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ORIGINAL PAPER

Validation of the Developmental, Dimensional and Diagnostic Interview (3Di) Among Chinese Children in a Child Psychiatry Clinic in Hong Kong

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Abstract Autism spectrum disorder (ASD) is a disorder with high levels of co-morbidities. The Developmental, Dimensional and Diagnostic Interview (3Di) is a relatively new instrument designed to provide dimensional as well as categorical assessment of autistic behaviours among children with normal intelligence. Its sound psychometric properties and relatively short administration time make it a versatile instrument. The 3Di was translated into Chinese (Cantonese) and its applicability among 194 clinic children was examined. Results found excellent reliability and validity, and achieved a sensitivity of 95 % and specificity of 77 %. It was able to capture the diagnosis of ASD among children presenting with attention deficit hyperactivity disorder. However, although the disorder of ASD is considered universal, the use of a western instrument in a Chinese context should also take note of cultural influences that may impact on the manifestation of its symptoms.

Keywords Autism spectrum disorder · 3Di · Chinese · Validation

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Introduction

Children with autism spectrum disorder (ASD) present with a range of social-communication deficits and repetitive and stereotyped behaviours. While it was once considered a distinct categorical entity, there is also the suggestion that these behavioural traits exist in a continuum and ASD represents its extreme end (Constantino and Todd 2003; Skuse et al. 2005; Prosserud et al. 2006; Ronald and Hoekstra 2011). Just like other child psychiatric disorders, high levels of psychiatric co-morbidities accompany ASD, with up to 70 % suffering from one or more co-morbidities (Simonoff et al. 2008; White et al. 2009; Gjevik et al. 2011). Although DSM-IV (American Psychiatric Association 1994) did not support a co-morbid diagnoses of attention deficit hyperactivity disorder (ADHD) and ASD, the presence of autistic difficulties (such as difficulties in social relationships, pragmatic language use and theory of mind) in children with ADHD, and of ADHD symptoms in children with ASD, are recognized to be common. Studies have reported that 20–50 % of children with ADHD would meet criteria for ASD (Reiersen et al. 2007; Mulligen et al. 2009; Rommelse et al. 2010) and 50–80 % of children with ASD also have ADHD (van Steijn et al. 2012). There are suggestions that children with a co-morbidity of ADHD and ASD showed an increase in oppositional behavior compared to ADHD or ASD alone (Grzadzinski et al. 2011; Guttmann-Steinmetz et al. 2009). Genetic evidence also suggests a shared heritability of ADHD and ASD of 50–72 % (van Steijn et al. 2012; Rommelse et al. 2010; Ronald et al. 2008).

Indeed, the co-existence of ADHD and ASD has led some researchers to hypothesize that the presence of autistic symptoms in ADHD represent a distinct subtype of ADHD that has an increased association with neurodevelopmental,

oppositional and conduct symptoms with potential implications for treatment and prognosis (Mulligen et al. 2009). All these point to the need to look out for autistic symptoms even when these are not the primary reason for referral.

A number of standardized interviews are available for the diagnosis of ASD, but each has its strengths and weaknesses (see Matson et al. 2007 for a review). Currently the most widely used 'gold standard' is the ADI-R (Autism Diagnostic Interview—Revised, Lord et al. 1994), which was developed over 20 years ago with the purpose of making a categorical diagnosis of ASD and to differentiate it from other childhood developmental disorders. More recently, Skuse et al. (2004) published the validation of their newly developed interview—the 3Di (Developmental, Dimensional and Diagnostic Interview), whose PDD (pervasive developmental disorder) module was primarily designed to assess autistic traits dimensionally in children with normal range abilities, although it can also be used for those with learning disabilities. It is administered as a standardized computer-based parental interview and provides both dimensional scores on five areas (reciprocal social interaction, language and communication skills, repetitive and stereotyped behaviours, social expressiveness, and use of gesture/non-verbal play) as well as categorical diagnosis (autism, Asperger or atypical autism). It emulates the ADI-R algorithm scoring (which defines autism as described in ICD-10 and DSM-IV) and has demonstrated excellent reliability and validity, and agreement with ADI-R on case status was very good. It is also a much shorter interview compared to the ADI-R—the PDD module takes approximately 90 min to complete. A briefer version consisting only of 53 items is also available (Santosh et al. 2009). A report providing the scores of the three dimensions used for generating diagnosis (i.e., reciprocal social interaction, language and communication skills, repetitive and stereotyped behaviours), as well as the categorical diagnosis can be generated immediately after the interview. In addition to the PDD module, the 3Di has other optional modules that generate diagnoses commonly comorbid with ASD. Given the significant changes made in the recent DSM-5 of the diagnostic criteria of ASD, Mandy et al. (2012) tested the 3Di subscales using confirmatory factor analysis and found that the DSM-5's two-factor model was represented in 3Di.

The versatility of the 3Di in providing both a dimensional and a categorical assessment of autistic impairment, together with its very promising psychometric properties, make it a potentially very useful clinical tool. The much shorter time needed in administration and in training also makes its use more feasible. As there is a lack of validated diagnostic instruments for use among Chinese populations in Hong Kong, the authors of this study translated the PDD module of the 3Di into Chinese (Cantonese) and tested its applicability among Chinese children in Hong Kong. Additionally, this study takes the validation of 3Di one step further by examining whether it can differentiate among clinic ADHD children with and without ASD.

Method

Instrument

The PDD module of the 3Di was translated into Chinese by an experienced child psychiatrist and back translated into English by a bilingual psychology graduate. To ensure content and semantic equivalence, detailed discussions were made and resolved between the research team and the 3Di authors. Because questions on the 3Di are meant to be read out as they are written, and because there are differences between oral Cantonese and written Chinese, discussions were also held among members of the research team to adjust the language so that the interview in written form could still be read out smoothly. The original authors' computer-scoring programme was used to generate the dimensional scores and categorical diagnoses.

Sample and Procedure

A consecutive series of Chinese children aged 6–12 referred to the child and adolescent psychiatry unit of a university-affiliated district general hospital because of suspected autistic, ADHD, and/or behavioral problems were recruited. Children were excluded if they had an IQ <70. The purpose of the study was explained to the parents of the recruited children and written consent obtained. The study was approved by the research ethical committee of the Chinese University of Hong Kong.

Clinical diagnoses of ASD and ADHD were made based on DSM-IV criteria by experienced child psychiatrists from detailed history obtained from the child's main carers and observations of the child. If a child was found to suffer from ASD, further classification into one of the specific clinical diagnoses (i.e., autism, Asperger's syndrome, PDD-NOS) was made. The diagnosis of ADHD was confirmed by clinical assessment and corroborated by endorsement of the DSM-IV ADHD checklist criteria by both parents and teachers.

The PDD module of the 3Di interview was administered within 1 month either before or after the clinical assessment by trained interviewers blind to the reasons for referral and the clinical diagnoses. Children were chosen at random for inter-rater and test–retest reliabilities. Inter-rater reliabilities were obtained by simultaneous rating on informant's responses by two interviewers. Test–retest

Table 1 Clinical diagnosis versus 3Di classification

Clinical diagnosis	3Di classification (N)				Total (N)
	Autism	Asperger	Atypical autism	Non-ASD	
ASD-only (N = 44)					
Autism	9	4	11	0	24
Asperger	1	7	6	2	16
PDD-NOS	1	1	0	2	4
ASD + ADHD (N = 49)					
Autism	3	3	9	1	16
Asperger	2	12	9	0	23
PDD-NOS	0	3	7	0	10
ADHD-only (N = 76)	2	2	13	59	76
	18	32	55	64	169
Non-ASD-non-ADHD (N = 25)	0	1	5	19	25

reliabilities were obtained by recording the interviews and re-rating them by the same interviewer within a month.

Analysis

SPSS version 20.0 was used for statistical analyses. Inter-rater and test–retest reliabilities of the dimensional scores were calculated using intra-class correlation coefficients (ICCs). Separate analyses were done for those with and without a clinical diagnosis of ASD. With clinical diagnosis as the criterion, the 3Di's categorical agreement with it was computed, and AUC (Area under ROC curves) of the dimensional scores were analyzed. Sensitivities and specificities were calculated using the original authors' recommended cutoffs of the dimensional scores and diagnostic algorithm. The dimensional scores of children (1) with and without ASD, and (2) children with a sole diagnosis of ASD and those with ASD comorbid with ADHD were also compared.

Results

The sample consisted of 194 children, 159 (82 %) of whom were boys. The mean age was 7.9 years (s.d. 1.6 years). There was no age difference across gender (mean age for both boys and girls were 7.9 ± 1.6 years). The majority (88 %) was living with both parents. One-third (N = 65) of the children were primarily referred for suspected autistic problem, while 49 % (N = 95) were referred because of ADHD symptoms.

Based on clinical assessment, 93 (47.9 %) children had a diagnosis of ASD, of which 44 had ASD as a sole diagnosis (ASD-only group) and 49 were co-morbid with ADHD (ASD + ADHD group). The significant number of children with "Asperger's Syndrome" (16 out of 44 of the ASD-only group, 23 out of 49 of the ASD + ADHD group; Table 1) is likely to be due to the exclusion of children with learning disability in the study sample, as well as a reflection of the nature of the clinic which serves as both a secondary and tertiary center. Of the 101 children without ASD, 76 had a diagnosis of ADHD (ADHD-only group). The non-ASD-non-ADHD group consisted of children with a mix of other child psychiatric problems such as anxiety and behavioural problems. The ADHD-only group was only slightly older—less than a year (8.4 ± 1.5 years, $p < 0.01$ by ANOVA and post hoc analysis) than the other groups (7.7 ± 1.5 for ASD-only, 7.6 ± 1.5 for ASD + ADHD, 7.8 ± 1.7 for non-ASD-non-ADHD groups).

Reliability

Table 2 shows the inter-rater and test–retest reliabilities of the 3Di. Inter-rater reliability was available for 26 cases and the mean intra-class coefficient (ICC) across all dimensions was 0.96. Separate analyses for ASD (N = 12) and non-ASD (N = 14) groups showed very similar ICCs. Categorical agreement between raters was 88.5 % (*Kappa* 0.76, $p < 0.001$) for ASD vs non-ASD classification and 76.9 % (*kappa* 0.77, $p < 0.001$) for sub-categories of 3Di classification among those with a positive clinical diagnosis of ASD.

Test–retest reliability was also calculated using ICC and had a mean of 0.92. Separate analyses for ASD (N = 8) and non-ASD (N = 8) groups found very similar correlation coefficients (0.95 and 0.89 respectively).

Comparison of Dimensional Scores

A one-way ANOVA was performed to compare the various dimensional scores of the 3Di between the ASD (N = 93) and non-ASD (N = 101) groups with and without ADHD (Table 3). Significant group differences were found for all

Table 2 Inter-rater and test re-test reliabilities of dimensional scores

	Inter-rater reliability (95 % CI)		Test–retest Reliability (95 % CI)	
	ASD (N = 12)	Non-ASD (N = 14)	ASD (N = 8)	Non-ASD (N = 8)
Reciprocal social interaction	0.97*** (0.90–0.99)	0.93*** (0.79–0.98)	0.96*** (0.81–1.00)	0.82** (0.34–0.96)
Social expressiveness	0.97*** (0.88–0.99)	0.99*** (0.98–1.00)	0.98*** (0.91–1.00)	0.81** (0.32–0.96)
Language and communication	0.97*** (0.89—0.99)	0.97*** (0.90–0.99)	0.97*** (0.84–1.00)	0.94*** (0.74–0.99)
Use of gesture/non-verbal play	1.00	0.94*** (0.80–0.98)	0.91*** (0.62–0.98)	0.86** (0.45–0.90)
Repetitive/stereotyped behaviours	0.87** (0.54–0.96)	0.96*** (0.87–0.99)	0.95*** (0.78–1.00)	1.00

***$p < 0.001$, ** $p < 0.01$

Table 3 Comparison of mean scores according to clinical ASD/ADHD groups

3Di scores [Mean (s.d.)]	Clinical diagnosis				ANOVA	Post hoc
	ASD-only[b] (N = 44)	ASD + ADHD[c] (N = 49)	ADHD-only[d] (N = 76)	Non-ASD-non-ADHD[e] (N = 25)		
Reciprocal Social [10][a]	15 (3.0)	15.6 (3.4)	9.3 (4.1)	10.2 (3.9)	$F(3,190) = 39.76$, $p < 0.001$	1 = 2 > 3 = 4
Social expressiveness	2.3 (0.8)	2.0 (0.9)	1.1 (0.9)	1.6 (2.2)	$F(3,190) = 11.08$, $p < 0.001$	1 = 2 > 3 = 4
Language/Social communication [8][a]	12.4 (4.0)	12.4 (3.1)	6.9 (3.4)	7.3 (2.9)	$F(3,190) = 38.91$, $p < 0.001$	1 = 2 > 3 = 4
Gesture and non-verbal play	7.2 (2.8)	6.8 (2.8)	4.1 (2.4)	4.5 (2.3)	$F(3,190) = 17.58$, $p < 0.001$	1 = 2 > 3 = 4
Repetitive and stereotypies [3][a]	3.2 (2.2)	2.9 (2.1)	0.9 (1.4)	1.1 (1.1)	$F(3,190) = 16.41$, $p < 0.001$	1 = 2 > 3 = 4

[a] Denotes cutoff scores for the three diagnostic dimensions according to Skuse et al. (2004)

[b, c, d, e] Refers to groups for post hoc analysis

the dimensions ($p < 0.001$). In line with expectation, post hoc analyses using the Tukey HSD test found the ASD groups (with and without ADHD) to score significantly higher than the non-ASD groups across all dimensions ($p < 0.001$). The scores between the ASD-only and ASD + ADHD groups were remarkably similar. There was also no statistical difference in the scores between ADHD-only and non-ASD-non-ADHD groups.

Validity (Table 4)

Table 4 illustrates the 3Di's validity, which was examined by calculating the AUCs (Area under ROC curves) of the three dimensional scores used in the classification of ASD (i.e. reciprocal social interaction, language and communication skills, and repetitive stereotyped behaviours). Comparing clinically diagnosed ASD (with and without ADHD) vs non-ASD groups yielded a mean AUC of 0.84. Very similar AUCs were found when comparing ASD-only vs ADHD-only groups (mean AUC = 0.82), ASD-only vs non-ASD-non-ADHD groups (mean AUC = 0.84), and ASD (± ADHD) versus ADHD-only groups (mean AUC = 0.84).

Specificities and Sensitivities

Table 4 also shows the 3Di's specificities and sensitivities. Using the original authors' recommended cutoff scores found the "reciprocal social interaction skills" and "use of language and other communication skills" dimensions to have sensitivities (SE) that were higher (96.8 and 90.3 % respectively) than specificities (SP; 62.4 and 59.4 % respectively), meaning that there was a relatively lower rate of false negative but a higher rate of false positive. In contrast, the dimension of "repetitive and stereotyped behaviours" had higher SP and lower SE, meaning relatively higher false negative and lower false positive rates (SE 53.8 %, SP 88.0 %). By combining the three dimensional scores, we found an overall sensitivity of 94.6 % and specificity of 77.2 %.

The categorical agreement between clinical diagnoses and 3Di categories was examined (Table 1). For the broad distinction between ASD vs non-ASD cases, the agreement was 85.6 %, *kappa* 0.71 ($p < 0.001$). Examining the sub-categories of ASD diagnoses, however, revealed that there was frequent switching between sub-categories. As can be seen in Table 1, although 88 of the 93 (94.6 %) clinically

Table 4 Discriminant validity, sensitivity and specificity of diagnostic dimensions

	ASD (±ADHD) versus non-ASD (±ADHD)			ASD-only versus non-ASD-non-ADHD			ASD-only versus ADHD-only			ASD(±ADHD) versus ADHD-only		
	AUC (95 % CI)	SE (%)	SP (%)	AUC (95 % CI)	SE (%)	SP (%)	AUC (95 % CI)	SE (%)	SP (%)	AUC (95 % CI)	SE (%)	SP (%)
Reciprocal social interaction	0.86 (0.81–0.91)	96.8	62.4	0.85 (0.79–0.92)	93.2	65.8	0.82 (0.71–0.93)	93.2	52.0	0.87 (0.81–0.93)	96.8	65.8
Language and communication skills	0.87 (0.82–0.91)	90.3	59.4	0.85 (0.77–0.92)	86.4	59.2	0.85 (0.76–0.94)	86.4	60.0	0.86 (0.81–0.92)	90.3	59.2
Repetitive stereotyped behaviours	0.80 (0.73–0.86)	53.8	88.0	0.81 (0.72–0.90)	59.1	86.7	0.80 (0.69-0.90)	59.1	92.0	0.80 (0.73–0.87)	53.8	86.7

diagnosed ASD cases received a 3Di classification of ASD, 50 of these 88 cases had different ASD sub-categories on the 3Di compared to their clinical sub-categories. Over two-thirds of these discrepant cases (N = 35, 70 %) had the clinical diagnoses of autism or Asperger's syndrome falling into 3Di's "atypical autism" category. The single most common reason, accounting for 31 (88.6 %) of these 35 cases, was a failure to score above the cutoff scores of the 3Di's "repetitive and stereotyped behaviours" dimension. This is in contrast to the remaining four cases, which failed to meet the cutoff score of the "use of language and other communication skills" dimension. Another 10 of the 50 discrepant cases had a switch between autism and Asperger's syndrome (7 had a clinical diagnosis of autism classified as Asperger's syndrome by 3Di, and 3 vice versa). As the difference between these two 3Di sub-categories rests on whether there was a history of delayed language development, parents' recall bias under different interview settings could have contributed to this discrepancy. These patterns of discrepancy were similar in both the ASD-only and ASD + ADHD groups, and therefore comorbid ADHD appeared not to have been a contributing factor. Of the 101 clinically non-ASD cases, 23 (22.8 %) received a 3Di classification of ASD, of which 18 were classified as "atypical autism". Therefore, among those who did not receive a clinical diagnosis of ASD, approximately one in five had a 3Di ASD classification, and the proportion is similar in both the ADHD-only (22.4 %) and non-ASD-non-ADHD groups (24.0 %).

Item Endorsement

As the high discrepancy rates between clinical diagnoses and 3Di sub-classification of ASD was due to a failure to score above the "repetitive and stereotyped behaviors" threshold, an exploration into the pattern of item endorsement of this dimension was made. Results found that among the clinically diagnosed ASD group, endorsement of ASD items of this dimension was no more than 50 % (mean endorsement of 22.5 %, s.d. 10.7 %, compared to a mean of 10.1 %, s.d. 8 % of the non-ASD group). Behaviors that had the highest endorsement rates belonged to the subscale of "circumscribed interests" ["large store of factual information" (48 %), "over-riding particular interests" (51 %) and "preoccupation with interests" (45 %)]. On the other hand, questions on the persistent presence of manneristic behaviours were endorsed by <10 % of the ASD group.

It was also observed that the mean scores of the "reciprocal social interaction" dimension among the non-ASD groups were relatively high (ADHD-only = 9.3; non-ASD-non-ADHD = 10.2) (see Table 3), and were very close to the threshold score of 10 which determined

abnormality [$t(24) = 0.245$, $p = 0.809$]. Examination of item endorsements found respectively that 13 % (s.d. 10 %), 20 % (s.d. 17 %), 7 % (s.d. 5 %) and 16 % (s.d. 12 %) of the non-ASD group received ratings on its four subscales, (i.e. "use of non-verbal cues", "sib and peer relationships", "shared enjoyment" and "emotional reciprocity") that could be suggestive of ASD (vs 27 % (s.d.18 %), 33 % (s.d.22 %), 19 % (s.d. 11 %) and 39 % (s.d.16 %) respectively for ASD group). Several items saw as many as a third of the non-ASD children receiving ratings that could be suggestive of ASD, such as "looking away from person he's talking to" (34 %), not playing imaginary games with their siblings (31 %), and of those who play imaginatively with their siblings, 32 % were said not to be playing in a varied fashion. Moreover, within the context of Hong Kong, social activities for children outside of school is not a common occurrence: half of the non-ASD group did not get invited to others' homes (53 %), did not invite others home (54 %) and did not see their friends outside school (56 %).

Discussion

This study examined the psychometric properties of the translated Chinese (Cantonese) version of the PDD module of the 3Di when applied to a sample of children attending a university-affiliated child psychiatric service in Hong Kong. Results were able to confirm its reliability and validity when used in a Chinese context. Using the original authors' recommended cutoffs and classification algorithm achieved a sensitivity of 95 % with a specificity of 77 % among a clinic sample whose predominant presentations were symptoms of ASD and ADHD, both with high levels of co-morbidities. The significantly elevated 3Di scores in children with ASD irrespective of ADHD status provide encouraging support for the use of 3Di in detecting autistic symptoms in children with other comorbid disorders such as ADHD.

Several interesting observations have also emerged from the results. First of all, relatively high scores were found on the dimension of "reciprocal social interaction skills" even among children without an ASD diagnosis. There was also a relatively higher false positive rate derived from its cutoff score. This could, of course, reflect a "halo effect", since our subjects were all clinic attenders and parents might consider them to be more problematic in multiple domains anyway. However, it is also possible that the socio-cultural context of Hong Kong could have inadvertently contributed to the endorsement of behaviours that could be suggestive of ASD, such as the children's lack of social contact outside school. Even among children without ASD, half of them do not "get invited to others' houses", "invite other children to play at home", or "see any friends outside school e.g. around the neighbourhood or in a social setting such as a club". Several reasons could account for such phenomenon. Parents in Hong Kong tend not to encourage casual social activities as children are often busy with homework and frequent test revisions after school, and there is little free time for socializing. Weekends are also occupied by different academically- or learning-related classes that are arranged by parents. Children tend not to have the liberty to invite friends or organize social activities on their own. Moreover, the majority of families in Hong Kong live in apartments and these tend to be quite small. For families living in public or government-assisted housing (of which nearly 60 % of families in the geographical area of the clinic in this study do), the size of their apartment is often <40 m^2 (Hong Kong Housing Authority 2013), so families and children do not have the space to entertain peers at home. Parents are also unwilling to allow their children to play in playgrounds nearby for safety reasons. Therefore the lack of child-initiated social activities may reflect the expectations and lifestyle of Hong Kong families and not autistic symptoms. Similarly, on the questions about imaginary play, children in Hong Kong are more often seen playing on the computer or other electronic devices than being engaged in imaginative games or role play. The busy schedule and the emphasis on learning-related activities also mean little opportunity for play, perhaps explaining that a third of the non-ASD children do not play imaginary games with their siblings. These cultural factors would have been taken into consideration during clinical interviews, but a standardized interview developed from a western culture may have forced answers that in fact reflect the cultural reality, but not ASD symptomatology. This erroneously increases the false positive rate of this dimension. That cultural influences in the manifestation of ASD should be an area that warrants further exploration has also been suggested in a recent study by Mandy et al. (2014), which used the 3Di to compare UK and Finnish clinical samples, and found greater cross-cultural variability in symptomatology among those with milder autistic characteristics.

Secondly, although there was a good level of agreement of ASD diagnosis between clinical assessment and 3Di, sub-categorization into specific autism disorders according to DSM IV saw discrepancies. The most common reason for the discrepancy was due to scoring below the threshold of the "repetitive and stereotyped behaviours" dimension. Results from examining the pattern of item endorsement found that there were relatively few positive ratings for questions on the subscales of "ritualistic behaviours and mannerisms", and "non-functional use of objects". However, ritualistic behaviours commonly encountered in children with ASD in Hong Kong, such as insistent on

using the same public transport, following the same route, wearing the same set of clothes, appear not to have been included either in the items or in the scoring algorithm, and therefore are not captured. Consequently, the eventual score on this dimension does not cross the threshold. Adding more locally relevant items to this dimension may be one way of lowering its relatively higher false negative rate.

On the other hand, this relative lack of agreement on ASD subgroups between the 3Di and clinical judgment may also reflect the clinical reality of a lack of agreement on subgroup diagnoses among clinicians (Lord et al. 2012). This may partly support the abolition of subgroups in DSM 5 and acknowledges the dimensional nature of ASD. The ability of the 3Di to assess autistic features dimensionally, even in the presence of ADHD as found in this study, makes it a very useful instrument in documenting the clinical profiles of children presenting with complex psychopathology.

Limitations

Although our initial findings are very encouraging, several limitations need to be considered. Firstly, our test–retest reliability was based on a relatively small number of cases, and was obtained by recording the interview and later re-rating by the same interviewer. This method was adopted because of difficulties in asking the parents to attend the interview for a second time. However, this removes a potential source of variability—that parents give different answers in a second interview—and therefore could have inflated the estimates of test–retest reliability. Confirmation of the test–retest reliability will be needed by doing live retests on a larger number of cases.

Secondly, in any translation process, it is important that semantic equivalence be ensured. However, it is perhaps unavoidable that exact matches are sometimes not possible, so that some terms in their Chinese translation may have slight differences in connotations, thus running the risk that these are understood differently, and could have influenced parents' response. To assess these possible translation issues, bilingual Chinese parents could have been recruited to be interviewed by both the English and Chinese versions of the interview and the results compared.

Thirdly, we have used the original authors' scoring programme and algorithm, which were based on the profile of children in the West. To make the interview more culturally applicable, it should be tested in a sample of normally developing community children in Hong Kong, so that the norm profile can be compared to that of the western sample, and cutoff scores can be adjusted if necessary. Refinement to the items of the interview could also be made.

Lastly, the inclusion of other clinical comparison groups presenting with social difficulties, such as children with social anxiety disorders, could have further tested the 3Di's potential to capture autistic symptoms among different diagnoses. Finally, the small number of girls in the study sample also means that replication using a larger sample is needed, not only to corroborate the current findings, but also to explore if there are differences in 3Di profiles across gender.

Conclusion

The Chinese (Cantonese) version of the PDD module of the 3Di has been found to have excellent psychometric properties and provides a relatively brief and user-friendly tool in the assessment of autistic behaviours among clinic children in Hong Kong, achieving a sensitivity of 95 % and specificity of 77 %. Although ASD has a neurobiological aetiology, the manifestations and reporting of the autistic symptoms can still be influenced by socio-cultural factors. Interviews developed and based on behavioral observations in the West need to be validated in the local context before it is to be used.

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