The Factorial Structure of Schizotypy: Part II. Cognitive Asymmetry, Arousal, Handedness, and Sex

by John H. Gruzelier and Alex Doig

Abstract

We replicate relations between factors of schizotypy and cognitive asymmetry patterns assessed with recognition memory for words versus faces, and with arousal levels assessed with self-report scales. The withdrawn factor or subscales of loneliness and constricted affect were associated as before with a right hemisphere, face advantage asymmetry, as was physical anhedonia in males. Subjects with the opposite asymmetry and those high on the active factor—eccentricity and odd speech—had high self-report activation scores. These relations better characterized males who also had higher scores on the asymmetry-related factors. Females had higher scores on the third unreality factor—unusual perceptions and odd beliefs—which showed inconsistent relations with cognitive asymmetry. Non-right-handedness was associated with both hemisphere asymmetry patterns suggesting that the structural mechanism responsible for non-right-handedness is associated with bidirectional hemispheric functional imbalance.

The results support the importance of patterns of functional asymmetry in underpinning different aspects of schizotypy.


In the companion article (Gruzelier 1996b, Part I, this issue), we presented a replication of a three-factor structure of schizotypy as previously disclosed in the normal population (Gruzelier et al. 1995). Schizotypy was measured with the Schizotypal Personality Questionnaire (SPQ; Raine 1991), and the three-factor structure was largely retained with the inclusion of the physical anhedonia scale (Chapman et al. 1976) and the Eysenck Personality Questionnaire (EPQ; Eysenck and Eysenck 1975) with its scales of extraversion-introversion, neuroticism, and psychoticism.

In the original study (Gruzelier et al. 1995), we reported that the active and withdrawn factors were associated with opposite patterns of cognitive asymmetry, as was found in the active and withdrawn syndromes of schizophrenia (Gruzelier 1991, 1994, 1996a; Gruzelier et al., in preparation). The third, unreality, factor, was inconsistently associated with cognitive asymmetry, as was also the case in schizophrenia. In this article, we report an attempted replication of the cognitive asymmetry results and examine the influence of gender and handedness, which have moderating influences on cognitive asymmetry. We also examined arousal with self-report scales to replicate relations between arousal and both schizotypy syndromes and cognitive asymmetry.

The background for the associations between lateral asymmetry and the active and withdrawn syndromes in schizophrenia is as follows. In brief, we found in a series of reports that two of three syndromes in schizophrenia have a basis in lateral imbalances in cortical activation, while the third is inconsistently associated with hemisphere functions (for recent reviews see Gruzelier 1991).
Patterns of Lateral Asymmetry in Relation to Three-Syndrome Models of Schizophrenia

Evidence in our laboratory for three syndromes in schizophrenia first arose from a comprehensive clinical evaluation of acute, undrugged patients with the Present State Examination (Wing et al. 1974) and the Brief Psychiatric Rating Scale (BPRS; Overall and Gorham 1962). The clinical assessment was coupled with measurement of bilateral skin conductance orienting responses (Gruzelier 1981; Gruzelier and Manchanda 1982). These were hypothesized to be a marker of temporo-limbic amygdaloid and hippocampal influences (see also Mangina and Beuzeron-Mangina 1996). The schizophrenia patients were categorized on the basis of the direction of lateral asymmetry in electrodermal response amplitudes to examine the clinical features of the two asymmetry groups. The two syndromes that were delineated appeared to be related to a behavioral and physiological activation dimension. These syndromes came to be called "active" and "withdrawn" (Gruzelier 1986). The active syndrome with the left>right asymmetry was characterized by affective delusions and positive or labile affect, together with raised levels of cognitive activity, speech, and overactivity on the ward. The withdrawn syndrome with the right>left asymmetry consisted of negative symptom features such as social and emotional withdrawal, blunted affect, poverty of speech, and motor retardation. Both syndromes coexisted with a third syndrome consisting of Schneiderian symptoms of first rank (Schneider 1959), which provided a second positive syndrome. The nature of the two syndromes delineated by patterns of lateral asymmetry could be conceptualized as being at opposite extremes of an arousal dimension involving cognition, mood valence, and behavioral activity.

The constellation of symptoms when regarded from a neuropsychological perspective was interpreted as reflecting an imbalance of activity between the hemispheres (Gruzelier 1984). The left>right asymmetry pattern of the active syndrome was in keeping with the increased verbal and motor activity of the syndrome and its positive mood valence, all of which were consistent with activation of the left hemisphere. The right>left asymmetry pattern of the withdrawn syndrome was in keeping with the opposite state of hemispheric imbalance; poverty of speech is compatible with underactivation of the left hemisphere, while social withdrawal and negative emotional valence has been associated with activation of the right hemisphere.

In general terms, these distinctions were compatible with social interaction and withdrawal models of left versus right hemispheric specialization, respectively (Kinsbourne 1982; Tucker and Williamson 1984; Ehrlichman 1987; Davidson and Tomarken 1989).

Reviews of functional asymmetry and schizophrenia confirmed evidence, in what had become an extensive literature, of opposite patterns of asymmetry. Descriptions of the types of patients in the various studies to a large extent showed consistency between the direction of asymmetry and clinical features similar to, or commonly associated with, the active and withdrawn syndromes (Gruzelier 1983, 1991). Subsequently, the model has been validated; patients were classified with a rating scale devised to measure the syndromes and examined with a range of dependent variables. The scales have included lateralized neuropsychological tests of learning and memory (Gruzelier et al. 1988, in preparation; Gruzelier 1991), which in the case of studies of recognition memory for words and faces were accompanied by topographical electroencephalogram (EEG; Gruzelier et al. 1990, in preparation) and by an EEG spectrum analysis of visually evoked responses to a range of stimulus intensities (Gruzelier et al. 1993). The syndromes have been differentiated with somatosensory-evoked potentials to unimanual stimulation (Andrews et al. 1986, 1987).
Patterns of Lateral Asymmetry and the Schizotypal Personality

In research on the schizotypal personality, there is also evidence for the involvement of lateralized dysfunction. As outlined in a previous review (Gruzelier 1991), the direction of lateral asymmetry in schizotypy has been inconsistent across investigations, as in schizophrenia. The speculation offered was that a syndromal approach to schizotypy may elucidate the inconsistencies. Here, the literature on lateral asymmetry in schizotypy measured in the normal population is briefly considered. In a series of studies, Claridge and collaborators (Broks 1984; Broks et al. 1984; Claridge and Broks 1984; Rawlings and Claridge 1984; Rawlings and Borge 1987) found anomalies in left hemispheric processing. A schizotypal personality scale (STA; Claridge and Broks 1984) was used that has strong associations with the perceptual distortion and magical thinking components of schizotypy (Hewitt and Claridge 1989; Kelley and Coursey 1992).

With a divided visual-field letter identification task, Rawlings and Claridge (1984) found that low schizotypy scorers showed the expected left hemisphere advantage, whereas high scorers showed a right hemisphere advantage. In addition, the performance of high scorers in their superior visual field was better than that of low scorers in their equivalent field. Both features characterized students the day before an examination compared with a less stressful occasion in a closely similar tachistoscopic study (Gruzelier and Phelan 1991). This may imply the existence of anxiety in the high schizotypy scorers with a right hemisphere advantage. In a second experiment, Rawlings and Claridge (1984) used stimuli designed to involve local (left hemisphere) and global (right hemisphere) processing. Following laterality theory, these stimuli should produce right and left visual-field advantages, respectively. This was confirmed in the low schizotypy group, but high scorers showed an anomalous right hemisphere advantage for local processing.

Broks et al. (1984) applied a story comprehension test that Green et al. (1983) had used with schizophrenia patients and with children who have a parent with schizophrenia. Green et al. found that normal subjects had superior binaural and right-ear performance, whereas in schizophrenia patients, there was an impairment in binaural listening when compared with monaural performance. In addition, impairments in monaural performance were asymmetric in patients, with the direction of asymmetry depending on chronicity. In schizotypy, Broks et al. (1984) found that the direction of lateral asymmetry was the one more commonly associated with chronic or negative symptom schizophrenia. Congruent with this result, Rawlings and Borge (1987) subsequently found a shift away from left hemisphere language superiority in a verbal dichotic listening task in the high schizotypy scorers. Together these results may imply unusual right-sided language organization, a result in keeping with Chapman and Chapman's (1987) report of more mixed- and left-handedness in schizotypy.

Claridge et al. (1992) went on to investigate negative priming in a divided-field paradigm. The priming effect was found to be enhanced in the left hemisphere but was absent in the right hemisphere in high schizotypy scorers. This result was interpreted as reflecting an imbalance in excitation–inhibition processes, the right hemisphere being excitatory and the left hemisphere inhibitory.

Two other investigators have reported right hemispheric overactivation through the measurement of conjugate lateral eye movements in high schizotypy scorers, using as measures of psychosis-proneness the Minnesota Multiphasic Personality Inventory (Hathaway and McKinley 1943) and the Eysenck psychoticism scale, respectively (Winterbotham 1979; Raine and Manders 1988). Eye movements were found to be predominantly in a leftward direction—evidence of greater right than left hemispheric activation of the frontal eye fields. Such a leftward asymmetry pattern has not been commonly reported in schizophrenia, and when it has, it has been found in less florid patients as well as in psychotic patients with depression (Sandel and Alcorn 1980).

All of the above results may be interpreted in support of a rightward asymmetry in schizotypy. However, the opposite state of imbalance has also been reported. Raine and Manders (1988) found positive correlations between high schizotypy scores and left hemispheric activation and processing strategies evinced by right-ear auditory thresholds, a verbal dichotic listening task, and verbal haptic sorting strategies. They used a composite schizotypy measure, which could perhaps be conceptualized as having a broad positive symptom character including features having affinities with the active and unreality syndromes described above in schizophrenia. Jutai (1989), who measured schizotypy with several scales developed by Chapman and Chapman and colleagues, reported evidence in keeping with right hemispheric impairments and hence an imbalance that also favored the left hemisphere.
His results were particularly true of the magical ideation subscale (Eckblad and Chapman 1983), whereas physical anhedonia (Chapman et al. 1976) (the other subscale giving significant results) was related to bilateral impairments.

Here, as in our first schizotypy study, we measured hemispheric specialization with a test of recognition memory for words and faces that had been validated on neurological patients with unilateral lesions and had provided evidence of double dissociation between left and right temporoparietal regions (Warrington 1984). A validation study has also been carried out in normal subjects with topographical EEG (Burgess and Gruzelier, in press). Recognition of faces was accompanied by a reduction in alpha potential in the right temporoparietal region, a reduction that correlated with face memory scores. Word recognition was accompanied by an attenuation in alpha in the left parietal region.

We previously found in dextral subjects that those with a greater memory for faces than for words had higher scores on the withdrawn factor than on the active factor. Those with a greater memory for words than for faces had higher scores on the active factor than on the withdrawn factor. When individual subscales of the SPQ were examined, it was the core withdrawn subscales of no close friends and constricted affect that were associated with the face memory advantage. Regarding the active syndrome, odd speech was associated with the word memory advantage. Core features of the schizotypy factors are elaborated in the companion report.

One student in the previous study had been an extreme outlier in terms of his word-face discrepancy score. He approached chance performance on the word memory test. Subsequently, the student had two psychotic episodes. These episodes were characterized by withdrawn and unreality syndromes. In other words, the face-word discrepancy accurately predicted the presenting withdrawn syndrome rather than the active syndrome.

Here, arousal was measured, as before, with the Thayer self-report scales of activation-deactivation (Thayer 1967, 1989). In line with the arousal connotations of the active-withdrawn distinction, higher arousal in the active syndrome, those with the word memory superiority had higher scores on the high activation or tension scale. When subjects falling in the extreme quartiles were examined, those with the memory-for-faces advantage had higher scores on the general deactivation or calmness scale.

To comprehensively examine the influences of gender and handedness, in the present report, the sample of the original investigation was pooled with the present one. These samples were demographically homogeneous. Both gender and handedness are well-known moderators of hemispheric specialization and cognitive asymmetry. Accordingly, they should have a bearing on the putative basis of the active syndrome rather than the active syndrome, those with the memory-for-faces advantage had higher scores on the general deactivation or calmness scale.

Turning to handedness, sinistrals are less likely to manifest clear evidence of hemispheric specialization. This is also the case in dextrals with familial sinistrality. Further, familial sinistrality in sinistrals may be a marker for the genetic basis of sinistrality, as distinct from the role of deleterious perinatal factors that may have triggered a shift away from dextrality (Beaton 1985). Accordingly, non-right-handers may show associations with the inconsistently lateralized unreality factor.

Subjects and Methods

A total of 151 university students were tested—73 men and 78 women with a mean age of 21 years. Schizotypy was measured with the SPQ. This scale is comprised of nine subscales based on the nine features of personality in DSM-III-R schizotypy (American Psychiatric Association 1987). Physical anhedonia was examined (Chapman et al. 1976) to supplement the social anhedonic features of the SPQ withdrawn factor. Arousal was measured with the Thayer activation-deactivation scales, which consist of the subscales of tension (high activation), energy (general activation), calmness (general deactivation), and tiredness (high deactivation). Handedness was examined with the Edinburgh Inventory (Oldfield 1971), on which scores range from -100 to +100. Subjects were subdivided as dextrals (70-100), mixed (0-69), and sinistrals (< 0).

Cognitive asymmetry was measured with the Recognition Memory Test (Warrington 1984), which is in two parts—a test of memory for words and a test of memory for unfamiliar faces. In each memory modality, 50 items were presented for 3 seconds each, and the subjects marked
on a list whether the item was liked or disliked. This was followed by 50 pairs of items, with one of the items in each pair repeated from the previous list, and the subject indicated which item of each pair was in the previous list. A forced-choice procedure was adopted. The items were presented by slide projector. We have found in five investigations with normal subjects that there is approximately a fivescore advantage to memory for words over faces (Gruzelier 1994). Accordingly, words and faces scores were z-transformed. Where subjects were divided on the basis of pattern of cognitive asymmetry, the group assignment was based on differences in sign after subtraction of face from word z-scores.

Students were tested in two groups divided alphabetically by surname. The group A–Le were tested in the afternoon following an in-course examination in another subject. Test anxiety has been shown to reverse lateral asymmetry patterns (Gruzelier and Phelan 1991) and females have been shown to be more anxious than males, aside from social anxiety (Feingold 1994). In a multivariate analysis of variance (MANOVA), there was a significant interaction between sex, half class, and asymmetry such that in females, there was a word advantage in the group without the exam and a face advantage in the exam group. This was consistent with previous results showing that test anxiety enhanced right hemispheric functions (Gruzelier and Phelan 1991); results will be detailed elsewhere (Gruzelier, in preparation b). The result indicates that test anxiety may have compromised word recognition memory advantages in the exam group.

Regarding the Thayer scales, high scores on the energy-tiredness and tension-calmness dimensions were predicted to relate to the active factor, and low scores on these dimensions were predicted to relate to the withdrawn factor. It was predicted that opposite cognitive asymmetry patterns would be associated with active and withdrawn factors—active: words>faces; withdrawn: faces>words.

**Results**

**Cognitive Asymmetry Patterns.** Means and standard deviations (SDs) for subgroups based on word or face advantages are shown in table 1 for each sex. The factors were compared with a MANOVA with asymmetry, sex, and half class as independent variables. There was a significant interaction between asymmetry and factors. This was elucidated further with t test comparisons shown in table 1; one-tailed levels of significance were used where there were a priori predictions.

Regarding the withdrawn factor, males showed the predicted relation between withdrawal and a face memory advantage (p = 0.04). The component scale of no close friends made the strongest contribution (p < 0.0005), followed by constricted affect (p < 0.01). Combining both sexes disclosed a face memory superiority in those with no close friends (p = 0.015). There were no significant effects with the active factor, perhaps because left hemispheric advantages were compromised by test anxiety. Concerning the unreality factor, there was a weak relationship between unusual perceptual experiences and word memory superiority in females (p = 0.07, two-tailed) but not in males where the means were in the opposite direction.

**Arousal Scales.** Two sets of analyses were carried out. First, the memory asymmetry groups were examined for differences on the individual Thayer scales, as in the previous study (females were also subdivided by exam group). There were two significant effects, both in males. As shown in figure 1 those with a word >face advantage had higher energy scores as predicted (t = 1.63, df = 32, p = 0.07). By contrast those with a face>word advantage showed elevations on the tension scale (t = 2.02, df = 33, p < 0.05).

In the second analysis, subjects were subdivided into high and low scorers (approximately the top and bottom 10%) on the basis of frequency distributions of the three schizotypy factors with arousal ratings as dependent variables. Subjects high on the active factor were characterized by high energy scores (t = 2.32, df = 38, p = 0.024) and by a tendency for low tiredness scores (t = 1.68, df = 38, p < 0.10). Results are illustrated in figure 2. These effects were true of both sexes. There were no significant results with the other two factors.

Thus, there was a consistency between the two sets of analyses in that energy-arousal was associated with both the active syndrome and with the word>face cognitive asymmetry pattern, which in turn was associated with the active syndrome. The opposite face>word asymmetry was associated with tension, at least in males, in contradiction to the previous report, where it was the word advantage that was associated with tension (high activation).

**Physical Anhedonia.** Cognitive asymmetry was associated with physical anhedonia in the direction expected in males. Those with a faces memory advantage were the more
Table 1. Relationships between cognitive asymmetry pattern—Face/Word or Word/Face group—and schizotypy in dextral male and female subjects

<table>
<thead>
<tr>
<th>Schizotypy</th>
<th>Cognitive asymmetry</th>
<th>Face/Word (23 F:21 M)</th>
<th>Word/Face (30 F:16 M)</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Withdrawn</td>
<td>F 0.37 (0.93)</td>
<td>0.34 (0.65)</td>
<td>0.12</td>
<td>NS</td>
<td></td>
</tr>
<tr>
<td></td>
<td>M 0.42 (1.41)</td>
<td>-0.35 (0.75)</td>
<td>2.13</td>
<td>0.04</td>
<td></td>
</tr>
<tr>
<td>No close friends</td>
<td>F 1.04 (1.36)</td>
<td>1.03 (1.22)</td>
<td>0.03</td>
<td>NS</td>
<td></td>
</tr>
<tr>
<td></td>
<td>M 2.57 (2.04)</td>
<td>0.69 (0.79)</td>
<td>3.87</td>
<td>0.0005</td>
<td></td>
</tr>
<tr>
<td>Constricted affect</td>
<td>F 0.65 (0.83)</td>
<td>0.83 (0.87)</td>
<td>0.77</td>
<td>NS</td>
<td></td>
</tr>
<tr>
<td></td>
<td>M 1.53 (1.60)</td>
<td>0.81 (0.98)</td>
<td>1.67</td>
<td>0.01</td>
<td></td>
</tr>
<tr>
<td>Social anxiety</td>
<td>F 2.91 (1.95)</td>
<td>3.13 (1.59)</td>
<td>0.44</td>
<td>NS</td>
<td></td>
</tr>
<tr>
<td></td>
<td>M 3.38 (2.36)</td>
<td>3.18 (1.87)</td>
<td>0.28</td>
<td>NS</td>
<td></td>
</tr>
<tr>
<td>Active</td>
<td>F 0.05 (0.90)</td>
<td>0.34 (1.04)</td>
<td>1.07</td>
<td>NS</td>
<td></td>
</tr>
<tr>
<td></td>
<td>M 0.00 (1.03)</td>
<td>0.02 (1.05)</td>
<td>0.07</td>
<td>NS</td>
<td></td>
</tr>
<tr>
<td>Eccentricity</td>
<td>F 0.91 (1.24)</td>
<td>0.97 (1.30)</td>
<td>0.15</td>
<td>NS</td>
<td></td>
</tr>
<tr>
<td></td>
<td>M 1.57 (1.29)</td>
<td>1.38 (1.40)</td>
<td>0.44</td>
<td>NS</td>
<td></td>
</tr>
<tr>
<td>Odd speech</td>
<td>F 2.61 (1.85)</td>
<td>3.07 (1.80)</td>
<td>0.90</td>
<td>NS</td>
<td></td>
</tr>
<tr>
<td></td>
<td>M 2.95 (1.86)</td>
<td>2.94 (1.98)</td>
<td>0.02</td>
<td>NS</td>
<td></td>
</tr>
<tr>
<td>Unusual perceptions</td>
<td>F 0.29 (0.90)</td>
<td>0.12 (0.97)</td>
<td>0.68</td>
<td>NS</td>
<td></td>
</tr>
<tr>
<td></td>
<td>M -0.12 (1.00)</td>
<td>-0.17 (1.09)</td>
<td>0.15</td>
<td>NS</td>
<td></td>
</tr>
<tr>
<td>Odd beliefs</td>
<td>F 1.87 (2.01)</td>
<td>2.63 (2.01)</td>
<td>1.37</td>
<td>NS</td>
<td></td>
</tr>
<tr>
<td></td>
<td>M 2.03 (1.77)</td>
<td>1.38 (1.54)</td>
<td>1.23</td>
<td>NS</td>
<td></td>
</tr>
<tr>
<td>Ideas of reference</td>
<td>F 3.39 (2.37)</td>
<td>3.03 (2.04)</td>
<td>0.58</td>
<td>NS</td>
<td></td>
</tr>
<tr>
<td></td>
<td>M 3.19 (1.89)</td>
<td>3.25 (2.24)</td>
<td>0.09</td>
<td>NS</td>
<td></td>
</tr>
<tr>
<td>Suspicious</td>
<td>F 1.78 (1.78)</td>
<td>2.27 (1.53)</td>
<td>1.04</td>
<td>NS</td>
<td></td>
</tr>
<tr>
<td></td>
<td>M 2.70 (2.26)</td>
<td>1.81 (1.64)</td>
<td>1.48</td>
<td>NS</td>
<td></td>
</tr>
<tr>
<td>Unusual perceptions</td>
<td>F 2.44 (2.11)</td>
<td>3.23 (2.08)</td>
<td>1.84</td>
<td>0.07</td>
<td></td>
</tr>
<tr>
<td></td>
<td>M 2.66 (1.68)</td>
<td>2.19 (2.00)</td>
<td>0.77</td>
<td>NS</td>
<td></td>
</tr>
</tbody>
</table>

Note.—SD = standard deviation; NS = not significant; F = female; M = male.

Combined Sample Analyses

(anhedonic (face>word mean = 48.47; word>face mean = 43.44; t = 1.88; df = 1.29, p < 0.07). There was no effect in females (face>word mean = 50.71; word<face mean = 51.50; t = 0.44).

Handedness and Schizotypy. Significant differences in factor scores and subscales between the three handedness groups (right = 182, mixed = 99, and left = 19) on the basis of analysis of variances (ANOVAs) are shown in figure 3. These concerned the active factor and both its core subscales (eccentricity and odd speech) and the withdrawn subscales of no close friends and constricted affect. In other words, those two factors that were associated with cognitive asymmetry were associated with handedness. Associations were not found in the case of the unreality factor, the inconsistently lateralized factor.

The significant group effects were elucidated further with t-test comparisons between the three handedness subgroups for the schizotypy factors. With the active factor, the group effect was largely due to the higher scores of strong left-handers compared with strong right-handers (active: t = 2.10, df = 206, p < 0.027; eccentricity: t = 1.67, df = 206, p < 0.097; odd speech: t = 1.90, df = 206, p < 0.058). Withdrawn subscale effects are shown in figure 4.
With the withdrawn factor subscale of no close friends, the effects were due to the higher scores of strong left-handers compared with the remainder (sinistrals vs. dextrals/mixed: \( t = 2.13, df = 268, p < 0.034 \)). In the case of constricted affect, sinistrals differed from strong dextrals as well as from mixed-handers (dextrals/sinistrals: \( t = 2.12, df = 206, p < 0.019 \); sinistrals/mixed: \( t = 2.25, df = 98, p < 0.027 \)). Thus, sinistrality and to a lesser extent mixed-handness were associated with higher scores on the two schizotypy factors that relate to cognitive asymmetry.

Familial Sinistrality (FS). We then took into account FS in strong right- and left-handers. In right-handers FS is thought to represent a shift away from strict left hemispheric language dominance. Accordingly, this dextral subgroup may be characterized by the right hemispheric withdrawn factor. In line with this reasoning, strong right-handers with FS (\( n = 57 \)) compared with those without FS (\( n = 125 \)) showed tendencies to higher scores on constricted affect (FS mean = 1.46, without FS mean = 1.06; \( t = 1.73, df = 180, p < 0.09 \)) and physical anhedonia (FS mean = 1.70, without FS mean 1.30; \( t = 1.95, df = 81, p < 0.10 \)). This provided additional support for the association of sinistrality with the withdrawn factor.

In left-handers FS provides evidence of a genetic origin of handedness, and its absence may reflect exogenous causative factors. Left-handers were also divided according to FS: 5 with and 11 without (3 left-handers were unsure). A different factorial association emerged. Those without FS had higher scores on the unreality factor (FS mean = 7.58, without FS mean = 4.71; \( t = 2.24, df = 17, p < 0.04 \)), due largely to the odd beliefs subscale (FS mean = 2.58,
without FS mean = 0.57; $F = 0.46, df = 17, p < 0.003$).

It was also found that memory for words in those sinistrals without FS (mean = 42.46) was lower than in those with FS (mean = 49.00, $t = 2.56, df = 14, p < 0.01$). This contributed to a word advantage in those with FS ($z$ score = 0.22) and a face advantage in those without ($-0.51$).

As left-handers without a genetic association may have experienced subtle pathology early in ontogeny, this evidence of higher unreality factor scores may implicate a subcortical locus for this factor. Early compromise is also suggested by their abnormally low verbal scores, in this instance implicating the left hemisphere.

**Gender, Arousal, and Schizotypy.**

**Withdrawn factor.** Males scored higher than females, particularly on the subscales of no close friends ($t = 3.24, df = 288, p < 0.001$) and constricted affect ($t = 2.82, df = 288, p < 0.003$). In keeping with this association, males had more evidence of physical anhedonia than females ($t = 2.23, df = 138, p < 0.01$).

**Active factor.** Males scored higher on the active factor ($t = 2.41, df = 148, p < 0.01$), which had more to do with its component scale of eccentricity ($t = 3.39, df = 288, p < 0.001$), because only in the second experiment was there a tendency for higher scores on odd speech ($p < 0.08$).

**Unreality factor.** Females were characterized by higher scores on the unreality subscale of odd beliefs ($t = 1.98, df = 288, p < 0.05$) but not on the unreality factor itself. Social anxiety, associated with the unreality factor above, tended to be higher ($t = 1.67, df = 288, p < 0.095$) in females.

**Activation scales.** There were no sex differences on the activation scales that were consistent across the two experiments. Females provided evidence of higher calmness scores than males in the first investigation and evidence of higher tiredness scores in the second ($p < 0.01$), perhaps as a function of the exam. Men scored higher than women on energy ($p < 0.04$) in the second investigation.

In summary, there was some suggestion of males scoring higher on the two syndromes associated with cognitive asymmetry and females scoring higher on unreality, which is the inconsistently lateralized factor. In addition, there was some evidence of higher arousal in men and lower arousal in women.

**Hypothetical Vulnerability, Gender, and Arousal.** When considering how schizotypy may lead to schizophrenia, we reasoned that subjects high on two or more schizotypy factors, and thereby with higher total schizotypy scores, may be more vulnerable. The larger sample gave a better opportunity to examine this. We selected those subjects whose summated scores were in approximately the top 10 percent of the class on two or more schizotypy factors. In view of the longstanding theories on the importance of high or low arousal in the etiology of schizophrenia, we examined them with the arousal scales with separate analyses for each sex.

Significant effects are summarized in table 2. Male subjects in factor pairings involving unreality were charac-
Figure 4. Withdrawn factor and component scale of no close friends and constricted affect scores for strong right-handed, mixed, and strong left-handed groups

HANDEDNESS AND WITHDRAWN SYNDROME

Table 2. Examination with the Thayer arousal scales of subjects having high scores on two or more schizotypy factors

<table>
<thead>
<tr>
<th>Schizotypy factors</th>
<th>Gender</th>
<th>Variable</th>
<th>High</th>
<th>Low</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Withdrawn/unreality</td>
<td>Male</td>
<td>Tension factor</td>
<td>-0.47</td>
<td>-0.05</td>
<td>0.03</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>Tension</td>
<td>17.45</td>
<td>15.30</td>
<td>0.02</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Energy factor</td>
<td>-0.41</td>
<td>-0.04</td>
<td>0.03</td>
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<tr>
<td></td>
<td></td>
<td>Tiredness</td>
<td>17.71</td>
<td>14.92</td>
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<tr>
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<td>Male</td>
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<td>14.54</td>
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</tr>
<tr>
<td></td>
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<td>Tension factor</td>
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<td>0.05</td>
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<tr>
<td>Active/unreality</td>
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<td>Tension</td>
<td>17.25</td>
<td>15.00</td>
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<tr>
<td></td>
<td>Female</td>
<td>Tension</td>
<td>16.47</td>
<td>14.31</td>
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<tr>
<td>Active/withdrawn</td>
<td>Female</td>
<td>Calmness</td>
<td>14.31</td>
<td>16.47</td>
<td>0.01</td>
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<tr>
<td>Active/withdrawn/unreality</td>
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<td>Tension factor</td>
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<td>-0.06</td>
<td>0.03</td>
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<tr>
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<td>Energy factor</td>
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</table>

Note.—Thayer arousal scales (Thayer 1989).
Discussion

Cognitive Asymmetry. For two of the three schizotypy factors—active and withdrawn—there were associations either with different patterns of cognitive asymmetry or of handedness from which asymmetry of hemispheric functions is inferred. Accordingly, some clarification is offered for the inconsistency in directions of cognitive asymmetry reported in previous investigations of schizotypy in the normal population (Winterbotham 1979, unpublished manuscript; Broks et al. 1984; Rawlings and Claridge 1984; Rawlings and Borge 1987; Raine and Manders 1988; Claridge et al. 1992).

The combining of the neuropsychological tests with psychometry, together with considerations of gender and handedness, helped define what may be core features of the schizotypy factors.

Withdrawn factor. In males, as in both sexes in the first investigation (Gruzelier et al. 1995), the withdrawn factor was associated with a superiority for face over word memory, a cognitive pattern representing higher functional activity of the right rather than the left hemisphere. The subscale of no close friends showed strong and consistent associations with the right>left asymmetry pattern in males in both studies, a feature joined here by physical anhedonia. With the subscale constricted affect, both sexes showed the predicted face>word asymmetry pattern. This is noteworthy because, in the original delineation of the hemispheric-imbalance syndromes in schizophrenia patients, blunted affect (the clinical analog of constricted affect) was the best replicated of all clinical features in the association with hemispheric lateralization (Gruzelier 1981).

Active factor. The active factor, which in the first investigation was associated with the opposite functional asymmetry (i.e., word>face memory) found no such relation in either sex. Here the effect may have been to some extent compromised by exam anxiety, especially in females. Predicted relations, however, were found between this cognitive asymmetry and higher energy scores in males in support of the hypothesized raised activity attribute of the active factor. The existence of a relation with energy, but not with the active factor, may indicate that the SPQ does not adequately encompass the arousal features of the active syndrome. Support for this assumption has come from a subsequent investigation of psychosis-proneness with a new inventory (Gruzelier and Richardson 1994). The word>face cognitive asymmetry pattern accompanied an impulsive nonconformity factor, which encompassed activity as well as eccentricity. In that study, the opposite face>word cognitive asymmetry was again related to a negative, social-emotional withdrawal factor. This is discussed in the companion article (Gruzelier and Richardson 1994). The word>face cognitive asymmetry pattern accompanied an impulsive nonconformity factor, which encompassed activity as well as eccentricity. In that study, the opposite face>word cognitive asymmetry was again related to a negative, social-emotional withdrawal factor. This is discussed in the companion article (Gruzelier and Richardson 1994). The word>face cognitive asymmetry pattern accompanied an impulsive nonconformity factor, which encompassed activity as well as eccentricity. In that study, the opposite face>word cognitive asymmetry was again related to a negative, social-emotional withdrawal factor. This is discussed in the companion article (Gruzelier and Richardson 1994).

Sex. Sex has an important bearing on schizophrenia. In schizophrenia there is a substantive body of evidence showing that at a statistical level, males have an earlier onset and poorer prognosis and are more frequently characterized by negative symptoms. Females have a later onset and better prognosis and are more frequently characterized by a positive schizoaffective disorder (Lewine 1981; Goldstein and Link 1988).

In keeping with this, males had higher scores on the withdrawn factor, in particular its central features of no close friends and constricted affect. Males also were more anhedonic. All these features depicted negative symptoms. However, it was not the positive-negative distinction that distinguished males for they also had higher scores on the positive active factor, including both its subscales of eccentricity and odd speech. Thus, the male sex was associated with the two schizotypy factors that relate to cognitive asymmetry but not to the inconsistently lateralized unreality factor.

Females, on the other hand, disclosed an association specific to the unreality factor. Females had higher scores on the component odd beliefs subscale. The association of the female gender with unreality, the inconsistently lateralized factor, and not the two factors associated with hemispheric imbalance may elucidate results in schizophrenia patients obtained with the same recognition memory test. In female patients, there was mostly an absence of the predicted relations with the active syndrome present in males (Gruzelier et al., in preparation).

Sex influenced our attempt to conceptualize the role of arousal in putative vulnerability to schizotypy, indexed by high scores on more than one factor. Males were characterized by the absence of extreme arousal scores with a tendency to lower activation. Women, on the other hand, disclosed both extremes of arousal. Thus, the role of arousal and stress in schizotypy warrants further investigation. Although social and cultural factors undoubtedly play an important role, the fact that women in contrast to men are more susceptible to mood swings by virtue of the menstrual cycle may endorse the potential importance of endocrine influences on schizotypy (Gruzelier 1994).

Handedness. Relations with cognitive asymmetry patterns were also found with handedness. Sinistrality
and/or mixed-handedness, often termed "non-right-handedness" when both categories are combined, has been reported to be higher in those with high scores on schizotypy scales (Chapman and Chapman 1987; Kim et al. 1992). This was supported here, although the delineation of these factors of schizotypy produced a more complex relationship.

It follows from the hemisphere-imbalance syndrome model that non-right-handedness will be associated with the withdrawn factor. This prediction was supported. The withdrawn factor and its core subscales (no close friends and constricted affect) were all higher in strong lefthanders and to some extent in mixed-handers, implying an imbalance toward the right hemisphere in line with the withdrawn asymmetry. Similarly, evidence of sinistrality in the family of strong right-handers, interpreted as evidence among dextrals of a less lateralized brain organization, was associated with constricted affect and physical anhedonia. However, of theoretical importance was the association of non-right-handedness with the active factor as well as with the withdrawn factor. In other words, factors associated with both cognitive asymmetry patterns, rather than the right-left pattern which is the one predominantly associated with non-right-handedness, were associated with the mechanism responsible for symmetry or reversed asymmetry. Accordingly, the structural mechanism underlying non-right-handedness, such as symmetry or reversed asymmetry of temporo-parietal brain regions (Witelson 1991) also has a bearing on functional asymmetries, both leftward and rightward. In the light of this relation we speculate that the structural mechanism responsible for non-right-handedness may be responsible for the dyscontrol in functional asymmetry associated with our hemispheric imbalance model of schizotypic and schizophrenia.

Lateral brain organization in sinistrals is heterogeneous. Although opinion is divided on the exact proportion of sinistrals who have left hemisphere, right hemisphere, or bilateral organization of language, the majority view is that the greater proportion of strong left-handers, in contrast with mixed-handers, have the same brain organization as strong dextrals (Herron 1980). Nongenetic factors such as perinatal trauma may have deleteriously affected the left hemisphere and are responsible for both the reorganization of handedness and relocation of language to the right hemisphere. In keeping with these assumptions, the putative "pathological left-hander" group had a highly significant reduction in memory for words compared with the familial group.

The Unreality Factor and Inconsistent Asymmetry. An inconsistent relation between the unreality factor and cognitive asymmetry was confirmed. In the original sample there was no relation. In a subsequent study using the Oxford-Liverpool Inventory of Feelings and Experiences scale (Mason et al. 1995), there was also no relation between the unusual experiences scale and cognitive asymmetry (Gruzelier and Richardson 1994). Here in the replication study, there was no relation for the sample as a whole between the unreality factor and pattern of asymmetry. Nevertheless, the subscale of unusual perceptual experiences was associated with a left hemisphere advantage in females, whereas odd beliefs showed indirect relations with the right hemisphere. Notably, odd beliefs correlated with physical anhedonia, which itself was associated with a right-hemisphere faces memory advantage. Furthermore, odd beliefs was one of the two features that characterized left-handers without FS (i.e., the putative right hemisphere language subgroup). The other feature was a right-hemisphere faces memory advantage.

Inconsistent associations between unreality features may also be found in the literature. With the STA scale, which correlates positively with the perceptual aberration and magical ideation scales (Chapman et al. 1978; Eckblad and Chapman 1983), Claridge has associated schizotypy with right hemispheric advantages in divided visual-field tasks (Broks 1984; Claridge and Broks 1984; Rawlings and Claridge 1984). However, right hemisphericlike deficits have been reported in association with the magical ideation scale (Jutai 1989). Furthermore, in schizophrenia, when hallucinating patients were contrasted with nonhallucinating patients for asymmetries in auditory thresholds, hallucinators evidenced no overall asymmetry, whereas nonhallucinators showed a right-ear advantage (Mathew et al. 1993). Taken together, none of this evidence suggests any consistent relation between the unreality factor or syndrome and cerebral asymmetry.

In so far as the unreality factor is inconsistently lateralized, then mixed or "inconsistent" handedness may be found associated with unreality. This prediction was not supported in the present data, though it was in our subsequent investigation of the following year's study intake (Gruzelier and Richardson 1994). Even so, in the present report, left-handers without FS (the putative "pathological" group) did score significantly higher on the unreality subscale of odd
beliefs. This is theoretically consistent first with the notion that pathology, if it occurs at an early stage of development, will involve subcortical structures, and second with our hypothesis that the unreality factor involves early stages of processing (Richardson and Gruzelier 1994).

Conclusion

The importance of cognitive asymmetry for the expression of schizotypy and schizophrenia, and by implication the pathogenesis of schizophrenia, is endorsed by the present and previous findings (Gruzelier et al. 1995), which were largely replicated here. These took the form of associations between the word > face memory asymmetry and the active syndrome in schizophrenia and to some extent the active factor in schizotypy. Conversely, they also took the form of associations between the face > word asymmetry and the withdrawn syndrome in schizophrenia and the withdrawn factor in schizotypy.

In males, who are thought to have a more lateralized brain structure, the cognitive asymmetry relations were more marked and the asymmetry-related schizotypy factors scores were higher than in females who have a less lateralized brain. Consistent with this position, females scored higher on the unreality, inconsistently lateralized factor. In both sexes non-consistent-right-handedness, which may be associated with an abnormal brain symmetry or reversed structural asymmetry, was associated with higher scores on both asymmetry-related schizotypy factors. From this evidence, we infer that abnormal structural asymmetry may underpin the functional mechanism responsible for extremes and instability of hemispheric functional imbalance. The evidence from the previous investigation (Gruzelier et al. 1995), in which a student who was an extreme outlier in terms of a face-word discrepancy and who subsequently presented in a first and second psychotic episode with a withdrawn syndrome, supports the importance of extreme cognitive asymmetry as a vulnerability marker.

The relations between personality factors and the expression of the schizophrenia syndrome support the theoretical view that the predisposition to psychosis is at the level of basic personality organization (Eysenck 1967; Claridge 1985). The approach taken here of viewing the structure of schizotypy from the perspective of schizophrenia offers a fresh approach in contemporary research directed toward elucidating the neurophysiological underpinnings of psychosis-proneness.

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**The Authors**

John H. Gruzelier, M.A., Ph.D., is a Professor of Psychology, Department of Psychology, and Alex Doig, M.B., B.S., B.Sc., is a Medical Student, Charing Cross and Westminster Medical School, London, England.