

Annotation: The similarities and differences between autistic disorder and Asperger's disorder: a review of the empirical evidence

Kathleen E. Macintosh and Cheryl Dissanayake

School of Psychological Science, La Trobe University, Australia

Background: The ongoing controversy over the distinction between autistic disorder and Asperger's disorder is important to resolve because of the implications regarding an understanding of the aetiology and prognosis, and the diagnostic and clinical practices relating to these conditions. This paper provides a critical evaluation of current published research evidence. **Method:** Databases, such as PsychINFO and Medline, as well as book chapters, reference lists from relevant articles, and recent editions of key journals were searched for all relevant studies (until 2002) which incorporated participants diagnosed with high-functioning autism and Asperger's disorder using either cluster analysis or comparative approaches to examine similarities and differences between these groups. Keywords used in the searches included autistic disorder, Asperger's disorder, autism, high-functioning autism, and pervasive developmental disorder. **Results:** On the basis of the available evidence, there seem to be few qualitative differences between autistic disorder and Asperger's disorder. **Conclusion:** There is currently insufficient evidence to establish the validity of Asperger's disorder as a syndrome distinct from high-functioning autism. The findings are consistent with the view that these disorders belong on an autism spectrum. **Keywords:** Asperger's disorder, autistic disorder, classification, diagnosis, pervasive developmental disorder, high-functioning autism.

Autistic disorder is a well-established diagnostic condition (*Diagnostic and Statistical Manual of Mental Disorders*, DSM-IV, American Psychiatric Association, APA, 1994; International Classification of Diseases, ICD-10, World Health Organization, WHO, 1993) whilst Asperger's disorder was officially included as a discrete category in the most recent versions of these classification systems. However, the validity of Asperger's disorder as a distinct diagnostic category has yet to be resolved. There is remarkable similarity and overlap between autistic disorder and Asperger's disorder, with core impairments in socialisation, communication, and imagination being recognised as fundamental and universal in both conditions (Frith, 1996; Gillberg, 1999; Happé, 1994; Wing, 1996). As a result, there has been a long-standing controversy over the distinction between these disorders (Gillberg, 1998; Klin, Volkmar, & Sparrow, 2000; Schopler, Mesibov, & Kunce, 1998; Wing, 1991).

There are several reasons why it is important to determine whether Asperger's disorder is distinct from autistic disorder. If individuals with Asperger's disorder have qualitatively different impairments from those with autism, they are likely to have different needs in terms of intervention (Bishop, 1989; Klin et al., 2000; Kugler, 1998; Szatmari, 1991; Szatmari, Bartolucci, Finlayson, & Krames, 1986; Zwaigenbaum & Szatmari, 1999). Alternatively, if their symptoms closely resemble those seen in autism, they may then benefit from the wealth of knowledge acquired about the management of this disorder (Myhr, 1998; Zwaigenbaum & Szatmari, 1999).

If the two conditions are identified as distinct, the possibility is raised that they vary in terms of aetiology (Szatmari, 1998; Szatmari et al., 1986; Szatmari, Bremner, & Nagy, 1989; Volkmar & Klin, 2000). Such knowledge may promote early identification of children at increased risk of either disorder, early diagnosis of those demonstrating symptoms, an awareness of the potential for co-morbid psychiatric disorders, as well as identification of any potential preventative measures (Ghaziuddin & Gerstein, 1996; Klin & Volkmar, 1997; Myhr, 1998; Szatmari, 1998; Szatmari, Bartolucci, & Bremner, 1989; Szatmari, Bremner, et al., 1989; Szatmari et al., 1986). Furthermore, if the two disorders are distinct, it may be possible to distinguish between them in terms of their likely prognosis (Klin & Volkmar, 1997; Szatmari, 1991; Szatmari, Bartolucci, et al., 1989). Finally, empirically derived knowledge of the relationship between these disorders provides valuable information about the validity of current classification systems, and directions for how they may be improved (Bishop, 1989; Szatmari, 1998).

Much research has been conducted to determine whether autistic disorder and Asperger's disorder are discrete entities. Two approaches have been used to address this question. One is the empirical derivation of pervasive developmental disorder (PDD) sub-types through cluster analysis, and the second is the comparison of individuals allocated to the pre-classified diagnostic categories. A key purpose in the current review is to provide a detailed descriptive account and critique of published research (up until 2002) incorporating these methodological

approaches. Studies using quantitative statistical analyses were included for critical examination regardless of whether participants were diagnosed according to past or current DSM or ICD criteria, or other commonly recognised classification systems (e.g., Wing's (1981) criteria). The computer databases PsychINFO and Medline, recent book chapters, reference lists from relevant articles, and recent editions of key journals (e.g., *Journal of Child Psychology and Psychiatry*, *Autism*, *Journal of Autism and Developmental Disorders*) were used to identify the relevant articles. Keywords used in the literature searches included, but were not restricted to, autistic disorder, autism, high-functioning autism, Asperger's disorder, Asperger's syndrome, and pervasive developmental disorder.

Empirical sub-typing studies

Several researchers have attempted to determine the existence of distinct, homogeneous PDD sub-types through cluster analysis (e.g., Eaves, Ho, & Eaves, 1994; Fein et al., 1999; Prior et al., 1998; Rescorla, 1988; Sevin et al., 1995; Siegel, Anders, Ciaranello, Bienenstock, & Kraemer, 1986; Szatmari, Bartolucci, et al., 1989). The process typically involves recruiting participants who have been diagnosed with a form of PDD, collecting data on relevant areas of functioning, and then statistically generating sub-groups (Fein et al., 1999). These studies have often incorporated individuals varying widely in age and/or level of cognitive and language functioning, resulting in the identification of between 2 and 12 sub-types (Myhr, 1998; Pomeroy, 1998; Szatmari, 1992). A relatively consistent finding has been that differences between groups are largely interpretable as a function of symptom severity, intellectual ability and level of adaptive functioning (Fein et al., 1999; Myhr, 1998; Prior et al., 1998; Volkmar, Klin, & Cohen, 1997). Although some links are made between the identified clusters and formal diagnostic categories (i.e., autism and other-PDD), no attempts are made to clarify whether children with high-functioning autism are differentiated from those with Asperger's disorder.

Only two studies have focused on individuals with high-functioning autism and Asperger's disorder. Szatmari, Bartolucci, et al. (1989) performed a cluster analysis using 28 children with Asperger's disorder (diagnosed according to an adaptation of Wing's (1981) criteria) and 25 children with high-functioning autism. The children were matched on Full Scale IQ (FSIQ), and sorted into two and three clusters on the basis of parent information about impairments in socialisation, communication, and imagination. The groups in the two-cluster solution differed in the severity of deficits in each domain, and were thought to correspond to the categories of high-functioning autism and Asperger's disorder

respectively. In the three-cluster solution, a 'mixed' group was detected. This group was comparable to the 'autism' sub-type in regard to impairments in language and imagination, but resembled the 'Asperger' sub-type in socialisation difficulties. These findings were regarded as favouring a spectrum view of autistic disorders, with differences between sub-types being quantitative and not qualitative (Myhr, 1998; Szatmari, 1992; Szatmari, Bartolucci, et al., 1989). There were some limitations to this research, including an inadequate description of the sampling methods used and a failure to report the clinical significance of the sub-types (Szatmari, 1992). Moreover, as traditional cluster analysis necessarily creates sub-types, the hypothesis that high-functioning autism and Asperger's disorder may be most appropriately conceptualised on the same continuum could not be fully addressed, even though the results were believed to support this conclusion (Myhr, 1998; Pomeroy, 1998; Szatmari, 1992). Moreover, this study was conducted prior to formal criteria being available for Asperger's disorder; thus it is unclear to what extent the results for this group can be extrapolated to children diagnosed according to current classification systems (Prior et al., 1998; Volkmar et al., 1997).

Prior et al. (1998) used a sample of 135 participants diagnosed with high-functioning autism, Asperger's disorder, or PDD-not otherwise specified (without intellectual disability). Data were collected from parents regarding developmental and family history, and the triad of core impairments. In contrast to the Szatmari, Bartolucci, et al. (1989) study, a form of cluster analysis was used in which it is not necessary to decide how many clusters to produce a priori. A three-cluster solution appeared suitable. Correspondence between the three groups and clinical diagnosis was reasonably weak. Again, group differences were attributable to variations in severity of symptoms rather than reflecting alternate symptom profiles. The findings were considered most compatible with the hypothesis that Asperger's disorder is part of the autism spectrum. Unfortunately, the children diagnosed with Asperger's disorder also met criteria for autistic disorder according to DSM-IV (APA, 1994) criteria, making it unclear whether the findings were due to poor sample selection or accurately reflected the existence of an autistic continuum. It is also unclear whether the same results would have been achieved if groups had been matched on verbal mental age (VMA) and chronological age (CA).

In summary, empirical sub-typing studies have not provided much insight into the relationship between autistic disorder and Asperger's disorder. It is usually not clear whether individuals in the high-functioning subtypes are eligible for a diagnosis of Asperger's disorder, or are simply people with high-functioning autism (Szatmari, 1991, 1992). Such clarification is necessary in order to resolve the

debate over whether Asperger's disorder is distinct from autistic disorder. Even in the studies by Szatmari, Bartolucci, et al. (1989) and Prior et al. (1998) that focus on empirically sub-typing individuals with these conditions, a number of limitations have hampered definite conclusions.

A problem with the empirical sub-typing approach is that even if participants within a restricted CA and MA range are recruited, it is difficult to avoid the potentially confounding effects of differences between the statistically generated sub-groups on key developmental variables. As the researcher does not decide which children enter each cluster, it is not possible to ensure that the groups will be matched on these important variables.

Research is therefore required which directly compares individuals with Asperger's disorder and high-functioning autism who are closely matched on key developmental variables. The debate regarding the overlap between these conditions can only be resolved if the effects of such extraneous factors are diluted, allowing direct and uncontaminated comparison of relevant features (Gillberg & Ehlers, 1998; Szatmari, 1991, 2000a; Volkmar & Klin, 2000).

Comparative studies

Numerous studies have been conducted in which direct comparisons have been made between individuals with a diagnosis of high-functioning autism and Asperger's disorder on core and associated features.

Language and communication

According to both the DSM-IV (APA, 1994) and ICD-10 (WHO, 1993) classification systems, autistic disorder is distinguished from Asperger's disorder on the basis of language development. Delays and/or abnormalities in language functioning must be evident for a diagnosis of autistic disorder, whereas a criterion for Asperger's disorder is that there is 'no clinically significant general delay in language' (APA, 1994, p. 77). However, contrary to this criterion, the results from several studies indicate that some children whose symptoms seem otherwise to be consistent with Asperger's disorder have experienced significant difficulties in language development (e.g., Eisenmajer et al., 1996; Manjiviona & Prior, 1999; Prior et al., 1998). Furthermore, although the majority of children with autism experience severe language delay, it is not a universal feature of the disorder (Eisenmajer et al., 1996; Miller & Ozonoff, 2000). These findings bring into question the capacity for the 'course of language development' to distinguish the two disorders, and have implications for the validity of the current classification systems.

Comparative research on communication abilities has often focused on pragmatic difficulties. Fine,

Bartolucci, Ginsberg, and Szatmari (1991) found that individuals with high-functioning autism, unlike those with Asperger's disorder, demonstrated impoverished use of appropriate intonation in conversation. Gillberg (1989) differed in finding that the majority of young people with Asperger's disorder displayed flat intonation and/or odd vocal pitch but similarly found that these features were much more characteristic of high-functioning autism. As both these studies were conducted prior to the establishment of formal criteria for Asperger's disorder, it is difficult to determine the generalisability of the findings to individuals diagnosed according to current classification systems (Volkmar & Klin, 2000). Furthermore, it is possible that Gillberg's finding of substantial communication impairment in both groups was influenced by the requirement that all participants show language and non-verbal communication problems.

Fine, Bartolucci, Szatmari, and Ginsberg (1994) found that youth with high-functioning autism and Asperger's disorder both demonstrated peculiarities in referencing during conversation. However, whilst individuals with autism made relatively few links to previous details given in conversation, those with Asperger's disorder referred to previous aspects of conversation but in 'unclear' ways.

Fine et al. (1994) and Szatmari, Bartolucci, et al. (1989) both found that echolalia and pronoun reversal were much more common amongst children with high-functioning autism than Asperger's disorder. However, no differences were found by Szatmari, Bartolucci, et al. in parents' reports of the frequency of initiating speech, using repetitive language, and producing and understanding non-verbal forms of communication. Again, as this study was conducted prior to the development of formal diagnostic criteria for Asperger's disorder, a non-standard definition of this condition was used. The reliance on retrospective parental reports also limits the reliability of these findings. Miller and Ozonoff (2000), who did use DSM-IV (APA, 1994) criteria, found that an equally high percentage of individuals in both groups were reported as having a history of echolalia, pronoun reversal, and/or neologisms.

Eisenmajer et al. (1996) concurred with Szatmari, Bartolucci, et al. (1989) in finding echolalia to be less frequently associated with Asperger's disorder during the preschool period. However, they differed in finding that children with Asperger's disorder were reported by parents as using repetitive speech more often, compared to the children with high-functioning autism, from preschool age onwards. These authors also identified long-winded and pedantic speech, an unusual tone of voice, and the use of idiosyncratic words as more characteristic of Asperger's disorder, especially in the early years. Again, the accuracy of these findings is uncertain given the reliance on retrospective parent reports. However, findings from a study by Ghaziuddin and Gerstein

(1996), in which speech pathologists, blind to diagnosis, assessed audio-taped speech samples, also suggested that pedantic speech was more common amongst adolescents with Asperger's disorder. Interestingly, Eisenmajer et al. noted that with advances in age, there were fewer differences in communication impairments between the groups with high-functioning autism and Asperger's disorder, such that the former increasingly came to resemble the latter.

Ramberg, Ehlers, Nyden, Johansson, and Gillberg (1996) also found few differences between school-aged children with Asperger's disorder and high-functioning autism on measures of receptive and expressive language. Although participants with Asperger's disorder had a more sophisticated vocabulary, the groups were comparable in their performance on tasks assessing pragmatics, language comprehension, and prosody. However, contrary to formal diagnostic criteria (APA, 1994; WHO, 1993), the children with Asperger's disorder were permitted to have a history of delayed language acquisition. The use of the altered criteria may have contributed to a paucity of differences between the two groups.

Ozonoff, South, and Miller (2000), using strict DSM-IV (APA, 1994) criteria, found that the groups were differentiated on the basis of the age at which first words were acquired according to retrospective parent report. Furthermore, during their preschool years, the children with autism had shown greater communication dysfunction than those with Asperger's disorder. They were more likely to have had delayed acquisition of speech, impairments in two-way conversation, and stereotyped, idiosyncratic or repetitive language. These findings are compatible with those of Szatmari, Bartolucci, et al. (1989), but contradictory to the results of Eisenmajer et al. (1996). However, consistent with Eisenmajer et al., analysis of current communication difficulties, when participants were at least of primary school age, revealed that many of the earlier differences were no longer apparent. The only current discrepancy between the groups was that the participants with Asperger's disorder outperformed those with autism on tests of expressive language.

Like Fine et al. (1994) and Szatmari, Bartolucci, et al. (1989), Gilchrist et al. (2001), using ICD-10 (WHO, 1993) criteria, found that echolalia and pronoun reversal were more common amongst children with autism. They also demonstrated greater abnormalities in the use of conventional gestures, but were no different from the participants with Asperger's disorder in their use of verbal rituals, stereotyped utterances, or inappropriate questions. By adolescence, however, the only difference between the groups was that youth with Asperger's disorder were more inclined to engage in 'social chat'. Howlin (2003) also found that concerns about speech delays and language deficits had been more common amongst the parents of children with high-func-

tioning autism than Asperger's disorder. However, as adults, whilst communication impairments were evident for both groups, there was little basis for differentiation. Again, retrospective parent reports were the source of information regarding early development in both studies. Nevertheless, the findings from these studies, together with those of Eisenmajer et al. (1996) and Ozonoff et al. (2000), suggest that the extent to which language and communication impairments differentiate the two groups may vary as a function of age.

Cognitive and neuropsychological profiles

Intellectual functioning. Some researchers have found differential areas of strength and weakness in the cognitive profiles of individuals with autistic disorder and Asperger's disorder. Ehlers et al. (1997) found that participants with autism showed strengths in visuo-spatial and perceptual reasoning skills, and weaknesses in verbally mediated knowledge. The opposite pattern was apparent for participants with Asperger's disorder. However, these trends were observed only at the group level, with much variability in the cognitive profiles within each group. Furthermore, higher FSIQ and verbal ability in the Asperger's disorder sample were identified as the key factors accounting for the different cognitive profiles.

Klin, Volkmar, Sparrow, Cicchetti, and Rourke (1995) also found inconsistent patterns of skills and deficits between CA- and FSIQ-matched individuals with autism and Asperger's disorder. While Asperger's disorder was associated with difficulties in visual-motor integration, visual-spatial perception, visual memory, fine and gross motor skills, and non-verbal concept formation, these were areas of strength in the individuals with autism. Deficits in verbal memory, auditory perception, articulation, verbal output, and vocabulary were positively correlated with autism and negatively correlated with Asperger's disorder. A higher PIQ than Verbal IQ (VIQ) was typical of autism, whilst the reverse was found for Asperger's disorder. These discrepancies were suggested as potentially important distinguishing features between the disorders. However, a lack of independence between outcome measures and selection criteria in this study hampered interpretation of the group differences. The participants with Asperger's disorder were only recruited if they had a history of early motor clumsiness, which is an associated rather than necessary feature of the disorder (APA, 1994; WHO, 1993). As there is a correlation between impaired motor development and poor visuo-spatial perception, the selection criterion of 'motor clumsiness' in Asperger's disorder may account for the discrepancies between the groups in performance on visuo-spatial tasks (Ozonoff & McMahon Griffith, 2000; Volkmar & Klin, 2000; Wing, 1998). Nevertheless, when the data was re-analysed without this criterion, the differences

remained (Klin et al., 1995). There may have also been some circularity in the relationship between diagnostic criteria and the differences in language-based abilities. The superiority in VIQ and language-based tasks shown by participants with Asperger's disorder may have been a function of criteria specifying, in contrast to autism, an absence of language delay in their developmental history (Wing, 1998).

Iwanaga, Kawasaki, and Tsuchida (2000) used DSM-IV (APA, 1994) criteria to diagnose participants and found some limited support for the notion that preschool children with high-functioning autism have better visuo-motor skills, whilst those with Asperger's disorder have superior verbal abilities. The children with autism were better than those with Asperger's disorder on a puzzle task, but worse in following directions and repeating sentences. However, the two groups could not be differentiated on many tasks assessing other verbal and non-verbal skills. As Iwanaga et al. note, it is possible that the use of small samples (autistic disorder: $n = 15$; Asperger's disorder: $n = 10$) resulted in low power to detect some group differences.

Consistent support for the claim that individuals with autistic disorder and Asperger's disorder can be differentiated on the basis of their cognitive profiles has not been forthcoming. Szatmari, Tuff, Allen, Finlayson, and Bartolucci (1990) compared children with Asperger's disorder, high-functioning autism, and non-PDD-related social impairment on a range of psychological tests. Few differences were observed between the two PDD groups, although both displayed deficits in verbal and non-verbal abilities relative to the non-PDD participants. There was also no difference between the children with autism and Asperger's disorder on a test of visual-motor integration. Criticisms of this study have included the relatively broad criteria used to define Asperger's disorder, the lack of clarity regarding the extent of diagnostic differentiation between the PDD groups, and the failure to match them on CA and MA. All these factors have been suggested as potentially contributing to the null findings (Manjiviona & Prior, 1999; Ozonoff & McMahon Griffith, 2000; Volkmar & Klin, 2000).

Szatmari, Archer, Fisman, Streiner, and Wilson (1995) matched groups with high-functioning autism and Asperger's disorder on CA and again found no differences on a test of visual-motor integration or on standardised measures of spatial reasoning. Ozonoff, Rogers, and Pennington (1991) also found no differences on three tests of spatial cognition, with both groups achieving results comparable to those of control participants. However, VIQ was higher amongst individuals with Asperger's disorder. Again, it is unclear in both studies to what extent inadequacies in subject selection procedures accounted for the few group differences. Szatmari et al. did not ensure the mutual exclusivity of diagnoses, and many of the participants with Asperger's

disorder met criteria for autistic disorder. Overlap between diagnostic conditions could also have occurred in the Ozonoff et al. study because some children allocated to the Asperger's disorder group had previously been diagnosed with autism. Moreover, the ICD-10 (WHO, 1993) criteria were modified in a manner that could have reduced group differences with the 'age of onset' and 'no history of language delay' criteria for Asperger's disorder being removed (Manjiviona & Prior, 1999; Volkmar & Klin, 2000). However, Ozonoff et al.'s findings were somewhat substantiated by Gilchrist et al. (2001). Using formal ICD-10 criteria to define groups, they found that youth with Asperger's disorder had a higher mean VIQ and FSIQ than those with high-functioning autism, but the two groups were comparable on mean PIQ.

Some researchers have reported patterns of cognitive strengths and deficits deviating from the predicted profiles for autistic disorder and Asperger's disorder. Manjiviona and Prior (1995) found that PIQ was significantly elevated in Asperger's disorder relative to autism. As with the research by Ozonoff et al. (1991), conclusions based on this study are limited because the criterion of 'no early language delay' in Asperger's disorder was excluded (Ozonoff & McMahon Griffith, 2000). In contrast, Ghaziuddin, Butler, Tsai, and Ghaziuddin (1994) adhered to ICD-10 (WHO, 1993) criteria for Asperger's disorder, and ensured, for all cases, that a diagnosis of autism was not applicable. These researchers found that non-significant differences between VIQ and PIQ were the norm for both groups, and where differences were found, the direction of the discrepancy was mixed with no particular pattern prevailing.

In reviewing the above studies, it becomes apparent that the decision to either retain or eliminate the criterion specifying an absence of significant language delay in Asperger's disorder may determine whether or not group differences are found. When this criterion has been adopted, it seems that individuals with autistic disorder and Asperger's disorder are more likely to be differentiated on their patterns of cognitive abilities (e.g., Iwanaga et al., 2000; Klin et al., 1995). When the language delay criterion has been abandoned, thereby limiting diagnostic differentiation between the groups, few differences are found (e.g., Ozonoff et al., 1991; Szatmari et al., 1995). Although this pattern has not been consistently demonstrated (e.g., Ghaziuddin et al., 1994), it highlights the need for researchers to avoid circularity between their group allocation procedures and their findings by selecting dependent variables that are not closely related to diagnostic criteria (Klin & Volkmar, 1997; Volkmar & Klin, 2000).

Manjiviona and Prior (1999) compared the cognitive profiles of individuals with high-functioning autism and Asperger's disorder with and without adherence to the criterion of 'absence of language delay' for

Asperger's disorder. Their results were compatible with those of Ghaziuddin et al. (1994). Regardless of whether or not current diagnostic criteria were followed, no differences were found between the groups on verbal or performance sub-tests of standardised intelligence scales. There was also much variability in the cognitive profiles at the individual level, with no consistent areas of strength or weakness evident for either group. The main difference found between the groups was in FSIQ, which was higher amongst individuals with Asperger's disorder due to their better verbal abilities. However, again, the similarities between the groups could have been a product of poor initial group differentiation as all children in both groups met criteria for autistic disorder (Volkmar & Klin, 2000).

Miller and Ozonoff (2000) and Ozonoff et al. (2000), using strict DSM-IV (APA, 1994) criteria, also found that high-functioning autism and Asperger's disorder were not clearly distinguishable on the basis of cognitive profiles, with children in both groups showing mixed patterns of ability. Miller and Ozonoff concurred with some other researchers (Gilchrist et al., 2001; Manjiviona & Prior, 1999; Ozonoff et al., 1991) in finding that FSIQ and VIQ were higher for the group with Asperger's disorder. There were, however, no group differences in visual-perceptual skills. In both studies, the groups were comparable in the frequency and direction of VIQ-PIQ discrepancies. These findings are commensurate with those of other researchers using formal diagnostic criteria (Ghaziuddin et al., 1994; Manjiviona & Prior, 1999), suggesting that no particular profile of cognitive abilities is characteristic of either disorder.

Executive function. Executive function involves several abilities required for preparing and engaging in complex organised behaviour, including managing impulses, planning, problem-solving, and mental flexibility. Comparative studies on executive function have revealed an absence of differences between individuals with autistic disorder and Asperger's disorder (Manjiviona & Prior, 1999; Ozonoff et al., 1991; Szatmari et al., 1990). However, the participants in each group consistently showed deficits in at least some areas of executive function relative to non-PDD control groups. These findings have been substantiated by the results from recent studies using strict DSM-IV (APA, 1994) criteria (Ghaziuddin et al., 1994; Miller & Ozonoff, 2000; Ozonoff et al., 2000).

Processing of global and local stimuli. Rinehart, Bradshaw, Moss, Brereton, and Tonge (2000) examined interference effects of global and local stimuli on the responses of youth with high-functioning autism and Asperger's disorder during a computer-based task. Participants were presented with a sequence of single large numbers composed of many small numbers on a computer screen. The

small numbers were either 'congruent' or 'incongruent' with the large number. No differences were found between the clinical groups in the amount of errors associated with the interference of local detail on global processing. The results were interpreted as supporting the notion that autism and Asperger's disorder belong on the same continuum.

Social-cognitive abilities. Some researchers have examined first- and second-order theory of mind abilities in individuals with autistic disorder and Asperger's disorder. These abilities refer, respectively, to the understanding that others can hold false beliefs and act in accordance with these, and that a person may base behaviour on a false belief about another's true belief (Baron-Cohen, 1989; Baron-Cohen, Leslie, & Frith, 1985; Sigman, Arbelle, & Dissanayake, 1995). The results from some studies suggest deficiencies in first- and second-order theory of mind abilities are common to both people with autism and Asperger's disorder (Baron-Cohen, Wheelwright, & Jolliffe, 1997; Scott, 1985). Other available evidence indicates that these deficits are less characteristic of Asperger's disorder, and suggest that this may be a basis on which the two conditions can be distinguished (Ozonoff et al., 1991; Ziatas, Durkin, & Pratt, 1998).

Studies indicating differences in theory of mind abilities have often been criticised on the grounds that these findings could be attributable to poor subject matching on VIQ. There has been strong evidence for a positive correlation between verbal skills and theory of mind abilities (Eisenmajer & Prior, 1991; Ozonoff et al., 1991; Prior et al., 1998). Thus, the apparently better theory of mind capacity in people with Asperger's disorder may reflect their higher verbal abilities (Ozonoff & McMahon Griffith, 2000; Volkmar & Klin, 2000; Wing, 1998).

Research findings by Jolliffe and Baron-Cohen (1999) and Klin (2000) provide some support for this notion. In both studies, all participants had previously passed second-order theory of mind tests, the groups were matched on VIQ and current formal diagnostic criteria were used in participant selection. Jolliffe and Baron-Cohen examined performance on a modified version of Happé's Strange Stories Test where participants were given stories, with simple pictorial cues, involving social situations in which a person made a non-literal statement. They were asked whether or not this statement was accurate, and to explain the character's actions based on contextual cues. Relative to normally developing adults, those with autism and Asperger's disorder provided fewer accurate explanations for the story character's comments. Both clinical groups showed an equally poor ability to use contextual information to understand the character's mental states. The results were taken as supporting the view that autistic disorder and Asperger's disorder belong on the autistic spectrum.

Klin (2000) presented people with high-functioning autism and Asperger's disorder, and normally developing individuals, with videotaped recordings of various geometric shapes that moved and interacted in 'human-like' ways. The clinical participants were comparable in making fewer and poorer social attributions to the movements of the shapes than the control participants. The results indicate that individuals with these disorders may experience extreme social difficulties in real-life contexts because they fail to identify all of the important social cues.

Motor skills

Parental reports of developmental history regarding motor milestones and current motor abilities have been examined. Szatmari, Bartolucci, et al. (1989) interviewed parents about their children's acquisition of various abilities, including dressing, tying shoelaces, using pencils and eating with cutlery. The children with high-functioning autism and Asperger's disorder were not different in their acquisition or performance on these tasks, but both were delayed in their achievements relative to the non-autistic psychiatric control participants. However, there were several limitations to this study, particularly the lack of a clear definition of 'motor clumsiness' and the use of a non-standardised measure of motor abilities (Ghaziuddin, Tsai, & Ghaziuddin, 1992). In a later study, using parents' responses to items on a standardised interview measure, Szatmari et al. (1995) again found that the two groups were similar with regard to early motor development. Eisenmajer et al. (1996) found no differences in parents' reports of the age at which children with high-functioning autism and Asperger's disorder first sat up and crawled. However, the onset of walking was more likely to have been delayed in the children with autism. Unfortunately, all of the children with Asperger's disorder also met criteria for autistic disorder. Thus, the extensive similarities in motor development could reflect inadequate diagnostic separation of the groups (Ozonoff & McMahon Griffith, 2000; Smith, 2000). Howlin (2003) compared these groups on ADI-R parent report measures of gross and fine motor skills, and similarly, found no differences. However, as the author acknowledges, the study was limited by the lack of direct standardised assessment of motor abilities.

Gillberg (1989) tested participants on a standardised instrument and found that gross motor clumsiness was more prevalent amongst individuals with Asperger's disorder. However, again, there was a failure to use a standard definition of motor clumsiness and no reference to fine motor skills (Ghaziuddin et al., 1992; Kugler, 1998; Smith, 2000).

In reviewing chart records, Klin et al. (1995) found that participants with Asperger's disorder were much more likely to have a history of fine and gross motor difficulties. However, this difference

may be due to the participants with Asperger's disorder, unlike those with autism, only being recruited if they had an early history of problems in motor development (Ozonoff & McMahon Griffith, 2000; Smith, 2000; Volkmar & Klin, 2000; Wing, 2000). Nevertheless, the group differences in motor skills persisted once this criterion of motor delay was removed.

Szatmari et al. (1990) found that participants with Asperger's disorder demonstrated more problems in manual speed and dexterity compared to those with high-functioning autism when using their non-dominant hand, but performed similarly with their preferred hand. However, it has been suggested that the younger age of the participants with Asperger's disorder could have enhanced group differences (Ozonoff & McMahon Griffith, 2000).

Rinehart, Bradshaw, Brereton, and Tonge (2001) examined movement preparation and execution in these groups using a motor reprogramming task in which participants were required to press different sequences of buttons on a response board depending on the nature of increasingly complex visual stimuli. Although both groups showed normally developed abilities in executing movements, they showed deficits in preparing for movement relative to CA-, sex- and FSIQ-matched typically developing control groups. The nature of the movement preparation deficits differed, however. The participants with Asperger's disorder showed 'atypical' responses in the movement preparation phase, whereas those with autism demonstrated a 'lack of anticipation' prior to performing the motor act. The authors propose that these discrepancies may indicate differences in the functioning of the fronto-striatal brain region in these two disorders.

Iwanaga et al. (2000) found that some sensory-motor impairment was evident in all preschool-aged children with Asperger's disorder and most children with high-functioning autism, thereby concluding that motor deficits were not a diagnostic marker for Asperger's disorder. They argue that children with Asperger's disorder may be more susceptible to motor problems in their early years than those with autism, such that with age, the difference in rate of motor dysfunction decreases.

Some researchers have reported a lack of difference overall in the motor performance of individuals with autistic disorder and Asperger's disorder. Ghaziuddin et al. (1994) compared CA-, VIQ- and PIQ-matched children and adolescents on a standardised measure of upper limb coordination, and gross and fine motor abilities. Both groups performed poorly relative to age-appropriate norms, but were similar to each other in all areas. This finding was replicated in a subsequent study using the same test (Ghaziuddin & Butler, 1998). An advantage of this research programme was that none of the participants with Asperger's disorder had ever met criteria for autism. Manjiviona and Prior (1995) also

reported no differences between the two groups on a standardised test of ball skills, balance, and manual dexterity. Unfortunately, a bias towards reduced group differences in this study could have occurred because the criterion of no language delay in Asperger's disorder was excluded (Ozonoff & McMahon Griffith, 2000). Nevertheless, Miller and Ozonoff (2000), who used strict DSM-IV (APA, 1994) criteria, substantiated these findings using the most recent version of the same test.

Aetiological and biological factors

Limited comparative research has been undertaken on aetiological and biological markers. Ghaziuddin, Shakal, and Tsai (1995) found no differences between individuals with high-functioning autism and Asperger's disorder in the occurrence of obstetric insults. Similarly, Gillberg (1989) and Eisenmajer et al. (1996) found few differences in difficulties during pregnancy, birth and infancy, and in the occurrence of various medical disorders.

Gillberg (1989) and Gillberg, Steffenburg, and Jakobsson (1987) found that individuals with high-functioning autism and Asperger's disorder were similar in their rates of cerebral atrophy, levels of cerebrospinal fluid albumin, abnormalities in electroencephalogram and auditory brainstem response readings, and oculomotor functioning. However, as these studies were conducted prior to formal diagnostic criteria for Asperger's disorder, the applicability of the findings to children diagnosed according to current classification systems is unclear (Kugler, 1998; Volkmar & Klin, 2000).

There is evidence for a genetic relationship between autistic disorder and Asperger's disorder, such as the over-representation of males amongst individuals with both conditions, the raised incidence of autism in families of individuals with Asperger's disorder and vice versa, and the increased prevalence of psychiatric diagnoses such as affective disorders, attention problems, obsessive-compulsive disorder and Tourette's disorder in both groups and their families (Eisenmajer et al., 1996; Gillberg, 1989, 1999; Gillberg & Ehlers, 1998; Gillberg & Wing, 1999; Volkmar, Klin, & Pauls, 1998). Thus, to date, there is little evidence to differentiate these conditions on aetiological or biological factors.

Epidemiology, onset and prognosis

Prevalence. Based on the few existing population studies, Gillberg and Ehlers (1998) propose that Asperger's disorder may be considerably more common than high-functioning autism. If it is accepted that autism occurs in approximately 7 to 16 per 10,000 children, and Asperger's disorder affects 3 to 7 in every 1000 children, then high-functioning autism (occurring in 11 to 34% of autism cases) is much rarer than Asperger's disorder.

Onset. While DSM IV (APA, 1994) states that some symptoms must be evident prior to three years of age for a diagnosis of autistic disorder, no such specification is made for Asperger's disorder. Three studies have compared these groups on the age-of-onset criterion, and yielded reasonably consistent results. Szatmari, Bartolucci, et al. (1989) compared parental reports of the age at which the symptoms of children with high-functioning autism and Asperger's disorder were identified and found no differences. There was, however, a trend towards earlier 'onset' in autism ($M = 1.6$ years) than Asperger's disorder ($M = 2.2$ years). Howlin (2003) found that the age at which parents of children with high-functioning autism ($M = 15$ months) became concerned was earlier than that for children with Asperger's disorder ($M = 21$ months), but the difference only just reached significance. Eisenmajer et al. (1996) found that Asperger's disorder was diagnosed later ($M = 8.9$ years) than high-functioning autism ($M = 6.0$ years), but no difference was found in the age at which parents became concerned about their child's development (autism: $M = 1.8$ years; Asperger's disorder: $M = 1.6$ years).

Outcome. Although outcome in autism and Asperger's disorder is variable, some research has indicated that individuals with Asperger's disorder have a better prognosis than people with high-functioning autism. Szatmari et al. (1995) and Szatmari, Bartolucci, et al. (1989) reported higher achievement by people with Asperger's disorder in regard to self-help skills and social interaction, and in their need for fewer special education classes during the school years. Ozonoff et al. (2000) confirmed the finding that children with high-functioning autism receive more special education services than children with Asperger's disorder and are mainstreamed at a later grade. Howlin (2003) found that there were more adults with Asperger's disorder with university qualifications, but no group differences emerged regarding employment levels, degree of independence from family, and friendship status. There were also no differences in scores on the Social domain of the ADI-R, for both retrospective parent reports on child behaviour and for current reports on adult functioning.

In contrast to Szatmari et al. (1989, 1995) and Howlin (2003), Tonge, Brereton, Gray, and Einfeld (1999), using strict DSM-IV (APA, 1994) criteria to diagnose participants, found that adolescents and young adults with Asperger's disorder were reported by parents as having more social difficulties than those with high-functioning autism. The discrepancy between these results and those of Szatmari et al. was attributed to the latter's use of informal diagnostic criteria for Asperger's disorder, and their failure to exclude a diagnosis of autistic disorder in this group. This argument also applies to the difference in results from Howlin's (2003) study, wherein

ADI-R scores were used to separate groups rather than strict *DSM-IV* criteria.

Co-morbidity. There has been some evidence of greater psychiatric co-morbidity in Asperger's disorder over high-functioning autism. Szatmari (1991) and Szatmari, Bremner, et al. (1989) suggested that anxiety symptoms and a schizotypal personality are more common in Asperger's disorder. Eisenmajer et al. (1996) found that individuals with Asperger's disorder were more likely to have a co-morbid attention deficit/hyperactivity disorder. Tonge et al. (1999) found high rates of emotional and behavioural disturbance in youth with high-functioning autism (65%) and Asperger's disorder (85%). However, according to parent report, youth with Asperger's disorder showed more symptoms of anxiety and disruptive or anti-social behaviour. These differences were not attributable to variations between groups in IQ and CA, which were statistically controlled for in analyses. Further evidence for a potentially greater risk of psychopathology in Asperger's disorder has also emerged from research indicating more disorganised thinking in this group (Ghaziuddin, Leininger, & Tsai, 1995).

Differences have not always been found between the groups on co-morbid psychiatric disorders. On the basis of parental report, Kim, Szatmari, Bryson, Streiner, and Wilson (2000) found equally high rates of anxiety and depression in children and adolescents with the two disorders. Unfortunately, although participant selection procedures were based on *DSM-IV* (APA, 1994) criteria, the researchers gave precedence to a diagnosis of Asperger's disorder over high-functioning autism. Thus, many of the participants with Asperger's disorder may have met criteria for autism, resulting in poor initial group differentiation. Howlin (2003) also found a lack of differentiation on the basis of co-morbid psychiatric conditions. However, as the author states, formal mental status examination was not undertaken, so the nature and existence of psychiatric illness could not be verified.

Restricted and repetitive rituals, behaviours and interests

Little comparative research has been conducted on circumscribed interests, ritualistic behaviours or impaired imagination, even though these are accepted as core deficits in both autism and Asperger's disorder (Frith, 1996; Happé, 1994; Kugler, 1998; Wing, 1996). Szatmari, Bartolucci, et al. (1989) requested parents to rate the extent to which bizarre preoccupations, insistence on preserving sameness, and imaginative play were observed during the preschool years, middle childhood, and adolescence. Across all time intervals, a greater percentage of individuals with high-functioning autism than Asperger's disorder were rated as showing bizarre

preoccupations. However, it was not clear whether there were differences in the type of 'bizarre preoccupations' observed between the groups. The participants with autism were also more likely to have lacked imaginative play and shown resistance to change. However, the very low frequency of behaviours indicating 'resistance to change' for both groups raises doubts about the clinical meaningfulness of the difference. Furthermore, the fact that the participants with autism were mostly young adults, whereas those with Asperger's disorder were mostly adolescents, may have contributed to some of the differences. The findings from some studies suggest that in 'autism spectrum' disorders, circumscribed, odd preoccupations may only develop in the late childhood and adolescent years (Szatmari, 2000b; Waterhouse et al., 1996). Thus, the greater evidence of bizarre interests in the autism sample may have reflected the greater opportunity for such symptoms to emerge and become salient amongst members of this older group.

These differences in symptoms were somewhat replicated in a subsequent study using CA-matched children. Szatmari et al. (1995) found that children with high-functioning autism were more inclined to engage in compulsive and ritualistic behaviours and showed more resistance to change. Nevertheless, overall, few differences were found between the groups on measures of repetitive and restricted behaviours, and the range and type of repetitive behaviours were comparable. Unfortunately, this research was compromised by a failure to exclude a diagnosis of autism in many cases allocated to the Asperger's disorder group. Howlin (2003) reported an absence of group differences on the ADI-R measure of stereotypies, regardless of whether ratings were made for participants when they were children or adults.

The issue of whether autistic disorder and Asperger's disorder can be differentiated on the basis of circumscribed interests is further complicated by findings suggesting that these symptoms are more common amongst individuals with Asperger's disorder. Gillberg (1989) found that almost all of the children with Asperger's disorder were reported as displaying intense preoccupations, whereas this was true of only a third of the children with autism. Again, circularity between subject selection criteria and the results was apparent since a diagnosis of Asperger's disorder was only given to individuals who had at least one circumscribed interest.

Ozonoff et al.'s (2000) findings are compatible with those of Szatmari et al. (1995) and Szatmari, Bartolucci, et al. (1989) in indicating that individuals with high-functioning autism (of primary school age or older) showed greater deficits in imaginative play and more intense demands for sameness. However, the results are more akin to those of Gillberg (1989) with respect to problems of intense, circumscribed interests, these being much more common amongst

youth with Asperger's disorder. There were also several indices of current repetitive behaviours that did not differentiate the groups.

An advantage of the Ozonoff et al. (2000) study was that the participants' early history as well as current presentation of restricted, stereotyped patterns of behaviour was compared. They found more differences in repetitive behaviours during the preschool years than at subsequent developmental stages. The children with autism were reported as showing more severe symptoms such as less frequent engagement in make-believe play, more purposeless, ritualistic behaviour and routines, and a greater preoccupation with object parts. Gilchrist et al. (2001) also found a reduction in the group differences between early childhood and adolescence with regard to stereotyped behaviours. According to parent report, at an early age, children with high-functioning autism were more likely to have had unusual attachments and sensory interests, compulsions and rituals, and had more often engaged in body-rocking than children with Asperger's disorder. By adolescence, the only remaining difference related to body-rocking. It is noteworthy that in this study, as well as in those by Ozonoff et al. (2000) and Szatmari, Bartolucci, et al. (1989), some differences in the extent and nature of restricted, stereotyped behaviours persisted throughout the childhood and adolescent years.

Social behaviour

Despite the fact that impairments in social interaction are a core feature of both autism and Asperger's disorder (Buitelaar, 1995; Charlop-Christy & Kelso, 1999; Frith, 1996; Happé, 1994; Prior & Ozonoff, 1998; Wing, 1996; Zwaigenbaum & Szatmari, 1999), comparative research on their social behaviour is scant. The research that has been conducted has relied almost solely on parent and teacher reports.

Szatmari, Bartolucci, et al. (1989) and Szatmari et al. (1990) compared the social responsiveness of children with high-functioning autism and Asperger's disorder (currently aged between 8 and 18 years) during the period from birth to five years, using parent report. During their early years, the children with Asperger's disorder were reported as more likely to have been socially responsive to caregivers and other adults, shared interests with parents, been affectionate and displayed an interest in peers. There were no differences between the groups in the proportion of social interactions during which the children avoided eye contact and initiated conversations. Unfortunately, in addition to the limitations of relying exclusively on retrospective parental reports, the Asperger's disorder group was defined according to an 'adapted' version of Wing's (1981) criteria. Thus, the generalisability of these findings to children diagnosed according to current criteria is not guaranteed (Szatmari, 2000a; Volkmar & Klin, 2000).

Some of these methodological problems were addressed in a subsequent study (Szatmari et al., 1995) in which parents participated in structured interviews and provided information about their children's (aged between 4 and 6 years) current clinical characteristics. Once again, both children with autism and Asperger's disorder showed deficits on most dimensions of social and communicative competence and where differences existed, these were in the direction of children with Asperger's disorder demonstrating superior social interaction skills. More children with Asperger's disorder were reported as showing social intentions, affection, social reciprocity, comfort seeking, greeting behaviours, and pleasure or excitement in social interactions. These children also scored much higher than those with autism on the Socialisation domain of the Vineland Adaptive Behavior Scales, according to parent, but not teacher, report.

The two groups were not distinguishable on any dimension of social communication and some aspects of social interaction. There were no differences in participation in conversation, verbal rituals, gestures (including pointing), imitation, the use of vocal expressions and anticipatory gestures, nor in the range and appropriate use of facial expressions. Furthermore, no group differences were reported in the existence of friendships, the use of comforting behaviours, engagement in shared activities, the extent of regular involvement in social play and separation anxiety.

In considering these findings, it is particularly striking that although the children with Asperger's disorder displayed more social awareness and interest than those with autism, this did not result in greater involvement in social play or more friendships in the former group. The research by Eisenmajer et al. (1996) and Gillberg (1989) also supports the conclusion that Asperger's disorder may be associated with a stronger desire for friendship and a greater ability to engage in prosocial behaviours than high-functioning autism, but not necessarily a superior capacity for forming and maintaining friendships.

Research findings by Ozonoff et al. (2000) also support the notion that children with Asperger's disorder exhibit greater social competence compared to children with high-functioning autism during the first few years of life. On the basis of retrospective parental reports of behaviour at four to five years of age, children with Asperger's disorder showed fewer deficits in reciprocal social interaction. At the time of the study, however, when participants were between 6 and 21 years old, these differences no longer remained. Furthermore, the groups could not be distinguished on the basis of observed deficits in social interaction, as assessed in a clinical setting. Similarly, Gilchrist et al. (2001) found that in early development, children with Asperger's disorder showed fewer deficits than those with high-functioning autism in imitative social play, physically

preparing themselves to be lifted, attention- and help-seeking, and greeting behaviour. According to parent report, there were no differences between the groups once the children reached adolescence. When observed in a clinic setting, the only difference was in conversation, with the adolescents with Asperger's disorder engaging in this activity more frequently. Again, these findings of fewer differences in social competence between people with autism and Asperger's disorder with increasing age highlights that these two conditions may become more similar over time.

Discussion

In establishing whether Asperger's disorder is separate from high-functioning autism, well-designed and controlled empirical research incorporating participants diagnosed according to current formal criteria, and comparing them on variables independent of those used in the initial definition of samples, is essential (Klin et al., 2000; Kugler, 1998; Szatmari, 1998, 2000a; Volkmar & Klin, 2000). Clear, consistent evidence of qualitatively different or unique patterns in key behaviours, symptoms, developmental course and aetiology associated with each condition is necessary to support the claim that these are distinct diagnostic entities (Gillberg, 1998; Gillberg & Ehlers, 1998; Szatmari, 2000a, b; Wing, 2000). Conversely, reliable evidence of an absence of differences or purely quantitative differences is required to support the notion that high-functioning autism and Asperger's disorder are manifestations of the same syndrome. Quantitative (but not qualitative) differences can be considered to exist when there are similarities in the range and patterns of functioning on key variables, with discrepancies being in relation to frequency, intensity or severity only.

Overall, based on the evidence to date, the validity of Asperger's disorder as a unique syndrome, separate from high-functioning autism, has not yet been either conclusively established or refuted (Klin et al., 2000; Schopler, 1998; Szatmari, 1998; Volkmar, Klin, Schultz, Rubin, & Bronen, 2000). Currently, firm conclusions are not possible as relevant research has been insufficient in quantity, scope and content, and has been hampered by methodological problems. A key methodological issue lies with the use of modified DSM/ICD criteria in diagnosing Asperger's disorder, which results in a lack of comparability across studies. A related problem has been the failure to consistently differentiate the two diagnoses. Moreover, empirically derived knowledge in some key areas is negligible or non-existent. The dearth of research on central features crucial to the diagnosis of both disorders, such as social impairments, is especially remarkable. Just as differences in areas hypothesised as distinguishing the disorders

must be established through well-designed research, the extent to which these conditions are comparable on symptoms presumed to be shared must also be empirically determined (Gillberg & Ehlers, 1998; Kugler, 1998; Szatmari, 1998).

Nevertheless, on the basis of the accumulated research evidence, it appears that there are very few qualitative distinctions between high-functioning autism and Asperger's disorder, with most symptoms, associated features, and biological indices being shared or overlapping to some degree. It is noteworthy that the findings from the comparative research are often marked by an absence of differences, or only quantitative differences between these conditions. This is apparent even when strict diagnostic criteria have been adhered to in the process of group assignment. It also appears that identified differences may be more pronounced during the first years of life than during middle childhood or later (Eisenmajer et al., 1996; Gilchrist et al., 2001; Howlin, 2003; Szatmari et al., 1995). Furthermore, where differences have been detected, these can often be interpreted as an outcome of circularity between the criteria for subject selection and the findings (Klin & Volkmar, 1997; Klin et al., 2000; Schopler, 1998; Szatmari, 2000b; Volkmar & Klin, 2000; Volkmar et al., 1997, 1998). The empirical sub-typing studies also indicate that the statistically generated sub-types are not qualitatively unique from each other. Instead, differences between them have typically been regarded as reflecting variations in the severity of impairments (e.g., Borden & Ollendick, 1994; Fein et al., 1999; Myhr, 1998; Prior et al., 1998; Sevin et al., 1995; Volkmar et al., 1997; Waterhouse et al., 1996).

The absence of any real qualitative differences identified to date suggests that Asperger's disorder is on a continuum with autistic disorder. However, as several researchers argue, until a clear consensus has been achieved that is well grounded in empirical evidence, it would be a mistake to prematurely terminate the debate over whether the disorders are separate or essentially the same (Schopler, 1998; Szatmari, 1998, 2000a, b; Volkmar & Klin, 2000). The overlap between the disorders and others with which they share features, such as schizoid personality disorder, non-verbal learning disability, and semantic-pragmatic language disorder, needs to be more fully researched (Gillberg, 1992, 1998; Gillberg & Ehlers, 1998; Szatmari, 1998; Volkmar & Klin, 2000).

A recent theory proposed by Szatmari (1998, 2000a, b), that the similarities and differences between autism and Asperger's disorder may be accounted for by the existence of two distinct developmental trajectories that have the potential to converge over time, also merits consideration. According to this model, in the early years, the more advanced language abilities of children with Asperger's disorder place them on one developmental trajectory. Those children without functional speech

(more typical of autism) start along another pathway, with their greater language impairments more severely affecting the subsequent development of communication, socialisation and imagination. Over time, some children from the latter group develop functional speech, and then cross over to the other trajectory, with their skills eventually approximating those of children with Asperger's disorder.

Given that the validity of Asperger's disorder as a unique syndrome has not yet been established, its inclusion as a separate diagnostic category in the classification systems does, as Schopler (1998) has argued, appear somewhat premature. In light of the available evidence, it may be that the best solution for clinical practice is to use the broader category of 'autism spectrum disorder' or an equivalent (Szatmari, 2000b), but also to specify which sub-type (i.e., autistic disorder or Asperger's disorder) is most applicable. This would allow researchers to continue to investigate the relationship between autistic disorder and Asperger's disorder. Ultimately, it is only well-designed research in which the precise manifestations of the deficits in autistic disorder and Asperger's disorder are documented that will provide valuable information about the validity of current diagnostic systems, and directions for how they may be improved. Indeed, it seems inevitable that the criteria for Asperger's disorder will need to be revised given the common difficulties experienced in adhering to current criteria both in research and in clinical practice (Szatmari, 2000a; Volkmar & Klin, 2000; Wing, 2000).

Correspondence to

Cheryl Dissanayake, School of Psychological Science, La Trobe University, Victoria, 3086, Australia; Email: c-dissanayake@latrobe.edu.au

References

- American Psychiatric Association. (1994). *Diagnostic and statistical manual of mental disorders* (4th edn). Washington, DC: American Psychiatric Association.
- Baron-Cohen, S. (1989). The autistic child's theory of mind: A case of specific developmental delay. *Journal of Child Psychology and Psychiatry*, 30, 285–287.
- Baron-Cohen, S., Leslie, A.M., & Frith, U. (1985). Does the autistic child have a 'theory of mind'? *Cognition*, 21, 37–46.
- Baron-Cohen, S., Wheelwright, S., & Jolliffe, T. (1997). 'Is there a language of the eyes?' Evidence from normal adults, and adults with autism and Asperger syndrome. *Visual Cognition*, 4, 311–331.
- Bishop, D.V.M. (1989). Autism, Asperger's syndrome and semantic-pragmatic disorder: Where are the boundaries? *British Journal of Disorders of Communication*, 24, 107–121.
- Borden, M.C., & Ollendick, T.H. (1994). An examination of the validity of social subtypes in autism. *Journal of Autism and Developmental Disorders*, 24, 23–37.
- Buitelaar, J.K. (1995). Attachment and social withdrawal in autism: Hypotheses and findings. *Behaviour*, 132, 319–350.
- Charlop-Christy, M.H., & Kelso, S.E. (1999). Autism. In V.L. Schwann & D.H. Saklofske (Eds.), *Handbook of psychosocial characteristics of exceptional children* (pp. 247–273). New York: Kluwer Academic/Plenum Publishers.
- Eaves, L.C., Ho, H.H., & Eaves, D.M. (1994). Subtypes of autism by cluster analysis. *Journal of Autism and Developmental Disorders*, 24, 3–22.
- Ehlers, S., Nyden, A., Gillberg, C., Dahlgren Sandberg, A., Dahlgren, S.O., Hjelmquist, E., & Oden, A. (1997). Asperger syndrome, autism and attention disorders: A comparative study of the cognitive profiles of 120 children. *Journal of Child Psychology and Psychiatry*, 38, 207–217.
- Eisenmajer, R., & Prior, M. (1991). Cognitive linguistic correlates of 'theory of mind' ability in autistic children. *British Journal of Developmental Psychology*, 9, 351–364.
- Eisenmajer, R., Prior, M., Leekam, S., Wing, L., Gould, J., Welham, M., & Ong, B. (1996). Comparison of clinical symptoms in autism and Asperger's disorder. *Journal of the American Academy of Child and Adolescent Psychiatry*, 35, 1523–1531.
- Fein, D., Stevens, M., Dunn, M., Waterhouse, L., Allen, D., Rapin, I., & Feinstein, C. (1999). Subtypes of pervasive developmental disorder: Clinical characteristics. *Child Neuropsychology*, 5, 1–23.
- Fine, J., Bartolucci, G., Ginsberg, G., & Szatmari, P. (1991). The use of intonation to communicate in pervasive developmental disorders. *Journal of Child Psychology and Psychiatry*, 32, 771–782.
- Fine, J., Bartolucci, G., Szatmari, P., & Ginsberg, G. (1994). Cohesive discourse in pervasive developmental disorders. *Journal of Autism and Developmental Disorders*, 24, 315–329.
- Frith, U. (1996). Social communication and its disorder in autism and Asperger syndrome. *Journal of Psychopharmacology*, 10, 48–53.
- Ghaziuddin, M., & Butler, E. (1998). Clumsiness in autism and Asperger syndrome: A further report. *Journal of Intellectual Disability Research*, 42, 43–48.
- Ghaziuddin, M., Butler, E., Tsai, L., & Ghaziuddin, N. (1994). Is clumsiness a marker for Asperger syndrome? *Journal of Intellectual Disability Research*, 38, 519–527.
- Ghaziuddin, M., & Gerstein, L. (1996). Pedantic speaking style differentiates Asperger syndrome from high-functioning autism. *Journal of Autism and Developmental Disorders*, 26, 585–595.
- Ghaziuddin, M., Leininger, L., & Tsai, L. (1995). Brief report: Thought disorder in Asperger syndrome: Comparison with high-functioning autism. *Journal of Autism and Developmental Disorders*, 25, 311–317.
- Ghaziuddin, M., Shakal, J., & Tsai, L. (1995). Obstetric factors in Asperger syndrome: Comparison with high-functioning autism. *Journal of Intellectual Disability Research*, 39, 538–543.
- Ghaziuddin, M., Tsai, L.Y., & Ghaziuddin, N. (1992). Brief report: A reappraisal of clumsiness as a diagnostic feature of Asperger syndrome. *Journal of Autism and Developmental Disorders*, 22, 651–656.
- Gilchrist, A., Green, J., Cox, A., Burton, D., Rutter, M., & Le Couteur, A. (2001). Development and current

- functioning in adolescents with Asperger syndrome: A comparative study. *Journal of Child Psychology and Psychiatry*, 42, 227–240.
- Gillberg, C. (1989). Asperger syndrome in 23 Swedish children. *Developmental Medicine and Child Neurology*, 31, 529–531.
- Gillberg, C. (1992). The Emmanuel Miller Memorial Lecture 1991: Autism and autistic-like conditions: Subclasses among disorders of empathy. *Journal of Child Psychology and Psychiatry*, 33, 813–842.
- Gillberg, C. (1998). Asperger syndrome and high-functioning autism. *British Journal of Psychiatry*, 172, 200–209.
- Gillberg, C. (1999). Autism and its spectrum disorders. In N. Bouras (Ed.), *Psychiatric and behavioural disorders in developmental disabilities and mental retardation* (pp. 73–95). Cambridge, MA: Cambridge University Press.
- Gillberg, C., & Ehlers, S. (1998). High-functioning people with autism and Asperger syndrome: A literature review. In E. Schopler, G.B. Mesibov, & L.J. Kuncze (Eds.), *Asperger syndrome or high-functioning autism?* (pp. 79–106). New York: Plenum Press.
- Gillberg, C., Steffenburg, S., & Jakobsson, G. (1987). Neurological findings in 20 relatively gifted children with Kanner type autism or Asperger syndrome. *Developmental Medicine and Child Neurology*, 29, 641–649.
- Gillberg, C., & Wing, L. (1999). Autism: Not an extremely rare disorder. *Acta Psychiatrica Scandinavica*, 99, 399–406.
- Happé, F. (1994). *Autism: An introduction to psychological theory*. Cambridge, MA: Harvard University Press.
- Howlin, P. (2003). Outcome in high functioning adults with autism with and without early language delays: Implications for the differentiation between autism and Asperger syndrome. *Journal of Autism and Developmental Disorders*, 33, 3–13.
- Iwanaga, R., Kawasaki, C., & Tsuchida, R. (2000). Brief report: Comparison of sensory-motor and cognitive function between autism and Asperger syndrome in preschool children. *Journal of Autism and Developmental Disorders*, 30, 169–174.
- Jolliffe, T., & Baron-Cohen, S. (1999). The strange stories test: A replication with high-functioning adults with autism or Asperger syndrome. *Journal of Autism and Developmental Disorders*, 29, 395–406.
- Kim, J.A., Szatmari, P., Bryson, S.E., Streiner, D.L., & Wilson, F.J. (2000). The prevalence of anxiety and mood problems among children with autism and Asperger syndrome. *Autism*, 4, 117–132.
- Klin, A. (2000). Attributing social meaning to ambiguous visual stimuli in higher-functioning autism and Asperger syndrome: The social attribution task. *Journal of Child Psychology and Psychiatry*, 41, 831–846.
- Klin, A., & Volkmar, F.R. (1997). The pervasive developmental disorders: Nosology and profiles of development. In S.S. Luthar (Ed.), *Developmental psychopathology: Perspectives on adjustment risk and disorder* (pp. 208–226). Cambridge, MA: Cambridge University Press.
- Klin, A., Volkmar, F.R., & Sparrow, S.S. (2000). Introduction. In A. Klin, F.R. Volkmar, & S.S. Sparrow (Eds.), *Asperger syndrome* (pp. 1–21). New York: Guilford Press.
- Klin, A., Volkmar, F.R., Sparrow, S.S., Cicchetti, D.V., & Rourke, B.P. (1995). Validity and neuropsychological characterisation of Asperger syndrome: Convergence with nonverbal learning disabilities syndrome. *Journal of Child Psychology and Psychiatry*, 36, 1127–1140.
- Kugler, B. (1998). The differentiation between autism and Asperger syndrome. *Autism*, 2, 11–32.
- Manjiviona, J., & Prior, M. (1995). Comparison of Asperger syndrome and high-functioning autistic children on a test of motor impairment. *Journal of Autism and Developmental Disorders*, 25, 23–39.
- Manjiviona, J., & Prior, M. (1999). Neuropsychological profiles of children with Asperger syndrome and autism. *Autism*, 3, 327–356.
- Miller, J.N., & Ozonoff, S. (2000). The external validity of Asperger disorder: Lack of evidence from the domain of neuropsychology. *Journal of Abnormal Psychology*, 109, 227–238.
- Myhr, G. (1998). Autism and other pervasive developmental disorders: Exploring the dimensional view. *Canadian Journal of Psychiatry*, 43, 589–595.
- Ozonoff, S., & McMahon Griffith, E. (2000). Neuropsychological function and the external validity of Asperger syndrome. In A. Klin, F.R. Volkmar, & S.S. Sparrow (Eds.), *Asperger syndrome* (pp. 72–96). New York: Guilford Press.
- Ozonoff, S., Rogers, S.J., & Pennington, B.F. (1991). Asperger's syndrome: Evidence of an empirical distinction from high-functioning autism. *Journal of Child Psychology and Psychiatry*, 32, 1107–1122.
- Ozonoff, S., South, M., & Miller, J.N. (2000). DSM-IV-defined Asperger syndrome: Cognitive, behavioral, and early history differentiation from high-functioning autism. *Autism*, 4, 29–46.
- Pomeroy, J.C. (1998). Subtyping pervasive developmental disorder: Issues of validity and implications for child psychiatric diagnosis. In E. Schopler, G.B. Mesibov, & L.J. Kuncze (Eds.), *Asperger syndrome or high-functioning autism?* (pp. 29–76). New York: Plenum Press.
- Prior, M., Eisenmajer, R., Leekam, S., Wing, L., Gould, J., Ong, B., & Dove, D. (1998). Are there subgroups within the autistic spectrum? A cluster analysis of a group of children with autistic spectrum disorders. *Journal of Child Psychology and Psychiatry*, 39, 893–902.
- Prior, M., & Ozonoff, S. (1998). Psychological factors in autism. In F.R. Volkmar (Ed.), *Autism and pervasive developmental disorders: Cambridge monographs in child and adolescent psychiatry* (pp. 64–108). New York: Cambridge University Press.
- Ramberg, C., Ehlers, S., Nyden, A., Johansson, M., & Gillberg, C. (1996). Language and pragmatic functions in school-age children on the autism spectrum. *European Journal of Disorders of Communication*, 31, 387–414.
- Rescorla, L. (1988). Cluster analytic identification of autistic preschoolers. *Journal of Autism and Developmental Disorders*, 18, 475–492.
- Rinehart, N.J., Bradshaw, J.L., Brereton, A.V., & Tonge, B.J. (2001). Movement preparation in high-functioning autism and Asperger disorder: A serial

- choice reaction time task involving motor programming. *Journal of Autism and Developmental Disorders*, 31, 79–88.
- Rinehart, N.J., Bradshaw, J.L., Moss, S.A., Brereton, A.V., & Tonge, B.J. (2000). Atypical interference of local detail on global processing in high-functioning autism and Asperger's disorder. *Journal of Child Psychology and Psychiatry*, 41, 769–778.
- Schopler, E. (1998). Premature popularization of Asperger syndrome. In E. Schopler, G.B. Mesibov, & L.J. Kuncie (Eds.), *Asperger syndrome or high-functioning autism?* (pp. 385–399). New York: Plenum Press.
- Schopler, E., Mesibov, G.B., & Kuncie, L.J. (Eds.). (1998). *Asperger syndrome or high-functioning autism?* New York: Plenum Press.
- Scott, D.W. (1985). Asperger's syndrome and nonverbal communication: A pilot study. *Psychological Medicine*, 15, 683–687.
- Sevin, J.A., Matson, J.L., Coe, D., Love, S.R., Matese, M.J., & Benavidez, D.A. (1995). Empirically derived subtypes of pervasive developmental disorders: A cluster analytic study. *Journal of Autism and Developmental Disorders*, 25, 561–578.
- Siegel, B., Anders, T.F., Ciaranello, R.D., Bienenstock, B., & Kraemer, H.C. (1986). Empirically derived subclassification of the autistic syndrome. *Journal of Autism and Developmental Disorders*, 16, 275–293.
- Sigman, M., Arbelle, S., & Dissanayake, C. (1995). Current research findings on childhood autism. *Canadian Journal of Psychiatry*, 40, 289–294.
- Smith, I.M. (2000). Motor functioning in Asperger syndrome. In A. Klin, F.R. Volkmar, & S.S. Sparrow (Eds.), *Asperger syndrome* (pp. 97–124). New York: Guilford Press.
- Szatmari, P. (1991). Asperger's syndrome: Diagnosis, treatment, and outcome. *Psychiatric Clinics of North America*, 14, 81–93.
- Szatmari, P. (1992). The validity of autistic spectrum disorders: A literature review. *Journal of Autism and Developmental Disorders*, 22, 583–600.
- Szatmari, P. (1998). Differential diagnosis of Asperger disorder. In E. Schopler, G.B. Mesibov, & L.J. Kuncie (Eds.), *Asperger syndrome or high-functioning autism?* (pp. 61–76). New York: Plenum Press.
- Szatmari, P. (2000a). Perspectives on the classification of Asperger syndrome. In A. Klin, F.R. Volkmar, & S.S. Sparrow (Eds.), *Asperger syndrome* (pp. 403–417). New York: Guilford Press.
- Szatmari, P. (2000b). The classification of autism, Asperger's syndrome, and pervasive developmental disorder. *Canadian Journal of Psychiatry*, 45, 731–738.
- Szatmari, P., Archer, L., Fisman, S., Streiner, D.L., & Wilson, F. (1995). Asperger's syndrome and autism: Differences in behavior, cognition, and adaptive functioning. *Journal of the American Academy of Child and Adolescent Psychiatry*, 34, 1662–1671.
- Szatmari, P., Bartolucci, G., & Bremner, R. (1989). Asperger's syndrome and autism: Comparison of early history and outcome. *Developmental Medicine and Child Neurology*, 31, 709–720.
- Szatmari, P., Bartolucci, G., Finlayson, A., & Krames, L. (1986). A vote for Asperger's syndrome. *Journal of Autism and Developmental Disorders*, 16, 515–517.
- Szatmari, P., Bremner, R., & Nagy, J. (1989). Asperger's syndrome: A review of clinical features. *Canadian Journal of Psychiatry*, 34, 554–560.
- Szatmari, P., Tuff, L., Allen, M., Finlayson, J., & Bartolucci, G. (1990). Asperger's syndrome and autism: Neurocognitive aspects. *Journal of the American Academy of Child and Adolescent Psychiatry*, 29, 130–136.
- Tonge, B.J., Brereton, A.V., Gray, K.M., & Einfeld, S.L. (1999). Behavioural and emotional disturbance in high-functioning autism and Asperger syndrome. *Autism*, 3, 117–130.
- Volkmar, F.R., & Klin, A. (2000). Diagnostic issues in Asperger syndrome. In A. Klin, F.R. Volkmar, & S.S. Sparrow (Eds.), *Asperger syndrome* (pp. 25–71). New York: Guilford Press.
- Volkmar, F.R., Klin, A., & Cohen, D.J. (1997). Diagnosis and classification of autism and related conditions: Consensus and issues. In D.J. Cohen & F.R. Volkmar (Eds.), *Handbook of autism and pervasive developmental disorders* (pp. 5–40). New York: John Wiley & Sons.
- Volkmar, F.R., Klin, A., & Pauls, D. (1998). Nosological and genetic aspects of Asperger syndrome. *Journal of Autism and Developmental Disorders*, 28, 457–463.
- Volkmar, F.R., Klin, A., Schultz, R.T., Rubin, E., & Bronen, R. (2000). Asperger's disorder. *American Journal of Psychiatry*, 157, 262–267.
- Waterhouse, L., Morris, R., Allen, D., Dunn, M., Fein, D., Feinstein, C., Rapin, I., & Wing, L. (1996). Diagnosis and classification in autism. *Journal of Autism and Developmental Disorders*, 26, 59–86.
- Wing, L. (1981). Asperger's syndrome: A clinical account. *Psychological Medicine*, 11, 115–130.
- Wing, L. (1991). The relationship between Asperger's syndrome and Kanner's autism. In U. Frith (Ed.), *Autism and Asperger syndrome* (pp. 93–121). Cambridge, UK: Cambridge University Press.
- Wing, L. (1996). *The autistic spectrum: A guide for parents and professionals*. Suffolk, UK: St Edmundsbury Press.
- Wing, L. (1998). The history of Asperger syndrome. In E. Schopler, G.B. Mesibov, & L.J. Kuncie (Eds.), *Asperger syndrome or high-functioning autism?* (pp. 11–28). New York: Plenum Press.
- Wing, L. (2000). Past and future of research on Asperger syndrome. In A. Klin, F.R. Volkmar, & S.S. Sparrow (Eds.), *Asperger syndrome* (pp. 418–432). New York: Guilford Press.
- World Health Organization. (1993). *International classification of diseases* (10th edn). Geneva: World Health Organization.
- Ziadas, K., Durkin, K., & Pratt, C. (1998). Belief term development in children with autism, Asperger syndrome, specific language impairment, and normal development: Links to theory of mind development. *Journal of Child Psychology and Psychiatry*, 39, 755–763.
- Zwaigenbaum, L., & Szatmari, P. (1999). Psychosocial characteristics of children with pervasive developmental disorders. In V.L. Schwann, & D.H. Saklofske (Eds.), *Handbook of psychosocial characteristics of exceptional children* (pp. 275–298). New York: Kluwer Academic/Plenum Publishers.