Why Do Autistic Individuals Show Superior Performance on the Block Design Task?

Amitta Shah* and Uta Frith†

Abstract—Systematic variations of the block design task were given to 20 autistic, 33 normal and 12 mildly retarded subjects. Designs were contrasted which were either “whole” or segmented, rotated or unrotated, and which did or did not contain obliques. Only segmentation, but neither of the spatial orientation factors, revealed a significant group difference. Autistic subjects, regardless of age and ability, performed better than controls when presented with unsegmented designs. This result suggests that they need less of the normally required effort to segment a gestalt, and thus supports the hypothesis of weak central coherence as a characteristic of information processing in autism.

Keywords Autism, IQ profiles, block design, islets of ability

Introduction

One of the many puzzling aspects of autism is the marked dissociation between various cognitive abilities. This is reflected in an uneven level of performance on IQ subtests and appears to occur in autistic people of all ages and ability levels. Research on autism has, for the most part, concentrated on the performance impairments. The phenomenon of islets of ability has been regarded as something of a myth or else as merely an interesting but theoretically unimportant fact. There have been few attempts to elucidate why islets of ability occur so frequently in autism, or, more generally, how good performance is achieved on certain IQ subtests by individuals whose achievement on other subtests is so poor. The explanation of islets as intact areas of functioning is one possibility, but lacks predictive power. To overcome this impasse, Frith (1989) suggested that it might be possible to explain both positive and negative extremes of performance in terms of a single underlying cognitive dysfunction.

We previously reported on the superior ability of autistic adolescents to find embedded figures suggesting that autistic people have a special facility in seeing parts in wholes (Shah & Frith, 1983). A relative superiority has also been shown in autistic children’s ability to learn and to recall random strings of words compared to meaningful

Accepted manuscript received 30 April 1993

*Lifecare NHS Trust, Croydon, Surrey, U.K.
†MRC Cognitive Development Unit, London, U.K.

Requests for reprints to: Uta Frith, MRC Cognitive Development Unit, 4 Taviton Street, London, WC1H 0BT, U.K.
prose, the opposite of normal children's pattern of performance (Hermelin & O'Connor, 1971). Similar results were found when the stimuli were either random or structured strings of words or colours (Frith, 1970a, b). Autistic subjects appear to process unconnected stimuli, outside a meaningful context, with remarkable efficiency. But tasks with this requirement are unusual. They are found more often in the laboratory than in real life. Information processing in real life almost always involves interpretation of individual stimuli in terms of overall context and meaning. Laboratory tasks and tests of academic skills are often difficult for normal children precisely because they do not involve global meaning. The opposite may be the case for autistic individuals, at least those who perform well on certain IQ tests, but fail markedly in real life situations. On the basis of these and other considerations, Frith (1989) proposed that the normal "effort after meaning" which appears to be a manifestation of an autonomous characteristic of human information processing, and which she terms central coherence, is abnormally weak in autism. This hypothesis relates the efficiency in processing unconnected stimuli to an unusual ease with which autistic individuals can resist the normal "pull" of strongly coalescing, i.e. meaningful wholes. One expectation from this postulated facility is a relative preference for processing local as opposed to global features. This idea fits well with superior performance on embedded figures. It might also go some way towards explaining superior performance on other tasks where a local rather than global processing strategy is adaptive, such as rote memory for unconnected stimuli.

The aim of the present study was to test the central coherence hypothesis by investigating strategies underlying performance on the block design task. We chose this task because it is the only subtest of the Wechsler intelligence scales (Wechsler, 1974, 1981) on which autistic subjects as a group have been consistently reported as showing superior performance relative to other subtests (Lockyer & Rutter, 1970; Tymchuk, Simmons & Neafsey, 1977; Ohta, 1987). Recent reports by Bowler (1992) and Venter, Lord and Schopler (1992) again confirmed this fact as a robust phenomenon. Block design superiority may well be an important marker for autism. It is hardly ever reported for non-autistic mentally handicapped persons.

The block design task was invented by Kohs (1923). The task is to construct a design as fast as possible. Kohs considered his test to be an adequate measure of intelligence: "It requires first the breaking up of each design presented into logical units, and second a reasoned manipulation of blocks to reconstruct the original design from separate parts. The results of this activity, it is presumed, yield a fair index of this analytic-synthetic power which we term 'intelligence'". This analysis suggests that the block design task, just like embedded figures, may favour weak central coherence. In both tasks designs with a strong Gestalt quality have to be segmented into constituent parts.

The block design task still constitutes an important part of currently popular batteries for measuring intelligence. For example, it features in the Wechsler intelligence scales for children (Wechsler, 1974), and for adults (Wechsler, 1981), and the British Ability Scales (Elliot, Murray & Pearson, 1979). In these tests the block design task is considered a useful tool for measuring non-verbal abstract conceptualisation and spatial visualisation (Sattler, 1974). Factor-analytic studies of the Wechsler Scales in normal populations showed that the block design subtest contributes substantially to the space-performance or perceptual organisation factor. They also found it to be the best
estimate of "g" among the performance scale subtests, and the fourth-best measure of "g" among the 12 subtests (Maxwell, 1959; Cohen, 1959).

There has also been some interest in the clinical use of the block design test. In the past various authors (Bolles & Goldstein, 1938; Nadel, 1938; Reissenweber, 1953; Shapiro, 1952) have reported that psychiatric patients and patients suffering from certain cerebral lesions perform poorly on the test. Children with Williams syndrome are also substantially impaired on this task, and, interestingly, show difficulties when processing the global features of stimuli in a figure-copying task (Bihrl, Bellugi, Delis & Marks, 1989). It has been claimed that different types of errors on the block design task can be distinguished in adult patients with left-hemisphere and right-hemisphere lesions (Kaplan, 1983). Right-hemisphere-damaged patients in contrast to left-hemisphere patients were found to make errors which broke the overall pattern (Ben-Yishay, Diller, Mandelberg, Gordon & Gerstman, 1971). However, such errors are probably not specific to right hemisphere lesions; they are also shown by normal adults without lesions and by adults with a history of alcoholism (Kramer, Kaplan, Blusewicz & Preston, 1991).

Apart from the suggestion of intact visuo-spatial skills (e.g. Prior, 1979), little has been offered by way of explanation of superior block design performance in autism. Indeed it is difficult to understand why the block design task proves so difficult for people with diverse types of brain damage, yet is apparently easy for autistic people who, we must assume, also have brain abnormalities. A task analysis suggests that at least the following components are amenable to experimental manipulation: segmentation, obliqueness and rotation. These components may influence the adoption of particular strategies and crucially contribute to the superior performance of autistic individuals.

**Segmentation**

Gestalt psychologists (e.g. Wertheimer, 1923; Koffka, 1935) have ascribed great importance to the tendency to perceive *patterns as wholes* rather than as collections of details. However, when details of the whole need to be perceived, for example, the constituent elements in the block design task, this tendency has to be overcome and new structures (mapping onto the individual blocks) have to be mentally imposed. This step appears to require both time and effort, but in varying degrees for different individuals. Children appear to be less efficient at overcoming the tendency to see the whole than adults (Cramaussel, 1924; Witkin, 1950; Ames, Learner, Metraux & Walker, 1953; Meili-Dworetzki, 1956; Hemmendinger, 1953; Ghent, 1956). Furthermore, the ability to segment the gestalt may be particularly susceptible to the effects of brain injury (Teuber, Battersby & Bender, 1951; Teuber & Weinstein, 1956; Cobrinik, 1959).

Gestalt psychologists suggested that the balance between perception of parts and wholes is normally tilted towards wholes, and this has found recent experimental support in the global precedence effect (Navon, 1977, 1981). The bias in favour of wholes can be seen as a manifestation of central coherence. From the hypothesis that autistic individuals exhibit weak central coherence we would expect that for them the balance would be tipped towards parts. They should therefore show a special facility for the mental segmentation component of the block design task.
Obliqueness

The second factor concerns presence or absence of oblique lines, that is, lines which are at a 45° angle relative to the square frame of the whole design. Accurate perception and reproduction of obliqueness is thus an important factor for successful construction which involves correct positioning of diagonals. Diagonals present more difficulty than horizontals and verticals in tasks testing perception and reproduction (Burns, Mandel, Ogilvie & Taylor, 1958; Olson & Hildyard, 1977; Bryant, 1969). Furthermore, mastering the oblique in terms of memory for direction of slant is a relatively late development (Rudel & Teuber, 1963; Olson, 1970). Children with brain-damage have been reported to find obliques especially difficult (Rudel & Teuber, 1971), as do adult psychiatric patients (Shapiro, 1951, 1952, 1954).

Rotation

In addition to orienting the lines within a single block segment, the subject must construct the whole design in the correct spatial orientation relative to the page. One factor which is known to increase the task difficulty of the block design task is a 45° orientation of the whole design, so that a diamond shape is presented. Thus, in the Wechsler Scales all the most difficult designs of the task are presented at 45° rotation. Increased difficulty due to presenting square designs as diamonds has been reported by Shapiro (1952) for brain-damaged and schizophrenic patients.

Manipulating these three task components enables us to test two hypotheses: individual differences in speed and accuracy on the block design test may be due to differences solely in terms of general spatial ability. If superior general spatial ability in autistic subjects accounts for their superior performance, then this should be manifest in better ability to deal with all three components (segmentation, obliqueness and rotation) relative to controls. In contrast, the central coherence hypothesis proposes that the advantage of autistic subjects in the block design task is due specifically to their postulated facility for segmentation. If so, this advantage should be manifest only when designs with unsegmented shapes are presented, regardless of their spatial orientation. To test these alternatives we manipulated the block design task in such a way that we could compare performance on segmented and unsegmented patterns, and independently on oblique and non-oblique, rotated and unrotated patterns. We compared autistic subjects with normally developing children and, in order to evaluate the specificity of the findings to autism, we also compared them to mentally retarded children of the same age and non-verbal IQ.

Method

Subjects

Twenty autistic subjects aged between 16 and 25 years took part in this experiment. They were recruited through schools and training centres run by the National Autistic Society, and had all received a diagnosis of autism based on DSM-III or DSM-IIIR (American Psychiatric Association, 1983, 1987). IQ was tested with the WISC-R or the WAIS except for two subjects who were not able to comprehend task instructions for some of the subtests. These subjects were tested on the Leiter International Performance Scale (Leiter, 1980), Leiter IQ being comparable to the non-verbal IQ of the WISC-R in autistic children.
Block design in autism

(Shah & Holmes, 1985). The non-verbal IQ of the autistic group ranged from 57 to 108. To achieve more homogeneous groups with regard to intellectual ability, the subjects were divided into two groups with a cut-off point of non-verbal IQ of 85 (one standard deviation from the mean on the Wechsler Scales). The High IQ autistic group consisted of autistic people with at least normal non-verbal IQ. The Low IQ autistic group consisted of autistic people with non-verbal IQs at the borderline or upper end of the mildly retarded range. The advantage of using homogeneous groups of autistic people is that each group can be matched to its own control group on stringent criteria. We therefore included three control groups.

The old normal group consisted of 17 children with normal non-verbal IQ, to be compared with the High IQ autistic group. Although they were, on average, a little younger than the autistic subjects, they were all over the age of 15 and likely to have reached an adult level of functioning. These subjects were tested only on the non-verbal scale of the WISC-R or the WAIS. The young normal group consisted of 16 normally intelligent children from a local primary school. They were younger than the low IQ autistic subjects, but their performance (in terms of raw scores) on the WISC-R non-verbal scale was of a similar level.

The learning disabled group consisted of 12 subjects with non-verbal IQ in the mildly retarded or borderline range, comparable to the Low IQ autistic group in terms of both non-verbal IQ and chronological age. Their verbal, and hence full-scale IQ is higher than that of the autistic group. This was inevitable because of the tendency for non-verbal IQ to be much higher than verbal IQ in the autistic group. These subjects were recruited from a College of Further Education which has a special course for school-leavers with mild learning difficulties. The subject characteristics of the five groups are given in Table 1.

<table>
<thead>
<tr>
<th>Table 1. Subject characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Male: female ratio</td>
</tr>
<tr>
<td>n</td>
</tr>
<tr>
<td>Age (years)</td>
</tr>
<tr>
<td>Mean</td>
</tr>
<tr>
<td>s.d.</td>
</tr>
<tr>
<td>Performance IQ</td>
</tr>
<tr>
<td>Mean</td>
</tr>
<tr>
<td>s.d.</td>
</tr>
<tr>
<td>Verbal IQ</td>
</tr>
<tr>
<td>Mean</td>
</tr>
<tr>
<td>s.d.</td>
</tr>
<tr>
<td>Full-scale IQ</td>
</tr>
<tr>
<td>Mean</td>
</tr>
<tr>
<td>s.d.</td>
</tr>
</tbody>
</table>

Design and materials

The basic task modelled the classic Kohs' block paradigm. The subject was shown a two-dimensional pattern on a card and was required to construct a similar pattern always using four blocks. Four identical yellow and black one-inch cube blocks were used, as shown in Fig. 1. These blocks remained the same throughout, while task demands dictated by the type of design used, were varied. Figures 2 and 3 show the complete sets of designs. The designs were grouped into sets such that each of the three component factors, segmentation, obliqueness and rotation, were combined with each other equally. The designs
Fig 1 Example of the experimental block design task. The design is to be constructed from four blocks, each of which has the faces shown.

Fig 2. Complete set of "whole" designs, without obliques, rotated and unrotated.

Fig 3. Complete set of "whole" designs, with obliques, rotated and unrotated.

were drawn individually on two-inch square white cards. There were five designs in each set, making a total of forty. There were three additional designs for demonstration. One example from each of the eight sets of designs used is shown in Fig. 4.

The effect of segmentation was investigated by presenting the same designs as wholes or as four separate blocks (see examples in Fig. 4). The effect of presence or absence of oblique lines relative to the design contour,
was investigated by presenting designs containing at least one oblique compared with designs which contained only horizontal and vertical contours. The effect of orientation of the whole shape was investigated by presenting the same designs as either squares or diamonds, i.e., rotated by 45° relative to the page.

Procedure

The Wechsler tests, including the block design subtest, were given in the prescribed manner. The experimental block design tasks were carried out in a separate session. The subject was given a rectangular piece of cardboard to work on. The card with the design was also placed on a similar piece of cardboard. Both were placed in a fixed position with their edges parallel to the table. First, the subject was shown the four blocks and was told that all four were the same; that is, they all had one side that was yellow, one side that was black, two sides that were divided horizontally into yellow and black and two sides that were divided diagonally into yellow and black. The subject was then given three practice trials, with the request to work as fast as possible.

Each subject was tested on each of the eight sets, i.e., a total of forty designs. After each trial, the examiner picked up the four blocks and dropped them back randomly. The time taken (in seconds) was recorded with a maximum time limit of three minutes. The order of presentation of the sets was the same for all subjects (4, 3, 2, 1, 8, 7, 6, 5) in an attempt to equalize practice effects. The segmented...
sets were all presented in the second half of the testing session after the unsegmented sets. This was done because of the strong possibility that subjects would be alerted to the facilitating effect of strategically segmenting the designs into individual blocks. We were not interested in the ability to improve performance by this sort of insight, but rather in the ability to solve the mental segmentation problem spontaneously. Nevertheless, the fixed order is a weakness in the design which does not enable us to assess higher order interactions or main effects of conditions. For our specific predictions we were, however, only interested in three possible group interactions (group × segmentation; group × oblique, group × rotation) which we hoped would not be subject to systematically different effects of practice or fatigue.

Results

Wechsler block design performance

The block design score was the peak of performance relative to all given subtests for seven of the 10 high IQ autistic subjects (scaled scores 13–19), and for six of the 10 low IQ autistic subjects (scaled scores 9–15). In all cases where block design did not yield the highest score, object assembly did, or else both tests were equal. The single exception was subject TC in the high IQ autistic group. TC had a block design score of 9, which was as low as object assembly and lower than his scores on picture arrangement and coding subtests. He showed significantly poorer performance on block design than any of his peers, who all performed at least 1 sd above the mean. Only one subject in the low IQ autistic group, with a score of 6 on block design, performed below average relative to chronological age. However, his score for object assembly was 10. Figure 5 illustrates the group subtest profiles showing pronounced

![Figure 5: Wechsler performance scale profiles](image-url)

Fig 5 Wechsler performance scale profiles
performance peaks in block design, and secondarily object assembly, for both autistic groups, but not for the controls.

**Experimental block design performance**

The accuracy level, that is, the percentage of designs constructed correctly within the time allocated, was extremely high for all the autistic and normal subjects, ranging from 96% to 100% with a mean of 99%. For the learning disabled subjects, however, the accuracy was significantly lower and ranged from 62% to 100%, with a mean of 90%. Four of the 12 individuals in this group performed below the level of any of the other subjects tested. Accuracy in this group was particularly poor for unsegmented sets.

The following analyses are based on time scores. For each subject, the time taken for the five designs in each set was summed to give a total time (in seconds) for each set. The maximum time allowed for a single design was 180 sec whether or not the design was completed.

Table 2 gives the mean and standard deviations of the log time taken for each set by each group. The results were analysed by means of analysis of variance on logarithmic transformation of the raw data. This transformation was necessary in order to normalise the distribution of scores. The mean scores based on these transformations, comparing the three task factors, are illustrated for all 5 groups in Fig. 6. Inspection suggests that only the segmentation factor was interacting with diagnostic group and this was indeed borne out by the statistical analysis.

<table>
<thead>
<tr>
<th>Set</th>
<th>High IQ autistic Mean</th>
<th>Low IQ autistic Mean</th>
<th>Old normal Mean</th>
<th>Young normal Mean</th>
<th>Mentally handicapped Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.57</td>
<td>1.76</td>
<td>1.68</td>
<td>1.89</td>
<td>2.18</td>
</tr>
<tr>
<td></td>
<td>s.d.</td>
<td>1.15</td>
<td>1.18</td>
<td>1.12</td>
<td>1.36</td>
</tr>
<tr>
<td>2</td>
<td>1.62</td>
<td>1.78</td>
<td>1.70</td>
<td>1.89</td>
<td>2.13</td>
</tr>
<tr>
<td></td>
<td>s.d.</td>
<td>1.13</td>
<td>1.12</td>
<td>1.12</td>
<td>1.34</td>
</tr>
<tr>
<td>3</td>
<td>1.76</td>
<td>1.98</td>
<td>1.85</td>
<td>2.14</td>
<td>2.49</td>
</tr>
<tr>
<td></td>
<td>s.d.</td>
<td>1.24</td>
<td>1.18</td>
<td>1.20</td>
<td>1.32</td>
</tr>
<tr>
<td>4</td>
<td>1.93</td>
<td>2.13</td>
<td>1.95</td>
<td>2.30</td>
<td>2.52</td>
</tr>
<tr>
<td></td>
<td>s.d.</td>
<td>2.8</td>
<td>2.3</td>
<td>2.20</td>
<td>2.40</td>
</tr>
<tr>
<td>5</td>
<td>1.54</td>
<td>1.63</td>
<td>1.50</td>
<td>1.54</td>
<td>1.66</td>
</tr>
<tr>
<td></td>
<td>s.d.</td>
<td>.15</td>
<td>.15</td>
<td>.13</td>
<td>.08</td>
</tr>
<tr>
<td>6</td>
<td>1.56</td>
<td>1.69</td>
<td>1.58</td>
<td>1.70</td>
<td>1.78</td>
</tr>
<tr>
<td></td>
<td>s.d.</td>
<td>.12</td>
<td>.16</td>
<td>.12</td>
<td>.13</td>
</tr>
<tr>
<td>7</td>
<td>1.60</td>
<td>1.74</td>
<td>1.56</td>
<td>1.69</td>
<td>1.80</td>
</tr>
<tr>
<td></td>
<td>s.d.</td>
<td>.15</td>
<td>15</td>
<td>.09</td>
<td>.12</td>
</tr>
<tr>
<td>8</td>
<td>1.66</td>
<td>1.77</td>
<td>1.65</td>
<td>1.82</td>
<td>2.07</td>
</tr>
<tr>
<td></td>
<td>s.d.</td>
<td>.12</td>
<td>.19</td>
<td>.13</td>
<td>.10</td>
</tr>
</tbody>
</table>

An overall ANOVA including all 5 groups was rejected because of inhomogeneity of variance. This was due to outliers in the learning-disabled group where time scores were distorted due to low accuracy levels. The analysis of normal and autistic groups...
using a $2 \times 2 \times 2 \times 2 \times 2$ factorial design (with two group factors, diagnosis and ability, and three task factors, segmentation, obliqueness and rotation) produced a single highly significant interaction of task and group factors, namely diagnosis $\times$ segmentation ($F = 16.61$, df 1,46, $p < .001$). This interaction was confirmed separately in three subsequent analyses comparing high IQ autistics and older normals ($F = 3.69$ df 1,24, $p < .06$), low IQ autistics and younger normals ($F = 12.58$, df 1,23, $p < .001$), and also low IQ autistic and learning disabled subjects ($F = 13.66$, df = 1,19, $p < .001$). The interaction can be readily interpreted by reference to Fig. 6: autistic subjects performed better than their controls only when whole designs are presented, but not when they are pre-segmented. It is possible, but implausible, that this effect reflects differences in how the groups responded to the order of presentation: one would have to assume that the autistic subjects, compared to all the other subjects, were more alert in the first half of the session and showed less facilitation by practice in the second half. The effects of obliqueness and rotation were very similar in all groups; designs which contain obliques and designs which are rotated are more difficult for everybody. Finally, as expected, subjects of lower ability levels performed more poorly on the experimental tasks than those of higher ability, and younger children performed less well than older children.
**Discussion**

When explaining peaks rather than troughs in the performance of autistic individuals, we are in a position to rule out a host of factors which are sometimes claimed to confound the explanation of impairments in autism. We can rule out problems in motivation, pragmatic difficulties, or language problems which might compromise task understanding. This study again provided evidence for superior performance by autistic individuals on the block design subtest of the Wechsler Scales, superior relative to their performance on other subtests and superior relative to mildly retarded individuals of similar age and non-verbal IQ. One other subtest, object assembly, which is a type of jigsaw puzzle, also gave rise to high performance in autistic people. Block design and object assembly tasks are similar in that both require the construction of a whole from parts. While object assembly may be performed in a top-down fashion, guided by the meaningful whole or gestalt, it is also possible to construct the design in a bottom-up way on the basis of local connections (lines, contours) between the puzzle pieces. Indeed, since for the more difficult test items the subject is not told the identity of the final whole shape, a local, bottom-up, strategy may be more adaptive. In this way it is possible to explain the relatively good performance seen in the autistic group on object assembly and block design in terms of the same processing characteristics.

We hypothesised that a facility to segment parts in wholes is a consequence of weak central coherence in autistic individuals. We proposed that this facility alone could explain their performance superiority on the block design task. Using eight variants of the target task we found that subjects with autism, regardless of overall ability, performed significantly better than controls precisely in those conditions where whole designs had to be mentally segmented. This superiority disappeared when the patterns were presented in pre-segmented form. For the control groups the difference between the time taken to construct whole versus pre-segmented designs was considerable. This suggests that the task component of mental segmentation is a major cause of difficulty with the block design test for most subjects. We also found that obliques and rotated shapes contribute to task difficulty. However, segmentation was the only task component which discriminated subjects with autism from controls. They were affected by the two visuo-spatial orientation components to the same extent as their normal and learning-disabled peers. This suggests that the autistic islet of ability on the Wechsler block design subtest cannot be explained in terms of superior general spatial ability. It does not follow, however, that good block design performance in other populations is necessarily to do with segmentation skill rather than general spatial ability. Likewise, poor block design performance will usually indicate an impairment in general spatial processing. This may be the case, for example, in Williams Syndrome and some cases of right-hemisphere damage.

In the high IQ autistic group one subject (TC) did not show a performance peak on either block design or object assembly subtests. We cannot extrapolate from our small numbers as to how frequently this pattern might occur. When this subject was removed the average time difference between segmented and unsegmented patterns for the able autistic group was further reduced (1.61 and 1.54 log time, compared to 1.72 and 1.54). Thus the speed advantage of the autistic group over the normal
controls on unsegmented patterns became even more pronounced. While we are confident that the results of the experimental block design task relate to Wechsler block design performance and accurately reflect group trends, we clearly cannot attribute performance superiority and a facility for mental segmentation to every individual autistic subject.

The present study confirms that there is an islet of ability in block design performance in autism, which appears to be independent of other aspects of IQ. It also strengthens the hypothesis that this islet is a consequence of weak central coherence here manifested in an enhanced ability to segment a gestalt. A useful contrast is provided by the mentally handicapped individuals. For this group, the task component of segmentation was a major source of difficulty even with the simplest designs of the task. Normally strong, rather than abnormally weak, coherence would have to be presumed in this group.

Although the present task and the embedded figures task (Shah & Frith, 1983) differ, one particular cognitive requirement is the same: in both tasks, the tendency to see the whole has to be resisted in favour of seeing the constituent elements. Clearly there can be many different reasons for showing this type of local over global preference. For instance, a difference in cognitive style or in consciously adopted strategy may result in a preference for parts over wholes. Witkin and his colleagues (Witkin et al., 1954; Witkin, Dyk, Faterson, Goodenough & Karp, 1962) have hypothesised that performance on embedded figures reflects the cognitive style of field dependence/independence. Individuals who have particular difficulty in overcoming a preference for wholes, for example, mentally retarded children, show a field-dependent mode of perceiving. They do not readily separate an item from its context (Witkin & Goodenough, 1981). On academic tasks in particular this could be a disadvantage. Here field independence aids performance. Conversely, on many real-life tasks where overall context needs to be taken into account, field independence may have detrimental effects. It remains to be seen whether the hypothesis of weak central coherence in autism relates to cognitive style and context sensitivity in normal individuals. It also remains to be seen just what aspects of the syndrome of autism weak central coherence is capable of explaining. Before a systematic attempt is made, it will be essential that further empirical tests of the hypothesis are carried out. Such tests are currently in progress.

Acknowledgements—The experiments included in this paper were carried out while the first author held a research post at the MRC Social Psychiatry Unit and were reported in her doctoral thesis (Shah, 1988). The authors would like to thank Francesca Happé and Chris Frith for their help in preparing this paper. They are grateful to the staff and pupils of the following establishments for their participation and co-operation in the study: Helen Allison School for Autistic Children and Jubilee Workshop, Gravesend; the Sybil Elgar School for Autistic Children, Ealing; Overcliffe House, Gravesend, South East London College of Further Education, Lewisham, Woodmansterne School, Streatham.

References

Block design in autism


