The Extreme Male Brain theory and gender role behaviour in persons with an autism spectrum condition

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ABSTRACT

According to the Extreme Male Brain theory persons with autism possess masculinised cognitive traits. In this study masculinisation of gender role behaviour is evaluated in 25 persons with an autism spectrum condition (ASC) and matched controls with gender role behaviour as part of a shortened version of the Minnesota Multiphasic Personality Inventory-2 and the Empathizing Quotient and Systemizing Quotient. Both males and females with an ASC showed minimum male role behaviour. It is suggested that the minimum male gender role could be related to an underdeveloped Theory of Mind, a well-known feature of autism.

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1. Introduction

Autism is considered to be one of the most devastating childhood disorders. It is characterized by an abnormal development in social behaviour, communication, and the presence of stereotyped behaviour, interests and activities (DSM-IV, 1994). Despite the high prevalence of this lifelong disorder the causes and symptoms of autism are still unclear (Hill & Frith, 2003). The extreme heterogeneity, leading to the collective term autism spectrum condition (ASC), is hampering research into the causes of autism. Bridging brain and behaviour, cognitive theories could be vital in reducing dozens of behavioural features down to one or two underlying psychological processes. One such cognitive theory is the Extreme Male Brain (EMB) theory which tries to elucidate both social and non-social features of autism (Baron-Cohen, 2002, 2009).

The EMB theory proposes that persons with autism are characterized by weak empathizing skills (the ability to identify the mental states of others and give an appropriate emotional reaction to another person’s thoughts and feelings) and strong systemizing skills (meaning the drive to analyze or construct systems by noting regularities and rules) (Baron-Cohen, 2009; Baron-Cohen, Knickmeyer, & Belmonte, 2005). Since females on average have stronger empathy skills and males have a stronger drive to systemize, the EMB theory states that persons with autism possess an extreme male brain (Baron-Cohen, 2002; Baron-Cohen et al., 2005). According to the EMB theory the shift to an extreme male brain in people with autism is the result of elevated levels of prenatal testosterone (Auyeung et al., 2009).

Taken together, the EMB theory states that people with autism have had elevated levels of prenatal testosterone leading to an extreme male brain with regard to their cognitive skills. Although this theory can explain a lot of the characteristics of autism, the disorder is still not completely understood. For this reason it would be interesting to see to what extent the
‘masculinisation’ introduced by the EMB theory is apparent in other domains next to cognition. In this study we choose to focus on gender role behaviour since this is also under the influence of prenatal testosterone and stands for fundamental male and female behaviours (Hines, 2006). Therefore it would be interesting to study in what way these evolutionary behaviours are different in people with autism.

Gender role behaviour regards shared expectations of behaviour may differ by gender (Grumbach, Hughes, & Conte, 2003; Stets & Burke, 2000). Men and women differ in certain behaviour domains like aggression, parenting rehearsal, and peer/group interaction. A typical gender role might include men who invest in the worker role and women who invest in the family role. Behavioural features matching with these gender roles are assertiveness, independence and self-confidence for ‘typical’ males and gentle, communicative and tactfulness for ‘typical’ females (Delfos, 2003; Peterson & Dahlstrom, 1992).

Determinants of gender role behaviour are thought to be both biological and social-cognitive (Hines, Brook, & Conway, 2004). Because autism is related to prenatal testosterone there is a focus on the role of androgens in psychosexual development. Information about the relationship between elevated rates of testosterone and the human gender roles has come from persons with an unusual hormonal environment, like persons with congenital adrenal hyperplasia, a congenital deficiency that may result in an overproduction of androgens, including testosterone (Pinel, 1999).

Childhood play behaviour is a typical example of gender role behaviour which is often studied and can be used to examine the relationship between elevated prenatal testosterone levels and gender role behaviour. It appears that boys with congenital adrenal hyperplasia show decreased rough-and-tumble play compared to normal males (Hines & Kaufman, 1994). This led to the hypothesis that the effect of prenatal testosterone on play behaviour in boys may show an inverted-U relationship (Knickmeyer, Wheelwright, & Baron-Cohen, 2008). When girls are exposed to high levels of prenatal testosterone levels their childhood play behaviour changes to more typical boy behaviour. In case of girls with an ASC there would be a linear relationship between prenatal testosterone and masculinisation of play behaviour.

We expect males with an ASC to show less male role behaviours and more female role behaviours as compared to controls due to the inverted-U relationship mentioned above. Females with an ASC are expected to show more male role behaviours and less female role behaviours as compared to controls. As far as we know, current research has yet to explore the gender role behaviour of persons with an ASC.

The aim of the present study is to examine the gender role behaviour of adults with an ASC to see to what extent these gender roles are masculinised or feminised by their autistic condition. Since the sample of this study is relatively small, different diagnoses of an ASC were included. Two measures of the EMB theory were employed in order to confirm the theory: the Empathizing Quotient (EQ) (Baron-Cohen & Wheelwright, 2004) and the Systemizing Quotient (SQ) (Baron-Cohen, Richler, Bisarya, Gurunathan, & Wheelwright, 2003). Next to this, gender role behaviour was measured with the Gender-Masculine (GM) scale and the Gender-Feminine (GF) scale of the Minnesota Multiphasic Personality Inventory-2 (MMPI-2). The GM and GF scales measure stereotypically masculine and feminine occupations (Woo & Oei, 2008).

2. Methods

2.1. Participants

2.1.1. ASC group

This group contained 25 adults with an autism spectrum condition (16 males, 9 females). Participants in this group were recruited by a mental health clinic through an information letter (Mondriaan Zorggroep, locations Maastricht and Heerlen). All subjects had been diagnosed by experienced clinicians using established criteria for an ASC. The standard diagnostic process includes anamneses, a heteroanamnesis, a psychiatric examination, a neuropsychological examination, and a logopedic examination. The intake anamneses was executed with a questionnaire based on the three ASC criteria described in the Diagnostic and Statistical Manual of Mental Disorders, 4th Edition (DSM-IV, 1994). Parts of the E2-Rimland questionnaire were used during the heteroanamnesis (Rimland, 1968). The neuropsychological examination comprised among others the full version of the Wechsler Adult Intelligence Scale-Revised (WAIS-R) (Wechsler, 1997). 9 subjects (7 males, 2 females) were diagnosed with Asperger Syndrome, 8 subjects (6 males, 2 females) were diagnosed with autism, and another 8 subjects (3 males, 5 females) were diagnosed with Pervasive Developmental Disorders Not Otherwise Specified (PDD-NOS).

2.1.2. Control group

This group comprised 25 volunteers (16 males, 9 females) selected on the basis of being age- and sex matched with the ASC group. The subjects of this group were students from Maastricht University and family members of the researcher. This research has obtained approval by the Ethical Committee of The Faculty of Psychology and Neuroscience of Maastricht University (ECP-03-07-2009/2).

2.2. Procedure

Participants with an ASC were invited to take part in the study with an information letter they received from their clinician. If they agreed to participate in the study, they were invited for assessment. Before the assessment started, they completed an informed consent. Next, they received three questionnaires, the Empathy Quotient (EQ), the Systemizing...
Quotient (SQ) and a shortened version of the Minnesota Multiphasic Personality Inventory-2 (MMPI-2). Information about their total IQ and diagnoses was recruited out of the patients' records. Unfortunately, there is no IQ information for 5 of the 25 patients. Control participants were generally invited by sending them an email with an informational letter. After agreeing to participate, they received four questionnaires; the Autism Quotient (AQ), the EQ, the SQ, and the shortened version of the MMPI-2. They were asked to send them back anonymously and an appointment was made in order to perform the IQ test and fill in the informed consent form. Unfortunately, not every participant was able to make an appointment in order to execute the IQ measurement. Therefore 3 participants received an envelope with the four questionnaires and were asked to indicate their highest education level. Their total IQ was calculated based on this highest education level with the Groninger Intelligieng Test-2 (GIT-2) (Luteijn & Barelds, 2004). They also completed an informed consent and were asked to send this back together with the education level. After completion the participants received a short summary and description of their personal results.

2.3. Materials

Empathizing skills were assessed with the in Dutch version of the EQ. The EQ consists of 60 questions; 40 questions tapping empathy and 20 filler items. The filler items were built-in to distract the subject from a persistent focus on empathy. The EQ requires respondents to indicate on a 4-point scale ranging from 'strongly disagree' to 'strongly disagree' how well each item describes them (Baron-Cohen & Wheelwright, 2004). In this way a higher score on the EQ means more empathizing skills.

The SQ, also the Dutch version, was developed to measure systematic qualities and has the same format as the EQ. A higher score on the SQ means someone has stronger systematic skills (Baron-Cohen et al., 2003).

The Gender-Masculine (GM) scale and the Gender-Feminine (GF) scale of the Dutch version of the MMPI-2 (Derkson, de Mey, Sloore, & Hellenbosch, 1993) were administered in this study. The MMPI-2 is the most widely used and researched personality assessment instrument. The GM and GF scales are both bimodal and a higher score on GM and GF scales indicate a stronger masculine/feminine gender role.

An additional questionnaire was administered in the control group in order to exclude an autism spectrum disorder with the AQ. The AQ was developed by Baron-Cohen, Wheelwright, Skinner, Martin, and Clubley (2001) to measure ‘autistic traits’ in adults with normal IQ. The original version consists of 50 questions, made up of 10 questions assessing 5 different areas; social skills, attention switching, attention to detail, communication, and imagination. The AQ requires respondents to indicate on a 4-point scale ranging from 1 (definitely agree) to 4 (definitely disagree) how well each item describes them. A score between 0 and 10 is a low score which indicates there are almost no autistic traits, a score between 11 and 22 is an average score, a score between 23 and 31 is an above average score indicating there are some autistic traits, and a score between 32 and 50 is a high score which implies an autism spectrum condition.

2.4. Control measures

Age and sex was included to determine if participants in both groups were comparable in regard to this background factor. Age at the time of testing was calculated from the date of birth. General intelligence was measured in order to include subjects with an IQ in the normal range. The WAIS-R (Wechsler, 1997) was already used to measure general intelligence of participants with an ASC during the diagnostic process. For the control group we used a less time consuming intelligence test, the Dutch version of the National Adult Reading Test (NART), the Nederlandse Leestest voor Volwassenen (NLV) (Schmand, Lindeboom, & Van Harskamp, 1992). The NLV measures verbal IQ by requiring participants to pronounce 50 words correctly. The verbal IQ is measured by counting the number of words pronounced correctly. The NLV gives an estimation of the general intelligence and corresponds with the total IQ of the WAIS-R (Eling, de Haan, Hijman, & Schmand, 2003).

2.5. Statistical analyses

SPSS (Statistical Package for Social Science) 17 was used to analyze the data. The alpha level of significance was set at 0.05, two tailed. Variables were formulated and contained the subject number, group, gender, age, IQ, score on the AQ only for the control group, EQ, SQ, GM (male role), and GF (female role). Descriptive statistics were executed for all variables to check for normality. Outliers were found but did not distort the means. A bivariate correlation method was executed to obtain a first impression about the relationship between the different variables. Means were calculated and both groups were compared with Independent Sample T-tests and two-way ANOVA. Next, an item analysis was used as a method to observe the differences in means on the GM and GF items. This method was used to cluster the items on which males and females with autism scored differently as compared to controls.

3. Results

Comparison of mean scores of the questionnaires are shown in Table 1.

The AQ was only administered in the control group to demonstrate that they had no autism spectrum condition. A total score on the AQ higher than 22 corresponds to an above average score and may be indicative for an autism spectrum
condition. There was no difference between males and females on the AQ, $t(23) = 1.14, p = 0.27$. Males had a mean score of 11.81, which is an average level of autistic traits indicating they do not have an autistic spectrum condition. Females had a mean score of 9.67 on the AQ questionnaire which indicates a low level of autistic traits.

With regard to the EQ questionnaire, both men and women with an ASC scored lower on the EQ compared to controls, $t(30) = −5.72, p < 0.00$ and $t(16) = −5.35, p < 0.00$. There was no difference between males and females with an ASC, $t(23) = −0.52, p = 0.61$, and no difference between males and females without an ASC, $t(23) = −1.44, p = 0.16$.

For the SQ, males with and without an ASC did not differ in their score on the SQ, $t(30) = 0.39, p = 0.70$. Females with an ASC scored, as expected, higher on the SQ compared to control females, $t(16) = 2.60, p = 0.02$. Also, as hypothesized, there were no differences in SQ between males and females with an ASC, $t(23) = 0.16, p = 0.88$, while control males had higher SQ scores than control females, $t(22.80) = 2.71, p = 0.01$.

Major differences were seen on the GM scale with respect to gender and group of participants. As hypothesized, males with an ASC scored lower on the GM scale as compared to control males, $t(30) = −5.67, p = 0.00$. However, females with an ASC scored also lower on the GM scale compared to control females, $t(16) = −2.11, p = 0.05$. Females with an ASC scored higher on the GM compared to males with an ASC, $t(23) = 2.81, p = 0.01$. Contrary to this, within the control group males scored higher on the GM scale as compared to females, $t(23) = 7.69, p < 0.00$. Regarding the GF scale, control males scored lower as compared to control females, $t(23) = −5.77, p < 0.00$.

### 3.1. Control variables

There was no difference in age for both groups of males, $t(30) = 0.63, p = 0.53$, and both groups of females, $t(16) = −0.02, p = 0.89$. Concerning the IQ, both males and females with and without an ASC had an IQ within the normal range.

### 4. Discussion

In this exploratory study the gender roles of persons with an ASC were examined in order to extend the most prevailing theory in the field of autism, the Extreme Male Brain theory. According to this theory, autism develops as a result of elevated prenatal testosterone levels which leads to the development of high systemizing skills and low empathizing skills and makes persons with autism having a sexual differentiated brain that looks like an ‘extreme’ male brain. It was tested whether gender roles in persons with an ASC are also masculinised.

The results on the EQ and SQ were in line with the EMB theory (Baron-Cohen & Wheelwright, 2004; Baron-Cohen et al., 2003) except for the high score of control males on the SQ. It is known that the score on the SQ can be influenced by the kind of profession, therefore we took a closer look at the professions of our control males (Baron-Cohen et al., 2003). It appeared that 8 out of 16 control males had an analytical or technical profession which might explain the relative high score of the control males on the SQ.

Gender roles, a concept of the human psychosexuality, was the main parameter in this study. It appeared that both males and females with an ASC score lower on the male role scale compared to controls. However, there was no difference between the ASC group and controls on the female role scale. In order to check the validity of both control groups, their scores on the gender role scales were compared to the norm scores of the MMPI-2 based on research with 563 females and 681 males. It appears that the control females had the same scores on the gender role scale compared to the MMPI-2 norm scores. However, the control males in this study scored significantly higher on the male role scale compared to the MMPI-2 norm scores. This could have affected the comparison between males with an ASC and was therefore taken into account.

Next, the psychosexuality of the ASC group was compared with the control group. Concerning the gender role, we hypothesized that males with an ASC would score lower on the male role compared to control males; we find this to be true. However, the higher score on the male role scale of control males could have caused the extreme difference between the

### Table 1

Mean scores and standard deviations for the control variable and questionnaires for both males and females with an ASC and controls. Mean scores are compared between both male groups and between both female groups.

<table>
<thead>
<tr>
<th></th>
<th>Males ASC ($n = 16$)</th>
<th>Controls ($n = 16$)</th>
<th>Females ASC ($n = 9$)</th>
<th>Controls ($n = 9$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>$34.81 \pm 9.37$</td>
<td>$32.50 \pm 11.30$</td>
<td>$27.89 \pm 10.87$</td>
<td>$28.00 \pm 10.87$</td>
</tr>
<tr>
<td>AQ</td>
<td>$24.06 \pm 8.59^{**}$</td>
<td>$44.00 \pm 11.00^{**}$</td>
<td>$25.89 \pm 8.18^{**}$</td>
<td>$50.67 \pm 11.23^{**}$</td>
</tr>
<tr>
<td>EQ</td>
<td>$41.81 \pm 14.61$</td>
<td>$39.75 \pm 15.43$</td>
<td>$40.89 \pm 13.78^*$</td>
<td>$27.22 \pm 7.83^*$</td>
</tr>
<tr>
<td>GM</td>
<td>$30.63 \pm 5.70^{**}$</td>
<td>$39.56 \pm 2.68^*$</td>
<td>$24.78 \pm 3.27^{***}$</td>
<td>$28.67 \pm 4.44^*$</td>
</tr>
<tr>
<td>GF</td>
<td>$29.56 \pm 3.67$</td>
<td>$27.06 \pm 4.12$</td>
<td>$32.78 \pm 6.53$</td>
<td>$35.89 \pm 2.62$</td>
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</table>

AQ, Autism Quotient; EQ, Empathy Quotient; SQ, Systemizing Quotient; GM, Gender Masculine; GF, Gender Feminine.

$^*P < 0.05$

$^{**}P < 0.01$
control males in this study and the males with an ASC. Therefore the scores of males with an ASC were compared to the norm scores of the MMPI-2 and it appears that males with an ASC still had an extremely low score on the male role scale. An item analysis was executed in order to detect the items on which males with an ASC scored lower than control males. By clustering these items it appears that males with an ASC describe themselves as timid, pessimistic, depressed, anxious and tired. Furthermore, they reported that they lack self-confidence, they are embarrassed quickly and they are afraid to enter a room where others have already met and are talking. Males with an ASC also do not seek out sensational or exuberant situations. They stated they never did anything dangerous only for the thrill, they do not like being in the spotlight or becoming a leader and they get embarrassed by grimy jokes. Finally, they get nervous when they have to make important decisions. As expected the type of gender roles displayed by males with an ASC deviates from the typical male role. In fact, males with an ASC display more feminized gender roles. Besides a low score on the male role scale we hypothesized that males with an ASC would score higher on the female role scale compared to control males. Males with an ASC did score higher on female roles as compared control males, but this group difference was not significant.

For females with an ASC, we expected masculinisation of both gender roles. However the results showed the contrary; as they scored lower on the male role scale as compared to control females. A post hoc item analysis was executed in order to detect the items on which females with an ASC scored lower than control females. It appears that females with an ASC experience more stress since they more often have headaches, are scared awake in the middle of the night and/or get nervous when they have to make important decisions. Next to this they lack self-confidence and can become shy quickly in many situations. Females with an ASC also reported lack in persistence. When something goes wrong they tend to give up quickly. Finally they avoid risk as seen by their lack of participation in dangerous activities as thrill-seekers and aversion to leadership roles. Concerning the female role, we expected that females with an ASC would score lower on this scale compared to controls, but there appeared to be no group difference in female role.

The overall similarity for psychosexuality in persons with an ASC is a relatively low score on the male role scale. The male role scale measures, besides obvious features, a more subtle meaning of the male role. This underlying meaning of the male role can be found in the primal behaviour of males. From an evolutionary view males have an open attitude towards their environment. Terms as outgoing, active and dominant characterize the core features of the male role (Delfos, 2003; Peterson & Dahlström, 1992). From our study it appears that both males and females with an ASC display an underdevelopment of these features. One possible explanation for the underdevelopment of the male role in persons with autism could be an underdeveloped Theory of Mind (ToM). The ToM is a mechanism which describes the ability to form representations of other people’s mental states, and to use these representations to understand, predict and judge their behaviour (Baron-Cohen, Leslie, & Frith, 1985; Martin & McDonald, 2003). There are two reasons why ToM and the masculine gender role could be related. First both ToM and the psychosexuality of an individual develop around the age of 5 years (Grumbach et al., 2003). Second, both concepts concern being conscious about the environment. ToM is the ability to form representations of mental states of other persons and to use these representations to understand, predict and judge their behaviour. The male role bears on making predictions about other persons and the environment in order to protect themselves and their families.

To summarize, the present results show that the Extreme Male Brain theory cannot be expanded to the gender roles of people with an ASC. However, measuring gender roles in the diagnostic process of autism could have an added value in diagnosing autism since these typical features are not explained by the EMB theory: being shy, introverted, soft, lacking self-confidence, having depressed feelings and preferring safe situations. The present study also shows that, persons with an ASC are not extremely masculine in their gender role behaviour. In fact, males with an ASC even have a feminized gender role. This finding corresponds to the inverted U-relationship between the level of prenatal testosterone and masculine behaviour in the studies with children with a CAH. It is still unclear what causes elevated fetal testosterone levels to feminization of the typical-male behaviour. Recently, Mathews, Fane, Conway, Brook, and Hines (2009) suggested a possible explanation for feminization of male behaviour in males with an CAH that could be generalized to autism. They stated that neural feedback systems regulate androgen production in male mammals in response to androgen elevation from different sources. In males with a CAH this would mean that testosterone levels may be elevated initially, but because of negative-feedback systems and reduced testicular production the testosterone levels will decrease to normal levels, or to even lower than normal levels.

When interpreting the results of the present study, one should keep in mind some limitations. First, the size of both ASC samples was relatively small and it is necessary to replicate results in larger samples. Next to this the group of persons with an ASC was not homogenous and could have had comorbid diagnoses.

5. Conclusion

The current study explored gender role behaviour in subjects with an ASC to determine if levels of masculinisation are in line with EMB theory. Male role behaviour in males with an ASC showed a feminized pattern, while females with an ASC failed to show a masculinised pattern and had similar scores on the male role scale to males with an ASC. This suggests that the underdevelopment of the male role behaviour in persons with an ASC can be linked to an underdeveloped Theory of Mind, as both concepts concern the link between environmental interpretation and human actions. The findings also suggest that the inclusion of gender role behaviour may be helpful in the diagnostic evaluation of an ASC.
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References


