Identifying ‘hyper-systemisers’ and the ‘hyper-vigilant’ within particular academic disciplines

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Identifying ‘hyper-systemisers’ and the ‘hyper-vigilant’ within particular academic disciplines

**ABSTRACT**

Baron-Cohen (2003) has popularised the theory that autistic traits may be better understood as abilities in ‘systemising’ over ‘empathising’, leading Silberman (2001) to claim that ‘hyper-systemisers’ are more frequently found in high-tech environments. Jensen et al. (2007) has also redefines ADHD ‘disordered’ children as ‘hyper-vigilant’, with the propensity for heightened creativity (Hartmann, 2001). The current study aimed to investigate these theories by distributing the Autism Spectrum Quotient (AQ) and the Adult Self-Report Scale for ADHD (ASRS V1.1) to a minimum of 100 students of maths, computing, English and drama to see how academic discipline would inform their scores on these measures. One-way independent ANOVAs determined that only the AQ had a significant main effect across the four programmes, $F(3,90)= 4.07$, $p= .009$. Within this, only differences between AQ scores of computing and drama students were found to be significant, $p= .021$ at the 0.05 level. Ultimately, rather than identifying extremely **high** traits of systemising in computing and maths students, the AQ more significantly identified extremely **low** systemising traits in drama students, and subsequently drama students represent a low end of the continuum of autistic traits more significantly than computing students represent an extreme end.

**KEY WORDS:** AUTISM ADHD HYPER-SYSTEMISING HYPER-VIGILANCE BARON-COHEN
Introduction

The disorder of autism lies along a ‘spectrum’ (Wing, 1981) ranging from mild to severe cases. Asperger’s Syndrome for example is considered to sit at the milder end of this continuum, characterised by ‘social deficits’ (including inflexible and pedantic language, lack of flexible thought and indifference to emotion), timely language acquisition and an IQ within average range or above. Since acceptance into mainstream thought in the 1990’s, the prevalence of Asperger’s Syndrome has risen continually with studies now suggesting that 1 in 100 UK school children are eligible for diagnosis (Baron-Cohen, 2003). During an analysis of over 1000 diagnostic assessments over a period of 12 years, Attwood (2007) recognised a notable difference in gender prevalence, with males more likely than females to receive a diagnosis at a ratio of 4:1.

Rather than distinct disorders, it is now thought that autism spectrum conditions as defined in the DSM-IV represent the upper extreme of one or more quantitative traits which may be continuously distributed in the population (Constantino & Todd, 2003), and Simon Baron-Cohen further proposes that these traits can be explained as innate abilities for ‘systemising’ (2003). Accordingly, extreme aptitude for systemising due to Asperger’s is known as ‘hyper-systemising’, and exemplifies a cognitive style governed by detailed analysis. As a result, below-average ability in ‘empathising’ is often apparent in Asperger’s individuals, demonstrated by difficulties in communication and interaction with others.

Whilst it is acknowledged that autism can be disabling to varying degrees, it is also important to recognise that some Asperger traits may prove to be adaptive within particular tasks and contexts. Hans Asperger himself believed that autistic individuals ‘can almost always achieve professional success, usually in highly specialised academic professions, with a preference for abstract content’ (1938). This has been supported by Silberman (2001) in his article for Wired Magazine (controversially entitled ‘Geek Syndrome’) which suggests that hyper-systemisers with narrow interests and preferences for rigid structure and sameness are disproportionately represented in the innovative world of Silicon Valley.

Although Baron-Cohen is critical of this view stating that ‘at present there is no evidence at all that the rate of autism and Asperger’s is higher in such high-tech environments, compared with other environments’ (2003, p. 165), an earlier study by Baron-Cohen et al., (1998) did find autism to be more commonly reported amongst families of professional engineers, mathematicians and physicists; suggesting there may be a relationship between autistic traits and the pursuit of certain professions.

A second childhood disorder characterised by specific qualities is Attention-Deficit Hyperactivity Disorder (ADHD), which is diagnosed when six or more symptoms of ‘inattention’ plus six or more symptoms of ‘hyperactivity’ and ‘impulsiveness’ have persisted for at least six months in two or more settings, impairing social, academic or occupational functioning. ADHD has increased in incidence from 4% to 5-9% and more in the 21st century (Swanson et al., 1998), with boys 3 to 10 times more likely to receive diagnosis (Zito et al., 2000).

Although some studies have shown that students with ADHD have more persistent academic difficulties (such as lower average marks and expulsions) than those without ADHD (Johnston, 2002), Jensen et al. (1997) argue that ADHD occurs at too
high a frequency in the general population to represent a disease which would by
definition place those who have it at a disadvantage. They instead propose that
ADHD is the result of intrinsic ‘hyper-vigilance’ which would once have provided
evolutionary advantage in dangerous territory, whereby the more contemplative
individual would have been considered ‘environmentally challenged’.

This response-ready cognition allows for information from multiple senses to be
processed concurrently, which Professor Bonnie Cramond (quoted in Hartmann,
2001) suggests may lead to heightened levels of creativity. As a result, Munden and
Arcelus (1999) suggest reframing ADHD ‘disordered’ children as ‘experience-
seeking, alert and curious’ (pg. 76), who benefit from adapting their environment to
better suit these traits. An example of this is provided by Hallowell & Ratey (1994)
who advise that an ‘enhanced capacity for creative thought’ (pg. 56) can often be
channelled into successful performing arts careers.

Both autism and ADHD are partly diagnosed with the use of self-administered
questionnaire measures. The Autism Spectrum Quotient (AQ) developed by Baron-
Cohen et al. (2001) is the key questionnaire used to place people within the autistic
spectrum, by asking individuals to report how strongly they agree with statements
about social preferences. Its 50 questions are reported to measure 5 facets of
autistic behaviour; namely social skills, communication skills, imagination, attention
to detail and tolerance of change.

Currently the foremost tool used to inform ADHD diagnosis is the Adult Self-Report
Scale (ASRS V1.1) for ADHD (Kessler, Adler & Ames, 2005), which has been
devised in conjunction with the World Health Organisation and the Workgroup on
Adult ADHD. It comprises of 18 questions within two subsets (Parts A and B), and
measures levels of hyperactivity, inattention and impulsiveness. Neither the AQ nor
ASRS V1.1 measures are intended to be completely diagnostic, but both are used in
a clinical setting alongside interviews to help provide a full evaluation of an
individual. If a person under assessment is too young to complete the measure on
their own behalf, formative answers to statements are provided by parents based on
behaviours they have witnessed in their child.

For some this method of assessment is controversial, as a lack of irrefutable medical
evidence to attribute people’s autistic or ADHD-type behaviours to physical
abnormality means the ‘cut-off’ point between ‘normal’ and ‘abnormal’ is determined
by a value which the authors of the measures have determined during the scale
development process. For example, Kessler et al. (2007) administered the ASRS
V1.1 to a sample of 668 subscribers to a US health plan and concluded subset Part
A of the measure to be most reliable in identifying ADHD traits, whereby a score of
four or more positive answers out of 6 questions warrants further clinical enquiry. In
initial trials of the AQ, Baron-Cohen et al. (2001) found the average score of a control
group to be 16.4 out of 50, with men scoring slightly higher than women (at around
17 versus 15). 80% of adults diagnosed with autism spectrum disorders scored 32 or
more compared with only 2% of the control group, and as such a score or 32 or
above is now cited as indicating ‘clinically significant levels of autistic traits’ (2001,
pg. 6).

Diagnosis may also be influenced by cultural ideals which determine whether a
particular trait is viewed positively or negatively (thus as ‘normal’ or ‘abnormal’), and
they may not always mirror the Western ideals within which autism and ADHD have been constructed. For example, symptomology of Asperger’s includes the refusal to make eye-contact, as it is considered to exemplify incompetent social interaction. Moran, Harris & Moran (2007) notes in Japan however it is considered disrespectful to look someone in the eye, and conversely children are actively encouraged to lower their gaze when talking to elders.

Disproportionate gender prevalence in autism has been explained by Baron-Cohen (2003), who points to evidence that male brains inherently have slightly lower empathising skill and slightly better systemising skill than female brains, suggesting a ‘statistically significant sex difference’ (p.133). No such claims of innate difference have been made regarding ADHD however, even though the same disparity in diagnosis is plain to see. This has led some to claim that a persistent gender bias against males is apparent in psychiatry due to boys’ behaviour being perceived differently to that of girls, even when the same traits are displayed (Taylor, 1994).

Nonetheless both males and females with debilitating levels of autism and ADHD are often treated with medication, and as a result there has been a 7000% increase in UK prescriptions for stimulant medication in the past decade for ADHD alone (Department of Health, 2007). Timimi, Gardner & McCabe (2011) however accuse pharmaceutical companies of praying on parental concerns by offering stimulants, anti-psychotics and anti-depressants as a ‘quick-fix’ solution to a so-called ‘epidemic’ of behavioural problems, even though many are not licensed for use with children and none are licensed for use in autism. Still, many parents actively seek a diagnosis of developmental disorder for their children, as it serves not only to remove worries about other diagnoses (such as mental illness) but can be used to correct others’ assumptions of malicious intent, causing positive change in people’s expectations, acceptance and support (Attwood, 2007).

Some studies conducted within families claim to see a pattern of autism emerge (see Ghaziuddin, 2005), and while no one gene has yet been identified as causing autism, researchers have begun searching for irregular segments of genetic code which autistic children may have inherited. A natural progression of this may be to screen prenatally for autism, as evidenced by Watson (2003) who in his book DNA: The Secret of Life states his eagerness in starting to explore how biotechnology could eliminate ‘learning difficulties’.

A real worry of this is that if Baron-Cohen’s (2003) theory of ‘hyper-systemising’ in autism and Jensen et al.’s (1997) theory of ‘hyper-vigilance’ in ADHD are correct, then such preventative measures will not only serve to eradicate incapacitating traits of autism and ADHD at extreme ends of the scale, but also those traits at various stages of the continuum which may in fact serve a purpose in certain contexts, facilitating skills within particular academic or occupational settings.

The current research aims to support Hans Asperger in his assertion that ‘Not everything that steps out of line, and thus ‘abnormal’, must necessarily be ‘inferior’ (1938, p.56) by investigating the claims made by Baron-Cohen (2003) and Jensen et al. (1997) that characteristics which lie on the continuum of both autism and ADHD (but which are not severe enough to impair functioning) may lend themselves to preferences for particular fields of study. This will be tested by distributing both the AQ (Appendix 1) and the ASRS V1.1 for ADHD (Appendix 2) questionnaires to
samples of students studying mathematics, computing, English and drama, and comparing the results of each set.

Informed by the research of Silberman (2001) it is hypothesised that ‘hyper-systemisers’ will be more evident within the maths and computing sample, demonstrated by those students obtaining significantly higher scores on the AQ than ‘empathetic’ English and drama students. Secondly it is hypothesised that the drama sample will achieve significantly higher scores than maths and computing students on the ASRS V1.1 for ADHD due to ‘hyper-vigilance’, which as suggested by Hallowell & Ratey (1994) may have inspired the pursuit of this academic subject. Furthermore it is hypothesised that based on unequal gender prevalence for autism and ADHD in general society; males will score significantly higher than females on both the AQ and the ASRS V1.1 for ADHD.

Method

Participants

A minimum of 100 students across years 1, 2 and 3 at Manchester Metropolitan University will be recruited in order to ensure large and easily accessible participant numbers. Permission to have students participate has first been sought from Heads of Department for each course via email (see Appendix 3), explaining the research proposal and allowing them to respond with any queries. The sample type is purposive as it requires only students in specific academic courses, but also opportunistic as it relies on whom is available from that subset on the day.

Specific samples to be recruited have been identified by researching autism and ADHD symptomology and behavioural characteristics. Autistic individuals are assumed to be highly skilled in ‘systemising’ due to their need for sameness and dedication to rules. Based on this it has been supposed that hyper-systemisers will pursue further education in BSc Hons Computing and BSc Hons Mathematics, as they demand organised functions and require a passion for numbers and hard data.

ADHD individuals have been recognised as ‘hyper-vigilant’ (Jensen et al., 1997) in processing many external stimuli at once, with heightened levels of creativity (Cramond quoted in Hartmann, 2001). As a result it is supposed that these traits will be apparent in drama students as they are highly capable of learning lines, following direction and reacting to others’ behaviour simultaneously, and respond less well to rigid structure. BA Hons English students have also been selected in an effort to exemplify ‘empathisers’ as opposed to ‘systemisers’, which would be evident in a significantly lower mean AQ score for English students than maths and computing students.

Design

The proposed research will use a survey based design, which is appropriate methodology to be applied to the research aims as the study uses closed-question established questionnaires which can quickly gather traditional quantitative data, and attribute numerical values of significance. The responses gathered will be analysed in both Likert and binary format using the category variables ‘gender’ and ‘programme of study’, encompassing four academic subjects of BA Hons Drama, BA Hons English, BSc Hons Computing and BSc Hons Mathematics. Measured
variables of ‘academic performance’ and ‘questionnaire score’ will also be analysed. Each Department Head will provide the researcher with lecturers who are able to distribute the questionnaire measures to their students, and therefore travel between the School of Computing, Mathematics and Digital Technology, the Faculty of Humanities, Law and Social Science and the site of the Manchester School of Theatre will be required of the researcher. As it cannot be guaranteed that classes across years 1, 2 and 3 will be encountered in the same day, two weeks have been allocated for the data collection process to ensure that a big a sample as possible is obtained.

Materials

Each questionnaire measure has already gained established validity within their respective fields. The Autism Spectrum Quotient (AQ) (Baron-Cohen et al., 2001) has been supplied by the Autism Research Centre in connection with the Department of Developmental Psychiatry at the University of Cambridge, via their website. The test consists of 50 statements whereby a forced-choice format obtains responses on a Likert scale of ‘definitely agree’, ‘slightly agree’, ‘slightly disagree’ or ‘definitely disagree’. Questions cover the five different domains of the autism spectrum; namely social skills, communication skills, imagination, attention to detail and tolerance of change.

The AQ scoring key (Appendix 4) suggests that a score of 32 or above out of 50 indicates clinically significant levels of autistic traits, whilst for the clinical practice of ‘screening’ scores of less than 26 mean that a diagnosis of Asperger’s can be ruled out. Hoekstra et al. (2008) report that the AQ has good test-retest reliability and moderate internal consistency, with Cronbach’s alpha varying from .63 to .78. Exploratory factor analyses have found inconsistent results however, supported by Austin (2005) who claims only three factors out of five to be reliable.

The Adult Self-Report Scale for ADHD (ASRS V1.1) (Kessler et al., 2005) has been composed in conjunction with the World Health Organisation and the Workgroup on Adult ADHD, which includes psychiatrists and researchers. The ASRS V1.1 has 18 questions and 5 forced choice responses ranging from ‘never’ to ‘very often’ in reporting levels of hyperactivity, inattention and impulsiveness (which is consistent with DSM-IV criteria for ADHD). Answers of ‘never’ and ‘rarely’ are always scored negatively, answers of ‘often’ and ‘very often’ are always scored positively, and answers of ‘sometimes’ are scored positively in 7 of the 18 questions (see Appendix 5).

Four or more positive answers in the first 6 questions most reliably indicate a clinically significant level of ADHD, whilst the further 12 ‘frequency scores’ provide additional cues. Following their own research Kessler et al. (2007) report Part A of the measure to have a respectable internal consistency in the range of .63–.72, and good test-retest reliability also. Both measures state that high questionnaire scores cannot be diagnostic until combined with in-depth interviews with clinicians.

The AQ and the ASRS V1.1 have been formatted onto one document (see Appendix 6), which includes a short introductory paragraph about the research aims. Participants are asked to indicate their gender, age, academic programme and average percentage mark awarded to them for work in the current academic year (or
their last piece of work if they are first year students). They are further asked to reveal whether they have ever received a formal diagnosis of either autism or ADHD.

Procedure

Firstly, analyses of internal consistency will be conducted on the AQ and the ASRS V1.1 (divided into Part A, Part B and the total of Parts A and B) in both Likert and binary format, to investigate whether this has an effect on the Cronbach’s Alpha. In order to have significant internal consistency within the study the Cronbach’s Alpha must be significantly above the minimum .7 level, as determined by Nunnally (1978).

ANOVA's are useful in testing hypotheses about the mean of a dependent variable across 3 or more groups. As a result, 2 x 4 ANOVA's will be employed to analyse data from the current research, using category variables of ‘gender’ and ‘programme of study’ (either BA Hons Drama, BA Hons English, BSc Hons Computing or BSc Hons Maths) to both establish any significant differences in mean scores between gender and to note any significant interaction between gender and programme of study.

One-way independent ANOVA's will be conducted between each programme of study and scores on the AQ and Part A, Part B and total of Parts A and B of the ASRS V1.1 individually, to determine any effect of autism or ADHD trait within each field of study. This will be conducted in both Likert and binary format, to note any difference this may produce in results. It is hypothesised that in both Likert and binary format maths and computing students will score significantly higher on the AQ than drama and English students, whilst the reverse will be true for scores on the ASRS V1.1. A post-hoc Turkey test will determine whether any differences between the mean scores for each group are significant, and a test of homogeneity of variances will further establish a Levene statistic of significant difference in variance across groups. If the sample size allows for it, a multiple regression will be conducted for each academic course, to see how far the criteria of ‘university mark (or grade) and age can predict scores on each questionnaire measure.

It is hypothesised that for all samples, scores on the AQ and ASRS V1.1 will be positively correlated with academic performance, under an assumption that stronger or more prevalent traits will increase ability within their field of study. For 80% power using two predictors and 5% probability level, the minimum sample size within the English and drama (or ‘arts’) and computing and maths (or ‘sciences’) sets required to conduct a multiple regression is 50, based on an anticipated effect size of 0.2, which is the recommended minimum effect size to represent a ‘practically’ significant effect (Ellis, 2010).

If many participants disclose formal diagnoses of either autism or ADHD this will be analysed within each academic course, using chi square, as it useful for comparing categorical responses between two independent groups. The number of official diagnoses will also be compared to the number of people who score significantly highly on either the AQ or the ASRS V1.1 to ascertain whether more people present with clinical levels of each disorder in these sample groups than in the general population.
Ethical Considerations (Appendix 10)

All participants will be reassured that although questionnaire measures are used to inform the diagnosis of autism and ADHD the current study is in no way intended to be diagnostic. An introductory paragraph will explain to participants that submission of completed measures indicates agreement to have their data included in the final group analysis, but that they have the right not to participate and can withdraw responses at any time up until the point of collection. Anonymity of individual results will be stressed and they will be given a contact email address in order to access the final publication.

Asking for university grades and enquiring whether a formal diagnosis has ever been received are both sensitive issues and will be approached accordingly so, by reiterating that responses are anonymous and answers are simply used to inform overall analysis. Contact information for organisations with further advice and resources regarding both disorders will be distributed to those who request it by email after the date disclosed in the introductory paragraph of the questionnaire measures.

Results

The use of Likert data allows for a detailed analysis of responses made from a choice of four or five options. Table 1 shows the results of internal reliability analyses on the Autism Spectrum Quotient and the Adult Self-Report Scale V1.1 for ADHD measures, whilst Table 2 shows one-way ANOVA descriptives for the data. Table 3 presents the mean scores and standard deviations for the measures within each individual programme of study.

Table 1
*Cronbach’s Alpha (internal consistency) for Autism Spectrum Quotient (AQ) Questionnaire and the Adult Self-Report Scale for ADHD (ASRS V1.1) Questionnaire Likert Data (N = 93)*

<table>
<thead>
<tr>
<th>Variable</th>
<th>Number of items in variable score</th>
<th>Cronbach’s alpha</th>
<th>95% Confidence Interval for alpha</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Lower</td>
</tr>
<tr>
<td>AQ</td>
<td>50</td>
<td>.84***</td>
<td>.79</td>
</tr>
<tr>
<td>ASRS Part A</td>
<td>6</td>
<td>.69</td>
<td>.58</td>
</tr>
<tr>
<td>ASRS Part B</td>
<td>12</td>
<td>.81***</td>
<td>.75</td>
</tr>
<tr>
<td>ASRS Total</td>
<td>18</td>
<td>.84***</td>
<td>.78</td>
</tr>
</tbody>
</table>

Note: *F* test with true value = 0.7, *p < .05. **p < .01. ***p < .001

Table 1 shows that in Likert format, 3 of the questionnaires have an internal consistency significantly above the minimum .7 level (as recommended by Nunnally, 1978). The ASRS V1.1 Part A is not significantly above .7, although the observed value is close to the .7 threshold.
Table 2  
**Descriptive Statistics for Likert Data for the Autism Spectrum Quotient (AQ) Questionnaire and the Adult Self-Report Scale for ADHD (ASRS V1.1) Questionnaire (N = 93)**

<table>
<thead>
<tr>
<th></th>
<th>M</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>AQ</td>
<td>101.67</td>
<td>14.47</td>
</tr>
<tr>
<td>ASRS Part A</td>
<td>17.76</td>
<td>4.81</td>
</tr>
<tr>
<td>ASRS Part B</td>
<td>32.70</td>
<td>7.18</td>
</tr>
<tr>
<td>ASRS Total</td>
<td>50.46</td>
<td>10.42</td>
</tr>
</tbody>
</table>

Table 2 shows that the mean Likert score for all participants on the AQ was below the theoretically obtainable score of 125 (calculated by the number of questions and number of responses available), and similarly all participants scored below the theoretical mean of the ASRS V1.1 Part B and the Total ASRS V1.1 questionnaire. For the ASRS V1.1 Part A, the whole participant sample scored close to the theoretical mean of 18.

Table 3  
**Descriptive Statistics for Likert Data of Scores on the Autism Spectrum Quotient (AQ) Questionnaire and Adult Self-Report Scale (ASRS V1.1) for ADHD Questionnaire within each Programme of Study (N=93).**

<table>
<thead>
<tr>
<th>Programme</th>
<th>English (n = 8)</th>
<th>Drama (n = 36)</th>
<th>Maths (N =16)</th>
<th>Computing (N=34)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AQ</td>
<td>M</td>
<td>SD</td>
<td>M</td>
<td>SD</td>
</tr>
<tr>
<td>AQ</td>
<td>107.75</td>
<td>15.16</td>
<td>94.33</td>
<td>12.20</td>
</tr>
<tr>
<td>ASRS Part B</td>
<td>36.88</td>
<td>6.33</td>
<td>34.58</td>
<td>7.37</td>
</tr>
<tr>
<td>ASRS Total</td>
<td>57.13</td>
<td>10.50</td>
<td>52.53</td>
<td>11.07</td>
</tr>
</tbody>
</table>

Table 3 shows the mean Likert scores and standard deviations of responses within each programme of study. English student responses averaged higher than all other programmes on all parts of the ASRS V1.1 and the AQ. Drama students scored the furthest below the actual mean for the AQ, and scored below on all parts of the ASRS V1.1. Maths students scored below the actual mean on all questionnaires except Part A of the ASRS V1.1, which was slightly higher. Computing students had the lowest average scores of all the programmes on each aspect of the ASRS V1.1.
A one-way independent ANOVA was performed on the Likert data for the AQ and a significant main effect across the four programmes of study was observed, \( F(3, 89) = 5.89, p = .001 \). A post-hoc Turkey test revealed that there was only a significant difference between the scores of those in Drama and Computing, \( p = .004 \) at the 0.05 level, and this is further illustrated below by Figure 1 as the ‘confidence bands’ do not overlap with each other. A test of homogeneity of variances found no significant difference in variance across groups (see Appendix 8).

![Figure 1: Mean AQ score and 95% CI for each mean on each programme of study (Likert data)](image)

Analysis of binary data allow for responses to be calculated using the standardised scoring key for each measure. Table 4 shows the results of internal consistency analyses on the AQ and the ASRS V1.1 for ADHD measures, whilst Table 5 presents one-way ANOVA descriptives for the data. Table 6 presents the mean scores and standard deviations for the measures within each individual programme of study.
Table 4
Cronbach’s Alpha (internal consistency) for Autism Spectrum Quotient (AQ) Questionnaire and the Adult Self-Report Scale for ADHD (ASRS V1.1) Questionnaire Binary Data (N = 93)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Number of items in variable score</th>
<th>Cronbach’s alpha</th>
<th>95% Confidence Interval for alpha</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Lower</td>
</tr>
<tr>
<td>AQ</td>
<td>50</td>
<td>.80**</td>
<td>.74</td>
</tr>
<tr>
<td>ASRS Part A</td>
<td>6</td>
<td>.27</td>
<td>.02</td>
</tr>
<tr>
<td>ASRS Part B</td>
<td>12</td>
<td>.69</td>
<td>.59</td>
</tr>
<tr>
<td>ASRS Total</td>
<td>18</td>
<td>.57</td>
<td>.44</td>
</tr>
</tbody>
</table>

Note: F test with true value = 0.7, * p < .05. **p < .01. *** p < .001

Table 4 shows that once the responses are converted to binary based on the scoring keys provided only the AQ has an internal consistency significantly above the recommended minimum level of .7 (Nunnally, 1978), with Part A of the ASRS V1.1 demonstrating the least internal consistency. Interestingly, all four questionnaires have a much lower Cronbach’s Alpha in binary format.

Table 5
Descriptive Statistics for Binary Data for the Autism Spectrum Quotient (AQ) Questionnaire and the Adult Self-Report Scale for ADHD (ASRS V1.1) Questionnaire (N = 93)

<table>
<thead>
<tr>
<th></th>
<th>M</th>
<th>SD</th>
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</thead>
<tbody>
<tr>
<td>AQ</td>
<td>14.95</td>
<td>6.46</td>
</tr>
<tr>
<td>ASRS Part A</td>
<td>3.04</td>
<td>2.82</td>
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<td>ASRS Part B</td>
<td>4.32</td>
<td>2.54</td>
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<tr>
<td>ASRS Total</td>
<td>7.36</td>
<td>4.30</td>
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</table>

Table 5 shows that the mean binary score of participants as one group on Part B and the total score of the ASRS V1.1 was below the theoretically obtainable score. This is also true of the AQ, and was also below the average mark of 16.4 obtained by the general population within Baron-Cohen’s (2001) study. Regarding the ASRS V1.1 Part A, the mean score of the participants was slightly above the theoretical mean score.
Table 6
*Descriptive Statistics for Binary Data of Scores on the Autism Spectrum Quotient (AQ) Questionnaire and Adult Self-Report Scale (ASRS V1.1) for ADHD Questionnaire within each Programme of Study (N=93).*

<table>
<thead>
<tr>
<th>Programme</th>
<th>English (n = 8)</th>
<th>Drama (n = 36)</th>
<th>Maths (N =16)</th>
<th>Computing (N=34)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Questionnaire</strong></td>
<td><strong>M</strong></td>
<td><strong>SD</strong></td>
<td><strong>M</strong></td>
<td><strong>SD</strong></td>
</tr>
<tr>
<td>AQ</td>
<td>17.00</td>
<td>7.50</td>
<td>12.14</td>
<td>5.34</td>
</tr>
<tr>
<td>ASRS Part A</td>
<td>4.00</td>
<td>1.20</td>
<td>2.97</td>
<td>1.48</td>
</tr>
<tr>
<td>ASRS Part B</td>
<td>5.88</td>
<td>2.03</td>
<td>4.86</td>
<td>2.76</td>
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<tr>
<td>ASRS Total</td>
<td>9.88</td>
<td>2.95</td>
<td>7.83</td>
<td>3.80</td>
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</tbody>
</table>

Table 6 shows the mean binary scores and standard deviations of responses within each programme of study. English student's scores on Part B and the overall total score for the ASRS V1.1 were the highest of the four programmes. Drama students scored the lowest below the actual mean score for the AQ, and Maths students scored the lowest of all participants on the ASRS V1.1 Part B. Computing students scored the lowest on Part A of the ASRS V1.1 and also had the lowest average score for the ASRS V1.1 in total. When separated into four distinct programmes, the English, maths and computing sample all obtained an average AQ score extremely close to that found in the general population by Baron-Cohen (2001), whilst drama students averaged a score significantly below.

A one-way independent ANOVA was performed on the binary data for the AQ and a significant main effect across the four programmes of study was observed, $F(3,90)=4.07, p=.009$. A post-hoc Turkey test revealed that there was only a significant difference between the scores of those in Drama and Computing, $p=.021$ at the 0.05 level. This difference is illustrated below in Figure 2, demonstrated by the way the 'confidence bands' do not overlap with each other. A test of homogeneity of variances found no significant difference in variance across the groups (see Appendix 8).
The authors of the AQ cite a score of 32 or more as indicating clinically significant levels of autistic traits, and in binary format it is evident that one participant from the maths set scored considerably above this with 36. Two participants from the computing set almost reached clinical significance, with scores of 31 and 30. The authors of the ASRS V1.1 cite a score of 4 or more on Part A as indicative of ADHD symptoms, and many participants from all 4 programmes obtained scores above this. As no participants reported a diagnosis of either autism or ADHD, a chi square analysis was not necessary.

Low participant response meant that multiple regressions could not be utilised, and instead t-test correlations were performed on each programme of study using the variables of gender, age, percentage mark/grade and total questionnaire score. Although some correlations found a degree of significance this cannot be considered reliable, due to the small number of participants within samples (see Appendix 9 for an example), and this is also true of subsequent ANOVAS conducted within programmes of study. In an attempt to combat this English and drama groups were combined to form an ‘arts’ set and maths and computing groups combined to form a ‘sciences’ set, however ultimately the number of participants within each set was still too low to produce significant results.
Discussion

Findings

An internal consistency analysis of the Likert data for each measure found the AQ to have the most internal reliability, with a Cronbach’s Alpha of .84. Part B of the ASRS V1.1 and the total of Parts A and B of the ASRS V1.1 also had significant internal reliability with Cronbach’s Alpha above the minimum .7 level. Although Part A of the ASRS V1.1 did not reach this level the value was very close to the threshold, and it is estimated that analysis of a bigger sample size would have shown it to be significant. Additionally, within the current study the AQ demonstrated an internal consistency much higher than the range of reliability values reported by Hoekstra et al. (2008), and Part A of the ASRS V1.1 had internal consistency within the range suggested by Kessler et al. (2007).

Descriptive statistics revealed that although all participants scored below the theoretical mean score of each measure, drama students averaged the lowest score on the AQ and computing students averaged the lowest score on all aspects of the ASRS V1.1. One-way independent ANOVAs determined only the AQ to have a significant main effect across the four programmes, $F(3,89)= 5.89$, $p= .001$, within which a Turkey test revealed a significant difference between scores of the drama and computing sets ($p= .004$ at the 0.05 level).

An internal consistency analysis of the binary data for each measure found that in this format only the AQ had significant internal reliability above the .7 level, and although the value was lower than that obtained with Likert data, it was still within the range of reliability values provided by previous research. Conversely, Part A of the ASRS V1.1 had the least internal consistency (even though it is cited as providing the surest indication of ADHD traits), with a value much lower than that reported by Kessler et al. (2007), even when scores on all parts of the ASRS V1.1 were combined.

Descriptive statistics also inferred that as one unified group participants scored above the theoretical mean of Part A, whilst still averaging below on other subsections and on the AQ. English, maths and computing students obtained AQ scores extremely close to those found in the general population by Baron-Cohen et al. (2001), whilst drama students averaged much lower. Importantly, drama students still averaged the lowest score on the AQ and computing students still obtained the lowest average score on all parts of the ASRS V1.1. One-way independent ANOVAs again found only the AQ to have a significant main effect across the four programmes, $F(3,90)= 4.07$, $p= .009$, and the Turkey test once more determined a significant difference between the scores of the drama and computing sets ($p= .021$ at the 0.05 level).

Only one participant obtained an AQ score above that which Baron-Cohen (2001) cites as indicating clinically significant levels of autistic traits, and they were found to be a female maths student. The second highest scoring participant was a computing student of undisclosed gender with 31, followed by a male computing student with a score of 30. Conversely, many participants across all four programmes gained a
score of 4 or more out of 6 on Part A of the ASRS V1.1, which Kessler, Adler & Ames (2005) advise warrants further clinical enquiry.

Implications

Analyses have found the AQ to have significant internal consistency when using both Likert and binary data, which supports Hoekstra et al. (2008) and more generally contributes positive findings to research into the reliability of the measure. As a factor analysis of the five facets was not conducted, we can neither support nor contradict criticisms made by Austin (2005), but perhaps this could be explored in further research.

Descriptive statistics ascertain that the computing and maths sample do not have higher average scores for systemising traits than the general population, which challenges Silberman’s (2001) claims that systemising tendencies are disproportionately prevalent within these academic programmes. A one-way independent ANOVA however did find a main effect of the AQ across the four programmes, with a significant difference found between the scores of computing and drama students.

As a result, within this study it can be claimed that rather than identifying extremely high traits of systemising in computing students, the AQ has more significantly identified extremely low systemising traits in drama students. Subsequently drama students represent a low end of the continuum of autistic traits (Constantino & Todd, 2003) more significantly than computing students represent an extreme end. This was further reiterated by descriptive means which highlighted that drama students were the only sample to average a score much lower than that found by Baron-Cohen et al. (2001) in the general population. By identifying strong preferences for sociability, communication and imagination and low preferences for detailed analysis and rigid structure within drama students, the AQ may have also inadvertently served a purpose in informing us how best to construct a university drama course that most appeals to its students.

Results further indicated that maths and computing students did not score significantly higher than English students on the AQ and that against expectations English students averaged the highest AQ score of all four programmes of study. This suggests that English students were wrongly selected to typify ‘empathisers’ rather than ‘systemisers’, as conversely they were found to show frequent systemising preferences. Nevertheless, as there were a very low number of participants within the English sample, we cannot determine these results to be conclusive.

The hypothesis that drama students would score significantly higher on the ASRS V1.1 than maths and computing students was also not supported by the results of the study, leading to one of two conclusions; either the assumption that drama students would epitomise hyper-vigilant individuals was a misjudgement, or that the ASRS V1.1 is not a reliable measure. Internal reliability analysis lends support to the second of these conclusions, as in binary format (used for scoring the measure in a clinical setting) neither Part A, Part B nor the total score of Parts A and B of the
measure had a significant Cronbach’s Alpha (as determined by Nunnally, 1978), or a consistency value close to that proposed by Kessler et al. (2007).

Reasons for this may become apparent when considering that the questionnaire is constructed using a forced-choice format to obtain responses on a Likert scale, as The British Psychological Society (1997) acknowledges that responses will vary depending on how each person interprets the operational definition of such words as ‘often’ and ‘usually’. Nevertheless, the AQ is constructed in the same format, and was found to have significant internal consistency.

An important difference between the two measures however is that the ASRS V1.1 provides 5 available responses (as opposed to 4), which allows individuals to make a ‘middle-ground’ selection of ‘sometimes’. Although such a response would infer that the statement is true of their preferences only 50% of the time, it is scored as a positive indicator of ADHD trait on 7 out of 18 questions, which may go some way in providing explanation for the high prevalence of ADHD reported in society whilst this measure is the foremost diagnostic tool.

Limitations

A survey design methodology of data collection meant that although the collection of quantitative data was quick to achieve, it was not a sure-fire way of obtaining all the relevant information necessary for analysis. Perhaps because compiling both the AQ and the ASRS V1.1 produced a fairly long document, some participants did not respond to the extra questions added concerning personal details, and as a result this affected subsequent data analysis. For example, many people did not disclose gender, age or academic grade, and thus these variables could not be analysed in terms of their effect on questionnaire score.

Further to this, only a relatively low number of participants were successfully obtained by opportunistic sampling, as lecturers struggled to distribute the questionnaire during term-time. The researcher attempted to rectify this by opportunistic sampling around university buildings, but although this served to increase the overall number of participants it meant that the final sample did not consist of equal numbers of students within each programme or within each gender, which affected either the reliability or generalisability of subsequent analysis.

For example, as each programme (or each set of ‘arts’ or ‘sciences’) did not consist of at least 50 people a multiple regression could not be conducted to ascertain whether a significant positive correlation between questionnaire score and academic performance existed. Disappointingly, even though a high disparity in gender prevalence for both disorders within society provides much relevance for investigating the effect of gender on questionnaire score, such analysis could not be reliably performed within the current study.

Future Research

Guided by the limitations of the current research, future studies would require much larger samples of participants in order to ensure that specific types of data analysis were viable for use, and that any significant variable effects found could be reliably
generalised. The fact that only participants who gained scores above or extremely close to 32 (indicating clinical significance) were from the 'sciences' set suggests that further research into systemising preferences within certain academic fields is a relevant endeavour, and perhaps more high-scorers would have been found within a bigger sample of participants.

Descriptive statistics which showed that computing and maths students did not score significantly higher on the AQ than those in the general population however may mean that Baron-Cohen (2003) was correct in criticising Silberman’s (2001) claims that systemisers dominate these environments, and perhaps instead more significant results would be obtained from the response data of participants studying physics and engineering (as proposed in Baron-Cohen et al.’s 1998 family study). To further improve on this research, the ‘empathising quotient’ (EQ) and ‘systemising quotient’ (SQ) developed by Baron-Cohen and Wheelwright (2004) could be distributed alongside the AQ, to more accurately determine levels of systemising and empathising traits within students in certain academic subjects and to investigate gender differences within these samples.

Although no significant effect was found between the programme of drama and ASRS V1.1 scores as hypothesised, perhaps this is due to the fact that none of the participants within the sample disclosed their gender to be male, and may in fact have all been female. As prevalence ratios show that within the general population males are significantly more likely to be diagnosed with ADHD than females, further research should be conducted with samples of males in performing arts to determine whether the ASRS V1.1 is found to more significantly identify traits in male students than female students within this academic area.

References


