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Autistic Traits in the Neurotypical Chinese Population: A Chinese version of Glasgow Sensory Questionnaire and a Cross-Cultural Difference in Attention-to-Detail

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Ethics statement

The study was approved by the Ethics Committee of Southwest University.

Author Contribution

ZR was responsible for data collection; JW and JQ were responsible for the original design;

JW was responsible for writing with all authors contributing to edits.

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Running Head: autistic traits in Chinese population

Abstract (120 words)

The aim of this study was to assess cross-cultural differences in autistic traits relating to sensory sensitivity / attention-to-detail versus socio-communicative problems in a Chinese sample. A measure of atypical sensory sensitivity (Glasgow Sensory Questionnaire, GSQ) was translated into Chinese and compared against another measure of autistic traits (Chinese version of Autism Quotient, AQ). A second Chinese sample was administered English-language versions. We show that the translated GSQ has: good internal reliability; a similar profile of item responses to the English version; and a significant correlation with the AQ. Secondly we report an unexpected, but replicable, finding amongst the Chinese. Specifically, attention-to-detail was negatively correlated with socio-communicative difficulties (whereas in Western samples it is the reverse).

Keywords: autism; cross-cultural; sensory sensitivity; attention-to-detail; AQ; GSQ

INTRODUCTION

Autism spectrum disorder (ASD) was traditionally defined by a triad of impairments consisting of problems in social understanding, communication and limited repertoire of interests (Wing & Gould, 1979). However, our contemporary understanding of the autism phenotype is much broader. The most recent diagnostic criteria, DSM-V, include atypical sensory sensitivities including hyper-sensitivity ('sensory overload', aversion to lights and sound) and hypo-sensitivities (e.g. stimulating the senses) (American Psychiatric Association, 2013). Although not part of the diagnostic criteria, it is also widely recognised that autism is linked to certain abilities such as better attention-to-detail (e.g. finding an object from a cluttered array), and increased interest in systems and patterns (e.g. C. E. Robertson & Baron-Cohen, 2017). These now permeate our cultural stereotypes of autism from prodigious savants such as 'Rainman' to socially awkward detectives with an eye for detail ('The Bridge'). However, these stereotypes – like the scientific research that underpins them – are Western dominated, and we have very little understanding as to how autism manifests itself around the globe.

A wide range of tests and measures of perceptual functioning have been shown to be relevant to autism including: figure-ground segmentation (Joliffe & Baron-Cohen, 1997); less inattention blindness and deafness (Remington, Swettenham, Campbell, & Coleman, 2009); and more perceptual stability (C. E. Robertson, Kravitz, Freyberg, Baron-Cohen, & Baker, 2013). This is often subsumed within the idea that people with autism may have enhanced processing of local information (e.g. parts within wholes) possibly also accompanied by, or driven by, problems in global/contextual processing (Happé, 1999). It is also referred to as enhanced attention-to-detail (Baron-Cohen, Ashwin, Ashwin, Tavassoli, & Chakrabarti, 2009), although this concept is also often extended to symbolic details (e.g. numbers in license plates)

as well as purely sensory ones. Aside from cognitive tests, there are questionnaire measures that attempt to capture this characteristic. The Autism Spectrum Quotient (AQ) contains five subscales which include attention-to-detail (high traits being indicative of autism), as well as four subscales linked to impairment (social skills, communication, imagination, attention switching; Baron-Cohen, Wheelwright, Skinner, Martin, & Clubley, 2001). The newer diagnostic symptom of atypical sensory sensitivity is defined in terms of subjective report and several recent questionnaire measures have been developed to capture this (A. E. Robertson & Simmons, 2013; Tavassoli, Hoekstra, & Baron-Cohen, 2014).

The present study develops a Chinese version of the Glasgow Sensory Questionnaire, GSQ (A. E. Robertson & Simmons, 2013). People with a diagnosis of autism score higher than neurotypical people (e.g. Ward et al., 2017), and scores within the neurotypical population show moderate to strong correlations with autistic tendencies measured by the AQ (e.g., A. E. Robertson & Simmons, 2013). In addition, the study determines the extent to which one of the key traits of autism in the West, namely attention-to-detail, so related to other autistic traits in a Chinese sample. Evidence that these traits are, at least partially, separable is discussed below.

Whether the sensory/attentional symptoms of autism and the socio-communicative impairments are two aspects of the same thing (e.g. mediated by a common biological underpinning) or reflect different, but related, symptom clusters is a matter of debate. Palmer Paton, Enticott, and Hohwy (2015) used cluster analysis (a data-driven method of grouping participants) of the AQ in a large neurotypical sample and suggested that the pattern was best explained by two clusters: one related to attention-to-detail and another related to sociability/mentalising. Other psychometric analyses of the AQ in Western samples yield similar divisions (Austin, 2005; Hoekstra, Bartels, Cath, & Boomsma, 2008), although it is to be noted that increased attention-to-detail and socio-communicative difficulties are positively

correlated in all of these studies suggesting only partial autonomy. Molecular genetic measures of different autistic symptoms also lead to similar conclusions (Warrier et al., 2019).

There is some evidence that this positive association of socio-communicative and attention-to-detail traits may not be cross-culturally universal. Lau et al. (2013) translated and administered a Chinese version of the AQ to a large sample of adults (either parents of autistic children or parents of typically developing children). They examined the psychometric properties of this version and produced a broadly similar set of subscales to those developed in the West. They proposed a five-factor structure of the AQ (containing 35 of the original 50 items) consisting of: Socialness, Mindreading, Patterns, Attention-to-detail, and Attention Switching. However, two of the subscales – Patterns and Attention-to-detail (both of which were in the original Attention-to-detail subscale of the AQ) – correlated negatively with the other subscales. This suggests that these symptoms are not related to the socio-communicative impairments in neurotypical ethnic Chinese. If anything, good attention-to-detail may be contra-indicative of autistic traits in Chinese people, unlike the Western stereotype of the “Rain man” or autistic savant.

Although other studies have used the Chinese version of the AQ they have not always reported subscale scores (Zhou, Wang, & Chasson, 2018) or have not reported the correlations between them (Chiang, Chen, Lin, Tseng, & Gau, 2017; Zhang et al., 2016). Pang et al. (2018) discuss the problems in diagnosing autism within the Chinese population both in terms of logistical challenges (e.g. stigma) but also in terms of suitability of the diagnostic instruments. In line with this, Zhou et al. (2018) note a prevalence of high autism traits ($AQ \geq 32$) of 1.5% in Chinese college students which is lower than that reported by similar studies in the West. As such, further research is needed to determine if there are genuine cross-cultural differences in the way that autism manifests itself or, relatedly, we need different diagnostic measures across cultures (over and above a simple linguistic translation).

The present study produces a Chinese version of the GSQ and contrasts this with performance on a Chinese version of the AQ (including the different subscales). In addition, a second sample of Chinese participants, fluent in English, are tested using the standard (English) versions of these measures to determine if the differences reflect ethnicity/culture independent of language. The degree of association between the different measures are reported and contrasted against those from Western samples.

METHOD

Participants

Participants (N=401), recruited from XXXX, China, took part in the Chinese-language version (mean age = 21.04 years, S.D.=1.27, range=18-26; 111 males/290 females). The inclusion criteria were age (18 or over), being a native Chinese speaker, and providing complete answers to both measures. A further 130 Chinese participants (mean age = 29.65 years, S.D.=5.48, range=20-49; 59 males/71 females) were recruited via an online survey provider (Qualtrics, Provo, UT) to take the original English-language version of the same measures, so that effects of ethnicity/culture versus test language could be assessed. In addition to the inclusion criteria above, this sample were required to confirm the following question for inclusion: “Are you proficient in English such that you can easily understand and answer questions relating to personality and behaviour?”. All of this second sample were currently resident in China. The study was approved by the Ethics Committee of XXXX.

Measures

Glasgow Sensory Questionnaire (GSQ)

The GSQ contains 42 items that are drawn from seven sensory modalities (vision, hearing, taste, smell, touch, proprioception, vestibular) with six questions for each modality

divided equally into questions about hyper-sensitivity and hypo-sensitivity (A. E. Robertson & Simmons, 2013). However, it is common practice to report a single score, rather than subscale scores, for this measure because it has been shown that items load on to a single-factor solution. The questions are answered on a 5-point scale (never=0, rarely=1, sometimes=2, often=3, always=4), giving a range of possible answers from 0 to 168. Example items included “Do you find certain noises or pitches of sound annoying?”, “Do bright lights ever hurt your eyes or cause a headache?” and “Do you ever feel ill just from smelling a certain odour?”. The questions were translated into Chinese by one of the researchers (XXXX) at XXXX, China, and were then verified through back-translation and correction of a small number of items by a bilingual Chinese-English speaker based in the UK. The translated version is included as Supplementary Material.

Autism Spectrum Quotient (AQ)

The AQ consists of 50 items comprising 10 items from 5 subscales (social, attention switching, attention-to-detail, communication, imagination) (Baron-Cohen et al., 2001). Examples items from each subscale are: “I find it hard to make new friends” (social), “I often notice small sounds when others do not” (attention-to-detail), “I enjoy social chit-chat” (communication). “I find it easy to do more than one thing at once” (attention-switching), “I find it very easy to play games with children that involve pretending” (imagination). For comparability with most previous research, we retain the original subscale classification although we note alternative item groupings have been proposed in both English (e.g. Palmer et al., 2015) and Chinese (Lau et al., 2013). Responses are given on a 4-point scale (definitely agree, slightly agree, slightly disagree and definitely disagree), but are typically binarised for scoring purposes such that a score of 1 corresponds to endorsing an autistic trait (but see, e.g., Austin, 2005, for a continuous scoring method). Thus the range of scores is 0-50, where a

score of ≥ 32 corresponds to self-reported autistic traits comparable to those with a formal diagnosis of autism.

Procedure

Chinese students were first given the translated GSQ followed by an existing Chinese translation of the AQ (Zhang et al., 2016). Questions were presented in a fixed order, and were completed online in a University laboratory as part of a research class. The bilingual Chinese-English participants were recruited from the Qualtrics ‘Online Sample’ with the inclusion criteria of being of Chinese nationality/ethnicity and sufficient ability in English (“Are you proficient in English such that you can easily understand and answer questions relating to personality and behaviour?”). They completed the standard English versions of the GSQ (A. E. Robertson & Simmons, 2013) and AQ (Baron-Cohen et al., 2001), administered online using Qualtrics, and presented in that order (with questions in a fixed random order).

RESULTS

Chinese version of the Glasgow Sensory Questionnaire (GSQ)

The reliability of the new Chinese GSQ, Cronbach’s alpha, was 0.907. There were 3 items which, if deleted, would have improved the reliability of the scale but only by very small amounts (each was 0.001). Hence, it was decided to retain all items.

The mean score for the Chinese sample taking the Chinese version was 50.72 (S.D.=18.33, range =5-101). Males and females did not differ in their scores ($t(399)=.304$, $p=.761$). The mean and SDs of each item are shown in Table 1, together with comparable scores from a neurotypical UK-based sample (from Ward, Brown, Sherwood, & Simner, 2018). The mean scores of each item ($N=42$) show a significant correlation, with large effect size,

when comparing Chinese and English versions ($r=0.614$, $p<.001$). However, closer comparison of individual questions (Supplementary Material) reveals some item-specific discrepancies across the cultures that are most apparent for items referring to taste and smell (the UK sample are more sensitive than the Chinese). Removing all taste and smell items increases the item-based correlation between UK and Chinese version ($r=0.820$, $p<.001$). Whilst deleting these items minimises cross-cultural differences, it does not ‘improve’ the measure in any statistical sense: it does not increase the Cronbach’s alpha (it reduces it) and nor does it affect the size of the relationship between the GSQ and the AQ (as shown below). Both the English and Chinese versions are equally valid, but care must be taken when pooling or comparing across cultures.

English version of the GSQ given to Chinese Participants

The mean score for the Chinese sample taking the English version was 69.60 (S.D.=22.87, range =17-140). The Cronbach’s alpha was .938. The by-items ($N=42$) correlation of the mean scores for each question for the two Chinese samples (differing only by language of administration) was $r=.743$ ($p<.001$). As such, we are confident that the Chinese and English versions generate broadly similar response patterns both within and across cultures.

Autism-Spectrum Quotient (AQ)

For the Chinese sample taking the Chinese version, the mean AQ score was 19.84 (SD = 5.68). Males scored significantly higher than females ($t(399)=2.715$, $p=.007$; males=20.73 [S.D=5.32], females=19.14 [S.D=5.19]). The reliability of the AQ, Cronbach’s alpha, was .633. Considering single items, deletion of 10 items would have increased the reliability. It was noted that many of these items were from the ‘attention to detail’ subscale and omission of all

10 items from that subscale increased Cronbach's alpha to .735. For the Chinese sample taking the English version, the mean AQ score was 22.52 (SD = 5.34). The reliability of the AQ, Cronbach's alpha, was .631. Again, males scored significantly higher than females ($t(399)=2.715$, $p=.007$; males=20.73 [S.D=5.32], females=19.14 [S.D=5.19]).

The descriptive statistics for the different subscales are shown in Table 1, alongside previously published norms for a UK-based University sample for comparison (Baron-Cohen et al., 2001).

INSERT TABLE 1 ABOUT HERE

Relationship between GSQ and AQ subscales

For the Chinese sample given the Chinese questionnaires, the correlation between the AQ and GSQ was $r=.232$, $p<.001$ (bootstrapped 95% bias-corrected confidence intervals of .151 to .316). It is not increased substantially by deleting the taste and smell items from the GSQ which were shown to differ most cross-culturally ($r=.249$, $p<.001$). Table 2 shows a breakdown of the correlations between the AQ subscales as well as the GSQ. The different AQ subscales tend to correlate positively together with the exception of attention-to-detail, which shows significant negative correlations. That is, high attention-to-detail does not appear to act as cognitive marker of autistic tendencies in this neurotypical Chinese sample, unlike in Western samples.

INSERT TABLE 2 ABOUT HERE

Table 3 shows that the same pattern is found when Chinese participants are given the standard English language versions of the AQ and GSQ. That is, attention-to-detail is not

associated with other autistic traits and this seems to be due to ethnicity/culture rather than language (including any trivial issues stemming from translation of these measures). The correlation between the overall AQ score and GSQ for these participants was $r=0.352$, $p<.001$ (bootstrapped 95% bias-corrected confidence intervals of .203 to .480).

INSERT TABLE 3 ABOUT HERE

The cross-cultural differences relating to the AQ are summarised in Figure 1. As noted previously, there is a positive association between attention-to-detail and other traits measured by the AQ in the Western sample but a negative association in the two Chinese samples. It is to be noted that the Chinese sample recruited from the online platform tended to score higher overall (similarly for the GSQ) and this is considered in the Discussion.

INSERT FIGURE 1 ABOUT HERE

DISCUSSION

The initial aim of this study was to develop a Chinese language version of the Glasgow Sensory Questionnaire (GSQ), a quantitative measure of sensory sensitivity based on the DSM-V diagnostic criteria for autism spectrum disorder (American Psychiatric Association, 2013). This aim was achieved. A secondary aim, that emerged during the course of data collection, was to document cross-cultural differences in the degree of association between non-sensory (socio-communicative) and sensory traits linked to autism (sensory sensitivity, attention-to-detail). Specifically, we note that the correlation between GSQ and AQ in Chinese people, whilst significant, is lower than typically reported from Western samples and, secondly, that

the attention-to-detail subscale of the AQ is negatively correlated with other AQ subscales in Chinese samples (but positively correlated in Western samples). We show that the same pattern occurs when Chinese people are given the English-language versions of these measures too. These two important observations are discussed in turn.

Considering the relationship between GSQ and AQ, British samples report correlations amongst neurotypical samples of $r=.42$ ($N=180$; Ward et al., 2018), of $r=.48$ ($N=772$; Horder, Wilson, Mendez, & Murphy, 2014) and $r=.60$ ($N=158$; Roberston & Simmons, 2013). Ujie and Wakabayashi (2015) translated the GSQ into Japanese and reported a correlation of $r=.25$ ($N=417$) between GSQ and AQ (i.e. similar to that which we found for Chinese). Future research should consider comparing ethnic differences more rigorously including meta-analytic techniques. It is not easy to know whether cross-cultural differences in the degree of association of traits stems from genuine differences in that trait, versus differences in the measurement tool (which may underestimate a true difference). The approach taken here of using bilingual participants given an identical measure goes some way to disambiguating this. Ujie and Wakabayashi (2015) also conducted a joint factor analysis on the AQ and GSQ and found that four of the five AQ subscales formed one factor and the GSQ formed a second factor: attention-to-detail was not linked to either factor (the correlations between AQ subscales were not reported).

With regards to cross-cultural differences in the AQ, the original translation into Chinese also found a negative correlation between attention-to-detail and other autistic traits (Lau et al., 2013). The authors offered an explanation in terms of social desirability. Their scale had been validated using a sample of mothers of autistic children, and the authors suggested that the mothers would not want to appear to be inattentive to their children. However, the AQ attention-to-detail questions are clearly related to noticing sensory stimuli and patterns (none refer to parenting style) and there is no reason why our student sample would

interpret the questions in this unusual way. As such we assume that this is a genuine cross-cultural difference. We replicated this on a second sample, who had volunteered to complete online surveys, and completed it in English. Although the same pattern was found with regards to decoupling of attention-to-detail with other traits, it was noted that scores were higher across all measures for this second group. Whether this is related to bilingualism or an artefact of this method of recruitment (i.e. it tends to attract participants higher on the spectrum) is not clear. Further studies can address this by recruiting a bilingual set of participants (from the same subject pool) and randomly assigning them Chinese or English versions of the same measures, and compare them against monolinguals from the same pool.

It is important to make a clear distinction between cross-cultural differences in the level of a given trait (e.g. assessed by the mean), versus cross-cultural difference in the degree to which traits are associated (e.g. assessed by correlations). Thus, the scores on attention-to-detail from our two Chinese samples are similar to that from Western samples so this trait is likely to be still present amongst Chinese people (and other ethnic groups). It would be important to determine this using objective measures known to correlate with this subscale (Ward et al., 2018). However, the cross-cultural differences primarily lie in whether variation in this trait is indicative of a wider autism phenotype. Other cross-cultural comparisons have focussed on the level of these traits but not on their degree of association (Freeth, Sheppard, Ramachandran, & Milne, 2013).

The present research is concerned with neurotypical variation in autistic tendencies rather than diagnosed cases of autism. It is conceivable that people with a diagnosis of autism in countries such as China do have high attention-to-detail (as found in the West), but it would be harder to make the case that this is simply a quantitative exaggeration of a normal pattern (because the normal pattern is for them not to associate in this way). An alternative conceptualisation is to not imagine a single distribution within a culture, but a multi-

dimensional one. This possibility is illustrated in Figure 2 which shows a two-dimensional space rather than a linear spectrum of autistic traits. Consistent with a two-dimensional spectrum, Kitazoe, Fujita, Izumoto, Terada, & Hatakenaka (2017) performed a cluster analysis of the AQ on a large Japanese neurotypical sample and noted two mismatching groups (high-low, low-high) with respect to attention-to-detail and other subscales and three matching groups (high-high, mid-mid, low-low). Thus it is conceivable that clinical levels of autism are always high-high but set against a backdrop of a more prevalent pattern that is predominantly high-low and low-high (like China, perhaps) or predominantly low-low and mid-mid (like the UK). Whatever the explanation, we suggest it may be more helpful to conceive of autism as a multi-dimensional spectrum rather than a linear one and this may help to capture cross-cultural variation.

INSERT FIGURE 2 ABOUT HERE

This way of thinking about the autism spectrum can be extended to other measures and constructs, such as the distinction between empathizing and systemizing (Baron-Cohen, 2002, 2009). Empathizing refers to an ability to understand and share the thoughts and feelings of others, whereas systemizing is an ability to understand lawful rule-based systems. Whether these are opposite poles of a linear continuum, or separate dimensions in a multi-dimensional space, is an important question for further research that would benefit from a cross-cultural perspective. Note that systemizing and attention-to-detail are likely to be related constructs, as are empathising and the social/communication subscales of the AQ. As such, the present study predicts that similar cross-cultural differences are likely to be found here too. A further claim of empathizing-systemizing theory is that women tend to have a stronger empathizing tendency, and men have stronger systemizing tendencies, with autistic people having an

‘extreme male brain’ profile (systemizing >> empathizing; Baron-Cohen, 2002). The extent to which these Western gender-based differences are replicated in other cultures is important for future research to consider.

In summary, the present research shows that the coupling of high attention-to-detail and socio-communicative difficulties is not a feature of neurotypical variation of autistic traits in Chinese samples. Secondly, we validated a Chinese version of a common measure of sensory sensitivity and show that this correlates with other autistic traits (possibly less strongly than in Western samples, although that claim requires further research). More generally, we emphasize the importance of considering the degree of association of autistic traits across cultures (as well as any mean differences that may exist) and suggest neurotypical variation in these traits may not be best explained by the notion of a linear spectrum.

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Figure 1: The correlation between the AQ attention-to-detail subscale and the other combined subscales in a UK sample (Green), a Chinese sample given the AQ in Chinese (Red) and a Chinese sample given the AQ in English (Blue). Error bars show 1 SEM.

Figure 2: Neurotypical variation in autistic traits could be conceptualised as a multi-dimensional space (shown here in terms of the two dimensions of attention-to-detail and socio-communicative difficulties) rather than a linear spectrum. Cross-cultural differences, shown here by the size of the clusters, might lead to different patterns of association within the neurotypical population. The dotted line shows the different direction of correlation between the traits, such that Culture 1 may be an East Asian pattern (overall negative correlation), and Culture 2 a European pattern (overall positive correlation). However, it remains conceivable that people with a clinical diagnosis of autism reside in the 'high-high' portion across different cultures.

Table 1: Descriptive statistics for the different AQ subscales from the two Chinese samples, alongside previously published norms for a UK-based University sample for comparison (S. Baron-Cohen et al., 2001).

	Social	Attention switching	Attention to detail	Communication	Imagination
Chinese sample in Chinese	3.74 (2.48)	5.14 (1.63)	4.66 (2.13)	3.09 (1.93)	2.94 (1.63)
Chinese sample in English	3.78 (2.35)	4.98 (1.71)	6.04 (2.02)	3.86 (2.25)	3.86 (1.49)
UK sample in English	2.3 (2.2)	4.5 (2.0)	5.3 (2.2)	2.9 (2.0)	2.5 (1.9)

Table 2. Pearson's correlations between subscales of the AQ and the GSQ, for the Chinese sample given Chinese versions of the AQ and GSQ. (Red and green indicate significant negative and positive correlations respectively).

	Social Skills	Attention Switching	Communication	Imagination	Glasgow Sensory Questionnaire
Attention –to- detail	-.260, p<.001	-.146, p<.001	-.197, p<.001	-.104, p=.037	+.103, p=.039
Social Skills		+.334, p<.001	+.458, p<.001	+.329, p<.001	+.084, p=.094
Attention Switching			+.317, p<.001	+.078, p=.118	+.078, p=.117
Communication				+.316, p<.001	+.254, p<.001
Imagination					+.108, p=.031

Table 3. Pearson's correlations between subscales of the AQ and the GSQ, for the Chinese sample given English versions of the AQ and GSQ. (Red and green indicate significant negative and positive correlations respectively).

	Social Skills	Attention Switching	Communication	Imagination	Glasgow Sensory Questionnaire
Attention –to- detail	-.347, p<.001	-.204, p=.020	-.248, p=.004	-.318, p<.001	-.090, p=.310
Social Skills		+.390, p<.001	+.552, p<.001	+.348, p<.001	+.232, p=.008
Attention Switching			+.342, p<.001	+.197, p=.025	+.304, p<.001
Communication				+.377, p<.001	+.391, p<.001
Imagination					+.076, p=.391