronic schizophrenics, apparently suffering from deficiencies of memory and attention, were more than usually prone to assemble objects in the wrong way if a number of alternatives existed. With this in mind, tasks have been made unskilled as far as possible and their method of execution structured as far as is compatible with efficient working.

The present study is intended to establish whether chronic schizophrenics find sequential operations, where they are required to carry-forward the memory of the previous action, intrinsically more difficult than they are for a normal, or whether our empirical observations were due to specific complexities in the tasks observed. The study is theory-derived only insofar as observations and experience have led to the formulation and adoption of working hypotheses about the abilities of this class of patient. It is one of these working hypotheses that is to be tested by this study.

Hypothesis to be Tested

Increasing the number of elements in a sequential cycle will lead to decreased speed and accuracy for both schizophrenics and normals, but the

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decrements experienced by the schizophrenics will be considerably greater than those of the normals.

Samples Used

A group of 8 chronic schizophrenics were matched with a group of 8 normals for age. Age seemed a most important variable to control, as an earlier study (Wadsworth *et al.*, 1961) had indicated that performance and age were related for normal subjects.

The second basis for matching was in respect of practice at the task; all the subjects included had had at least 100 hours of practice before the commencement of the study.

The experimental subjects were obtained by taking all the available normal workers who fell within a fairly limited age range, i.e. 41–53 years, and then drawing randomly from the list of those patients who also met the criteria of age and practice. The schizophrenic group consisted of 4 males and 4 females. The sub-diagnoses were—3 hebephrenics, 2 simplex, and 3 paranoid cases. The mean age of the group was $48 \cdot 1 \pm 4 \cdot 0$. Full-scale WAIS I.Q. was $97 \cdot 1 \pm 5 \cdot 3$, and the mean period of hospitalization was $14 \cdot 8 \pm 8 \cdot 9$. The normal group consisted of 8 female part-time workers at the rehabilitation unit. The mean age of the group was $47 \cdot 9 \pm 4 \cdot 1$, and the mean full-scale WAIS I.Q. was $100 \pm 8 \cdot 5$. There were no significant differences between the groups on the variables matched.

The Task

The task studied was the assembly, by gluing, of a piece of white card to a crepe shape; this being a basic process in the manufacture of carnival hats. This basic task was studied under four different conditions; the conditions depending upon the number of piles of card that were placed on the subject's desk and the fact that he was required to use materials from these piles in a set sequence. The conditions were as follows:

Condition 1: There was only one pile of card shapes; the subject had no choice and used these in his assembly.

Condition 2: Two piles of cards were placed on the subject's desk. They were apparently quite identical except that their pile number was written in pencil on their undersides, and that the piles were clearly designated by half-inch black numbers "1" and "2", attached to the desk, in front of the respective piles. The subject was required to use a card from pile 1, then one from pile 2, returning to pile 1 and continuing to work in this sequence.

Condition 3: There were three piles of cards, similarly pencil-marked and identified by half-inch numbers. The subject was required to use cards from them in sequence, i.e. 123123123 etc.

Condition 4: Involved four piles of cards similarly treated, and the subject was required to work to the sequence 123412341234 etc.

In the following discussion a sequential cycle will refer inclusively to the number of hat assemblies that must be completed in a given sequence before the sequence is repeated. Each assembly represents one element. Hence Condition 3 is a sequential cycle containing three elements. When the third element (or assembly) is completed, the subject then starts on a new cycle. Condition 1 is

therefore a job cycle having only one element, and acts as the baseline against which to evaluate performance on the sequential cycles.

It must be emphasized that the time needed to complete an assembly, under any of four conditions, would be the same. The packs of card were placed at an equal distance from the subjects' hand so that the physical movements involved were the same under all conditions.

Summary of Method

Although the subjects were all well practised in the task under Condition 1 conditions, they had not previously had more than one pile of material or been required to use materials in fixed sequence. Accordingly, it was necessary to allow 15 minutes before each experimental session for practice. The experimenter showed each subject the sequence that they were required to perform and kept returning to check that it was being adhered to, and that the principle was understood. The experimenter was able to check on the accuracy of the subject's sequential performance retrospectively by removing the finished assemblies from the finished work-box and checking the sequence of the concealed numbers pencilled on them. The practice was not in respect of the gluing operation itself, but of working in sequences, and to allow the experimenter sufficient time to make sure that each individual understood clearly what was required.

The experiment was designed so that the data could be evaluated by a two-way analysis of variance. The order of experimental conditions was randomized so that 2 subjects from each group performed, under each of the four conditions, on each of the four days that the research ran. The subjects worked for 1¼ hours each day, from 9.0 a.m.–10.15 a.m. The first 15 minutes were given to practice, followed by the one hour experimental session. The experimental sessions were held on consecutive days. The work completed during the experimental session was kept separate from the completed practice assemblies by placing a marker card on top of the work in the finished work-box at the beginning of the experimental session, and another one at the end to prevent the inclusion of any assemblies completed previously or subsequently.

During the sessions, the experimenter, helped by an assistant, made regular tours around the experimental rooms to answer any queries, or replace any materials. Queries were dealt with only by re-explaining the sequence; never by indicating which particular pile was next to be used. The experimenter also reiterated the conditions to any subject who seemed to be in difficulties, but without staying to supervise any assemblies.

The results were scored in two ways:

1. *Speed Score:* by recording the total number of assemblies completed during the experimental session.
2. *Accuracy Score:* by scoring only those assemblies that had been done in correct sequence. This was done by checking the pencilled numbers on the underside of the card shapes.

Results

All of the numbers listed in the following tables refer to the number of assemblies completed in the one hour experimental sessions.

TABLE I

Normals Speed Score

Conditions	Subject 1	2	3	4	5	6	7	8	Totals	$\bar{X}$
1	118	131	129	119	105	162	169	210	1143	142·875
2	123	133	125	138	112	138	173	178	1120	140·000
3	106	132	140	140	117	133	160	179	1107	138·375
4	110	119	121	137	102	140	146	149	1024	128·000
	457	515	515	534	436	573	648	716	4394	

Analysis of Variance

Correction Term = $4394^2/32$ = 603351·125
Total Sum of Squares = 622576—C.T. = 19224·875
Between Subjects = 618860·0—C.T. = 15508·875
Between Conditions = 604359·25—C.T. = 1008·125

Source	Df.	S.O.S.	M.S.V.	V.R.	Significance
Between Subjects ..	7	15508·875	2215·55	17·181	
Between Conditions	3	1008·125	336·04	2·606	<0·05
Residual	21	2707·875	128·95		
Total	31	19224·875			

Conditions Compared	Mean Difference	t	Significance Level
1 v 2	2·875	0·506	N.S.
1 v 3	4·500	0·793	N.S.
1 v 4	14·875	2·620	<0·05
2 v 3	1·625	0·286	N.S.
2 v 4	12·000	2·113	<0·05
3 v 4	10·375	1·827	N.S.

TABLE II

Normals Accuracy Score

Conditions	Subject 1	2	3	4	5	6	7	8	Totals	$\bar{X}$
1	118	131	129	119	105	162	169	210	1143	142·875
2	118	130	122	135	109	138	164	166	1082	135·250
3	110	129	138	137	114	133	149	171	1072	134·000
4	109	117	112	132	99	135	127	140	971	121·375
	446	507	501	523	427	568	609	687	4268	

Analysis of Variance

Correction Term = $4268^2/32$ = 569244·5
Total Sum of Squares = 587202—C.T. = 17957·5
Between Subjects = 582074·5—C.T. = 12830·0
Between Conditions = 571149·75—C.T. = 1905·25

Source	Df.	S.O.S.	M.S.V.	V.R.	Significance
Between Subjects ..	7	12830·0	1832·86	11·945	
Between Conditions	3	1905·25	635·08	4·139	<0·05
Residual	21	3222·25	153·44		
Total	31	17957·5			

Conditions Compared	Mean Difference	t	Significance Level
1 v 2	7·625	1·231	N.S.
1 v 3	8·875	1·433	N.S.
1 v 4	21·500	3·471	<0·01
2 v 3	1·250	0·202	N.S.
2 v 4	13·875	2·240	<0·05
3 v 4	12·625	2·038	N.S..

TABLE III

Patients Speed Score

CONDITIONS	SUBJECT 1	2	3	4	5	6	7	8	Totals	$\bar{X}$
1	25	43	41	26	85	67	54	32	373	46·625
2	30	41	49	20	72	59	60	29	360	45·000
3	27	37	42	23	76	66	46	24	341	42·625
4	25	37	48	24	80	64	36	22	336	42·000
	107	158	180	93	313	256	196	107	1410	

Analysis of Variance

Correction Term = $1410^2/32$ = 62128·125
Total Sum of Squares = 73338—C.T. = 11209·875
Between Subjects = 72708—C.T. = 10579·875
Between Conditions = 62238·25—C.T. = 110·125

Source	Df.	S.O.S.	M.S.V.	V.R.	Significance
Between Subjects ..	7	10579·875	1511·41	61·04	
Between Conditions	3	110·125	36·71	1·483	N.S.
Residual	21	519·875	24·76		
Total	31	11209·875			

Conditions Compared	Mean Difference	t	Significance Level
1 v 2	1·625	0·653	N.S.
1 v 3	4·000	1·608	N.S.
1 v 4	4·625	1·859	N.S.
2 v 3	2·375	0·955	N.S.
2 v 4	3·000	1·206	N.S.
3 v 4	0·625	0·251	N.S.

TABLE IV

Patients Accuracy Score

CONDITIONS	SUBJECT 1	2	3	4	5	6	7	8	Totals	$\bar{X}$
1	25	43	41	26	85	67	54	32	373	46·625
2	23	37	44	17	33	30	44	22	250	31·250
3	15	30	40	18	26	25	34	16	204	25·500
4	14	16	45	20	23	25	22	12	177	22·125
	77	126	170	81	167	147	154	82	1004	

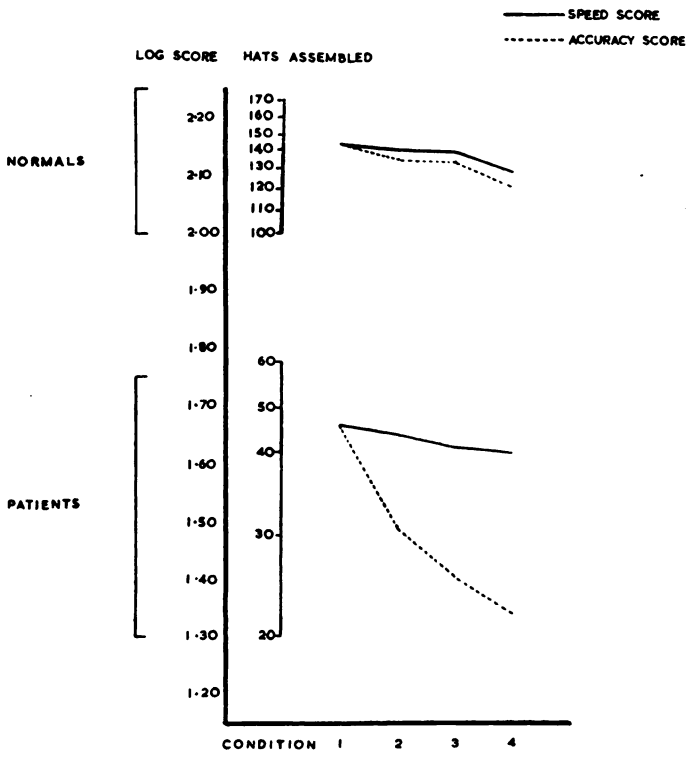
Analysis of Variance

Correction Term = $1004^2/32$ = 31500·5
Total Sum of Squares = 39438—C.T. = 7937·50
Between Subjects = 34301—C.T. = 2800·50
Between Conditions = 34321·75—C.T. = 2821·25

Source	Df.	S.O.S.	M.S.V.	V.R.	Significance
Between Subjects ..	7	2800·50	400·07	3·628	
Between Conditions	3	2821·25	940·42	8·528	<0·01
Residual	21	2315·75	110·27		
Total	31	7937·50			

Conditions Compared	Mean Difference	t	Significance Level
1 v 2	15·375	2·928	<0·01
1 v 3	21·125	4·023	<0·001
1 v 4	24·500	4·666	<0·001
2 v 3	5·750	1·095	N.S.
2 v 4	9·125	1·738	N.S.
3 v 4	3·375	0·643	N.S.

LOG GRAPH OF GROUP MEAN PERFORMANCE SCORED FOR SPEED AND ACCURACY.



The graph is drawn on a log scale with mean scores superimposed. The function is to show the proportional penalties paid by each group as the job elements are increased.

TABLE V

Summary of Results

Normals

Scored for Speed Only		Scored for Accuracy	
Conditions Compared	Signf. of Diff.	Conditions Compared	Signf. of Diff.
1 v 2	N.S.	1 v 2	N.S.
1 v 3	N.S.	1 v 3	N.S.
1 v 4	<0·05	1 v 4	<0·01
2 v 3	N.S.	2 v 3	N.S.
2 v 4	<0·05	2 v 4	<0·05
3 v 4	N.S.	3 v 4	N.S.

Patients

Scored for Speed Only		Scored for Accuracy	
Conditions Compared	Signf. of Diff.	Conditions Compared	Signf. of Diff.
1 v 2	N.S.	1 v 2	<0·01
1 v 3	N.S.	1 v 3	<0·001
1 v 4	N.S.	1 v 4	<0·001
2 v 3	N.S.	2 v 3	N.S.
2 v 4	N.S.	2 v 4	N.S.
3 v 4	N.S.	3 v 4	N.S.

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Discussion of Results and Conclusions

It will be seen from the above tables that the normal subjects, as predicted, showed significant decrements in their performance, both in respect of their speed and their accuracy, with the increase in elements in the sequential cycle. Both these results depended upon the relatively large drop in score for Condition 4, although smaller decrements had occurred from Condition 1 through to Condition 3.

One was surprised to find that the patients did not show a significant drop in speed of output when the task was made more complex by the addition of further elements to the cycle; but less surprised to discover that any addition beyond one resulted in a very substantial drop in accuracy. That the significant differences occurred only between Condition 1 and all the other conditions, reflects the fact that the accuracy of the work depended mainly upon there being no other choices to which they could respond.

The hypothesis was only partly confirmed by the results. Inspection of group mean performances in Tables I and III shows that the normals showed a continuous speed decrement whilst the patients were little affected.

The prediction that the patient group would suffer a greater decrement in accuracy was supported by the results shown in Tables II and IV. The pattern of decrement was different for the two groups: the decrement suffered by the normals was a graded one, from Conditions 1 to 4, though with the greatest drop between Conditions 3 and 4. The patients, by contrast, showed their greatest decrement between Conditions 1 and 2, with smaller progressive decrements to Condition 4. They were less affected by the introduction of further choices, as the introduction of a single choice had immediately reduced their performance to a very low level. This explains the lack of significant difference between their accuracy scores for Conditions 2 v 3, 2 v 4 and 3 v 4.

The results highlight the chronic schizophrenic's inability to deal efficiently with semi-complex psycho-motor tasks. The task studied involved such factors as attention and distractability, and both long and short-term memory functions. In this context long-term memory is held to refer to remembering the instructions for the sequence to be performed, and short-term memory refers to the remembering of which element (pack of cards) has just been used, and then using this information as the cue to the next element to be performed. It is not possible from this study to establish which particular functions are impaired; this will clearly require further systematic studies.

The fact that the schizophrenics showed no significant drop in their speed of working when they were presented with longer sequential operations, though these were accompanied by very significant accuracy decrements, suggests that the schizophrenics, unlike the normal group, were not taking time for consideration and worked steadily on, uncritical of their performance. Such an interpretation would be congruent with what is known about schizophrenia.

The practical conclusion is a simple one; the most suitable tasks for chronic schizophrenics are those in which the choices of reaction are kept to a bare minimum. There are obvious decrements in some aspects of attention and memory, and with this in mind it follows that tasks should be de-skilled as far as possible and the number of elements in any cycle should be kept down; this, of course, implies short cycle times. Short cycle operations have the added advantage of keeping training and re-training times within the capabilities of the staff.

Failure to control these factors will result in:

(1) Increased overheads due to wastage of materials.

(2) The necessity of providing groups of individuals given to the expensive process of repairing incorrectly assembled work.

(3) Reduced earnings by patients.

On the other hand simplifying and de-skilling tasks helps to enable the patient to attain a success situation.

Reference

Wadsworth, W. V., Scott, R. F., and Wells, B. W. P., "Employability of long-stay schizophrenic patients", *Lancet*, 1961, *ii*, 593-5.

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