Research study

Behaviour profiles of children with attention deficit hyperactivity disorder and autism spectrum disorder on the parent Pervasive Developmental Disorder Behaviour Inventory

IL Cohen*

Abstract

Substantial overlap exists between autism spectrum disorder and attention deficit hyperactivity disorder at multiple levels. Aetiological, similarity exists in genetic liability for the two disorders. Phenotypically, comorbidity exists between autism spectrum disorder and symptoms of attention deficit hyperactivity disorder with rates varying between 28% and 92% and both groups have similar problems with social cognition. The aim of this study was to discuss behaviour profiles of children with attention deficit hyperactivity disorder and autism spectrum disorder on the parent PDD Behaviour Inventory.

Materials and methods

Parent ratings of children with autism spectrum disorder (with and without attention deficit hyperactivity disorder behaviours) were compared with parent ratings of children with attention deficit hyperactivity disorder behaviours who did not have autism spectrum disorder (the attention deficit hyperactivity disorder group) using the PDD Behaviour Inventory, a rating instrument that is age-standardised on children with attention deficit hyperactivity disorder (ADHD) at multiple levels. Aetiological, similarity exists in genetic liability for the two disorders. Phenotypically, comorbidity exists between ASD and symptoms of ADHD with rates varying between 28% and 92% and both groups have similar problems with social cognition. Where there is comorbidity between ASD and ADHD, studies suggest that a more severe phenotype exists in terms of increased oppositional and anxiety behaviours, decreased IQ and adaptive skill and worse response to intervention. As a result of these observations, the new Diagnostic and Statistical Manual of Mental Disorders (DSM-5), now permits provision of both diagnoses whereas this was not the case in previous versions.

Many of the studies that have investigated similarities and differences between the two groups have utilised either structured diagnostic interviews or rating scales standardised on typically developing children. The former do not provide quantitative assessments on severity and the latter may have only a few items relevant to ASD and/or have skewed score distributions since they ask questions that are expected to be atypical in the general population. One study that did employ a variety of ASD-related scales to compare ASD and ADHD utilised instruments that are not age-standardised, emphasise aberrant behaviours and not adaptive skills, and which had, as its primary purpose, examining the classification accuracy of these tools.

Results

The attention deficit hyperactivity disorder group’s maladaptive behaviours were rated as more severe than those in the autism spectrum disorder group, especially on those domains assessing fears and aggression. Further, the attention deficit hyperactivity disorder group was rated as having greater severity of fears and aggression when compared with those in the autism spectrum disorder group who also had comorbid attention deficit hyperactivity disorder behaviours. By contrast, the attention deficit hyperactivity disorder group was rated as having better expressive language ability than the autism spectrum disorder group especially when compared with those in the autism spectrum disorder group with comorbid attention deficit hyperactivity disorder behaviours. It is hypothesised that the increased severity of fears and aggression in the attention deficit hyperactivity disorder group may reflect their relatively increased ability to communicate these problems to others.

Conclusion

These data extend findings from previous studies and suggest that a unique attention deficit hyperactivity disorder profile may exist for children with attention deficit hyperactivity disorder on the PDD Behaviour Inventory.

Introduction

Substantial overlap exists between autism spectrum disorder (ASD) and attention deficit hyperactivity disorder (ADHD) at multiple levels. Aetiological, similarity exists in genetic liability for the two disorders. Phenotypically, comorbidity exists between ASD and symptoms of ADHD with rates varying between 28% and 92% and both groups have similar problems with social cognition. Where there is comorbidity between ASD and ADHD, studies suggest that a more severe phenotype exists in terms of increased oppositional and anxiety behaviours, decreased IQ and adaptive skill and worse response to intervention. As a result of these observations, the new Diagnostic and Statistical Manual of Mental Disorders (DSM-5), now permits provision of both diagnoses whereas this was not the case in previous versions.

Many of the studies that have investigated similarities and differences between the two groups have utilised either structured diagnostic interviews or rating scales standardised on typically developing children. The former do not provide quantitative assessments on severity and the latter may have only a few items relevant to ASD and/or have skewed score distributions since they ask questions that are expected to be atypical in the general population. One study that did employ a variety of ASD-related scales to compare ASD and ADHD utilised instruments that are not age-standardised, emphasise aberrant behaviours and not adaptive skills, and which had, as its primary purpose, examining the classification accuracy of these tools.

Licensee OA Publishing London 2013. Creative Commons Attribution License (CC-BY)

The purpose of this study was to investigate this phenomenon by examining similarities and differences in parent PDDBI ratings of children with ASD and children with ADHD behaviours referred to our clinic for differential diagnosis. Data indicate that, in general, parents (typically mothers) of children with ADHD behaviours perceive the severity of their children’s behaviour problems as worse than do parents of children with ASD (including parents of children with ASD who are reported by the parents to show ADHD traits). This behaviour pattern was highly predictive of diagnosis.

Materials and methods

Participants

The original sample consisted of 169 children evaluated at the George A. Jervis clinic because of concern regarding their diagnosis and development. From this sample, 139 cases were selected based on the following criteria:

- Parent completion of PDDBI prior to the clinical evaluation,
- Age at time of evaluation greater than 2.5 years,
- Absence of a known aetiology linked to a developmental disability (such as Down syndrome, Fragile X syndrome, Cerebral palsy, etc.),
- Behavioural observation with ADOS-G, and
- For cases without ASD (defined as failure to meet criteria for ASD based on the ADOS-G and clinical observations), a behaviour pattern suggestive of ADHD (see below)

A Vineland Adaptive Behaviour Scales or Vineland-II, average domain score ≥55 in order to remove cases with severe to profound delays.

Children were between the ages of 2.4 and 13.8 years (mean (SD) = 5.0 (2.3) years) at the time the parent completed the PDDBI, which was filled out approximately one month prior to the clinical evaluation. Eighty-four percent were boys. One hundred and nineteen were diagnosed as having ASD and 16 had a behaviour profile suggestive of ADHD without ASD (defined as the ADHD group; see below). All diagnoses of ASD were based on parent interviews and direct observation with the ADOS-G. Final diagnoses were based on DSM-IV or DSM-IV-TR criteria.

Seventy-eight percent of parents were Caucasian, 8% Hispanic, 6% Pacific Islander, 1% Asian and the remainder were of mixed ethnicity. This group was largely middle to upper middle class in terms of education and economic status.

Groups did not significantly differ in mean age (ASD mean (SD) = 4.9 (2.2); ADHD mean (SD) = 5.3 (3.0); F(1,133) = 0.28, ns) or Vineland Communication Domain Score (ASD mean (SD) = 79.8 (18.2); ADHD mean (SD) = 85.8 (11.9); F(1,133) = 1.66, p = 0.20). Males represented 69% of the ADHD group and 87% of the ASD group (maximum likelihood χ²(1) = 2.9, p = 0.09).

In the ASD group, 54% met criteria for Autistic Disorder; 38% for PDD-Not Otherwise Specified and 8% for Asperger’s Disorder. Within the ADHD group, 63% were given a primary diagnosis of ADHD, 19% a primary diagnosis of Mixed Receptive-Expressive Language Disorder and the remainder had a mix of diagnoses. The children with the ADHD diagnosis were older (mean age = 6.3 years) than those with Mixed Receptive-Expressive Language Disorder (mean age = 2.9 years).

Assessments

PDDBI

The PDDBI, completed by the mother or both mother and father in 94% of cases, served as the primary dependent measure and is briefly described here with the description abstracted from the manual, where more detail can be found on its reliability and validity, along with a description of the standardisation sample.

The PDDBI is constructed, a priori, in a hierarchical manner. At the first level, the PDDBI is divided into two orthogonal behavioural dimensions: (a) AWPs, assessing maladaptive behaviours and (b) Receptive/Expressive Social Communication Abilities (REXSCA), assessing social communicative competence. Each of these dimensions comprises a number of separate behavioural domains best reflecting that dimension.

The PDDBI generates age-normed T-scores (mean (SD) = 50 (10)) for each domain and for each composite score (representing a summary of the domain scores) for children between 1.5 and 12.5 years of age. An Autism composite score is generated based on those domain T-scores most relevant to a diagnosis of autism. These domain and composite T-scores are normally distributed within the standardisation sample. The PDDBI is constructed, a priori, in a hierarchical manner. At the first level, the PDDBI is divided into two orthogonal behavioural dimensions: (a) AWPs, assessing maladaptive behaviours and (b) Receptive/Expressive Social Communication Abilities (REXSCA), assessing social communicative competence. Each of these dimensions comprises a number of separate behavioural domains best reflecting that dimension. The PDDBI generates age-normed T-scores (mean (SD) = 50 (10)) for each domain and for each composite score (representing a summary of the domain scores) for children between 1.5 and 12.5 years of age. An Autism composite score is generated based on those domain T-scores most relevant to a diagnosis of autism. These domain and composite T-scores are normally distributed within the standardisation sample.
reference sample, enabling complex statistical models to be utilised.

Each domain, in turn, consists of separate clusters that best represent the overall domain construct. Finally, each cluster consists of items (scored from 0 to 3) designed to best characterise that cluster. While originally developed to measure response to intervention, several of the scores generated from the PDDBI agree very well with diagnoses made by both Autism Diagnostic Interview-Revised andADOS-G criteria16.

What follows is a brief description of the domains in the parent version, which was age-standardised on 369 well-diagnosed children.

**AWPs Dimension Domains**  
The first four domains of this dimension describe behaviours typically associated with autism while the remainder reflect non-specific behaviour problems. Higher domain T-scores indicate increasing levels of severity.

- **Sensory/Perceptual Approach Behaviours (SENSORY):** This domain includes behaviours that are largely non-communicative and involve an approach toward non-social stimuli (e.g. staring at objects, hand flapping, repetitive toy play, etc.).
- **Ritualisms/Resistance to Change (RITUAL):** This domain describes behaviours that communicate the child’s desires to carry out rituals or to indicate dissatisfaction with a change in the environment or routine.
- **Social Pragmatic Problems (SOCAPP):** This domain assesses the difficulties children with autism have in reacting to the approaches of others, understanding social conventions or initiating social interactions with others.
- **Semantic/Pragmatic Problems (SEMPP):** This domain assesses the difficulties children with autism have in using spoken language to indicate comprehension, communicate meaning, respond to the interests of others and sustain a conversation.
- **Arousal Regulation Problems (AROUSE):** This domain consists of behaviours that are largely non-communicative or unresponsive and reflect emotional constriction, the apparent seeking of kinesthetic sensation and difficulty with sleep regulation.
- **Specific Fears (FEARS):** This domain consists of behaviours that communicate the fears and anxieties associated with withdrawal from social or asocial stimuli (e.g. aversion to loud noises).
- **Aggressiveness (AGG):** This domain consists of aggressive approach towards self or others and the negative mood changes often associated with such behaviours.
- **Expressive Language (EXPRESS):** This domain assesses the ability of children to speak the sounds associated with the English language and to use words and sentences that indicate competence with grammar, tone of voice and the pragmatic aspects of communicating with others.
- **Learning, Memory and Receptive Language (LMRL):** This domain assesses two areas of competence in children with autism: (a) memory and (b) receptive language.

**REXSCA Dimension Domains**

The first two domains of this dimension describe social and expressive language skills typically lacking in autism while the third describes more generic memory and receptive language skills that may or may not be deficient in autism. Higher domain scores indicate increasing levels of competence. Each of these domains is highly correlated with tested IQ (Pearson’s r (n = 76) ranging from 0.63 to 0.77)12.

- **Social Approach Behaviours (SOCAPP):** This domain assesses those non-vocal social communication skills that are difficult for children with autism (e.g. eye contact, joint attention, effective use of gesture, imaginative skills).
- **Specific Fears (FEARS):** This domain describes fears and anxieties associated with withdrawal from social or asocial stimuli.
- **Arousal Regulation Problems (AROUSE):** This domain consists of behaviours that reflect emotional constriction, apparent seeking of kinesthetic sensation and difficulty with sleep regulation.
- **Expressive Language (EXPRESS):** This domain assesses the ability of children to speak the sounds associated with the English language and to use words and sentences that indicate competence with grammar, tone of voice and the pragmatic aspects of communicating with others.

**Autism composite (AUTISM)**

This score serves as a global measure of lack of appropriate social communication skills along with repetitive and ritualistic behaviours. It is normally distributed within the autism standardisation sample. Higher or lower scores indicate greater deviations from a typical case of autism.

**Derivation of ADHD behaviour score from the PDDBI**

One of the most commonly used instruments for categorising children as having ADHD is the Conners’ Parent Rating Scale-Revised (CPRS-R)17. Data from this instrument were available on only a small subset (n = 8) of the current sample. However, both CPRS-R and PDDBI data were available from a larger dataset (n = 50) of children followed because of their placement in the neonatal intensive care unit. Such children are at risk for developmental problems including autism18. These data enabled development of an ADHD behaviour score from relevant PDDBI items.

Items from the PDDBI that matched as closely as possible to the ADHD factor of the CPRS-R (most PDDBI items were from the Arousal Regulation Problems domain; see Table 1) were added together and correlated with the CPRS-R ADHD factor. The overall r was 0.83, p = 0.000 and did not statistically differ between males (r(32) = 0.86) and females (r(14) = 0.80). Children with an ADHD behaviour score ≥9 (which agreed well with the CPRS cut-off of 65) were classified as having ADHD behaviours (mean ADHD behaviour score (SD) = 12.2 (2.7)). Besides identifying the ADHD group, this cut-off score identified 71 of the 119 children with ASD (60%) as having ADHD behaviours (mean ADHD behaviour score (SD) = 12.0 (1.8)).

**Statistical analyses**

Data were analysed with Statistics 10.019. Repeated-measures MANOVAs were computed followed by MANOVA univariate tests.

**For citation purposes:** Cohen IL. Behaviour profiles of children with attention deficit hyperactivity disorder and autism spectrum disorder on the parent Pervasive Developmental Disorder Behaviour Inventory. OA Autism 2013 May 01;1(1):10.
Results

ASD compared with ADHD group: AWP Domains

There was a significant main effect for group \((F(1,133) = 16.1, p = 0.000)\) and a significant group-by-domain interaction \((\text{multivariate } F(6,128) = 4.5, p = 0.000)\). As shown in Figure 1 (left), groups significantly differed on three of the first four domains—domains typically associated with ASD: SENSORY \((F(1,133) = 3.5, p = 0.064)\); RITUAL \((F(1,133) = 5.5, p = 0.021)\) and SEMPP \((F(1,133) = 5.3, p = 0.022)\). They also showed much greater differences on the last three domains: AROUSE \((F(1,133) = 8.8, p = 0.004)\); FEARS \((F(1,133) = 25.5, p = 0.000)\) and AGG \((F(1,133) = 20.8, p = 0.000)\). The ADHD group was rated as more severely affected than the ASD group across all domains.

For this comparison, there was a significant main effect for group \((F(1,133) = 3.3, p = 0.069)\) and a borderline significant group-by-domain interaction \((\text{multivariate } F(2,132) = 2.6, p = 0.077)\). The ADHD group was rated as having better expressive language skills than the ASD group \((F(1,133) = 5.8, p = 0.018)\), as shown in Figure 1 (right).

ASD compared with ADHD group: AUTISM composite

Groups did not significantly differ on this measure \((F(1,133) = 1.21, p = 0.27)\), as shown on the far right side of Figure 1 (i.e. the severity of their autistic features was similar across ADHD and ASD groups).

ASD, ASD–ADHD and ADHD groups: REXSCA Domains

For this comparison, there was a significant main effect for group \((F(2,132) = 38.3, p = 0.000)\) and a significant group-by-domain interaction \((\text{multivariate } F(12,254) = 5.1, p = 0.000)\). As shown in Figure 2 (left), there were two major effects. First, the ASD group was rated as much less severely affected than the other two groups across all domains. Second, the ADHD and ASD–ADHD were very similarly affected except for the FEARS \((F(1,132) = 16.2, p = 0.000)\) and AGG \((F(1,132) = 11.8, p = 0.001)\) domains with the ADHD group again having the worst scores even though these groups had virtually identical mean ADHD behaviour scores.

ASD, ASD–ADHD and ADHD groups: REXSCA Domains

For this comparison, there was a significant main effect for group \((F(2,132) = 6.9, p = 0.001)\) and a significant group-by-domain interaction \((\text{multivariate } F(4,262) = 4.2, p = 0.003)\). As shown in Figure 2 (right), the ASD and ADHD groups were rated as having similarly impaired social approach skills while the ASD–ADHD group had much worse social skill ratings. The EXPRESS’s domain T-score was slightly better in the ADHD group relative to the ASD group (planned comparison

Licensee OA Publishing London 2013. Creative Commons Attribution License (CC-BY)
p = 0.09) and much better than the ASD–ADHD group (p = 0.008) while the EXPRESS domain T-score did not differ between the ASD and ASD–ADHD groups (p = 0.18). The LMRL domain did not significantly differ across groups.

**ASD, ASD–ADHD and ADHD groups: AUTISM composite**

Here there was a significant main effect (F(2,139) = 13.28, p = 0.000). Planned comparisons indicated that the ADHD group scored worse than the ASD group (p = 0.003) but was similar to the ASD–ADHD group (p = 0.18) while the ASD–ADHD group scored worse than the ASD group (p = 0.000), as shown in Figure 2 (far right). The AUTISM score for the ASD group was less than one SD below the expected mean for children with autism.

**Classification tree analysis**

Based on the results of the ASD vs. ADHD set of analyses, the ability of the SENSORY, RITUAL, SEMPP, AROUSE, FEARS, AGG and EXPRESS domains to predict group membership and identify subgroups was examined with a classification tree, a non-parametric and non-linear algorithm for finding cut-off scores that best separate groups. Due to the relatively small sample size of the ADHD group, prior probabilities were set to ‘equal’ and 10-fold cross-validation (a leave-one-out procedure) was used to avoid over-fitting of the tree in order to allow for better generalisation of the findings.

The classification tree selected the FEARS, EXPRESS, AROUSE and RITUAL domains to predict group membership as shown in Figure 3. It can be read as follows: at the first level, if the FEARS score was 69 or greater (2 SDs greater than the expected ASD mean) then cases were classified as ADHD, thus predicting an ADHD subgroup showing heightened anxiety without ASD. If the FEARS score was less than 69 and the EXPRESS score was 79 or greater (2 SDs greater than the expected ASD mean) then cases were classified as ASD–ADHD, thus predicting an ASD–ADHD subgroup showing heightened anxiety with ASD. The remaining cases were classified as ASD.

**Figure 1:** This figure shows means and 95% confidence limits (CI) for the mean, ADHD (blue) and ASD (red) groups across PDDBI domains and the AUTISM composite score. Domains to the left of the first solid vertical line denote those in the Approach/Withdrawal Problems dimension (higher scores indicate greater severity) while domains to the right of this line denote those in the Receptive/Expressive Social Communication Abilities dimension (higher scores indicate better skills). The AUTISM composite score is to the far right after the second solid vertical line and the higher the score, the greater the severity. Dotted lines along the ordinate denote ± one SD from the mean of the standardisation sample.

**Figure 2:** This figure shows means and 95% confidence limits (CI) for the mean, ADHD (blue) and ASD (red open squares) and ASD–ADHD (red solid squares) groups across PDDBI domains and the AUTISM composite score. Domains to the left of the first solid vertical line denote those in the Approach/Withdrawal Problems dimension (higher scores indicate greater severity) while domains to the right of this line denote those in the Receptive/Expressive Social Communication Abilities dimension (higher scores indicate better skills). The AUTISM composite score is to the far right after the second solid vertical line and the higher the score, the greater the severity. Dotted lines along the ordinate denote ± one SD from the mean of the standardisation sample.

**For citation purposes:** Cohen IL. Behaviour profiles of children with attention deficit hyperactivity disorder and autism spectrum disorder on the parent Pervasive Developmental Disorder Behaviour Inventory. OA Autism 2013 May 01;1(1):10.
Figure 3: This figure shows the classification tree that resulted from the analyses of the PDDBI domains that differed between the ASD (black bars) and ADHD (red bars) groups. The default position (step one) was ADHD. Proceeding down the tree one finds decision points based on the specific domain of interest and cut-off score. The leaf on the right indicates the first group identified—a predicted ADHD group with a much heightened FEARS score (more than two SDs above the standardisation mean). Children who failed this criterion (first choice point on the left) moved on to the next leaf where those who had an EXPRESS domain score less than 60 (less than or at one SD above the standardisation sample) were classified as ASD. Subsequent decision points further down the tree indicate additional predicted subgroups. The tree classified 94% of the ASD group and 87% of the ADHD group correctly (row percentage). Predictive validity was 99% for ASD and 48% for ADHD (column percentage), as shown in Table 2. In general, the subgroups identified by the tree mimicked the ADHD, ASD and ASD-ADHD group findings from the MANOVAs, except that it indicated two ADHD types—one with and one without comorbid anxiety features.

Discussion

These data indicate that parents (mostly mothers) of children with ADHD behaviours perceive the severity of their children’s maladaptive behaviours as the same or more severe than do parents of children with ASD, with or without similar levels of ADHD features. The PDDBI generates a royalty for Dr. Cohen. Conflict of interests: none declared. All authors contributed to the conception, design, and preparation of the manuscript, as well as read and approved the final manuscript. All authors abide by the Association for Medical Ethics (AME) ethical rules of disclosure.
behaviours. The similarities extend to the cardinal features of ASD including sensory behaviours, ritualistic behaviours, social pragmatic problems and repetitive language. Parents’ scores, however, did indicate better linguistic competence in the ADHD group relative to the ASD group. These data parallel, to some extent, findings that high-functioning children with ASD differ from ADHD children and from children with an anxiety disorder based on DSM-IV-TR criteria linked to communication and social relatedness (e.g. problems with making friends, seeking to share—similar to skills measured by the SOCAPP domain of the PDDBI) but not to criteria based on restricted and repetitive behaviours20 and that both ASD and ADHD children have similar problems with face recognition and social judgement (similar to problems measured by the SOCAPP domain of the PDDBI)21.

What was surprising was the observation that parents of children with ADHD rated their children’s ‘comorbid’ problems with fears and aggression more severe than parents of children with ASD (including those characterised as having ADHD features based on the same criteria used to define the ADHD group). These group differences were so strong that it was possible to correctly classify a substantial percentage of cases using a classification tree algorithm and the identified subgroups mimicked the original group classifications. This phenomenon is most likely related to the relatively greater social awareness and seeking of attention in children with ADHD as well as their relatively greater ability to communicate their emotions to their parents. If true, it is likely that this reported increased severity of problems behaviours in those with ADHD will not be seen by school teachers since these children’s more sophisticated social awareness may make them better behaved in more structured environments than children with ASD. This prediction has not been tested.

Recently, van der Meer21 and her group examined cognitive and behavioural characteristics (Social Communication Questionnaire and CPRS-R)parent reports) of a large sample (n = 664) of children and adolescents from a random population cohort and a clinical ASD–ADHD cohort. Based on latent class analysis, five classes were identified. Classes 1 and 2 were ‘normal’, 3 was described as ADHD (having only ADHD problems and no ASD) features, 4 had ADHD features and ASD features but the former were more prominent and was denoted as ADHD (+ASD) and 5 also had ADHD features and ASD features but the latter were more prominent than the former and it was called ASD (+ADHD). When the behaviour profiles based on parent reports were examined, some of the findings were quite similar to our MANOVAs and classification tree. For example, we also found an ADHD-only group. More interesting was their observation that levels of oppositional and emotional liability symptoms were much higher in the ADHD (+ASD) group than in the ASD (+ADHD) group, a finding almost identical to our observations. Unlike these researchers, we did see an ASD-only group and this group was relatively much better off than the ASD–ADHD group.

The overall similarity in behaviour profiles between ASD and ADHD observed in this study is consistent with other reports in the literature suggesting genetic similarities, as noted above. Furthermore, perinatal complications are common in children with ADHD22 as well as those with ASD18 and, so both epigenetic and genetic factors may influence when and where CNS effects manifest thereby impacting on diagnosis and affecting which CNS circuits are affected23. The estimated rate of ADHD amongst children with ASD in our sample (60%) overlapped with other studies4 but was towards the higher end and may reflect the fact that this was a clinic referred sample. Consistent with other reports24, these children were more severely affected than their ASD cohorts whose parents did not report ADHD behaviours, clinically indicating a greater need for various supports. As a group, they were the ones whose social communication scores and scores for classic ASD problems in the SENSORY, RITUAL, SOCAPP and SEMPP domains were similar to the standardisation sample while those ASD children who did not have ADHD traits were considerably lower, presenting with a more mild phenotype and, perhaps, better ability to respond to intervention4. It is predicted that some of these children will likely have a different genetic background than the ASD–ADHD group based on our research showing that an X-linked genotype linked to serotonin metabolism affects the severity of parent PDDBI scores for males with autism25, similar to reports by others26. Taken together, these data support, at both a clinical and research level, the need to allow for assigning an ADHD diagnosis in children with ASD.

Limitations
There are some issues to consider in interpreting these observations. First, our sample size for the ADHD group was relatively small not permitting more fine-grained analyses such as examining effects due to gender, ethnicity, complications of pregnancy, IQ, etc. Second, due to the young age of many of the children, it was difficult to assign an ADHD diagnosis since these children were not in classroom settings where such problems often first manifest. Third, this was a clinical sample and may not reflect the more general population of children with ASD and/or ADHD. Therefore, it will be important to systematically replicate these observations in an unbiased, longitudinal cohort.

Conclusion
These data, together with other studies in the literature, confirm that there are remarkable similarities between...
children diagnosed with ASD and those diagnosed with ADHD at multiple levels, suggesting similar aetiologies. As a group, children with ADHD are seen by their caregivers as showing more severe problems with anxiety and irritability than parents of children with ASD and therefore show a unique behaviour profile on the PDDBI.

Abbreviations list
ADHD, attention deficit hyperactivity disorder; ADOS-G, Autism Diagnostic Observation Schedule-General; ASD, autism spectrum disorder; PDDBI, PDD Behaviour Inventory.

Acknowledgement
The author is grateful to the parents who brought their children in for diagnostic evaluation.

References