Personality traits of the relatives of autistic probands

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ABSTRACT

Background. There is substantial evidence that the genetic liability to autism confers a risk for a range of more subtle social and communication impairments, as well as stereotyped and repetitive behaviours. Recent research suggests that increased expression of particular personality traits may be a manifestation of the liability to autism.

Methods. To investigate this we examined the personality traits of the adult relatives of 99 autistic and 36 Down’s syndrome probands, using the informant version of the Modified Personality Assessment Schedule.

Results. There was significantly increased expression of the traits anxious, impulsive, aloof, shy, over-sensitive, irritable and eccentric among the autism relatives with evidence of different profiles for male and female relatives and for parents and adult children. Factor analysis revealed three broad groups of traits, two of which (‘withdrawn’ and ‘difficult’) appeared to reflect impairments in social functioning and a third group of anxiety related traits (‘tense’). Each of these factors differed in their pattern of associations with the factor we termed ‘withdrawn’ showing a similar pattern of association to that found for other autism related conditions. The ‘tense’ factor appeared in part to be related to the burden of caring for an autistic child.

Conclusions. This study confirms the finding that particular personality traits may aggregate in the family members of autistic individuals and furthermore that some of these traits may be a manifestation of the liability to autism.

INTRODUCTION

Autism is a behavioural syndrome characterized by qualitative impairments in communication and reciprocal social interaction, along with stereotyped repetitive patterns of behaviour (World Health Organization, 1994). Identifiable, probably causal, medical disorders are found in some 10% of affected individuals (Bailey et al. 1996). Recent twin and family data (reviewed by Bailey et al. 1996) have shown that the remaining idiopathic cases are strongly genetically influenced and that the liability for autism also confers a risk among the relatives for other pervasive developmental disorders, as well as for more subtle combinations of social and communication impairments or repetitive and stereotyped interests. The ‘broader autism phenotype’ is the phrase used to describe this range of disorders (Fombonne et al. 1997).

There is also evidence that the relatives of autistic individuals may be at increased risk for affective disorders, particularly depression (De-long & Dwyer, 1988; Piven et al. 1991; Smalley et al. 1995). However, Bolton et al. (1994, 1998) found that the proband and relative characteristics that predicted familial loading of affective disorders differed from those associated with familiality of the broader autism phenotype which suggests that different mechanisms may be involved.

It is possible that expression of the liability to autism may be reflected in particular personality traits. The early clinical reports of Kanner (1949) and others, describing the parents of some autistic children as reserved, single-minded
perfectionists, appeared to be confirmed by a number of studies (reviewed by Cantwell et al. 1976). However, many of these studies suffered major methodological flaws such as small sample sizes, the inconsistent use of diagnostic groupings, a lack of objective measures and the use of inappropriate control groups (reviewed by Cantwell et al. 1976).

The next phase of studies which attempted to overcome these methodological limitations found little evidence that the relatives of autistic individuals showed distinctive personality attributes (Kolvin et al. 1971; Cox et al. 1975; McAdoo & de Myer, 1976; Cantwell et al. 1979). However, these studies tended to rely on personality questionnaires designed to measure broad dimensions of personality structure, which may not be adequate to assess the personality characteristics reported by clinicians to occur more frequently in the parents of autistic children. For example, Cantwell et al. (1979) compared the parents of autistic and dysphasic children using the Eysenck Personality Inventory (EPI) and did not find any significant group differences despite their clinical observations that odd personalities occurred more commonly in the autism group.

More recent studies of the personality traits of the relatives of autistic individuals lend support to the observations of Kanner and others. Wolff et al. (1988) interviewed the parents of autistic children and non-autistic mentally retarded controls blind to proband diagnosis. Within the autism group, 16 out of 35 parents were judged to have ‘schizoid’ personality traits compared with 0 out of 39 in the control group. Piven et al. (1994) in a companion study to this study found that compared with controls the parents of autistic individuals demonstrated significantly higher rates of the traits aloof, tactless and undemonstrative. In a separate study of parents in multiple incidence autism families Piven et al. (1997a,b) found higher rates of expression of the traits aloof, hypersensitive, anxious and rigid, in addition to social and communication deficits.

This study was designed to investigate: (1) whether or not the relatives of autistic probands would have increased expression of personality traits that might be conceptualized as milder expression of some aspects of autism; (2) to examine the factors that might be associated with familial loading of such personality traits (e.g. the characteristics of relatives and probands); and, (3) to assess the relationship between personality traits and psychiatric disorders in the relatives.

In order to control for the possible effects upon the relatives of raising a handicapped child, we compared the adult first-degree relatives of autistic and Down’s syndrome probands. Unlike previous studies, we included both parents and adult siblings as one might predict that parents may be less likely to show impairments in social functioning than their adult children (as almost by definition they have been able to form relationships and raise children) and may also experience a greater burden of care, both of which could influence the personality profiles obtained.

METHOD

Sample selection

The sample selection and assessment procedures are described in detail elsewhere (Bolton et al. 1994, 1998). Briefly, 99 randomly selected Maudsley clinic probands with idiopathic autism, aged between 5 and 36 years, and stratified by sex and IQ were group matched using the multivariate distribution of age, sex, social class, birth order and maternal age, with 36 Down’s syndrome probands drawn from a large community sample.

There were 498 first-degree relatives in these families. Including only subjects over 18 left 416 relatives (195 parents and 97 siblings of autistic probands, and 72 parents and 52 siblings of the Down’s syndrome probands).

Proband assessments

Standardized diagnoses of autism were made according to ICD-10 criteria, using the Autism Diagnostic Interview (ADI) and the Autism Diagnostic Observation Schedule (ADOS) (Le Couteur et al. 1989; Lord et al. 1989). The ADI data were used to determine the symptom severity of autism (by totalling the number of ADI Algorithm symptoms endorsed) and also to construct a measure of behavioural and developmental disturbances (the Behavioural Abnormalities Score – BAS) that previous research had suggested were stressful to parents (Bebko et al. 1987; Konstantareas & Homatidis,
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1989; Freeman et al. 1991) and which, on clinical grounds, we predicted should index the burden of raising a child with autism (Bolton et al. 1998). The score was made up from a number of taxing maladaptive behaviours and developmental abnormalities that were considered to be the most worrying and demanding for parents. They included aggression, self-injury, hyperactivity, intrusive and disruptive rituals, embarrassing socially inappropriate behaviour, incontinence, epilepsy and marked tics and stereotypies. The BAS and the symptom severity score correlated 0.36 (P < 0.001). The BAS was created to allow us to indirectly investigate the relationship between burden of care and the expression of particular personality traits.

Obstetric histories were obtained from mothers, using a specially devised investigator-based Obstetric Enquiry Schedule (OES) (Bolton et al. 1997). Details from the OES were then used to construct an optimality score, that indexed the degree of obstetric adversity. This score has been shown to correlate well with data from contemporaneous birth records (Bolton et al. 1997). The optimality score correlated 0.21 with the symptom severity score (P = 0.04) and 0.26 with the BAS (P = 0.01). The optimality score has previously been found to predict familial loading of the broader autism phenotype (Bolton et al. 1994, 1997) and obstetric complications to be a reflection of the genetic liability for autism.

Apart from confirming the diagnosis of trisomy 21 and the absence of autism, no other assessment of the Down’s syndrome probands was conducted.

Assessment of the relatives

The Modified Personality Assessment Schedule

The personality interview, the Modified Personality Assessment Schedule (M-PAS), used in this study was adapted from the Personality Assessment Schedule (PAS) (Tyrer & Alexander, 1979; Tyrer et al. 1979; Tyrer, 1988; Hill et al. 2000), a semi-structured interview that has been shown to have adequate inter-rater and test-retest reliability (Tyrer et al. 1979, 1983). Whereas the PAS was designed to formalize the assessment of personality disorder, the M-PAS was constructed as a measure of both normal (i.e. no associated impairment) and abnormal (i.e. associated with impairment) dimensions of personality. The M-PAS consists of 18 personality traits, 14 derived from the PAS, two from initial modifications of the PAS (supernitious and self-conscious) and two (undemonstrative and unresponsive) developed specifically for this study based on hypotheses regarding the expression of genetic liability to autism in relatives. Ten items from the PAS were deleted from the M-PAS after pilot work because of low reliability, or because they were rarely endorsed in autism families. Informant and subject versions of the M-PAS were developed.

For each trait, a set of mandatory and optional follow-up questions was used to elicit information about expression of the traits. During the interview, informants were asked to give specific examples illustrating the presence or absence of these traits. Information had previously been collected on the subject’s psychiatric history and informants were asked to disregard periods when the subject may have been experiencing an episode of psychiatric disorder but instead to give examples of behaviour most indicative of their general style of functioning. Interviewer ratings were based on behavioural examples given by the informant and were not determined on the basis of observations or interpretations made by the interviewer.

Each trait was rated on two scales, a 0–4 scale known as the ‘characteristic scale’ to indicate the degree to which a particular trait was present and a 0–4 scale known as the ‘impairment scale’ to indicate the degree of associated impairment.

Procedure

Following training, each adult relative (i.e. those aged 18 or over) was assessed by one of four interviewers using an informant version of the M-PAS. In the case of the parents, the informant was usually a spouse and in the case of the siblings a spouse or parent. Due to the degree of involvement required of families in the overall family study, interviewer blindness could not be maintained.

Other measures

Parents in both groups were interviewed using a reliable standardized investigator based instrument, the Family History Interview (FHI). This was developed to document the presence of any developmental disorders of speech, reading and
spelling, psychiatric disorders and abnormalities in socio-emotional development (Bolton et al. 1994). Following the interview, a case vignette was completed describing all possible abnormalities in development and social functioning. These vignettes were rated blindly by four researchers using a set of pre-determined codings designed to identify relatively severe deficits or disorders and consensus codings were obtained.

The measures from the FHI were combined to produce a working definition of the broader autism phenotype. Relatives were categorized as exhibiting the ‘Broad Phenotype’ if they demonstrated deficits in one of three areas usually implicated in autism (Bolton et al 1994; Fombonne et al. 1997).

Each relative was also assessed using the Maudsley version of the Schedule for Affective Disorders and Schizophrenia – Lifetime Version, to assess lifetime prevalence of psychopathology. The Maudsley SADS-L is a semi-structured investigation version of the original SADS-L (Spitzer & Endicott, 1978; Harrington et al. 1988). Except for eating disorders, where DSM-III criteria were employed, psychiatric diagnoses were made using Research Diagnostic Criteria (Spitzer & Robins, 1978) with revisions as described by Mazure & Gershon (1979). The findings on psychiatric disorders in relatives are presented in Bolton et al. (1998).

Statistical methods
Weighted kappa statistics and their standard errors were calculated using a program written in GLIM (Baker, 1985) by A.P. Factor analysis was undertaken using SPSS-PC (Norusis, 1990). Factor scores were log transformed to approximate normality prior to subsequent analysis. All regression analyses were undertaken in STATA (StataCorp, 1997) making use of robust standard errors and test statistics computed by the method first proposed by Huber (1967). This approach allowed account to be taken of possible correlation in the ratings of members of the same family.

RESULTS
Sample characteristics
M-PAS assessments were obtained for 72.3% (214) of eligible autism relatives, 69.4% (86) of eligible relatives in the Down’s syndrome control group and 73.4% of parents and 69.4% of eligible siblings were assessed. Of eligible males, 68.8% were assessed and 74.1% of females. The mean age of responders was 41.8 years and non-responders was 41.6 years. None of these differences in response rate was significant and thus the sample attained appeared to be representative of the original study sample with respect to group membership, sex and type of relative (i.e. whether parent or sibling).

As information from the Family History Interview (FHI) was available on all relatives it was possible to examine whether there was any bias in ascertainment related to the subjects’ possession of the ‘Broad Phenotype’, 72.5% of eligible relatives who did exhibit the ‘Broad Phenotype’ and 71.3% of those relatives who did not were assessed. Again this difference was not significant.

M-PAS reliability
The inter-rater reliability of the M-PAS was examined. Three raters independently rated 25 audiotaped interviews conducted by one of the

<table>
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<tr>
<th>Characteristics</th>
<th>Weighted kappa</th>
<th>S.E.</th>
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<tbody>
<tr>
<td>1 Anxious (0–4)</td>
<td>0.63</td>
<td>0.13</td>
</tr>
<tr>
<td>2 Conscientious (0–4)</td>
<td>0.86</td>
<td>0.05</td>
</tr>
<tr>
<td>3 Rigid (0–3)</td>
<td>0.67</td>
<td>0.35</td>
</tr>
<tr>
<td>4 Impulsive (0–4)</td>
<td>0.72</td>
<td>0.20</td>
</tr>
<tr>
<td>5 Aloof</td>
<td>_*</td>
<td></td>
</tr>
<tr>
<td>6 Shy (0–3)</td>
<td>0.77</td>
<td>0.09</td>
</tr>
<tr>
<td>7 Undemonstrative (0–2)</td>
<td>0.35</td>
<td>0.22</td>
</tr>
<tr>
<td>8 Unresponsive (0–2)</td>
<td>0.52</td>
<td>0.21</td>
</tr>
<tr>
<td>9 Suspicious (0–1)</td>
<td>0.38</td>
<td>0.22</td>
</tr>
<tr>
<td>10 Sensitive (0–2)</td>
<td>0.79</td>
<td>0.18</td>
</tr>
<tr>
<td>11 Tactless (0–2)</td>
<td>0.72</td>
<td>0.70</td>
</tr>
<tr>
<td>12 Irritable (0–3)</td>
<td>0.53</td>
<td>0.21</td>
</tr>
<tr>
<td>13 Aggressive (0–4)</td>
<td>0.61</td>
<td>0.12</td>
</tr>
<tr>
<td>14 Submissive (0–3)</td>
<td>0.63</td>
<td>0.13</td>
</tr>
<tr>
<td>15 Eccentric (0–1)</td>
<td>_*</td>
<td></td>
</tr>
<tr>
<td>16 Self-conscious (0–2)</td>
<td>0.72</td>
<td>0.46</td>
</tr>
<tr>
<td>17 Superstitious (0–2)</td>
<td>0.74</td>
<td>0.41</td>
</tr>
<tr>
<td>18 Hypochondriacal (0–1)</td>
<td>0.57</td>
<td>0.14</td>
</tr>
</tbody>
</table>

Based on 25 subjects and three raters (P. B., E. F., M. M.). * Too few deviant ratings.
Table 2. Percentage of relatives with marked expression of M-PAS characteristics

<table>
<thead>
<tr>
<th>Down’s syndrome relatives</th>
<th>Autism relatives</th>
<th>Odds ratio</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Anxious</td>
<td>14</td>
<td>2.6</td>
<td>0.004</td>
</tr>
<tr>
<td>2 Conscientious</td>
<td>7</td>
<td>2.4</td>
<td>0.06</td>
</tr>
<tr>
<td>3 Rigid</td>
<td>4</td>
<td>2.6</td>
<td>0.08</td>
</tr>
<tr>
<td>4 Impulsive</td>
<td>1</td>
<td>10.3</td>
<td>0.005</td>
</tr>
<tr>
<td>5 Aloof</td>
<td>2.3</td>
<td>5.1</td>
<td>0.02</td>
</tr>
<tr>
<td>6 Shy</td>
<td>5</td>
<td>3.2</td>
<td>0.01</td>
</tr>
<tr>
<td>7 Undemonstrative</td>
<td>8</td>
<td>1.3</td>
<td>0.6</td>
</tr>
<tr>
<td>8 Unresponsive</td>
<td>9</td>
<td>1.2</td>
<td>0.7</td>
</tr>
<tr>
<td>9 Suspicious</td>
<td>2.3</td>
<td>3.0</td>
<td>0.1</td>
</tr>
<tr>
<td>10 Sensitive</td>
<td>4</td>
<td>3.5</td>
<td>0.006</td>
</tr>
<tr>
<td>11 Tacitless</td>
<td>1.2</td>
<td>3.5</td>
<td>0.09</td>
</tr>
<tr>
<td>12 Irritable</td>
<td>4</td>
<td>3.6</td>
<td>0.01</td>
</tr>
<tr>
<td>13 Aggressive</td>
<td>0</td>
<td>8.1</td>
<td>0.007</td>
</tr>
<tr>
<td>14 Submissive</td>
<td>4</td>
<td>9.5</td>
<td>0.1</td>
</tr>
<tr>
<td>15 Eccentric</td>
<td>0</td>
<td>6.1</td>
<td>0.02</td>
</tr>
<tr>
<td>16 Self-conscious</td>
<td>4</td>
<td>7.6</td>
<td>0.04</td>
</tr>
<tr>
<td>17 Superstitious</td>
<td>1</td>
<td>3.8</td>
<td>0.02</td>
</tr>
<tr>
<td>18 Hypochondriacal</td>
<td>0</td>
<td>3.8</td>
<td>0.07</td>
</tr>
</tbody>
</table>

Personality traits – group differences

There were very few ratings of 4 on the characteristic scale and very few individuals demonstrated any impairment. Subsequent analyses are thus based upon the characteristic scale ratings only. Table 2 shows rates for marked expression of each trait (i.e. rated ≥ 2) by group, together with odds ratios. Significantly increased expression of the traits: anxious, impulsive, aloof, shy, sensitive, irritable and eccentric was found in the autism group. In addition, though non-significant, expression of all other traits was increased among the autism relatives.

Mean item scores were computed and have been shown graphically as personality profiles in Figs. 1 and 2 to allow easy comparison. To ease interpretation, items were reordered so that adjacent items reflect the results of the factor analysis. Fig. 1 shows that although males and females have distinctive profiles, the general elevation in mean ratings among the autism relatives applied to both sexes. For females, the profile for the autism relatives was higher but essentially parallel to that of female Down’s syndrome relatives. For the male autism relatives, there was some evidence of a distinctive profile, with particularly increased expression of the traits aloof, shy, rigid, irritable and sensitive.

Fig. 2 shows the personality profiles for parents and adult siblings. As predicted, there were differences in the M-PAS personality profiles obtained. In the autism group, the traits anxious and conscientious were prominent among the parents, whereas in the siblings the traits aloof, shy, undemonstrative, impulsive, sensitive, self-conscious and eccentric were most pronounced.

Although there were significant group differences on a number of traits, two broad groupings emerged – those traits that appeared to reflect impairments in social relationships and those traits that could be broadly termed ‘emotional traits’. We hypothesized that these trait groupings might be associated with either the FHI ‘Broad Phenotype’ or a SADS-L diagnosis of either major depression or anxiety disorder (generalized anxiety disorder and panic.
disorder). The profiles of these three groups were distinctive. The traits aloof, shy, undemonstrative, unresponsive, suspicious, sensitive, aggressive, eccentric and self-conscious were significantly associated \((P < 0.05)\) with the FHI ‘Broad Phenotype’. The traits anxious, rigid, suspicious, sensitive, aggressive, superstitious and hypochondriacal were associated with M-SADS major depression \((P < 0.05)\). The traits anxious, conscientious, rigid, shy and hypochondriacal with SADS-L anxiety disorder \((P < 0.05)\). Using an extended concept of anxiety disorder that included panic disorder, there were significant associations with anxious, rigid, shy and hypochondriacal \((P < 0.05)\). After removing subjects identified on the FHI as showing the ‘Broad Phenotype’ and on the SADS-L as having a diagnosis of either major depression or anxiety disorder, significant group differences remained for the traits anxious, impulsive, sensitive and irritable \((P < 0.05)\).

**Group comparisons on factor scores**

To investigate the inter-relationship of traits on the M-PAS, an exploratory factor analysis was performed. Although a general factor analysis of the whole sample log transformed item scores gave five eigenvalues > 1, two of them were
Personality traits of the relatives of autistic probands

1417

(a)

0.5

1

1.5

0

(b)

0.5

1

1.5

0

Aloof

Shy

Undemonstrative

Self-conscious

Impulsive

Careless

Aggressive

Anxious

Conscientious

Rigid

Oversensitive

Hypochondriacal

Suspicious

Submissive

Eccentric

Superstitious

0.2. Personality profiles by group and relation: (a) sibling; (b) parent (—–, Down’s syndrome; ———, autism).

Fig. 2. Personality profiles by group and relation: (a) sibling; (b) parent (—–, Down’s syndrome; ———, autism).

close to 1. We therefore chose a three factor model and Table 3 shows the factor loadings greater than 0.4 from a varimax rotation for men and women separately.

For men these factors together accounted for 44.2% of the total variance. The first factor, labelled ‘withdrawn’ accounted for 26.0% of the variance; the second factor, labelled ‘difficult’ accounted for 10.0% and the third factor, labelled ‘tense’ accounted for 8.2%. For women the factors together accounted for 38.5% of the total variance, with the ‘tense’ factor accounting for 19.2%, the ‘difficult’ factor 11.1% and the ‘withdrawn’ factor 8.2%. The correlations between these factors were 0.25 ‘withdrawn’-‘tense’, 0.22 ‘withdrawn’-‘difficult’ and 0.15 ‘tense’-‘difficult’ for the Down’s syndrome group. For the autism group the factors were correlated 0.34 ‘withdrawn’-‘tense’, 0.28 ‘withdrawn’-‘difficult’ and 0.27 ‘tense’-‘difficult’.

On the basis of the results of the factor analysis scores, the following summary trait dimensions were calculated by summing item scores.

‘Withdrawn’ = undemonstrative, shy, aloof, unresponsive and self-conscious.

‘Tense’ = anxious, conscientious, rigid, sensitive and hypochondriacal.
Table 3. **M-PAS characteristics: factor loadings by sex (loadings > 0.4 shown)**

<table>
<thead>
<tr>
<th></th>
<th>Men</th>
<th></th>
<th>Women</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Factor 1 (Withdrawn)</td>
<td>Factor 2 (Difficult)</td>
<td>Factor 3 (Tense)</td>
<td>Factor 1 (Tense)</td>
</tr>
<tr>
<td>1</td>
<td>Anxious</td>
<td>0.71</td>
<td>0.63</td>
<td>0.45</td>
</tr>
<tr>
<td>2</td>
<td>Conscientious</td>
<td>0.48</td>
<td>0.55</td>
<td>0.50</td>
</tr>
<tr>
<td>3</td>
<td>Rigid</td>
<td>0.50</td>
<td>0.66</td>
<td>0.70</td>
</tr>
<tr>
<td>4</td>
<td>Impulsive</td>
<td>0.52</td>
<td>0.48</td>
<td>0.51</td>
</tr>
<tr>
<td>5</td>
<td>Aloof</td>
<td>0.55</td>
<td>0.58</td>
<td>0.55</td>
</tr>
<tr>
<td>6</td>
<td>Shy</td>
<td>0.52</td>
<td>0.69</td>
<td>0.69</td>
</tr>
<tr>
<td>7</td>
<td>Underinventario</td>
<td>0.50</td>
<td>0.83</td>
<td>0.72</td>
</tr>
<tr>
<td>8</td>
<td>Unresponsive</td>
<td>0.52</td>
<td>0.83</td>
<td>0.72</td>
</tr>
<tr>
<td>9</td>
<td>Suspicious</td>
<td>0.55</td>
<td>0.44</td>
<td>0.50</td>
</tr>
<tr>
<td>10</td>
<td>Sensitive</td>
<td>0.49</td>
<td>0.56</td>
<td>0.56</td>
</tr>
<tr>
<td>11</td>
<td>Tactless</td>
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<tr>
<td>12</td>
<td>Irritable</td>
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<td>Aggressive</td>
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<td>Submissive</td>
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<tr>
<td>15</td>
<td>Eccentric</td>
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<td></td>
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<tr>
<td>16</td>
<td>Self-conscious</td>
<td></td>
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<tr>
<td>17</td>
<td>Superstition</td>
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<tr>
<td>18</td>
<td>Hypochondriacal</td>
<td></td>
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</table>

‘Difficult’ = aggressive, irritable, tactless and impulsive.

As a result of the similarity of the factors for men and women subsequent analyses are focused upon these factor scores rather than individual items.

Reliability was also calculated for the factors which were used in the analysis and which were derived from a factor analysis of the whole sample. The intraclass correlations (Bartho & Carpenter, 1976) of the log transformed scores were 0.77 for ‘withdrawn’, 0.85 for ‘tense’ and 0.88 for ‘difficult’ and were all highly significant. Thus, the reliability for the factor scores was good. The main source of unreliability for the individual traits may have been the uncertainty in deciding how a particular behaviour should be coded, as a number of traits appeared to overlap.

The item total scored on each of these factors by an autism relative was on average more than twice that of a Down’s syndrome relative: 2.31 v. 1.13 for the ‘withdrawn’ factor (P < 0.001), 3.13 v. 1.29 for the ‘tense’ factor (P < 0.001); and, 1.64 v. 0.50 for the ‘difficult’ factor (P < 0.001).

Table 2 indicates that the individual traits ‘shy’ and ‘aloof’ made the greatest contribution to the between group differences on the ‘withdrawn’ factor. The traits anxious and sensitive made the greatest contribution to the between group difference on the ‘tense’ factor and the traits aggressive and irritable made the greatest contribution to the between group differences on the ‘difficult’ factor.

For subsequent analyses a combined affective disorder classification was created by combining SADS-L anxiety disorder and depression. This facilitated both a comparison with the study by Bolton et al. (1998), examining the patterns of aggregation of psychiatric disorders in these same samples and an examination of the relationships between the personality factors and psychiatric disorders in other family members. For the latter analysis FHI data were used to determine the presence or absence of affective disorder for those individuals for whom SADS-L data was missing or incomplete. The FHI allows for a diagnosis of combined affective disorder but not differentiation into anxiety disorder or depression. We had previously compared a comparable amalgamated set of diagnoses made following the SADS-L with the diagnosis of affective disorders recorded in the FHI. This indicated an acceptable level of agreement (kappa = 0.65).

A multiple regression analysis was carried out to examine the association of each of these dimensions with group membership (i.e. autism v. Down’s groups), the status of the relative (i.e. whether a parent or sibling), the sex of the relative, the ‘Broad Phenotype’ derived from the FHI and a diagnosis of combined affective disorder on the SADS-L.
The factors exhibited considerable specificity. The ‘withdrawn’ factor score was significantly associated with the FHI ‘Broad Phenotype’ and a diagnosis of combined affective disorder (i.e. expression was increased in relatives in each of these groups) and increased in male relatives. Possession of the FHI ‘Broad Phenotype’ significantly increased the score on this factor by 56%. A diagnosis of combined affective disorder significantly increased the expected score by 28%.

The ‘tense’ factor was significantly associated with a diagnosis of combined affective disorder, which increased the expected factor score by 73%. Possession of the FHI ‘Broad Phenotype’ increased the expected score by 15% although this was not statistically significant. Neither the sex nor status (i.e. parent or sibling) of the relative had a significant effect on the factor score.

The ‘difficult’ factor score was significantly associated with the sex of the relative (i.e. expression increased in male relatives) but not with either the FHI ‘Broad Phenotype’ or a diagnosis of combined affective disorder, which respectively led to a non-significant decrease of 9% and an increase of 20% in the expected factor score.

Despite these significant associations there was an incomplete overlap between the classifications based on the M-PAS ‘withdrawn’ factor and the FHI ‘Broad Phenotype’ and the M-PAS ‘tense’ factor and the SADS-L combined affective disorder classifications. Using cut-offs on the factor scores that gave comparable prevalences to those from the FHI and SADS-L classifications, the M-PAS identified 15 out of 36 ‘Broad Phenotype’ relatives (kappa 0.30, \( P < 0.001 \)) and 28 out of 72 cases of SADS-L combined affective disorder (kappa 0.28, \( P < 0.001 \)).

**Personality traits – familial loading**

Additional multiple regression analyses were carried out to examine the relationship of the factor scores to those proband characteristics found by Bolton *et al.* (1994, 1997) to predict familial loading for the broader autism phenotype. If the factor scores showed the same associations, this would suggest that expression of these personality traits might well reflect the same underlying liability. If they did not, this would suggest they might arise through some other route, such as a reaction to the burden of caring for a handicapped child. Controlling for the sex and status of the relative (i.e. parent or sibling), we examined the relationship with the proband’s ICD-10 autism symptom (ADI score), the proband’s BAS and the modified obstetric optimality score. In addition the presence or absence of speech (language level) was included because previous studies reported it to be a potential marker of heterogeneity (Bolton *et al.* 1994).

Table 5 shows the results of these analyses. The standardized coefficients for the BAS, ADI severity scores and optimality scores are presented (i.e. the coefficients are presented as if each of these variables had a standard deviation of 1).

An increase of 1 standard deviation (1 s.d.) on the ADI led to a significant increase of 17% on the expected score for the ‘withdrawn’ factor, with corresponding values of a significant increase of 17% for the optimality score and a non-significant increase of 6% for the BAS. An
increase of 1 s.d. on the BAS led to a significant increase of 20% in the expected score for the ‘tense’ factor while similar increases in the ADI and optimality scores led to non-significant increases of 3% and 4% respectively. The corresponding values for the ‘difficult’ factor are 12% increase for a 1 s.d. increase in the BAS, 14% increase for a 1 s.d. increase on the ADI score and a 9% decrease for a 1 s.d. increase in the optimality score all of which failed to reach significance. Although not shown, consistent with our previous reports we could find no impact of the sex of the proband.

The relationship between the personality factors and the presence, in any other first-degree relative, of the FHI ‘Broad Phenotype’ and combined affective disorders was also examined in order to determine whether there was any association beyond that predicted by the subject’s own disorder. Only the ‘withdrawn’ factor and a diagnosis of combined affective disorder were significantly associated ($P = 0.02$) all other associations failed to reach statistical significance.

**DISCUSSION**

Prior to examining the implications of these findings we must first consider those methodological aspects of the study that may have influenced the results. First, raters were not unaware of group membership and did not each assess the same proportion of subjects both in terms of total numbers and group membership. Rater bias could therefore have contributed to the group differences found. However, our findings are broadly consistent with a number of other studies (Piven et al. 1994; Smalley et al. 1995; Santangelo & Folstein, 1996) including three studies that incorporated blind ratings (Wolff et al. 1988; Landa et al. 1992; Piven et al. 1997b).

Secondly, although the inter-rater reliability was satisfactory for most M-PAS traits, inter-rater reliability for two traits (undemonstrative and suspicious) indicated poor reliability (weighted kappas 0.35 to 0.38) and only moderate reliability for three other traits (unresponsive, irritable, hypochondriacal: weighted kappas 0.52 to 0.57). However, most of our analyses were carried out on the trait groupings derived from the factor analysis and these factors were rated very reliably.

Thirdly, clinic referral bias may have influenced the make-up of the autism group if for example, parental personality attributes influenced referral practices. The fact that the rates of autism and pervasive developmental disorder in siblings in the study sample (3% and 5.8% respectively) was similar to those reported in epidemiological series (Smalley et al. 1988) suggests that parental characteristics linked to the broader autism phenotype did not influence referral practice. If they had, the rate of disorder in siblings would be greater than expected. However, it remains possible that other attributes may have played a part in influencing the likelihood of referral.

Fourthly the rate of attrition in the Down’s syndrome group was high at the point of recruitment into the study. As individuals who refuse to be involved in studies tend to be more likely to have psychiatric problems than those who cooperate, despite similar demographic

<table>
<thead>
<tr>
<th>Factor scores</th>
<th>'Withdrawn' factor</th>
<th>'Tense' factor</th>
<th>'Difficult' factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coefficient</td>
<td>$P$</td>
<td>Coefficient</td>
<td>$P$</td>
</tr>
<tr>
<td>Parent</td>
<td>−0.08</td>
<td>0.5</td>
<td>0.18</td>
</tr>
<tr>
<td>Female</td>
<td>−0.16</td>
<td>0.2</td>
<td>0.07</td>
</tr>
<tr>
<td>BAS-Score</td>
<td>−0.60</td>
<td>0.5</td>
<td>0.19</td>
</tr>
<tr>
<td>ADI-Score</td>
<td>0.16</td>
<td>0.02</td>
<td>0.63</td>
</tr>
<tr>
<td>Optimality score</td>
<td>0.16</td>
<td>0.02</td>
<td>0.04</td>
</tr>
<tr>
<td>Language level</td>
<td>0.11</td>
<td>0.4</td>
<td>−0.12</td>
</tr>
<tr>
<td>Adjusted $R^2$</td>
<td>0.08</td>
<td>0.06</td>
<td>0.07</td>
</tr>
</tbody>
</table>

$P$ values were derived from $t$ tests.
profiles (Cox et al. 1977), it is possible that the Down’s syndrome control group exhibited particularly low rates of psychiatric disorders and personality difficulties. For the personality traits examined, there are no normal population studies with which to compare however, comparison of the mean ratings for the parents in our study with those reported by Piven et al. (1994) shows a similar pattern of findings for informant ratings. It seems unlikely, therefore, that our parents of Down’s syndrome individuals were markedly atypical.

Finally, it is possible that the relatives of autistic individuals may be more sensitive than controls to minor differences in the personality traits of other family members (particularly for those traits that resemble aspects of autism) and therefore a reporting bias may occur. However, no evidence of such bias was found in the studies of cognitive impairment (Fombonne et al. 1997) and affective disorders (Bolton et al. 1998) in these same samples, both of which compared the data obtained from informant reports with direct assessment. Thus, by extrapolation, there is no reason to suppose that this would have occurred in the current study.

The expression of a number of traits was significantly increased among the autism relatives. However, as revealed by the factor analysis these fell into the three trait groupings that we have termed ‘withdrawn’, ‘tense’ and ‘difficult’.

Of the traits included in the ‘withdrawn’ factor only the traits shy and aloof showed significant group differences. The increased expression of these characteristics is consistent with the earlier reports of an increased rate of social isolation (Wolff et al. 1988; Bolton et al. 1994; Piven et al. 1994, 1997a, b) and social phobia (Smalley et al. 1995) among the relatives of autistic individuals.

The traits undemonstrative and unresponsive did not individually differentiate between groups because of the unexpectedly high level of expression among the Down’s syndrome relatives. Our findings contrast with those of Piven et al. (1994) and Landa et al. (1992) who both reported an increased rate of undemonstrativeness in the autism relatives. The failure of these traits to discriminate between groups could be a consequence of low specificity. Alternatively it may be that, while individually these traits do not discriminate between groups, they do contribute to the deficits in social functioning seen in some of the relatives of autistic individuals. There is some support for this hypothesis as both traits were individually found to be significantly associated with the FHI ‘Broad Phenotype’. Furthermore, Wolff et al. (1988) reported that while no measure of empathy differentiated significantly between groups, impairments in empathy did contribute to the significantly higher rate of schizoid personality found among the parents of autistic children compared with controls.

The traits included in the ‘withdrawn factor’ appear to index impairments that are qualitatively similar to those occurring in autism although generally less severe in expression suggesting this factor may represent a manifestation of the liability to autism. Further evidence for this hypothesis is provided by the significant associations with the proband’s optimality score and ADI score, both of which were found by Bolton et al. (1994) to predict familial loading of the broader autism phenotype defined on the basis of FHI assessments. The withdrawn factor was more common among males, in keeping with the sex difference observed for autism and it was significantly associated with the FHI ‘Broad Phenotype’ both findings which again suggest that it may stem from the same underlying genetic liability (Bolton et al. 1994). Moreover, the absence of a significant association with the BAS suggests that the burden of living with an autistic individual does not play a significant role in determining the expression of this factor.

If the ‘withdrawn’ factor does indeed represent expression of the genetic liability for autism, this liability may apply to a much higher proportion of relatives than is evident from either the rate of autism in family members or the rate of the FHI ‘Broad Phenotype’. This implies that autism and autism related disorders might represent a dimensional, rather than a categorical phenomena; this possibility warrants further study. If validated, quantitative trait loci approaches (Plomin, 1990) would constitute one useful molecular genetic research strategy.

The ‘withdrawn’ factor was significantly associated with a diagnosis of combined affective disorder (anxiety disorders and depression) and also with affective disorders in other relatives. The fact that investigators were explicitly in-
structed to question informants about lifelong traits and exclude periods of psychiatric illness, makes it unlikely that this association stems from simple measurement overlap. An alternative explanation is that expression of the ‘withdrawn’ factor may render an individual vulnerable to the development of affective disorders. Against this possibility is the fact that Bolton et al. (1998) did not find evidence of significant co-morbidity between the FHI Broad Phenotype and affective disorders. At present therefore, there is no clear explanation for the association between the withdrawn factor and affective disorders.

Of the traits included in the ‘tense factor’ only the traits anxious and sensitive significantly differentiated between groups. The results differ from those reported in early studies, where there was little evidence for increased rates of anxiety among relatives (Kolvin et al. 1971; Cox et al. 1975; Cantwell et al. 1979; Piven et al. 1994). However, they are in keeping with more recent studies (Santangelo & Folstein, 1996; Piven et al. 1997b) as well as reports of increased rates of generalized anxiety disorders among the relatives of autistic individuals (Delong & Dwyer, 1988; Piven et al. 1991). Our finding of an increased expression of the trait sensitive is consistent with the finding of Piven et al. (1997b) and the finding by Wolff et al. (1988) of a significant increase in ‘sensitivity to experience’ among the parents of autistic individuals.

The absence of a significant association with those proband characteristics found to predict familial loading of autism related disorders (Bolton et al. 1994) and with the FHI ‘Broad Phenotype’ suggests that the ‘tense’ factor does not represent expression of the genetic liability for autism. Furthermore, the absence of an association with the FHI ‘Broad Phenotype’ also implies that in general, expression of the ‘tense’ factor is not related to underlying social and communication impairments.

The ‘tense’ factor was significantly associated with the proband BAS implying that expression of this factor might be a reaction to the burden of caring for an autistic child. Moreover, expression of this factor was significantly higher in parents, who typically experience the greater burden of care. Although we attempted to control for this burden in the choice of comparison group, there is some evidence that the relatives of autistic individuals may experience greater stress than the relatives of Down’s syndrome individuals (Holroyd & McArthur, 1976; Fishman et al. 1989, Dumas et al. 1991). Unfortunately, the BAS provides us with an indirect, rather than a direct, measure of stress and then only for the probands with autism.

The ‘tense’ factor was also found to be significantly associated with a diagnosis of combined affective disorder on the SADS-L. The pattern of familial loading of the tense factor is similar to that found by Bolton et al. (1998) for affective disorders. Both the increased expression of the ‘tense’ factor and the increased rate of major depression among the autism relatives could be related to common environmental factors, such as the burden of caring for an autistic individual. However, the fact that the increased risk for major depression was not confined to the period following the birth of the proband was inconsistent with this hypothesis (Smalley et al. 1995; Bolton et al. 1998). Unfortunately, the data do not allow us to examine the personality traits of relatives before and after the birth of the proband to explore this issue further.

The group difference on the ‘difficult’ factor was unexpected. However, both Wolff et al. (1988) and Landa et al. (1992) described a pattern of social disinhibition and disinhibited communication occurring more commonly among the parents of autistic individuals, which may represent similar behaviours to those indexed by the trait impulsive in the current study. Unlike Piven et al. (1994), we did not find a significant group difference on the trait untactful (tactless) The pattern of findings overall was not consistent with any particular hypothesis and the results, therefore, must remain unexplained.

Lastly, in keeping with the findings of both Piven et al. (1994) and Wolff et al. (1988) we did not find significant group differences on the traits rigid and conscientious, both of which are thought to be index obsessionality. This is in contrast to the more recent findings of Piven et al. (1997b). Although Bolton et al. (1994, 1998) found an increase in stereotyped behaviours and obsessive–compulsive disorder among the autism relatives, their occurrence was rare and there was no evidence of an increase in isolated ritualistic or stereotyped behaviour. Thus, while
there are good reasons for supposing that obsessional behaviour is one manifestation of the genetic liability for autism it occurs largely in combination with communication and social impairments and is not a prominent familial feature.

To conclude, this study confirms that particular personality traits may aggregate among the relatives of autistic individuals. Furthermore, the findings suggest that this may involve at least two broad groups of traits, which may differ in their aetiological origins. Further research is needed to clarify the issue. The recent identification of several genetic loci which may be implicated in autism (Autism Consortium, 1998) should enable better definition of those characteristics and disorders genetically related to autism.

We wish to thank Hope Macdonald, Patricia Rios and Steven Scott for their assistance with this research. The study was supported by an MRC project grant and MRC Unit funds. Most of all we wish to express our gratitude to the families that helped with this research.

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