J Autism Dev Disord (2014) 44:2137–2146
DOI 10.1007/s10803-014-2088-8

ORIGINAL PAPER

The Mandarin Childhood Autism Spectrum Test (CAST): Sex Differences

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Published online: 23 April 2014

Abstract Sex differences in social and communication behaviours related to autism spectrum conditions (ASC) have been investigated mainly in Western populations. Little research has been done in Chinese populations. This study explored sex differences related to ASC characteristics by examining differences in item responses and score distributions in relation to a screening instrument, the Childhood Autism Spectrum Test (CAST), used with Chinese children. A Mandarin Chinese version of the CAST (M-CAST) was distributed to 737 children aged 6–11 years in mainstream schools in Beijing. Questionnaires from 682 (93 %) children were available for analysis. The median score for boys was higher than for girls [boys, median = 8 (IQR 6, 11); girls, median = 7 (IQR 4, 9); $p < 0.001$]. There were differences in the proportions of boys and girls across all three score groups ($\leq$11, 12–14, $\geq$15) with more boys being found in the higher score groups ($p = 0.035$). This finding provides evidence that boys and girls have different social and communication development profiles, consistent with previous findings in Western cultures. These results suggest that sex differences related to ASC are consistent across cultures.

Keywords Autism · Social behaviours · Communication · Sex differences · China

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Introduction

Autism spectrum conditions (ASC) are neurodevelopmental disorders and are characterised by impairments in social interaction and communication, alongside the presence of repetitive and stereotyped behaviours, narrow interests and activities (American Psychiatric Association 2000). Prevalence estimates of ASC in the UK have increased greatly, from 4.8 per 10,000 in 1979 (Wing and Gould 1979) to 116.1 per 10,000 in 2006 (Baird et al. 2006). One prevalence estimate was reported to be 113 per 10,000 in the US in 2012 (Centres of Disease Control and Prevention 2012). The sex ratio in prevalence estimates for boys versus girls has been reported to be around 4:1 in general populations (Coleman 1978; Fombonne 2005; Lord and Schopler 1985; Volkmar et al. 1993; Wing 1976) and higher in higher-functioning children with ASC (Gillberg et al. 2006). Sex differences in the social and communication profiles related to ASC have been

investigated for decades in the West (Lai et al. 2011; Lotter 1966) but the underlying mechanism is not yet fully understood (Baron-Cohen et al. 2005, 2011).

At a behavioural level, sex differences in children with an existing diagnosis of ASC have been explored. However, findings have been inconsistent. Unusual visual responses and inappropriate stereotyped play have been found to be more common in boys with ASC than in girls, examined using the Psycho-educational Profile (PEP) (Lord et al. 1982). Sex effects have also been found in social play on the Autism Diagnostic Interview-Revised (ADI-R) (McLennan et al. 1993). Recent studies focusing on the association between sex and genetic susceptibility to ASC suggest that girls with ASC are less severely affected than boys in the repetitive stereotyped behaviours dimension (Szatmari et al. 2012). However, another study using the ADI-R, not only reported no sex differences (Pilowsky et al. 1998) but also found that girls had more autistic-like symptoms than boys, in terms of both social-communication and attention problems than boys (Holtmann et al. 2007). Such findings may reflect referral patterns, which could be different for boys and girls.

In population samples, sex differences have been found in the amount of eye-contact made by infants at 12 months old (Knickmeyer et al. 2005). Males and females have also been reported to have a different style of friendships (Baron-Cohen and Wheelwright 2003), communication, and focus of attention (Baron-Cohen 2003). Girls may have better superficial social and communication skills (Gillberg and Coleman 2000; Lai et al. 2011) and more appropriate play and interests than boys (Kopp and Gillberg 1992; Wolff and McGuire 1995). However, studies in which participants matched according to age and IQ have reported inconsistent results (Lai et al. 2011). These inconsistent results may be partly due to variations in study methodology (Hartley and Sikora 2009).

The extreme male brain (EMB) theory has been proposed to explain the observed sex differences in behaviours (Baron-Cohen 2002), and suggests that ASC may be an extreme of the typical male brain in the domains of empathy and systemizing (Baron-Cohen et al. 2005). Empathising is the drive to recognise another person's feelings, thoughts and intentions and respond to these with an appropriate emotion (Baron-Cohen and Wheelwright 2004). Systemizing is the drive to identify variables of a system via an inductive process such as repeated observations to identify the underlying rules about how the system works (Baron-Cohen 2002; Baron-Cohen et al. 2003). According to the EMB theory, the male brain is more biased towards systemizing than empathising, while the female brain is more biased towards empathising than systemizing (Baron-Cohen 2002). At a general population level, instruments developed on the basis of the EMB theory, such as the empathy quotient (EQ) and the systemizing quotient (SQ), have also provided evidence for sex differences (Baron-Cohen 2003; Baron-Cohen and Wheelwright 2004).

In relation to screening instruments designed to identify autistic traits, previous instruments depend on the description of possible autistic behaviours in daily life. Higher scores for boys than girls on screening instruments have also provided evidence for sex differences in children with ASC (Lai et al. 2011). Such differences have been found in studies using the Autism Spectrum Screening Questionnaire (ASSQ) (Posserud et al. 2006), the Social Responsiveness Scale (SRS) (Constantino et al. 2003), the autism spectrum quotient (AQ) (Auyeung et al. 2008; Baron-Cohen et al. 2006) and the Childhood Autism Spectrum Test (CAST) (Williams et al. 2008). Autistic behaviours could be heterogeneous among different target populations, especially populations from other cultures. Previous research has suggested that a challenge is posed when applying screening instruments developed in Western countries into Asian cultures (Wallis and Pinto-Martin 2008). Possible differences in autistic traits between Western and Eastern cultures have been reported in terms of eye contact and early language development (Bernier et al. 2010; Daley and Sigman 2002). In Asian cultures, looking directly into another person's eye may be considered as an inappropriate behaviour, especially for people who just met each other. However, avoidance of eye contact is an autistic trait that has been well recognised in Western studies. So far, limited research has been conducted to explore whether there are similar sex differences in autistic traits in Asian populations. One study has looked at empathising and systemizing in adults in Japan using the EQ and the SQ. Women on average scored significantly higher than men on the EQ, while men scored significantly higher than women on the SQ. This result provided some evidence that the sex differences in dimensions related to autistic traits are cross-culturally stable (Wakabayashi et al. 2007).

ASC are considered as psychiatric disorders. In China, due to the stigma surrounding psychiatric conditions, parents of children with ASC in China may not initially accept a diagnosis of ASC (McCabe 2008; Sun et al. 2012). The recognition and acceptance of this condition limits the awareness and knowledge of ASC in the general population. In addition, particular cultural influences may further delay the identification of ASC. Interviews with parents of children with ASC in mainland China reveal that many parents and grandparents consider boys speaking late to be a good sign for their future development (Sun et al. 2013). Limited research has been carried out on ASC in Chinese populations. To date, sex differences in autistic traits have not been directly studied in mainland China.

It has been suggested that many children with ASC, especially those with subtle manifestations, are not identified until primary school (Kamio 2007). The CAST was developed as a screening instrument for ASC in primary

school-aged children (4–11 years) (Scott et al. 2002a), previously known as the Childhood Asperger Screening Test (Scott et al. 2002a, 2002b). This instrument can be used to detect children at risk for milder ASC and has been therefore renamed as the 'Childhood Autism Spectrum Test'(Baron-Cohen et al. 2009).The CAST is a 37-item parent-completed questionnaire, of which 31 items contribute to the final score (Scott et al. 2002a). Within the 31 items, each item scores one for an ASC-positive response and 0 for an ASC-negative response. Thus, the CAST score ranges from 0 to 31 (Baron-Cohen et al. 2009). A score of 15 has been recommended as a cut-off for the CAST (Scott et al. 2002a; Williams et al. 2005). CAST items measure social and communication skills in the following domains: the ability to initiate and maintain conversation and specific language difficulties, social interaction with peers and adults, play activities, stereotyped and repetitive behaviours, choice of interests and sharing interests with others (Williams et al. 2008).

Sex differences have been investigated using the CAST in a Social Communication Research and Epidemiological (SCORE) study in UK primary schools (Baron-Cohen et al. 2009). In the SCORE study, the median score for boys (Median = 5; inter-quartile ranges (IQR) 3, 8) was significantly higher than that for girls (Median = 4; IQR 2, 6) (*median test,* $p < 0.001$). A much higher percentage of boys (n = 81, 79.4 %) was found in the high score group (≥15), compared to girls (n = 21, 20.6 %) (Williams et al. 2008). The aim of the present study was to investigate using the same screening instrument, a Mandarin Chinese version of the CAST, to see whether similar sex differences exist in a Chinese population.

Method

Procedure

This study had full ethical approval from the Cambridge Psychological Ethics Committee and the Ethics Committee of the Peking University First Hospital (PUFH). A total of 737 children in school years 1–4 (6–11 years old) were recruited from two mainstream primary schools in Xicheng district of Beijing. The principals of these two schools were approached and asked for participation. After which, a screening package was distributed by class teachers to each child in school years 1–4 in these two schools, which consisted of a screening questionnaire (the Mandarin CAST), an invitation letter and a consent form. The invitation letter informed the parents about the study, and invited the parents to participate. After completion, the teachers collected the questionnaires including consent forms from the students and returned them to the research team. The distribution and collection of questionnaires took 1 month.

Analysis

Missing responses to CAST items were assigned a value of 0 (ASC-negative response) to generate a minimum score. If the questionnaire had more than five missing items, it was considered incomplete and was excluded from the analysis. Since the score distributions were skewed, the differences in item endorsements and score distributions were described using means, medians, IQR, standard deviation (SD) and ranges. The score distributions for boys and girls were compared using the Wilcoxon Rank Sum Test to test whether the difference was significant. The association between sex and score distribution across three score groups (≤11, 12–14, ≥15) was examined with the Chi-squared Test. The differences in the proportions of ASC-positive scores between boys and girls on each item were tested using the Chi-squared test. The effects of sex and age on the continuous score were examined using linear regression. The association between possible variables and the CAST score groups was examined by logistic regression. Unadjusted odds ratios were provided for the effects of sex, age, father's education, mother's education, father's occupation, and mother's occupation. All the analyses were conducted in STATA 10.0.

Three sensitivity analyses were conducted to examine the effects of missing data:

1. Missing responses to individual items were assigned a value of 1 (ASC-positive response) to generate a maximum score. Analyses were repeated using maximum scores for both boys and girls.
2. Analyses were conducted using the minimum score for boys and maximum score for girls to estimate the most extreme effect of missing data on the observed sex differences.
3. The third sensitivity analysis excluded children who were given a diagnosis of ASC in the Mandarin CAST validation study.

Results

Data Completion

In this study, n = 737 questionnaires were distributed and n = 714 (97 %) were returned. Of the 714 CAST questionnaires, 655 (91.7 %) were fully completed. 53 (7.4 %) had one or two missing items and six (0.8 %) had three to seven items missing. 13 questionnaires were excluded due to missing information about sex and another 19 were excluded due to missing information about age or because the child was outside the age range (6–11). This left n = 682 questionnaires for analysis. There were 360 boys

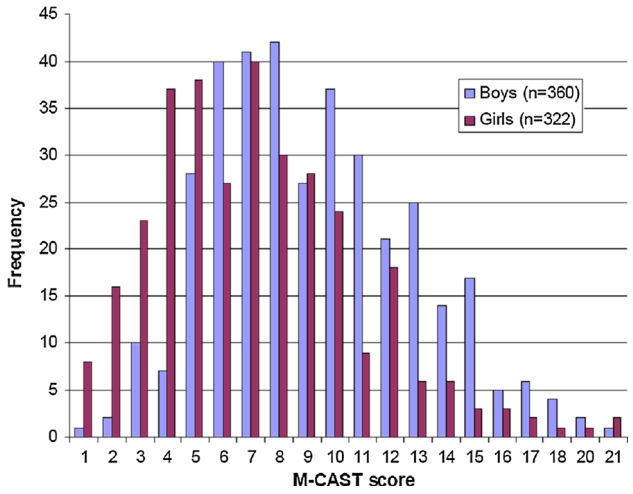

Fig. 1 Score distribution on the CAST in Chinese sample

and 322 girls. The mean age of the children was 8.4 years old (SD 1.2). 627 (91.9 %) Mandarin CAST questionnaires were fully completed, while 54 (7.9 %) questionnaires had missing values on 1–4 items.

Overall Score Distributions for Boys and Girls

The mean score of the whole sample on the Mandarin CAST was 7.8 (IQR 5, 10; range 0, 21) (n = 682). The mean score of boys (mean 8.3; IQR 6, 11; range 0, 21) was higher than that of girls (mean 7.2; IQR 4, 9; range 1, 21). Differences in the overall score distributions between boys and girls were significant (Wilcoxon Rank Sum Test, $z = -4.329$, $p < 0.001$). Figure 1 provides the score distributions of boys and girls.

Score Distributions Among Three Score Groups

When the scores were categorised into three groups as in previous studies (Baron-Cohen et al. 2009) (low score: ≤11; borderline score: 12–14; high score: ≥15), the differences in the proportions of positive endorsements between boys and girls across all three score groups were significant ($p = 0.035$) (see Table 1). Using logistic regression, only the association between sex and the CAST score groups was significant (Table 2). The unadjusted odds of being a boy increased 83 % per CAST score group (odds ratio = 1.83, 95 %CI 1.14, 2.93, $p = 0.012$). Using linear regression, no significant differences were found in mean scores between age groups ($p = 0.54$). The distribution of scores in each age group is shown in Table 3.

Item Endorsement in Boys and Girls

The proportions of item endorsement by boys and girls are shown in Table 4. There were significant differences between boys and girls on seven items (items 8, 14, 21, 24, 29, 31 and 36). Within these seven items, the proportions of boys who scored as ASC-positive were significantly higher than those of girls.

Sensitivity Analyses

The analyses were repeated firstly using the maximum score. The mean maximum score of boys was 8.4 and that of girls was 7.3. The effect of sex was a little smaller than before (odds ratio = 1.77; 95 % CI 1.12, 2.82, $p = 0.015$). When using the maximum score for girls and minimum score for boys to estimate the extreme effect of sex, the odds ratio of being a boy was lower than those obtained previously (1.70; 95 % CI 1.07, 2.71, $p = 0.025$). In these two sensitivity analyses, the same proportions of boys and girls were found in the high score group [boys: n = 18 (60 %), girls: n = 12 (40 %)].

After full diagnostic assessment, six children (four boys, two girls) were given a research diagnosis of ASC, all of whom did not have a previous diagnosis of ASC. After exclusion, the mean score of remaining boys (8.2) was still higher than that of remaining girls (7.1). When these children were excluded, the effect of sex was similar to that obtained previously (odds ratio 1.71; 95 % CI 1.08, 2.73, $p = 0.023$). The proportion of boys in the high score group (n = 16, 62 %) was still greater than the proportion of girls (n = 12, 38 %).

Discussion

Overall Findings

This study examined sex differences in relation to developmental profiles and autistic traits in a general population in mainland China. Boys on average had significantly higher scores on the Mandarin CAST than girls. This association was not influenced by age and was still observed when missing data were handled using different approaches. Autistic traits were found to be significantly higher in boys than in girls on seven Mandarin CAST items. This study provides evidence for sex differences in autistic traits in a Chinese cultural setting.

Limitations

Several limitations should be noted. The sample was drawn from two mainstream schools in Beijing which are in close proximity to each other. Beijing may not be representative of the whole population in mainland China due to its special political and economic status (National Bureau of Statistics of China 2012). Generalizability might therefore be limited. Thus, caution need to be paid when applying results from this

study at a national level. Previous studies have suggested possible differences in perspectives of children's behaviours between fathers and mothers (Donaldson et al. 2011; McCabe 2008). In this study, only one parent of each child filled in the CAST. Thus, any differences between father's and mother's perspectives cannot be investigated. In the future, the gender relationship and age of the informants should also be recorded. Some CAST items received more autism-positive endorsement in this sample. For example, more than 50 % of the boys and girls scored as positive on items 6 (notice unusual details) and 19 (have an unusual memory for details). Over 40 % of the boys and girls scored positive on item 14 (has an interest which takes up so much time). The general high endorsement of these items may be because the interpretation of these items by Chinese parents might be different from Western parents. Sensitivity analyses showed that missing data were unlikely to influence the findings.

Behavioural Differences Between Boys and Girls

Boys were found to have more autistic-like features than girls in this Chinese sample, particularly shown on seven items. Five items (items 8, 21, 24, 29 and 36) describe impairments in social interaction and communication, while two items (14 and 31) focus on narrow interests and repetitive behaviours. Item 29 ("Is his/her social behaviour very one-sided and always on his/her own terms?") and item 36 ("Does s/he often turn conversations to his/her favourite subject rather than following what the other person wants to talk about?") focus on the child's communication difficulties. Item 21 ("Are people important to him/her?") asks for the child's perception of other people. Item 24 ("Does s/he play imaginatively with other children, and engage in role-play?"), item 31 ("Does s/he prefer imaginative activities such as play-acting or story-telling, rather than numbers or lists of facts?") and item 8 ("When s/he was 3 years old, did s/he spend a lot of time pretending (e.g., play acting being a superhero, or holding teddy's tea parties?)") focus on the child's social interaction (role-play) with peers. According to Chinese parents' observations, boys have more difficulties in social interactions, such as role-playing and taking turns, in communication, and have more narrowed interests and behaviours. These findings were in line with previous findings from other studies. For example, boys were reported to have different approaches to friendship formation, confirming earlier studies (Baron-Cohen et al. 2003) and different types of play from girls, again confirming earlier studies (Knickmeyer et al. 2005). Also in agreement with previous findings, the current study provides further evidence that boys have narrower interests and more repetitive behaviours than girls. This has also been reported in two previous clinical studies based on diagnosed cases using face-to-face observation (ADOS) and parent interviews (ADI-R) (Lord et al. 1982; McLennan et al. 1993), whereas the current study used a parent self-completed screening questionnaire.

Although different methods of sex comparisons have been used within and across cultures, there is consistency in these

Table 1 Unadjusted association between variables and CAST score groups

Variable	Category	UOR	95 % CI	*p* value
Sex	Girl	1.00	Reference	
	Boy	1.83	(1.14, 2.93)	0.012
Age group (years)	6	1.00	Reference	
	7	0.70	(0.31, 1.56)	0.38
	8	1.06	(0.53, 2.05)	0.87
	9	1.04	(0.54, 2.00)	0.91
	10	0.89	(0.33, 2.40)	0.81
Father's occupation	Worker/farmer	1.00	Reference	
	Clerk	0.46	(0.22, 0.96)	0.04
	Technical staff	0.76	(0.37, 1.56)	0.46
	Manager	0.38	(0.08, 1.74)	0.21
	Own-business	1.14	(0.56, 2.31)	0.72
Mother's occupation	Worker/farmer	1.00	Reference	
	Clerk	1.11	(0.59, 2.11)	0.73
	Technical staff	0.55	(0.26, 1.16)	0.11
	Own-business	1.42	(0.73, 2.76)	0.31
Father's education	Junior high school	1.00	Reference	
	High school	0.89	(0.44, 1.78)	0.74
	College	0.56	(0.29, 1.10)	0.10
	Master or higher	0.56	(0.17. 1.80)	0.33
Mother's education	Junior high school	1.00	Reference	
	High school	1.14	(0.60, 2.18)	0.69
	College	0.53	(0.27. 1.03)	0.06
	Master or higher	0.67	(0.18, 2.47)	0.55

UOR unadjusted odds ratio

Table 2 Number (%) of boys and girls, by score group and overall

	CAST score group			Total
	≤11	12–14	≥15	
Boys	286 (50.5)	56 (65.1)	18 (60.0)	360
Girls	280 (49.5)	30 (34.9)	12 (40.0)	322
Total	566	86	30	682

findings. Studies using comparable methods have reported higher proportions of autistic trait scores in boys. Typically developing boys have been found to score higher than girls in adult, child and adolescent versions of the AQ (Auyeung et al. 2008; Baron-Cohen et al. 2006, 2001). Boys aged 7–9 in a large population scored significantly higher on the ASSQ than girls (Posserud et al. 2006). A study using the SRS to examine autistic traits in 7–15 years old children reported that boys' scores were on average 25 % higher than girls' (Constantino et al. 2003). Our previous study using the CAST identified sex differences in autistic traits in the UK general population. Sex differences in autism may be due to the different phenotypes in affected boys and girls (Williams et al. 2008). Girls may show more subtle difficulties than boys, and girls with ASC may have been trying hard to pretend to be normal (Holliday-Willey 1999). Third, cultural influence needs to be taken into consideration when examining the performance of the Mandarin CAST in a Chinese population. Due to the possible different views on the development of boys and girls, the endorsement of certain items in boys may be different from girls by Chinese parents in the first place. In many cultures, China included, girls are expected to be more submissive, obedient, quiet and obedient than boys in social contexts, while boys are expected to be more extrovert and more interactive. Based on such expectations, the social and communication difficulties in Chinese boys may be more noticeable than girls. However, it is also possible that the prevalence of ASC in boys is higher than girls in general. This explanation can be supported by previous screening and prevalence studies based on large population samples in different countries (Baron-Cohen et al. 2003; Centres of Disease Control and Prevention 2012; Volkmar et al. 1993).

Implications and Future Directions

Sex differences in autistic features were found in a general population in mainland China. Although the Mandarin CAST was being applied in an Asian culture for the first time, the findings of this study suggested that differences in the developmental profiles of boys and girls may exist across cultures. Although the underlying reasons for these differences are still unknown, this finding has implications for further investigations into ASC in China, and cross-culturally. It would be useful to conduct a population-based study that matches the IQs of boys and girls. In order to address differences in study methodologies, further research could adopt a combination of direct observation, caregiver interviews and self-report questionnaires for data collection. Further development of screening and diagnostic instruments needs to take different behaviours of boys and girls into account. Clinicians need to be aware of how ASC may differ in girls and boys when examining potential autistic cases, as girls may not show severe social and communication difficulties and they could have fewer circumscribed interests than boys. The question of whether these differences can be traced at a genetic or biological level needs to be further investigated in order to improve our understanding of the aetiology of ASC (Lai et al. 2011; Szatmari et al. 2012). In terms of the implications of the Mandarin CAST, potential baseline taking sex differences into consideration in endorsement suggests further studies need to examine whether it is reasonable to adopt a higher cut-off point for the Mandarin CAST for boys than for girls (Williams et al. 2008). Previous CAST studies have found significant sex differences in the general population but no differences between boys and girls with a diagnosis of ASC (Williams et al. 2008). It would be helpful to investigate whether sex differences exist among Chinese boys and girls with ASC using the Mandarin CAST.

Table 3 Distribution of score on the CAST by age and sex (n = 682)

Age	All			Boys			Girls		
	N	Median	IQR[a]	N	Median	IQR	N	Median	IQR
6	134	7	5,10	66	8	6,12	68	7	5,9
7	113	7	5,10	61	8	6,11	52	7	4,9
8	195	7	5,10	100	7	5,11	95	7	4,10
9	189	7	5,10	105	8	5,10	84	7	4,9
10	51	7	6,10	28	7.5	6,10	23	7	6,11
Total	682	7	5,10	360	8	6,11	322	7	4,9

[a] Inter-quartile range

Table 4 Endorsement of each item by sex in China (China n = 682)

No.	Item	Scoring response	Boys			Girls			*p* value
			Positive N (%)	Negative N (%)	Missing N (%)	Positive N (%)	Negative N (%)	Missing N (%)	
1	Does s/he join in playing games with other children easily?	No	17 (4.7)	343 (95.3)	0 (0.0)	22 (6.8)	299 (92.9)	1 (0.3)	0.23
2	Does s/he come up to you spontaneously for a chat?	No	37 (10.3)	322 (89.4)	1 (0.3)	26 (8.1)	296 (91.9)	0 (0.0)	0.32
3	Was s/he speaking by 2 years old?	Not scored	No = 29 (8.1)	Yes = 331 (91.9)	0 (0.0)	5 (1.6)	317 (98.5)	0 (0.0)	–
4	Does s/he enjoy sports?	Not scored	No = 30 (8.4)	Yes = 330 (91.7)	0 (0.0)	26 (8.1)	295 (91.6)	1 (0.3)	–
5	Is it important to him/her to fit in with the peer group?	No	28 (7.8)	332 (92.2)	0 (0.0)	21 (6.5)	301 (93.5)	0 (0.0)	0.53
6	Does s/he appear to notice unusual details that others miss?	Yes	250 (69.4)	109 (30.3)	1 (0.3)	213 (66.2)	108 (33.5)	1 (0.3)	0.36
7	Does s/he tend to take things literally?	Yes	82 (22.8)	276 (76.7)	2 (0.6)	69 (21.4)	251 (78.0)	2 (0.6)	0.68
8	When s/he was 3 years old, did s/he spend a lot of time pretending (e.g., play acting being a superhero, or holding teddy's tea parties)?	No	119 (33.1)	229 (63.6)	1 (0.3)	66 (20.5)	254 (78.9)	2 (0.6)	0.0002
9	Does s/he like to do things over and over again, in the same way all the time?	Yes	130 (36.1)	229 (63.6)	1 (0.3)	106 (32.9)	215 (66.8)	1 (0.3)	0.38
10	Does s/he find it easy to interact with other children?	No	33 (9.2)	327 (90.8)	0 (0.0)	23 (7.1)	299 (92.9)	0 (0.0)	0.34
11	Can s/he keep a two-way conversation going?	No	23 (6.4)	337 (93.6)	0 (0.0)	17 (5.3)	305 (94.7)	0 (0.0)	0.54
12	Can s/he read appropriately for his/her age?	Not scored	No = 61 (16.9)	Yes = 299 (83.1)	0 (0.0)	36 (11.2)	285 (88.5)	1 (0.3)	–
13	Does s/he mostly have the same interests as his/her peers?	No	47 (13.1)	313 (86.9)	0 (0.0)	36 (11.2)	286 (88.8)	0 (0.0)	0.46
14	Does s/he have an interest which takes up so much time that s/he does little else?	Yes	168 (46.7)	191 (53.1)	1 (0.3)	133 (41.3)	187 (58.1)	2 (0.6)	0.002
15	Does s/he have friends, rather than just acquaintances?	No	90 (25.0)	269 (74.7)	1 (0.3)	82 (25.5)	237 (73.6)	3 (0.9)	0.85
16	Does s/he often bring you things s/he is interested into show you?	No	25 (6.9)	335 (93.1)	0 (0.0)	18 (5.6)	304 (94.4)	0 (0.0)	0.47
17	Does s/he enjoy joking around?	No	99 (27.5)	259 (71.9)	2 (0.6)	78 (24.2)	243 (75.5)	1 (0.3)	0.32
18	Does s/he have difficulty understanding the rules for polite behaviour?	Yes	152 (42.2)	208 (57.8)	0 (0.0)	119 (37.0)	203 (63.0)	0 (0.0)	0.16
19	Does s/he appear to have an unusual memory for details?	Yes	267 (74.2)	92 (25.6)	1 (0.3)	231 (71.7)	88 (27.3)	3 (0.9)	0.56
20	Is his/her voice unusual (e.g., overly adult, flat, or very monotonous)?	Yes	97 (26.9)	261 (72.5)	2 (0.6)	78 (24.2)	244 (75.8)	0 (0.0)	0.39
21	Are people important to him/her?	No	49 (13.6)	309 (85.8)	2 (0.6)	25 (7.8)	293 (91.0)	4 (1.2)	0.015

Table 4 continued

No.	Item	Scoring response	Boys			Girls			*p* value
			Positive N (%)	Negative N (%)	Missing N (%)	Positive N (%)	Negative N (%)	Missing N (%)	
22	Can s/he dress him/herself?	Not scored	No = 6 (1.7)	Yes = 354 (98.3)	0 (0.0)	4 (1.2)	317 (98.5)	1 (0.3)	–
23	Is s/he good at turn-taking in conversation?	No	110 (30.6)	248 (68.9)	2 (0.6)	77 (23.9)	243 (75.5)	2 (0.6)	0.053
24	Does s/he play imaginatively with other children, and engage in role-play?	No	52 (14.4)	307 (85.3)	1 (0.3)	23 (7.1)	299 (92.9)	0 (0.0)	0.002
25	Does s/he often do or say things that are tactless or socially inappropriate?	Yes	93 (25.8)	263 (73.1)	4 (1.1)	78 (24.2)	239 (74.2)	5 (1.6)	0.65
26	Can s/he count to 50 without leaving out any numbers?	Not scored	No = 9 (2.5)	Yes = 350 (97.2)	1 (0.3)	4 (1.2)	318 (98.8)	0 (0.0)	–
27	Does s/he make normal eye-contact?	No	69 (19.2)	289 (80.3)	2 (0.6)	57 (17.7)	264 (82.0)	1 (0.3)	0.61
28	Does s/he have any unusual and repetitive movements?	Yes	74 (20.6)	286 (79.4)	0 (0.0)	57 (17.8)	265 (82.3)	0 (0.0)	0.35
29	Is his/her social behaviour very one-sided and always on his/her own terms?	Yes	98 (27.2)	262 (72.8)	0 (0.0)	58 (18.0)	263 (81.7)	1 (0.3)	0.005
30	Does s/he sometimes say "you" or "s/he" when s/he means "I"?	Yes	43 (12.0)	317 (88.1)	0 (0.0)	44 (13.7)	278 (86.3)	0 (0.0)	0.501
31	Does s/he prefer imaginative activities such as play-acting or story-telling, rather than numbers or lists of facts?	No	122 (33.9)	237 (65.8)	1 (0.3)	75 (23.3)	246 (76.4)	1 (0.3)	0.002
32	Does s/he sometimes lose the listener because of not explaining what s/he is talking about?	Yes	94 (26.1)	264 (73.3)	2 (0.6)	89 (27.6)	230 (71.4)	3 (0.9)	0.63
33	Can s/he ride a bicycle (even if with stabilisers)?	Not scored	No = 47 (13.1)	Yes = 312 (86.7)	1 (0.3)	51 (15.8)	271 (84.2)	0 (0.0)	–
34	Does s/he try to impose routines on him/herself, or on others, in such a way that it causes problems?	Yes	114 (31.7)	242 (67.2)	4 (1.1)	103 (32.0)	217 (67.4)	2 (0.6)	0.96
35	Does s/he care how s/he is perceived by the rest of the group?	No	112 (31.1)	243 (67.5)	5 (1.4)	85 (26.4)	237 (73.6)	0 (0.0)	0.14
36	Does s/he often turn conversations to his/her favourite subject rather than following what the other person wants to talk about?	Yes	114 (31.7)	244 (67.8)	2 (0.6)	69 (21.4)	253 (78.6)	0 (0.0)	0.002
37	Does s/he have odd or unusual phrases?	Yes	160 (44.4)	199 (55.3)	1 (0.3)	127 (39.4)	194 (60.3)	1 (0.3)	0.19

Conclusions

This study shows the sex differences in autistic traits also exist in Chinese children, which were similar to those reported based on Western populations. The Chinese boys show more difficulties in social and communication than girls, which support the hypothesis that the prevalence of ASC in boys is higher than that in girls. Sex differences may be universal across cultures and should be considered when developing screening and diagnostic instruments. Further research needs to be conducted to investigate the genetic, biological, neurological and other etiological mechanisms as well as social and mental health implications of these sex differences.

Acknowledgments We are grateful to all the participants in this study. We would like to thank Zhang Zhixiang and Jiong Qin for their advice and support throughout this study. This study was funded by the Waterloo Foundation, the Peking University First Hospital, the Cambridge Institute of Public Health and the Autism Research Centre in the University of Cambridge. XS was partly funded by the Cambridge Commonwealth Trust and Clare Hall of the University of Cambridge during the data collection and then funded by the International Development Fund—Cambridge-CUHK Collaboration on Autism Research in Hong Kong and China during the writing up of this paper. SBC, CA and BA were funded by the Medical Research Council UK and the Welcome Trust. This study was conducted in association with NIHR CLAHRC for the Cambridgeshire and Peterborough NHS Foundation Trust. FM was funded by MRC UK.

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