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Gestalt Perception in Schizophrenia

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Summary. An experiment is described which investigates perceptual processing in schizophrenia. It examines the extent to which subjects employ top-down and bottom-up processing strategies in the interpretation of tachistoscopically presented images. The findings support the hypothesis that schizophrenic subjects do not benefit as controls do from the use of automatic, top-down processing of deeper level stimuli containing semantic information. However, it illustrates that, given sufficient processing time (up to 1000 ms), schizophrenics are able to compensate for this deficit by employing a bottom-up strategy requiring longer processing time. The findings suggest that the specific processing abnormalities in schizophrenia are amenable to detailed measurement, and some suggestions are made for further investigation.

Introduction

Knight (1984) has suggested that schizophrenics show "some deficiency in perceptual schema formation, in automaticity, or in the holistic stage of processing". (p. 120). In a similar vein, it has been argued that subjects are less able to perceive stimuli in a "Gestalt", or holistic fashion but perceive information in a fragmented manner, being aware of the individual details of a stimulus as opposed to the overall pattern, i.e. they "concentrate on detail at the expense of theme" (Cutting, 1985). Cutting (1989) pointed out that as early as the 1950s Conrad (1954, 1958) and Matussek (1987, translation), had explained some of the phenomena of schizophrenia in terms of a breakdown in gestalt perception. Matussek described the lack of gestalt perception as the first of four stages in the formation of a delusional perception. In a very different tradition, Arieti (1976) has also referred to 'awholism' and 'perceptual and apperceptual fragmentation' in schizophrenia.

Contemporary cognitive psychology (e.g. Neisser, 1976) holds that cognitive activity comprises concurrent and interactive "top-down" and "bottom-up" processes. Bottom-up processing refers to stimulus-driven processes directly affected by stimulus input, while top-down or conceptually-driven processing refers to processing affected by what an individual brings to a stimulus situation, e.g. expectations determined by context and past experience, in terms of which the incoming stimulus is interpreted.

It has been proposed that schizophrenics are less able to employ conceptually driven or "top-down" strategies in processing, i.e. at interpreting incoming stimuli (whether from an internal or external source) with reference to a model composed of stored information of past experiences and knowledge in long-term memory (LTM), and must rely on stimulus-driven or "bottom-up" processing, wherein fragments of information from the stimulus are pieced together without reference to an expected or stored model (Hemsley, 1987). In this formulation, he points to "a weakening of the influences of stored memories of regularities of previous input on current perception which is postulated as basic to the schizophrenic condition". (p. 182).

Bemporad (1967) illustrated this in showing schizophrenics to perceive numbers made up of dots in a hazy background less well than normals, and that they tended to see the dots first, then the number (bottom-up processing) in contrast to the normals who saw the numbers first (top-down processing).

Schwarz-Place and Gilmore (1980) and Wells and Leventhal (1984) demonstrated, in a task requiring subjects to report the number of lines in displays where complexity of configurations was varied, that schizophrenics performed significantly better than the controls on the disorderly patterns. This suggested that schizophrenics do not profit from top-down use of organisational factors as do normals, but rely exclusively on a detailed local analysis. Normals appeared to search for some structure in the configuration; this disadvantages them in the random condition.

Further supporting evidence for this "piecemeal" approach to perceptual tasks in schizophrenia is provided by Reich and Cutting (1982). They asked acute schizophrenics, depressives and normals to identify the theme of complex picture scenarios. Schizophrenics were not significantly impaired relative to normals, but they differed from controls in that they began the task by consid-

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ering individual details rather then reaching the conclusion immediately.

The literature thus suggests that the ability to process material in a top-down fashion seems "automatic" in normal subjects. Schizophrenics must compensate for their lack of this ability through employing a "bottom-up" strategy, piecing together the individual elements to construct a whole, and thus taking more time to reach the result.

The present study set out to examine this phenomenon with reference to the levels of processing theory (Craik and Lockheart, 1972) which suggests that semantically encoded material is often more meaningful and may result in more durable and longer-lasting encodings, and give rise to more elaboration than shallow encodings which result from less meaningful information (e.g. non-semantic).

The study required the use of automatic, top-down processing to aid the subject in fast recognition of briefly presented stimuli which ranged from pictures of recognisable objects to random patterns. It was hypothesised that if the target stimuli were processed as meaningful, i.e. at a "deeper" or semantic, level this would aid faster recognition of subsequent related stimuli. Schizophrenic subjects would be predicted to perform poorly compared with controls, as measured by numbers correct and reaction time (RT).

The study follows the suggestion of Knight (1984) who recommended that we seek to expose differential patterns of performance of schizophrenic and control subjects, this being more meaningful than the more difficult to interpret "deficit" of performance in schizophrenics. The present study thus contains precise predictions of differential performance.

Subjects and Methods

Subjects

The subjects were 15 people with a diagnosis of schizophrenia and 15 normal control subjects. They were matched for age, mean age for the schizophrenics being 31.9 years, range 23–55 years, and for the normals 31.5 years, range 23–51 years. The schizophrenics were inpatients at the Bethlem Royal and Maudsley hospitals, and all gave written consent. Criteria for inclusion were: unequivocal diagnosis, no visual auditory or motoric difficulties, no drug or alcohol addiction, no electroconvulsive therapy (ECT) during the 2 weeks prior to testing and no neurological impairment or mental retardation. The Research Diagnostic Criteria (RDC) (Spitzer et al., 1978) were employed to classify the sample as definite and acute schizophrenic. Some of them were suffering from their first psychotic breakdown ($n = 3$) and the others ($n = 12$) were in an acute phase of their otherwise generally chronic disorder. Most were at a stage of partial recovery but were still symptomatic in terms of the RDC criteria.

The schizophrenic sample was rated on the Brief Psychiatric Rating Scale (BPRS) (Overall and Gorham, 1962) by the psychiatrist responsible for their care. This is a symptom scale providing a rapid assessment of symptomatic changes in psychiatric patients.

The normal volunteer control group consisted of a mixed sample of university employees, ranging from clerical and catering staff to post-graduate students. All were naive as to the purpose of the experiment. Exclusion criteria for the control subjects were any previous psychiatric history, uncorrected visual, auditory or motoric deficits, or substance abuse. Both schizophrenic and control subjects were asked to complete the junior vocabulary (A) scale of the Mill Hill Intelligence test, in order to control for any effect of intellectual level on test performance.

Apparatus

A four-field "Electronic Developments" tachistoscope, of which two fields were employed, was connected to a Racal-Dana 9900 Universal Counter Timer and to a response box containing two response buttons labelled 'yes' and 'no'. Onset of the timer was synchronous with the onset of the tachistoscope presentations. Offset was controlled by the subjects pressing either of the response buttons. An identical response box with additional lights to indicate which response had been chosen was situated in view of the experimenter to enable the recording of both response type and RT for each trial. The tachistoscope timer switches were employed to control both stimulus exposure and the inter-stimulus interval (ISI).

Method

The study addressed the question of whether schizophrenic subjects make use of higher-level or 'deeper' cues in a picture-matching task. Three types of target stimuli were employed, differing in the level or extent of information they contained. These were labelled 'semantic', 'structural' and 'random', decreasing respectively in the depth of information available and the opportunity for top-down processing. The stimuli are described fully below and are illustrated in Fig. 1.

A target was presented to the subject where it was briefly viewed and followed by a series of four alternative figures. Each of these was either a portion of the target picture or a distractor stimulus. Subjects made a 'yes/no' forced-choice button-press response to the question 'is this picture a part of the first picture?' Normal subjects were expected to gain an advantage in the semantic condition, as they would have labelled the pictures in a gestalt, top-down fashion, which would then be meaningful structures in memory. Reference to these labels should then aid recognition of picture parts which would be associated with the previous picture, and would be expected to yield more correct responses and faster RTs.

Deeper information is available in the semantic condition and so most RT facilitation would be expected in this condition. The structural condition, or symmetrical pattern, B, containing some limited information about the form of the picture, may have been expected to provide some limited cues to retrieval if perceived in gestalt fashion, and was thus included as the second condition to test the ability to extract and employ information from weaker cues. Subjects were expected to derive no cues from condition C, the random pattern stimuli, and there would be no differences expected between the control and schizophrenic subjects on this condition, the control subjects now being forced to employ a bottom-up strategy.

Schizophrenic subjects were expected to perform in a more uniform fashion across all three conditions, owing to their being less aided than control subjects by the

meaningful information gained in gestalt, top-down processing.

Stimuli

The experimental stimuli were as follows: there were six stimulus-1 pictures for each of the conditions A, Semantic, B, structural and C, random. For each of these target stimuli, there were four corresponding forced-choice stimuli (stimulus 2) comprising two 'correct' pictures (i.e. a fragment of the stimulus 1 picture) and two incorrect distractor pictures. See Fig. 1 for examples of these stimuli. They were constructed as follows:

(A) Semantic condition

Each target stimulus was a simple line drawing in black ink on white card of a high-frequency object, such as an umbrella, a drum, etc. These were easily recognisable by all subjects, as ascertained through questioning at the end of the experiment (Fig. 1a).

(B) Structural condition

The aim of these stimuli was to provide images in which subjects would be able to perceive some order of form which might provide limited cues to aid recall, but to provide no cues to aid semantic labelling, resulting in less depth of processing than in the semantic condition. Symmetrical patterns were thus chosen as the stimuli for this condition. The stimuli needed to be of the same level of complexity as the other conditions and thus the average number of lines and distinct features of the semantic drawings was calculated and the structural pictures were constructed through matching to an approximate number of features. See the example in Fig. 1b.

(C) Random condition

The aim of presenting these stimuli was to provide stimuli without semantic or structural cues, to result in the least depth of processing. The number of visual features was matched with the stimuli of conditions A and B, and the line drawings were composed of random configurations of shapes and lines (Fig. 1c).

All three sets of stimuli were presented to two independent judges, who were able to label only the semantic stimuli as meaningful.

For each of the conditions, each target stimulus was followed by four stimuli. These were again line drawings in black ink on white card. Two of these were "correct", i.e. a portion of the target stimulus just seen, and two were distractor stimuli. They were constructed as follows:

1) Correct stimuli. Each was constructed by choosing two or three major elements from the target stimulus. The two stimuli consisted of different elements from the target and were thus distinctly different from each other.

2) Distractor stimuli. Each was constructed from features similar in form to the target stimulus (e.g. straight lines

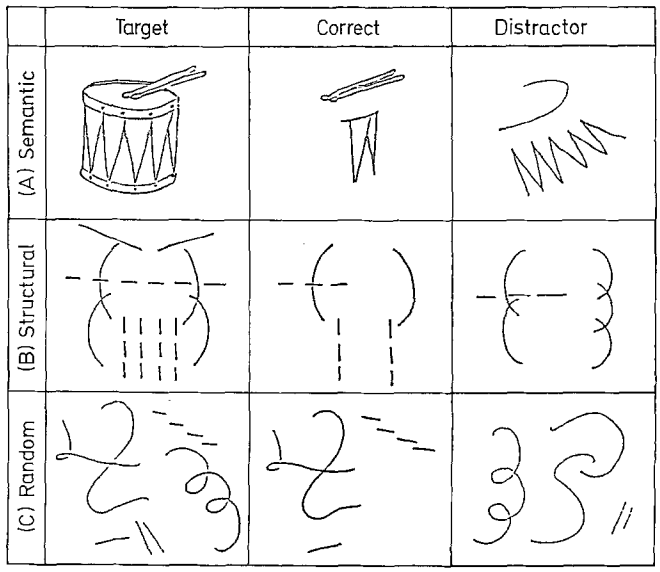

Fig. 1. Example of stimuli

if the target predominantly contained straight lines, curves if the target contained curves, etc.) but not sharing any of the actual features of the target and configured into a different pattern. They were matched with the "correct" stimuli for that target by the number of features. There were six target stimuli for each condition, each followed by four stimulus-2 stimuli; thus there were 72 trials in all.

Procedure

The BPRS was administered to the schizophrenic subjects by the ward psychiatrist several days before the experiment was begun. The control subjects were told that the purpose of the experiment was 'to investigate cognitive processes in picture recognition'.

Subjects were individually seated in front of the tachistoscope and shown the two response buttons labelled 'yes' and 'no' on the table before them. The instructions were as follows:

"You will be presented with two pictures, one following the other. The second picture may be a part of the first picture, or it may be different, and I would like you to study both pictures carefully, and then to indicate as quickly as possible after seeing the second picture whether 'yes', it is a part of the first picture, or 'no', it is not, and to press the corresponding button. By this I mean that the second picture must be an exact representation of a part of the first picture, with each detail correct and shown at the same orientation, i.e. the same way up. Do you have any questions?" Clarification was provided if required.

Subjects were then given 24 practice trials (6 stimulus-1 pictures, each with four stimulus-2 pictures). These stimuli were not included in the experimental test stimuli. The experimental trials followed immediately.

For each trial, stimulus 1 (the reference picture) was presented to subjects for a period of 1000 ms. This was followed by an interstimulus interval of 500 ms. Stimulus 1 was presented four times in succession, each time being

Table 1. Mean RTs for schizophrenics and controls over the three conditions

	Conditions						Differences			Total	
	A	SD	B	SD	C	SD	A–C	A–B	B–C	Mean	SD
Schizophrenic	168	91	151	61	148	63	20	17	3	158	70
Control	113	52	131	56	134	55	−21	−18	−3	126	53
Total	140	78	141	59	141	59	41	35	6		
Differences	55		20		14					30	

followed by a stimulus 2 which was either correct or a distractor. The order of presentation was randomised for each set. The order of presentation of sets, A, B and C (semantic, symmetrical or random pattern) was also randomised over trials. RTs and correctness of response were recorded.

Results

In order to test for the main effects of condition (A, B or C) and group (schizophrenic and controls) on reaction times and number of correct responses, univariate analyses of variance with repeated measures were performed using the MANOVA calculation of the SPSS-PC statistical package.

The ANOVA, employing RTs as the dependent variable, yielded a non-significant finding for group of $F(1,28) = 1.74$, $P = 0.198$ and a non-significant effect of condition (A, B and C) of $F(2,56) = 0.02$, $P = 0.981$. However, there was a highly significant interaction between group and condition of $F(2,56) = 8.05$, $P = 0.001$. These results are clarified in the table of mean RTs, Table 1, and the graph, Fig. 2, below.

These results show that schizophrenics and controls produce similar RTs in the random pattern condition C, with schizophrenics non-significantly slower than controls by a mean of 14 ms. The significant interaction between schizophrenics and controls is produced by the fact that, in the controls, there is increasing facilitation in RT as the level of information in the stimuli becomes greater (B and A conditions respectively). See the example stimuli in Fig. 1. This is most marked for condition A. In the schizophrenic group, there is a trend in the opposite direction, RTs lengthening with deeper levels of information. Differences between the two groups of subjects thus increase from 14 ms in condition C to 20 ms in condition B, to 55 ms in condition A, producing the trends illustrated in Fig. 2. These results support the hypothesis that normal subjects are aided by stimulus information which allows greater depth of processing (semantically interpretable stimuli in condition A, the presence of structural information in the symmetrical pattern in condition B and random, with least memorable information in condition C and they support the hypothesis that schizophrenics would not produce this pattern. The unpredicted finding that schizophrenics show a trend in increasing RT with increasing depth of information will be discussed below.

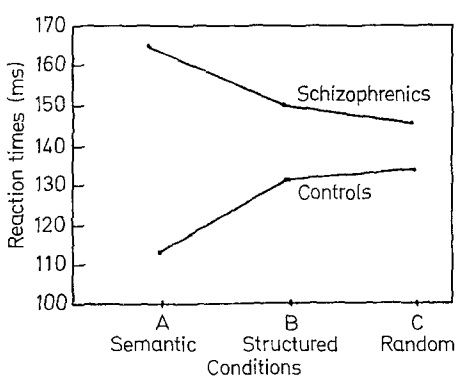

Fig. 2. Graph showing the interaction between schizophrenics and controls over RTs in the three conditions

Planned comparisons were carried out upon the differences in RT calculated over all subjects over A–C, A–B and B–C. The planned comparisons over the difference in RT scores between conditions A and C yielded the greatest difference, with a highly significant result of $F(1,28) = 4.05$, $P < 0.001$. This suggests that a high proportion of the variance was accounted for by RT differences between responses to A (semantic) and to C (random) conditions. The planned comparison over differences between A and B also yields a highly significant result of $t(28) = 3.15$, $P < 0.004$. The planned comparison between conditions B and C yielded a non-significant difference.

Thus, the "structured" stimuli are treated as more similar to random stimuli than semantic stimuli and the main effect of RT difference over the three conditions is due to the RT difference between condition A and the other two conditions.

These findings support the hypothesis that normals are facilitated by stimulus information which allows greater depth of processing (semantically interpretable stimuli in condition A yielding faster RTs than B and C. We also learn that the information contained in condition B was insufficient to aid significant RT improvement over the random stimuli, although there is a non-significant trend to this effect. In the schizophrenic group, B and C produce faster RTs than the semantic condition A, suggesting that extra processing time is required for the semantic condition. This pattern is the reverse of that for the control group and its implications will be more clearly understood in the light of the response correct data, presented below.

In order to examine the effect of group (schizophrenic and controls) and condition (depth A, B and C) on the

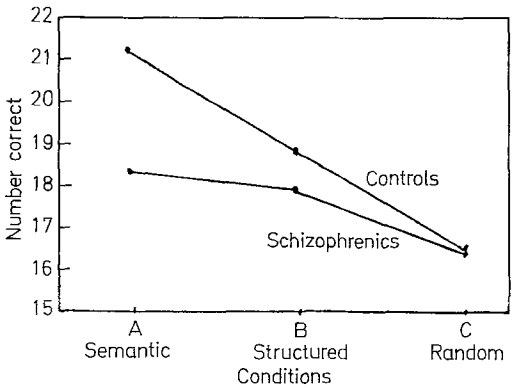

Fig. 3. Graph to illustrate number of correct responses of schizophrenic and control subjects over the three conditions

Table 2. Mean number of correct responses (/24) to conditions A, B and C

	A	SD	B	SD	C	SD
Schizophrenics	18.47	2.99	17.87	4.16	16.00	3.32
Controls	21.40	1.30	18.67	1.99	16.13	2.97
Total	19.93	2.71	18.26	3.23	16.06	3.09
Differences	2.93		0.80		0.13	

number of correct responses, a univariate ANOVA for repeated measures was carried out with the number of correct responses as the dependent variable.

Conditions (depth) was highly significant, $F(2, 56) = 14.18$, $P = 0.0001$, and this is illustrated in the trend (shown for both groups of subjects) showing increasing numbers of correct responses for the conditions containing greater levels of depth information. It will be noted that these changes are more marked for the control subjects, who appear to be aided most by the depth of information, as differences between schizophrenics and controls increase in conditions with the opportunity they afford for deeper levels of processing (conditions A and B) while condition C forces controls to process at a non-semantic and unstructured level, which has minimised the group differences.

However, this is merely a trend, as the interaction between group and depth was non-significant. $F(2, 56) = 1.01$, $P = 0.143$. The effect of group was non-significant ($F(1, 28) = 3.76$, $P = 0.063$), and this contributes to the explanation of the trend illustrated in Fig. 3 and the table of mean number of correct responses (Table 2). We must therefore conclude that, contrary to expectations, both groups benefit significantly from stimuli with greater depth of semantic information when the number of responses correct is considered.

Taking this together with the RT data, we note that normals produce RT facilitation with greater depth of information, but for schizophrenics RT inhibition occurs with increasing depth of information (i.e. from conditions C to B to A). Thus, schizophrenics' improvement in responses correct appears to be at the expense of speed of response, resulting in a possible picture of speed-error trade off. This is an interesting and unexpected finding which will be discussed in some detail below.

Discussion

The present study supports the hypothesis that normal subjects are facilitated in the processing of stimuli which allow for deeper levels of processing in a top-down fashion. It differs from expectations in that schizophrenic subjects also benefit in terms of numbers of correct responses when deeper levels of information are available. This benefit is at the expense of longer RT to respond. This unpredicted finding might be explained in the following way.

The studies of Bemporad (1967), Schwarz-Place and Gilmore (1980) and Reich and Cutting (1982) discussed above have illustrated how schizophrenics do not automatically process stimuli top-down but take time to construct the image from individual components when appropriate to the task requirements. That is, they are seen to employ a bottom-up strategy to enable them to address the question at hand.

It follows that they might equally adopt a bottom-up strategy in the present experiment, if considered appropriate to task requirements, which would allow them to construct a whole image of target stimulus 1. This would need to take place within the 1000 ms exposure time of stimulus 1. Use of non-automatic, bottom-up strategy would predict the need for longer processing time to construct the icon and this would result accordingly in a shorter storage period and rehearsal time of the icon before the onset of stimulus 2.

The next part of the task requires a matching of stimulus 2 to the retrieved memory of stimulus 1. Stimulus 1 will be a weaker memory trace, due to the shorter rehearsal time. This will render the matching of stimulus 2 to stimulus 1 a more difficult process and may result in a longer response RT. Thus, the schizophrenic group will produce correct responses, as do the controls, but may arrive there via a less automatic and more painstaking route.

This difference between schizophrenics and controls is smaller in the B and C conditions, because controls are not able to employ top-down strategies to interpret these stimuli, and are forced to go through the bottom-up process and matching, thus losing their RT advantage over schizophrenics.

The schizophrenic subjects showed the same pattern of correct responses, as did the controls, i.e. significantly more correct in the semantic condition than the structural and random conditions. This suggests that the schizophrenics were able to compensate for their lack of top-down processing by the bottom-up method and that this proved to be powerful enough to allow them to benefit from attaching a meaningful, semantic label to the stimuli. The matching task of stimulus 2 to stimulus 1 was then able to be performed in the same way as for controls.

This is consistent with the explanation of Knight et al. (1985) of their study of schizophrenic subjects' interpre-

tation of backward masking stimuli of different levels of complexity. In their meaningless "pattern mask" condition, they hypothesised of their schizophrenic subjects that "the less efficient perceptual organisation of poor premorbid subjects forces them to allocate additional processing to the pattern mask, thereby causing the mask to interfere as if it had meaningful content". That is, subjects allocated effort to building a bottom-up image of the mask stimulus in their search for a meaningful interpretation of the fragmented data. The difference in the present study is that subjects' less automatic, bottom-up search for meaning was helpful to their overall task performance, constituting a compensatory mechanism, and thus an appropriate response, resulting in a net gain in that semantic meaning is achieved and aids memory for the matching task. It would be interesting to explore further the conditions in which this bottom-up, effortful process will be brought into play.

In an attempt to exhaust all the possible interpretations of these data, a number of alternative explanations of these findings were also considered, and it will be interesting to discuss them briefly here.

One alternative or complementary explanation for the increase in RT for schizophrenics in the semantic condition might be that schizophrenic subjects were confused or distracted by the additional semantic information in condition A, thus requiring extra processing time; however, this is less likely, because they also produce more responses correct in this condition, and therefore increased interference in this condition is unlikely.

The present study thus leads to the conclusion that schizophrenic subjects are able to construct a bottom-up image within 1000 ms, which allows them to compensate for the lack of top-down processing and to benefit from use of the semantic cues in stimulus 1. They are then able to appropriately employ this information in a picture-matching discrimination task.

A further interpretation which has been suggested in opposition to this explanation is that it might be argued that the schizophrenic subjects' slower RTs for the semantic information were not due to failure of automatic, gestalt-like semantic processing, but rather to the opposite, too strong a reliance on gestalt-like semantic processing in condition A, causing subsequent difficulties in overcoming the impact of semantic meaning and in decomposing it into its non-meaningful details, which could be held to be required at the matching stage of the task. Although an interesting idea, there are a number of problems with this candidate hypothesis that should be addressed.

1). It is debatable whether the 'decomposition' of the image into constituent parts, required by the matching task, actually renders the constituent parts 'non-meaningful'. It would seem more likely that the semantic condition for both schizophrenics and controls is facilitated by the very fact that the component stimuli in stimulus 2 are interpreted in terms of the semantic qualities of the target stimulus 1 (e.g. 'part of an umbrella handle', as opposed to a meaningless line), thus taking on meaning consistent with prior context, which acts to facilitate recognition. This is consistent with the levels of processing theory (Craik and Lockheart, 1972).

2). If there were a problem with decomposition, we would expect a poorer overall performance in the semantic condition than in the conditions where the decomposition is already performed, i.e. the random and structural conditions. In fact, the opposite trend was discovered, with significantly more correct responses in the semantic than the random condition, mirroring the performance of the control subjects and illustrating enhanced performance due to the meaningful content of the information.

3). In view of the fact that performance trends in numbers correct were identical for both schizophrenic and control subjects, it would seem most parsimonious to hold that, for the interpretation of the stimulus 2 components in the matching task, both groups were benefitting in the same way and via the same cognitive mechanism from the presence of semantic meaning. It would therefore be unreasonable to hold that the schizophrenics needed to decompose the information into meaningless stimuli whereas controls would not and that they instead employ different mechanisms.

4). Finally, the literature cited above [e.g. Schwartz-Place and Gilmore, (1980), Hemsley, (1987)] supports more closely the view that schizophrenics' deficits are more due to a failure to integrate fragments of information in a gestalt fashion than the view that they have a difficulty with "disintegrating" it. This view is consistent with the present data which suggest that the schizophrenics are, in fact, spending longer on the difficult task of integration before they can benefit from the greater depth of information in the semantic condition.

One further alternative explanation not completely excluded by these data might be that schizophrenics may be using top-down processing but are taking longer to do so than normals. This would require a new model to explain the longer RT for the semantic condition. If the model were that semantic processing required longer time, owing to the additional effort that might be required to process more complicated material or to interference from richer material, we would then need to explain how schizophrenics discriminate when to employ top-down strategies and when it would be inappropriate, as with the random figures (condition C). Such an explanation would be unparsimonious compared with the bottom-up hypothesis discussed above. Furthermore, this as yet receives no support from other theories and is therefore a weaker candidate.

It is interesting to speculate whether schizophrenic subjects regularly employ the strategy of attempting to construct whole images, (as whole images would normally be beneficial in making sense of the world), but that, in the absence of the automatic top-down process, they must construct them via a bottom-up process, thus taking longer. This might contribute to the common finding of schizophrenics being generally slower at cognitive tasks. It would also help to explain the ease with which schizophrenic subjects are able to employ this strategy. Further experimental investigation will be necessary to determine the relative validity of these tentative explanations.

Conclusion

The study offers some support for the growing body of literature which suggests that schizophrenics suffer from a number of cognitive abnormalities which preclude full use of top-down processing strategies in the interpretation of incoming information (e.g. Hemsley, 1987).

In addition to confirming the hypothesis, the study produced additional unexpected findings. Bottom-up processing appears to be employed by schizophrenic subjects only where most appropriate for the task at hand (in the semantic level condition as evidenced by significantly more correct responses, and longer RTs, suggesting an effortful process). Thus, it is conceivable that subjects are able to discern when it is appropriate to employ the bottom-up strategy. It would be important to explore these possibilities further in terms of response to different task demands.

It is an interesting finding that despite the limitations on top-down, automatic, or 'gestalt' perception, schizophrenic subjects are nevertheless able to employ the integrated images, once formed through bottom-up processing, in a complex memory-matching task. The difference in processing between schizophrenics and controls therefore appears to lie at the stage of initial stimulus integration.

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