

RESEARCH ARTICLE

The Learning, Social and Emotion Adaptation Questionnaire-Short Form: A Measure of Adaptive Behavior for Primary School Students with Autism Spectrum Disorder

Hannah Man-yan Tse , Irene T. Ho, and Kathy Wong

Students with autism spectrum disorder (ASD) studying in mainstream classrooms have diverse adjustment difficulties in learning, social interaction, and emotion regulation. It is crucial to identify the areas these students find most challenging so that teachers can provide training and support accordingly. We therefore developed, examined, and provided norms for the Learning, Social and Emotion Adaptation Questionnaire-Short Form (LSEAQ-S), a teacher report instrument measuring 53 essential adaptive behaviors for mainstream primary school students in Hong Kong. Teachers completed the LSEAQ-S for three samples of 2,298, 2,690, and 3,305 students with ASD from 204 schools and a sample of 1,869 students without ASD from 112 schools. Our study showed that an 11-factor structure best describes the LSEAQ-S, which has high internal consistency and good convergent validity examined with the Social Responsiveness Scale-Second Edition (SRS-2). Normative data of the LSEAQ-S stratified by gender and grade (grades 1 to 3; grades 4 to 6) are presented. Gender and grade differences were found, with girls with ASD lagging behind their same-gender peers in related skills more than boys with ASD did, across both grade levels and especially in senior grades. The LSEAQ-S, together with its normative data, can reveal students' difficulties and needs, inform intervention priorities, and help monitor training progress. *Autism Res* 2021, 14: 959–972. © 2020 The Authors. *Autism Research* published by International Society for Autism Research and Wiley Periodicals LLC.

Lay Summary: This study introduces the Learning, Social and Emotion Adaptation Questionnaire-Short Form (LSEAQ-S), a teacher report instrument developed in Hong Kong measuring school adaptation of students with autism spectrum disorder (ASD) in mainstream primary schools. The measure helps education personnel identify behaviors in which a student falls behind his/her peers and facilitate training and support targeting those behaviors.

Keywords: adaptive behaviors; autism spectrum disorder; checklist; normative statistics; psychometrics; school adjustment; gender difference

Introduction

Under inclusive education policies, many children with autism spectrum disorder (ASD) are educated in mainstream schools. However, they often face challenges in school adjustment. Due to difficulties in social communication and interaction [American Psychiatric Association, 2013], students with ASD are often ignored, rejected or bullied by their peers in school [Chen & Schwartz, 2012]. Many of them also require support in regulating their emotions and acquiring essential learning skills [Ashburner, Ziviani, & Rodger, 2010; Berkovits, Eisenhower, & Blacher, 2017].

The Learning, Social and Emotion Adaptation Questionnaire (LSEAQ)

To understand the challenges faced by children with ASD in school so that appropriate intervention could be provided, a school adjustment checklist was developed by the Education Bureau (EDB) of Hong Kong for the assessment of adaptive behaviors of students with ASD in Hong Kong. A recent version of the checklist, revised in 2018, was named LSEAQ [EDB Educational Psychology Service (NTW) Section, 2018]. The LSEAQ comprehensively describes a list of 141 behaviors in schools across four areas: learning behaviors (28 items), social skills (87 items), emotion regulation (20 items), and restricted

From the Department of Psychology, The University of Hong Kong, Hong Kong, China (H.M.T., K.W.); Department of Educational Psychology, The Chinese University of Hong Kong, Hong Kong, China (I.T.H.)

Received June 5, 2020; accepted for publication October 26, 2020

Address for correspondence and reprints: Hannah Man-yan Tse, Department of Psychology, Room 627, 6/F, The Jockey Club Tower, Centennial Campus, The University of Hong Kong, Pokfulam Road, Hong Kong, China. E-mail: hannah-tse@hku.hk

This is an open access article under the terms of the Creative Commons Attribution-NonCommercial License, which permits use, distribution and reproduction in any medium, provided the original work is properly cited and is not used for commercial purposes.

Published online 8 November 2020 in Wiley Online Library (wileyonlinelibrary.com)

DOI: 10.1002/aur.2431

© 2020 The Authors. *Autism Research* published by International Society for Autism Research and Wiley Periodicals LLC.

interests and repetitive behavior (six items). These items were developed by professional educational psychologists in the Bureau, based on a review of related literature and on their experience working with children with ASD in schools.

With the LSEAQ, adaptive behaviors in school were conceptualized in terms of two major domains of functioning required of all students, namely academic learning and social development. The other two domains of emotion regulation and restricted interests and repetitive behavior were also included because they reflect maladaptive behaviors that are often observed in children with ASD, which would interfere with their everyday functioning [Ashburner et al., 2010; Leekam, Prior, & Uljarevic, 2011]. Together these four areas reflect the needs of students in academic skills improvement, social skills enhancement, and behavioral support, which are widely advocated to be the major aspects of school support for students with ASD [Aspy & Grossman, 2011; Autism Education Trust, 2014; Bellini, 2006; Bleiweiss, Hough, & Cohen, 2013; Henry & Smith, 2007; Koenig, Bleiweiss, Brennan, Cohen, & Siegel, 2009; Perner & Delano, 2013; Prizant, Wetherby, Rubin, Laurent, & Rydell, 2005; Sansosti, Powell-Smith, & Cowan, 2010].

A teacher who is familiar with the student completes this questionnaire by rating the frequency of the listed behaviors based on everyday observation in the past month. The results would help identify the student's difficulties in school adjustment so that appropriate intervention or support could be provided.

This 141-item checklist is useful for generating a detailed and comprehensive profile of adaptive skills and has been widely promoted for use in mainstream schools in Hong Kong by the EDB, being part of the official operation guide on school support for students with ASD [EDB Educational Psychology Service (NTW) Section, 2018]. However, three issues have received attention. First, most teachers find it too time-consuming to complete a questionnaire of this length, especially when they have to do it regularly to track student progress. Second, there was never any systematic investigation of its psychometric properties. While the four domains of behavior with their related items have high face and content validity based on the ASD literature as well as the judgment of experienced professionals, whether they represent the structure of adaptive behavior well was never statistically examined. Third, no normative information was available for making reliable comparisons across students or to show how students with ASD compare with peers of his/her age in different areas of functioning. We therefore worked on the LSEAQ-Short Form (LSEAQ-S) and carried out related statistical analysis to address these concerns.

Development of the LSEAQ-Short Form (LSEAQ-S)

Besides statistical analysis, expert involvement is also important when shortening a checklist [Coste, Guillemin, Pouchot, & Fermanian, 1997], hence six educational psychologists with ample experience in school-based support for students with ASD were involved in a two-stage item selection process for the short form. First, the team of researchers and psychologists inspected items with polychoric correlations greater than 0.80 and retained, revised or removed them according to three criteria. These criteria included: (a) retaining both items if they measure different constructs; (b) merging two items into one if a revised item suitably encompasses both items; and (c) removing an item if it measures a similar construct but is less observable than the other item. Examples of item pairs being considered according to these criteria are given in Table 1.

In the second stage of item selection, exploratory factor analysis and item response analysis were performed on 120 items selected in the first stage [Edelen & Reeve, 2007; Embretson & Reise, 2000]. The purpose was to select items that had high factor loadings and were more discriminative. These analyzes resulted in a model with 11 latent factors consisting of 53 items. These 11 latent factors became the subscales for LSEAQ-S, which could still be classified under the four domains in the original scale. Under the learning adaptation domain, there were three factors: classroom adaptive

Table 1. Criteria for Item Selection in Short Form Development

Retaining both items if they measure different constructs
<i>Example:</i>
<ul style="list-style-type: none"> • "Adjusts content, choice of word and length of conversation according to the situation and the target's age, status and experience" • "Adjusts content and manner of conversation according to the other's response (e.g. clarifies when others do not understand)"
<i>Decision: Both items retained as they measure different constructs</i>
Merging two items into one if a revised item suitably encompasses both items
<i>Example:</i>
<ul style="list-style-type: none"> • "Uses basic emotion words (e.g., happy, angry, sad, or afraid) to describe own emotional state" • "Utilizes basic emotion words (e.g., happy, angry, sad, or afraid) to describe others' emotional state"
<i>Decision: Merged to become: "Utilizes basic emotion words (e.g., happy, angry, sad, or afraid) to describe emotional states of oneself or others"</i>
Removing an item if it measures a similar construct but is less observable than the other item
<i>Example:</i>
<ul style="list-style-type: none"> • "Understands how one's behavior and appearance may affect others' impression on him or her" • "Adjusts behaviors and attends to his or her own appearance to make a good impression on others"
<i>Decision: The less observable item "Understands how one's behavior and appearance may affect others' impression on him or her" removed</i>

skills (six items), flexibility (two items), and higher-order thinking (two items). Under the social adaptation domain, there were five factors: communication skills (seven items), social thinking (four items), social problem solving (eight items), prosocial behavior (four items), and peer relationship and social initiation (six items). Under the emotion adaptation domain, there were two factors: basic emotion understanding (four items) and emotion expression and regulation (four items). The last domain of restricted interests and repetitive behavior remained a single factor as in the original long-form. A finer distinction of sub-factors under the four domains seemed to represent a more accurate picture of adaptive behavior. Based on reports from six organizations administering training programs in schools, over 800 teachers who completed this questionnaire for students with ASD indicated that filling out the LSEAQ-S took an average of 15 to 20 min, thus addressing teachers' concern about the length of questionnaire.

The present study aimed to examine psychometric properties of the LSEAQ-S, generate norms to facilitate the comparison of performance across students, and investigate gender and developmental differences in the adaptive behavior of students with ASD. The results would help address the remaining concerns mentioned above and strengthen the utility of the measure.

Method

Participants

Students with ASD. Data were collected from a 3-year territory-wide project (school years: 2015/16 to 2017/18)

that provided group training on adaptive skills for over 3,000 students with ASD in 204 mainstream primary schools. This project, jointly led by the EDB and The University of Hong Kong and with professionals from six non-governmental organizations administering the training, covered more than half of mainstream primary school students with a confirmed diagnosis of ASD and approximately 45% of Hong Kong mainstream primary schools [Director of Bureau: Secretary for Education, 2017]. Teachers filled out the LSEAQ-S for participating students in the planning stage of the program and then once a year, as part of the needs assessment and progress monitoring process.

The current study included data from three samples of students with ASD collected at different time points over the 3 years: sample 1 ($n = 2,298$) at the beginning of the project, sample 2 ($n = 2,690$) in the second year of the project, and sample 3 ($n = 3,305$) in the third year of the project. They all had confirmed ASD diagnosis based on school records. Sample sizes, demographic details, and information on their other characteristics are presented in Table 2.

Students without ASD. A total of 1,916 LSEAQ-S completed by teachers on non-ASD students were collected from 112 primary schools, with the distribution of districts and school bandings matched in accordance with school demographics in Hong Kong. Three students from each grade (grades 1 to 6) were randomly selected from each school. Given that we had a representative sample of students with ASD, weighting their data into the non-ASD population would generate norms with a more

Table 2. Participants Demographics

	ASD group			Non-ASD group
	Sample 1	Sample 2	Sample 3	
<i>n</i>	2,298	2,690	3,305	1,869
Gender, <i>n</i> (%)				
Male	2,021 (87.95)	2,362 (87.81)	2,892 (87.5)	941 (50.35)
Female	277 (12.05)	328 (12.19)	413 (12.5)	928 (49.65)
Grade, <i>n</i> (%)				
1	428 (18.62)	405 (15.06)	371 (11.23)	314 (16.80)
2	535 (23.28)	572 (21.26)	543 (16.43)	317 (16.96)
3	472 (20.54)	583 (21.67)	557 (16.85)	314 (16.80)
4	407 (17.71)	465 (17.29)	446 (13.49)	311 (16.64)
5	277 (12.05)	399 (14.83)	391 (11.83)	305 (16.32)
6	179 (7.79)	259 (9.63)	253 (7.66)	308 (16.48)
Special education needs ^a , <i>n</i> (%)				
ASD	2,298 (100)	2,690 (100)	3,305 (100)	0 (0)
SLI	1,618 (70.41)	1,990 (73.98)	2,482 (75.10)	75 (4.01)
ADHD	412 (17.93)	476 (17.7)	585 (17.70)	97 (5.19)
SpLD	206 (8.96)	215 (7.99)	240 (7.26)	107 (5.72)
ID	136 (5.92)	151 (5.61)	172 (5.20)	10 (0.54)

ADHD: attention-deficit/hyperactivity disorder; ASD: autism spectrum disorder; ID: intellectual disability; SLI: specific language impairment; SpLD: specific learning difficulties.

^aStudents may have more than one type of special education needs.

representative composition of students with ASD. We therefore excluded students diagnosed with ASD in this data collection process and included only typically developing students and students with other special education needs. After discarding questionnaires that were not filled out properly, data from 1,869 students (941 boys and 928 girls) were used for analysis. See Table 2 for the demographic details and other characteristics of these students.

Measures

LSEAQ-S. This 53-item questionnaire describes expected behaviors in school across three domains, namely, learning, social, and emotional adaptation, and an additional domain of restricted interests and repetitive behavior frequently observed in students with ASD. The questionnaire adopts four-point Likert scales for teachers to rate the frequency of the stated behavior observed in the previous month: 0 = *the student never showed this behavior*, 1 = *the student showed this behavior less than half of the time*, 2 = *the student showed this behavior more than half of the time*, 3 = *the student nearly always showed this behavior*. The restricted interests and repetitive behavior ratings were reverse-scored prior to analysis so that higher ratings indicated better adjustment in all domains. See earlier sections for a description of the origin and characteristics of this measure.

The Social Responsiveness Scale – second edition (SRS-2, Hong Kong Chinese version). This 65-item rating scale measures social impairment associated with ASD [Constantino & Gruber, 2012], comprising five subscales: social awareness, social cognition, social communication, social motivation, restricted interests, and repetitive behavior. Items are scored on a four-point Likert-type scale, ranging from 1 = *not true*, 2 = *sometimes true*, 3 = *often true*, to 4 = *almost always true*. Higher scores indicate more prominent ASD symptoms. The SRS-2 is an established measure of the severity of ASD symptoms and has been widely used in research in different cultural contexts, including Chinese societies like Hong Kong [Cen et al., 2017].

Procedure

At the beginning of the school project, before the commencement of any systematic student training, teachers filled out the LSEAQ-S and the SRS-2 for their respective students (ASD sample 1). This sample, representing more pure ASD behavior without interference of training effect, was used in all analyzes requiring this pure ASD effect, including norm development and investigations of gender and grade effects. In the 3 years that followed, LSEAQ-S ratings for participating students were gathered

two more times (ASD samples 2 and 3). Most students in these samples would have received training for some time but some were new participants joining in the second or third year. These two samples in their entirety were used for confirmatory factor analysis, while data from new participants would also be included in analyzes requiring more pure ASD effects as stated above.

In the same period, data for the non-ASD sample were collected. Recruitment letters were sent to all mainstream primary schools in Hong Kong to seek their participation. Using class and class number as a unique identifier to generate a full list of students, we randomly selected ten students from each grade at each participating school. Schools were requested to provide LSEAQ-S data for the first three selected students unless the student selected was diagnosed with ASD, or their teacher did not consent to participate, or all three selected students were of the same gender (except for single-gender schools). In these cases, the student concerned would be replaced by the next available student on the list. Teachers filled out the LSEAQ-S for the selected students.

Data Analysis

Data analyzes were carried out with R version 3.5.1 [R Core Team, 2018] using the psych [Revelle, 2018] and lavaan [Rosseel, 2012] packages. The lavaan package was used to run confirmatory factor analyzes.

Psychometric properties. Confirmatory factor analysis (CFA) of the LSEAQ-S was run with data from two ASD samples and one non-ASD sample, using diagonally weighted least square (DWLS) estimation with all items treated as ordinal variables [Rosseel, 2012]. Only cases without any missing items were included in the CFA. As a result, the final numbers included in the analysis were 2,373 students from ASD sample 2, 3,028 from ASD sample 3, and 1,773 from the non-ASD sample. Three models were tested on each of these samples: a unidimensional model where various adaptive behaviors in school could be conceptualized as a single ability; a four-factor model as conceptualized in the original LSEAQ, comprising distinct dimensions of learning adaptation, social adaptation, emotion regulation and restricted interests and repetitive behavior; and an 11-factor model suggested by preliminary exploratory factor analysis (EFA), as reported in previous sections on the development of the short form.

Cronbach's alpha coefficients were calculated to evaluate the internal consistency of the LSEAQ-S for all available samples. Only cases without missing subscale score were included. (Subscale scores were calculated by averaging the items within the corresponding latent factor. Subscales with more than half of the items missing were treated as missing.) As a result, the numbers of students

Table 3. Normative Information by Gender and Grade ($n = 5,550$)

Factor (no. of items)	Junior boys, M (SD)	Junior girls, M (SD)	Senior boys, M (SD)	Senior girls, M (SD)
<i>n</i>	2,705	791	1,452	602
Learning adaptation				
Classroom adaptive skills (6)	1.95 (0.65)	2.25 (0.63)	2.02 (0.63)	2.36 (0.56)
Flexibility (2)	2.13 (0.69)	2.35 (0.63)	2.19 (0.65)	2.39 (0.59)
Higher-order thinking (2)	1.62 (0.82)	1.79 (0.78)	1.78 (0.75)	1.95 (0.70)
Social adaptation				
Communication skills (7)	1.83 (0.70)	2.12 (0.65)	1.96 (0.68)	2.24 (0.60)
Social thinking (4)	1.79 (0.73)	2.08 (0.66)	1.95 (0.71)	2.28 (0.60)
Social problem solving (8)	1.79 (0.65)	2.02 (0.59)	1.84 (0.66)	2.16 (0.54)
Prosocial behavior (4)	1.91 (0.69)	2.21 (0.67)	1.97 (0.70)	2.32 (0.59)
Peer relationship and social initiation (6)	1.99 (0.68)	2.16 (0.63)	2.04 (0.67)	2.24 (0.61)
Emotion adaptation				
Basic emotion understanding (4)	1.79 (0.70)	2.00 (0.66)	1.93 (0.66)	2.19 (0.62)
Emotion expression and regulation (4)	1.65 (0.68)	1.83 (0.65)	1.74 (0.70)	2.03 (0.64)
Restricted interests and repetitive behavior (6)	2.57 (0.61)	2.68 (0.51)	2.57 (0.59)	2.68 (0.51)

included in this analysis were 2,167, 2,595, and 3,243 from ASD samples 1, 2, and 3, respectively, while for the non-ASD group, 1,869 students were included.

Convergent validity was examined by correlating scores on the LSEAQ-S and scores on the SRS-2 from ASD sample 1 ($n = 2,167$, after discarding questionnaires with missing subscales on either scale), collected together at the beginning of the project.

Normative statistics and comparisons across groups. Norms for measures of children's social behavior are usually developed according to developmental stage and gender [e.g., Achenbach & Rescorla, 2001; Constantino & Gruber, 2012; Gresham & Elliott, 1990, 2008], as significant differences based on these two attributes are often observed. In Hong Kong, primary schools consist of six grades and are usually divided into two grade levels: junior primary (grades 1 to 3, typical age between 6 and 9) and senior primary (grades 4 to 6, typical age between 9 and 12), and teachers generally have different expectations for students' behavior across these two levels. Correspondingly, we grouped students by these two grade levels to examine developmental differences.

We first checked that there were significant mean differences in the LSEAQ-S subscale scores across gender and the two grade levels in the non-ASD sample using multivariate analysis of variance (MANOVA). Normative statistics were then computed accordingly by weighting in the LSEAQ-S data of students with ASD into the normative data. Only data from students who had not started training in the project were included, mostly from sample 1 but also some from samples 2 and 3. As a result, a total of 5,550 students were included in norm calculation. Weighting was performed separately for boys and girls using the following formula: $\text{Weight} = (n_{\text{Non-ASD}} \times \text{Prevalence}) / (n_{\text{ASD}} \times (1 - \text{Prevalence}))$. The norms

derived for different gender and grade groups are given in Table 3. Finally, standard scores for students with ASD were computed using the normative statistics and group comparisons were again conducted using MANOVA based on the standard scores. This helped generate further understanding of the developmental differences between students with and without ASD.

Results

Factor Structure of the LSEAQ-S

Results of CFA performed on the two ASD samples and one non-ASD sample showed that the 11-factor model had the best fit among the three models for all samples, with $\text{RMSEA} < 0.06$, $\text{CFI} > 0.95$, $\text{TLI} > 0.95$, and $\text{SRMR} < 0.08$ [Hu & Bentler, 1999]. See Table 4 for the model fit indices and Table 5 for the standardized loadings of LSEAQ-S items onto the latent factors. As the 11-factor model fit all the three datasets well, the high stability of this factor structure was indicated.

Internal Consistency

Cronbach's alpha values were computed for the subscales of LSEAQ-S (Table 6). Internal consistency for all subscales was excellent for all four student samples (α s ranging from 0.83 to 0.93 for the ASD groups; 0.85 to 0.95 for the non-ASD group).

Convergent Validity

Table 7 presents the correlations between the subscale scores of the LSEAQ-S and the subscale scores of the SRS-2 as well as their total scores. A high negative correlation indicates good convergent validity as the items of the two scales were scored in opposite directions: high scores on the LSEAQ-S indicate good adaptation whereas high scores on the SRS-2 indicate more severe autistic

Table 4. Indices of Model Fit

	χ^2	df	DIFFTEST	RMSEA	CFI	TLI	SRMR
ASD (sample 2), $n = 2,373$							
Unidimensional	77,880.96**	1,325	-	0.156	0.955	0.953	0.102
4-factor	30,224.70**	1,319	6,432.6**	0.096	0.983	0.982	0.069
11-factor	10,440.94**	1,270	5,498.2**	0.055	0.995	0.994	0.042
ASD (sample 3), $n = 3,028$							
Unidimensional	103,344.82**	1,325	-	0.156	0.957	0.955	0.103
4-factor	42,536.98**	1,319	8,152.7**	0.102	0.983	0.982	0.071
11-factor	14,484.41**	1,270	7,176.2**	0.059	0.994	0.994	0.042
Non-ASD, $n = 1,773$							
Unidimensional	64,345.29**	1,325	-	0.165	0.974	0.973	0.107
4-factor	20,895.65**	1,319	3153.4**	0.092	0.992	0.992	0.058
11-factor	6,536.04**	1,270	3650.8**	0.048	0.998	0.998	0.033

χ^2 : chi-squared goodness of fit test; CFI: comparative fit index; RMSEA: root mean square error of approximation; SRMR: Standardized Root Mean Residual; TLI: Tucker-Lewis index.

** $P < 0.01$.

symptoms. Relationships between the social adaptation subtotal score of the LSEAQ-S and the four social subscales of SRS-2 were strong (r s ranging from -0.52 to -0.63 , $P < 0.001$); whereas correlations between the LSEAQ-S learning and emotion adaptation subtotal scores and SRS-2 social subscales were moderate to strong (r s ranging from -0.41 to -0.54 , $P < 0.001$). The correlation between the restricted interests and repetitive behavior subscale scores for the two measures was also strong ($r = -0.63$, $P < 0.001$). Overall, the correlation between the SRS-2 total score and the LSEAQ-S total score was a strong -0.70 , $P < 0.001$, which indicates excellent convergent validity of the LSEAQ-S.

Gender and Grade Differences

Differences in adaptive functioning across gender and grade levels were examined separately for ASD and non-ASD groups as follows.

Non-ASD group. Students in the non-ASD group were divided into four groups: junior boys ($n = 477$, grades 1 to 3: mean age = 7.7, SD = 0.95), junior girls ($n = 468$, mean age = 7.7, SD = 0.95), senior boys ($n = 464$, grades 4 to 6: mean age = 10.8, SD = 1.06) and senior girls ($n = 460$, mean age = 10.7, SD = 1.04). MANOVA results indicated a significant difference in the LSEAQ-S subscale scores between boys and girls (approximate $F(1, 1865) = 17.91$, $P < 0.001$, Wilks' $\Lambda = 0.904$, partial $\eta^2 = 0.10$) and between juniors and seniors (approximate $F(1, 1865) = 5.69$, $P < 0.001$, Wilks' $\Lambda = 0.967$, partial $\eta^2 = 0.03$). No significant interaction between gender and grade was found (approximate $F(1, 1865) = 0.97$, $P = 0.476$, Wilks' $\Lambda = 0.994$, partial $\eta^2 = 0.006$). Subscale scores and ANOVA results are presented in Table 8.

Post hoc Tukey honest significant differences (Tukey HSD) tests showed that girls scored significantly higher

than boys on all adaptive behaviors relating to learning, social functioning and emotions. Senior girls scored higher than junior girls on all adaptive behaviors except "flexibility," whereas senior boys scored higher than junior boys only in "higher-order thinking," "communication skills," "social thinking," and "basic emotion understanding." There was no significant difference in the display of "restricted interests and repetitive behavior" from junior to senior grades for both boys and girls.

ASD group. Similarly, we divided students in the ASD group into junior boys ($n = 2,228$, mean age = 7.5, SD = 0.90), junior girls ($n = 323$, mean age = 7.5, SD = 0.87), senior boys ($n = 988$, mean age = 10.4, SD = 0.99), and senior girls ($n = 142$, mean age = 10.3, SD = 0.96). MANOVA results suggested there were significant differences in the LSEAQ-S scores between boys and girls (approximate $F(1, 3677) = 6.16$, $P < 0.001$, Wilks' $\Lambda = 0.981$, partial $\eta^2 = 0.02$) and between juniors and seniors (approximate $F(1, 3677) = 13.31$, $P < 0.001$, Wilks' $\Lambda = 0.962$, partial $\eta^2 = 0.04$). No significant interaction between gender and grade was found (approximate $F(1, 1865) = 1.05$, $P = 0.398$, Wilks' $\Lambda = 0.997$, partial $\eta^2 = 0.003$). Subscale scores and ANOVA results are presented in Table 9.

Post hoc Tukey HSD tests suggested that gender differences within the ASD group were less straightforward compared to those observed in the non-ASD group. For juniors in the ASD group, girls scored higher than boys on "classroom adaptive skills" and "prosocial behavior" and displayed less "restricted interests and repetitive behavior," while boys scored higher on "higher-order thinking" than girls. For seniors, the only gender difference was that girls scored higher on "classroom adaptive skills" than boys.

Regarding grade difference, senior boys scored higher than junior boys on all adaptive skills pertaining to

Table 5. Standardized Loadings of LSEAQ-S Items from Confirmatory Factor Analysis

LSEAQ-S items	ASD (sample 2)	ASD (sample 3)	Non-ASD
<i>n</i>	2,373	3,028	1,773
Classroom adaptive skills			
Listens attentively during lessons	0.846	0.842	0.877
Follows teachers' instructions during lessons	0.844	0.810	0.882
Gives appropriate responses during lessons (e.g., looks at the teacher and nods to indicate understanding)	0.908	0.884	0.881
Writes the school diary correctly and properly	0.664	0.633	0.804
Completes work independently as instructed	0.879	0.869	0.940
Stays focused while working	0.879	0.905	0.935
Flexibility			
Is willing to accept new things	0.930	0.949	0.925
Accepts changes in rules and procedures	0.919	0.929	0.950
Higher-order thinking			
Makes reasonable deductions from different pieces of related information	0.970	0.972	0.976
Thinks from multiple perspectives	0.982	0.971	0.977
Communication skills			
Speaks at an appropriate speed	0.714	0.704	0.867
Verbal expressions are clear and organized	0.807	0.826	0.879
Uses nonverbal communication skills appropriately (e.g., eye gazes, body movements, postures and facial expressions)	0.838	0.867	0.906
Shares experiences, opinions or thoughts appropriately	0.895	0.891	0.928
Ends conversations appropriately	0.906	0.900	0.941
Changes topics naturally during conversations	0.915	0.922	0.924
Adjusts content and manner of conversation according to the others' responses (e.g., clarifies when others do not understand)	0.918	0.909	0.936
Social thinking			
Understands others' points of view, feelings or intentions	0.879	0.883	0.927
Understands the real meaning behind indirect messages, humor, proverbs, metaphors and sarcasm	0.873	0.859	0.877
Adjusts behaviors according to others' responses (e.g., emotions, thoughts, verbal and nonverbal responses)	0.828	0.844	0.925
Adjusts behaviors and attends to his or her own appearance to make a good impression on others	0.835	0.819	0.886
Social problem solving			
Is able to recognize the severity of problems without overreacting or underreacting	0.837	0.854	0.896
Handles interruptions from others appropriately	0.805	0.817	0.902
Respects others' opinions	0.846	0.860	0.932
Reacts to and reflects on criticisms calmly	0.738	0.761	0.818
Improves his or her own behaviors according to others' criticisms and opinions	0.823	0.829	0.879
Negotiates with others to achieve consensus and mutual benefits	0.899	0.914	0.921
Handles peer pressure appropriately (e.g., refuses to take part in illegal activities)	0.866	0.837	0.867
Deals with social bullying appropriately (e.g., teasing, spreading of rumors or cyber bullying)	0.854	0.868	0.887
Prosocial behavior			
Utilizes words to express politeness (e.g., "thank you" or "please")	0.804	0.815	0.884
Responds to compliments appropriately	0.882	0.894	0.927
Cares for or offers comfort to others	0.875	0.875	0.921

(Continues)

Table 5. Continued

LSEAQ-S items	ASD (sample 2)	ASD (sample 3)	Non-ASD
Shares others' happiness (e.g., cheers for or congratulates the winner in competitions)	0.859	0.875	0.919
Peer relationship and social initiation			
Takes initiative to make friends	0.823	0.825	0.859
Has appropriate expectations toward friendship (e.g., accepts the fact that friendship is not exclusive or gives a friend personal space)	0.871	0.890	0.948
Participates in games or activities with peers	0.819	0.812	0.898
Is able to engage in role-play (e.g., imaginative play or drama)	0.883	0.886	0.881
Knows how to join in others' games or activities	0.911	0.934	0.950
Takes initiative to invite others to join his or her games or activities	0.871	0.868	0.893
Basic emotion understanding			
Utilizes basic emotion words (e.g., happy, angry, sad, or afraid) to describe emotional states of oneself or others	0.823	0.823	0.908
Utilizes advanced emotion words (e.g., satisfied, excited, proud, depressed, frightened, bored, embarrassed, guilty, or jealous) to describe emotional states of oneself or others	0.874	0.869	0.894
Expresses emotions through facial expressions, body movements and intonations	0.669	0.664	0.886
Understands that there are different levels of intensity of emotions and is able to express different levels of emotional intensity appropriately	0.943	0.956	0.960
Emotion expression and regulation			
Understands the reasons behind others' emotions	0.925	0.927	0.963
Is able to notice his or her own bodily reactions due to emotions	0.901	0.894	0.926
Seeks attention, comfort or help from others appropriately when experiencing negative emotions (e.g., sad, uneasy or angry)	0.758	0.761	0.845
Utilizes appropriate strategies to regulate anxiety or disappointment	0.873	0.892	0.913
Restricted interests and repetitive behavior			
Is hyper- or hyposensitive to certain sensory inputs from the environment (e.g., gets extremely irritated by mild noises; neglects physical pain)	0.773	0.794	0.846
Loses ability to function normally due to a lack of coping strategies when facing excessive sensory stimulation	0.843	0.851	0.926
Shows exceptionally strong attachment or reaction to particular objects or persons	0.769	0.754	0.887
Overly insists on maintaining routines and sameness	0.804	0.812	0.882
Exhibits repetitive use of objects, body movements, or speech	0.881	0.884	0.968
Has highly restricted or fixated interests (e.g., always asks questions regarding the same topic)	0.782	0.776	0.897

Note. Items were translated from Chinese. The Chinese version of LSEAQ-S is available on request from the corresponding author.

learning, social and emotion areas. As for girls, significantly higher scores were also observed in most areas in senior grades except for "flexibility," "prosocial behavior," and "peer relationship and social initiation." The level of "restricted interests and repetitive behavior" stayed at a similar level from junior to senior grades for both boys and girls with ASD.

Differences between students with and without ASD. Using the normative data, we computed the standard scores (z-scores) for the ASD group and re-examined their gender and grade differences. MANOVA results suggested there were significant differences in the LSEAQ-S subscale z-scores between boys and girls (approximate $F(1, 3677) = 32.31, P < 0.001$, Wilks'

Table 6. Cronbach's Alphas for LSEAQ-S Subscales

LSEAQ-S subscales (no. of items)	ASD group			Non-ASD group (n = 1,869)
	Sample 1 (n = 2,167)	Sample 2 (n = 2,595)	Sample 3 (n = 3,243)	
Learning adaptation				
Classroom adaptive skills (6)	0.89	0.89	0.88	0.92
Flexibility (2)	0.85	0.85	0.87	0.86
Higher-order thinking (2)	0.89	0.92	0.93	0.92
Social adaptation				
Communication skills (7)	0.90	0.91	0.92	0.95
Social thinking (4)	0.85	0.85	0.85	0.90
Social problem solving (8)	0.90	0.91	0.92	0.94
Prosocial behavior (4)	0.86	0.86	0.87	0.90
Peer relationship and social initiation (6)	0.89	0.91	0.91	0.93
Emotion adaptation				
Basic emotion understanding (4)	0.84	0.84	0.84	0.91
Emotion expression and regulation (4)	0.83	0.86	0.87	0.91
Restricted interests and repetitive behavior (6)	0.87	0.87	0.87	0.92

Table 7. Pearson Correlation Coefficients between LSEAQ-S and SRS-2 Scores (n = 2,167)

LSEAQ-S Subscales	SRS-2 subscales					SRS-2 total
	Social awareness	Social cognition	Social communication	Social motivation	Restricted, repetitive behavior	
Learning adaptation						
Classroom adaptive skills	-0.51	-0.39	-0.40	-0.32	-0.42	-0.45
Flexibility	-0.41	-0.48	-0.44	-0.42	-0.43	-0.49
Higher-order thinking	-0.38	-0.45	-0.40	-0.37	-0.30	-0.42
<i>Learning adaptation - Subtotal</i>	-0.54	-0.50	-0.48	-0.41	-0.46	-0.53
Social adaptation						
Communication skills	-0.55	-0.56	-0.59	-0.51	-0.44	-0.59
Social thinking	-0.57	-0.55	-0.53	-0.38	-0.45	-0.55
Social problem solving	-0.53	-0.52	-0.51	-0.35	-0.48	-0.53
Prosocial behavior	-0.52	-0.41	-0.50	-0.43	-0.35	-0.49
Peer relationship and social initiation	-0.53	-0.52	-0.60	-0.58	-0.45	-0.61
<i>Social adaptation - Subtotal</i>	-0.62	-0.59	-0.63	-0.52	-0.50	-0.64
Emotion adaptation						
Basic emotion understanding	-0.48	-0.45	-0.46	-0.39	-0.29	-0.46
Emotion expression and regulation	-0.52	-0.50	-0.51	-0.39	-0.38	-0.51
<i>Emotion adaptation - Subtotal</i>	-0.53	-0.50	-0.51	-0.41	-0.35	-0.51
Restricted interests and repetitive behavior	-0.34	-0.52	-0.47	-0.39	-0.63	-0.55
LSEAQ-S - Total	-0.65	-0.65	-0.66	-0.55	-0.58	-0.70

Note. All correlations are significant, $P < 0.001$.

$\Lambda = 0.911$, partial $\eta^2 = 0.09$) and between juniors and seniors (approximate $F(1, 3677) = 13.31$, $P < 0.001$, Wilks' $\Lambda = 0.962$, partial $\eta^2 = 0.04$). A significant interaction between gender and grade was found (approximate $F(1, 3677) = 3.47$, $P < 0.001$, Wilks' $\Lambda = 0.990$, partial $\eta^2 = 0.010$). Subscale z-scores and ANOVA results are presented in Table 10.

Post hoc Tukey HSD tests showed that girls with ASD lagged behind their same-gender non-ASD peers within the same grade level significantly more than boys with ASD did on all subscales. The gaps between students with ASD and their same-gender non-ASD counterparts in "classroom adaptive skills" narrowed from junior to senior years for both boys and girls. For boys, gaps in

Table 8. Comparisons of LSEAQ-S Scores for Non-ASD Group by Gender and Grade

Factor (no. of items)	Junior boys, M (SD)	Junior girls, M (SD)	Senior boys, M (SD)	Senior girls, M (SD)	Gender (F)	Grade (F)
<i>n</i>	477	468	464	460		
Learning adaptation						
Classroom adaptive skills (6)	1.97 (0.65)	2.25 (0.63)	2.03 (0.63)	2.36 (0.56)	114.85 ^{***}	8.40 ^{**}
Flexibility (2)	2.15 (0.68)	2.35 (0.63)	2.20 (0.64)	2.39 (0.59)	45.55 ^{***}	2.25
Higher-order thinking (2)	1.65 (0.81)	1.79 (0.78)	1.79 (0.75)	1.95 (0.70)	19.28 ^{***}	17.71 ^{***}
Social adaptation						
Communication skills (7)	1.86 (0.69)	2.12 (0.65)	1.97 (0.68)	2.24 (0.59)	81.69 ^{***}	15.07 ^{***}
Social thinking (4)	1.82 (0.72)	2.08 (0.65)	1.96 (0.71)	2.28 (0.60)	87.27 ^{***}	28.93 ^{***}
Social problem solving (8)	1.82 (0.64)	2.02 (0.59)	1.85 (0.66)	2.16 (0.54)	85.61 ^{***}	8.78 ^{**}
Prosocial behavior (4)	1.93 (0.67)	2.22 (0.66)	1.98 (0.70)	2.33 (0.59)	107.47 ^{***}	6.29 [*]
Peer relationship and social initiation (6)	2.02 (0.66)	2.16 (0.62)	2.05 (0.67)	2.25 (0.60)	32.92 ^{***}	4.31 [*]
Emotion adaptation						
Basic emotion understanding (4)	1.81 (0.69)	2.00 (0.66)	1.93 (0.66)	2.19 (0.62)	52.87 ^{***}	25.70 ^{***}
Emotion expression and regulation (4)	1.67 (0.67)	1.83 (0.67)	1.75 (0.69)	2.03 (0.64)	51.46 ^{***}	19.46 ^{***}
Restricted interests and repetitive behavior (6)	2.59 (0.60)	2.69 (0.51)	2.58 (0.58)	2.68 (0.51)	14.61 ^{***}	0.09

Note. Interaction effects between gender and grade were not significant, therefore not included in this table.

* $P < 0.05$; ** $P < 0.01$; *** $P < 0.001$.

Table 9. Comparisons of LSEAQ-S Scores of Students with ASD before Training by Gender and Grade

Factor (no. of items)	Junior boys, M (SD)	Junior girls, M (SD)	Senior boys, M (SD)	Senior girls, M (SD)	Gender (F)	Grade (F)
<i>n</i>	2,228	323	988	142		
Learning adaptation						
Classroom adaptive skills (6)	1.44 (0.63)	1.53 (0.61)	1.61 (0.61)	1.83 (0.61)	18.54 ^{***}	74.89 ^{***}
Flexibility (2)	1.37 (0.66)	1.40 (0.68)	1.48 (0.64)	1.52 (0.63)	1.00	19.25 ^{***}
Higher-order thinking (2)	0.91 (0.75)	0.82 (0.72)	1.07 (0.72)	1.03 (0.74)	3.91 [*]	40.54 ^{***}
Social adaptation						
Communication skills (7)	1.09 (0.58)	1.05 (0.55)	1.22 (0.54)	1.17 (0.53)	2.31	42.95 ^{***}
Social thinking (4)	0.98 (0.59)	0.98 (0.60)	1.12 (0.57)	1.13 (0.54)	0.09	46.45 ^{***}
Social problem solving (8)	1.04 (0.57)	1.07 (0.58)	1.16 (0.54)	1.20 (0.54)	1.17	37.33 ^{***}
Prosocial behavior (4)	1.19 (0.67)	1.29 (0.68)	1.30 (0.65)	1.36 (0.64)	6.07 [*]	19.23 ^{***}
Peer relationship and social initiation (6)	1.08 (0.64)	1.13 (0.64)	1.24 (0.61)	1.24 (0.62)	0.99	47.75 ^{***}
Emotion adaptation						
Basic emotion understanding (4)	1.17 (0.60)	1.18 (0.57)	1.37 (0.58)	1.38 (0.59)	0.13	88.90 ^{***}
Emotion expression and regulation (4)	0.92 (0.58)	0.93 (0.59)	1.08 (0.56)	1.06 (0.57)	0.01	53.73 ^{***}
Restricted interests and repetitive behavior (6)	1.96 (0.66)	2.05 (0.63)	1.95 (0.66)	1.96 (0.64)	4.35 [*]	0.62

Note. Interaction effects between gender and grade were not significant, therefore not included in this table.

* $P < 0.05$; ** $P < 0.01$; *** $P < 0.001$.

“social problem solving,” “prosocial behavior,” “peer relationship and social initiation,” and “emotion expression and regulation” also narrowed over time. However, for girls, the gaps in “social thinking” and “prosocial behavior” widened over time. Overall, subscale standard scores showed that among juniors, boys with ASD on average fell behind other non-ASD boys by 0.79 to 1.33 SD, while girls with ASD on average fell behind other non-ASD girls by 1.14 to 1.67 SD. The gap between girls with ASD and girls without ASD widened even further in

their senior years, with differences ranging from 0.93 SD to 1.89 SD, while that of boys became narrower, with differences ranging from 0.65 SD to 1.19 SD.

Discussion

This study sought to strengthen a measure developed in Hong Kong for the assessment of school adaptation of children with ASD by providing evidence for its structure,

Table 10. Comparisons of Standard Scores of Students with ASD

Factor (no. of items)	Junior boys, M (SD)	Junior girls, M (SD)	Senior boys, M (SD)	Senior girls, M (SD)	Gender (F)	Grade (F)	Gender × Grade (F)
n	2,228	323	988	142			
Learning adaptation							
Classroom adaptive skills (6)	-0.79 (0.96)	-1.14 (0.98)	-0.65 (0.97)	-0.93 (1.08)	46.87***	17.56***	0.60
Flexibility (2)	-1.09 (0.96)	-1.50 (1.07)	-1.11 (0.99)	-1.49 (1.08)	67.44***	0.15	0.05
Higher-order thinking (2)	-0.88 (0.91)	-1.24 (0.92)	-0.94 (0.96)	-1.31 (1.06)	62.50*	3.57	0.00
Social adaptation							
Communication skills (7)	-1.06 (0.84)	-1.64 (0.84)	-1.08 (0.80)	-1.80 (0.89)	227.11***	1.20	2.57
Social thinking (4)	-1.13 (0.82)	-1.67 (0.92)	-1.16 (0.80)	-1.89 (0.89)	214.87***	4.30*	4.55*
Social problem solving (8)	-1.16 (0.88)	-1.60 (0.98)	-1.02 (0.81)	-1.77 (1.00)	155.67***	10.15**	10.60**
Prosocial behavior (4)	-1.05 (0.98)	-1.39 (1.02)	-0.95 (0.92)	-1.64 (1.09)	85.64***	2.52	10.87***
Peer relationship and social initiation (6)	-1.33 (0.94)	-1.64 (1.01)	-1.19 (0.90)	-1.66 (1.03)	59.01***	13.13***	2.75
Emotion adaptation							
Basic emotion understanding (4)	-0.90 (0.87)	-1.24 (0.87)	-0.85 (0.87)	-1.30 (0.94)	74.54***	1.50	1.22
Emotion expression and regulation (4)	-1.08 (0.86)	-1.38 (0.90)	-0.96 (0.80)	-1.51 (0.89)	81.65***	8.82***	7.82***
Restricted interests and repetitive behavior (6)	-1.00 (1.09)	-1.23 (1.23)	-1.06 (1.12)	-1.40 (1.25)	22.20***	3.04	0.88

P* < 0.05; *P* < 0.01; ****P* < 0.001.

validity, and reliability. Normative information for making useful comparisons across students was also provided. The LSEAQ-S was found to have high internal consistency and good convergent validity as examined with the SRS-2. Normative data were generated by combining nearly half of the mainstream students diagnosed with ASD with a randomly selected representative sample of students without ASD from Hong Kong mainstream primary schools.

Overall there are very strong correlations between the LSEAQ-S and the SRS-2, especially between their related social adaptation scales and the comparable restricted interests and repetitive behavior scales, which represent the two distinct feature areas associated with ASD [American Psychiatric Association, 2013]. This indicates that the LSEAQ-S is a highly valid measure of ASD-based difficulties manifested in the school context.

Structure of the LSEAQ-S

We confirmed the 11-factor structure of the LSEAQ-S generated in the earlier EFA is the best fitting model among three tested models, a result replicable with three separate samples of students with or without ASD. Adaptive behavior has been conceptualized in terms of four domains of adaptation in the original LSEAQ: learning adaptation, social adaptation, emotional adaptation, and maladaptive behaviors characterized by restricted interests and repetitive behavior. The present results show that under each of the learning, social and emotional domains, a few distinct subdomains could be identified, totaling 11 factors that better represent the structure of

adaptive behavior in school. A review of these subdomains shows that cognitive (e.g., social thinking), motivational (e.g., peer relationship and social initiation), and skill (e.g., communication skills) aspects of the more general domains of adaptation could be differentiated, which means that when a student does not display an expected behavior, such as not interacting with peers, care should be taken to tease out the extent to which the difficulty lies in related understanding of the situation, inadequate motivation, or inability to perform. This points to the need for more detailed assessment and specific goal setting rather than just focusing on training surface behavior. Otherwise intervention may not adequately address the students' intricate and specific needs. An assessment tool with more fine differentiation of factors, such as the LSEAQ-S, would serve this purpose well.

Utility of Normative Statistics

Norms for the LSEAQ-S generated in the present research would help education personnel see more clearly the extent to which students with ASD lag behind their peers in adaptive functioning. Although comparing raw scores obtained at different times (e.g., before and after intervention) may be sufficient for tracking student progress, reference to norms would provide the added advantage of an objective evaluation of a student's difficulties relative to his/her peers. In needs assessment for intervention, just relying on raw scores for the identification of relative strengths and weaknesses may lead to developmentally inappropriate goals. For example, in the current

study, while the raw scores for “flexibility” were found to be higher than those for “higher-order thinking” for all groups of students with ASD, the opposite was true when we looked at the standard scores, which indicated that ASD students fell behind their peers more in “flexibility.” Hence, this behavior should demand more attention than “higher-order thinking.” Thus the availability of normative statistics greatly enhances the utility of the LSEAQ-S.

Gender and Grade Differences

Results of comparisons across gender and grades using both raw scores and standard scores of the LSEAQ-S reveal developmental patterns of children in school adaptation. For children without ASD, the trend is that girls score higher than boys in all areas of functioning. Moreover, senior girls generally show better adaptive functioning than junior girls, while senior boys perform better than junior boys on related cognitive skills (higher-order thinking, social thinking, emotion understanding) and communication skills but not necessarily behavioral regulation aspects of adaptation. These results are largely in line with previous findings about girls scoring higher on assessments of prosocial behavior [Fabes & Eisenberg, 1998; Gresham & Elliott, 1990] and boys exhibiting more difficulties in classroom behavioral regulation and related self-discipline [Duckworth & Seligman, 2006; Wanless et al., 2013].

In contrast, for the ASD group, although girls in junior grades score higher than same-age boys on classroom skills, prosocial behavior and display less stereotypic behaviors, such gender advantage diminishes to only include classroom adaptive skills as they approach adolescence. Although generally both boys and girls show better adaptive skills in higher grades, junior and senior girls did not show significant differences in their prosocial tendency and behavior as well as flexibility, which suggests that their development in these areas remain stagnant over the primary school years. In comparisons with same-age peers without ASD, findings clearly show that girls with ASD generally lag behind their non-ASD peers in adaptive behavior more than boys with ASD do, and the gaps in social thinking and prosocial behavior between girls with and without ASD actually widen from junior to senior primary grades. In a word, girls with ASD fall behind their same-gender peers in school adaptation more than boys with ASD do, and they appear to fall further behind as they approach adolescence.

These results echo previous findings about gender differences in symptoms and adaptive behaviors of children with ASD [Constantino & Gruber, 2012; Halladay et al., 2015]. It has been reported that high functioning females with related difficulties are often undiagnosed in early years or misdiagnosed as having other special

education needs [Lai, Lombardo, Auyeung, Chakrabarti, & Baron-Cohen, 2015], probably due to their ability to mask their ASD symptoms in daily life. For example, they may stay in close proximity with other peers during recess [Dean, Harwood, & Kasari, 2017]. However, for girls who do get a diagnosis of ASD early, like many of those in our current study, more obvious or severe symptoms are likely to be seen. Therefore their adjustment difficulties relative to their same-gender peers would appear greater than those of boys with ASD [Dworzynski, Ronald, Bolton, & Happé, 2012]. The fact that girls in senior grades fall further behind their same-gender peers is probably a result of missing out on early intervention and less opportunities to improve on social skills from successful social experience. Thus more study on early identification as well as intervention that meets the specific needs of girls with ASD is needed in order to provide effective support for their development.

Limitations and Future Research

There are three main limitations of this study. First, the setting of the study did not provide a good context for the examination of interrater reliability and test-retest reliability. The project involved a large number of teachers and there was no mechanism for checking whether more than one teacher contributed to the completion of one questionnaire, which was sometimes the case to ensure accuracy in rating. Moreover, students would have received some training on adaptive skills shortly after their first assessment, therefore affecting the temporal stability of repeated measurements using the same tool. Future studies on these aspects of reliability other than internal consistency would provide further evidence for its psychometric strength.

Another limitation of the study is that the examination of developmental trends of school adaptation of children with ASD was done with only cross-sectional data. The comparison of how different age groups perform on the same variable allows us to infer about developmental patterns but is not a direct measure of individuals' development over time. Future longitudinal studies using the LSEAQ-S would help generate more conclusive findings about how the school adjustment of children with ASD change over time.

Finally, we did not have information on the students' intellectual ability for analysis. Access to intellectual ability scores was traded off for access to larger and more representative samples for norm development, because parent consent rate would be lowered and a biased sample would likely result if we had requested permission to access IQ scores. Future studies on adaptive behavior using the LSEAQ-S and factoring in intellectual ability as a variable would generate further insights into the varied needs of the heterogeneous population of students with ASD.

Conclusion

The 53-item LSEAQ-S is a short version of the LSEAQ, a comprehensive measure of school adjustment widely used for students with ASD in Hong Kong. While the brevity of the short form makes filling out the questionnaire less demanding for teachers, more importantly the current study succeeded in establishing some essential psychometric properties for the measure. Analysis replicated with three different samples pointed to the measure's highly stable 11-factor structure, with excellent internal consistency and strong correlation with corresponding scales of the SRS-2, indicating good convergent validity. While the discovery of the factor structure of the measure enables us to have a more precise understanding of the dimensions of adaptive behavior in school and how to plan for related intervention, the provision of related normative information enhances our perspective on the performance of students with ASD relative to their peers. In sum, the utility of the LSEAQ-S has been greatly enhanced through this study.

Acknowledgments

The authors would like to thank the participating students, teachers, schools, and NGOs for supporting the project. The authors also express thanks to the Education Bureau for arrangement with schools and to research assistants for data processing. The research was supported by the Hong Kong Jockey Club Charities Trust.

Conflict of Interest

The authors declare that they have no conflict of interest.

Ethics Statement

All procedures performed in the study were in accordance with the ethical standards of The University of Hong Kong Human Research Ethics Committee as well as the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. Informed consents were obtained from all participating parents, children and teachers.

References

- Achenbach, T. M., & Rescorla, L. A. (2001). Manual for the ASEBA school-age forms & profiles. Burlington, VT: University of Vermont, Research Center for Children, Youth, & Families.
- American Psychiatric Association. (2013). Diagnostic and statistical manual of mental disorders (5th ed.). Arlington, VA: American Psychiatric Publishing.
- Ashburner, J., Ziviani, J., & Rodger, S. (2010). Surviving in the mainstream: Capacity of children with autism spectrum disorders to perform academically and regulate their emotions and behavior at school. *Research in Autism Spectrum Disorders*, 4(1), 18–27. <https://doi.org/10.1016/j.rasd.2009.07.002>
- Aspy, R., & Grossman, B. (2011). *The Ziggurat model: A framework for designing comprehensive interventions for individuals with high-functioning autism and Asperger syndrome* (2nd ed.). Shawnee Mission, Kansas: AAPC Publishing.
- Autism Education Trust. (2014). *The national autism standards for schools and educational settings*. Retrieved from <http://www.autismeducationtrust.org.uk>.
- Bellini, S. (2006). *Building social relationships: A systematic approach to teaching social interaction skills to children and adolescents with autism spectrum disorders and other social difficulties*. Shawnee Mission, KS: Autism Asperger Publishing Company.
- Berkovits, L., Eisenhower, A., & Blacher, J. (2017). Emotion regulation in young children with autism spectrum disorders. *Journal of Autism and Developmental Disorders*, 47(1), 68–79. <https://doi.org/10.1007/s10803-016-2922-2>
- Bleiweiss, J. D., Hough, L., & Cohen, S. (2013). *Everyday classroom strategies and practices for supporting children with autism spectrum disorders*. Shawnee Mission, Kansas: AAPC Publishing.
- Cen, C.-Q., Liang, Y.-Y., Chen, Q.-R., Chen, K.-Y., Deng, H.-Z., Chen, B.-Y., & Zou, X.-B. (2017). Investigating the validation of the Chinese Mandarin version of the Social Responsiveness Scale in a Mainland China child population. *BMC Psychiatry*, 17(1), 51. <https://doi.org/10.1186/s12888-016-1185-y>
- Chen, P.-Y., & Schwartz, I. S. (2012). Bullying and victimization experiences of students with autism spectrum disorders in elementary schools. *Focus on Autism and Other Developmental Disabilities*, 27, 200–212. <https://doi.org/10.1177/1088357612459556>
- Constantino, J. N., & Gruber, C. P. (2012). *Social responsiveness scale (2nd ed.) [Manual]*. Torrance, CA: Western Psychological Services.
- Core Team, R. (2018). *R: A language and environment for statistical computing*. Vienna, Austria: R Foundation for Statistical Computing.
- Coste, J., Guillemin, F., Pouchot, J., & Fermanian, J. (1997). Methodological approaches to shortening composite measurement scales. *Journal of Clinical Epidemiology*, 50(3), 247–252. [https://doi.org/10.1016/S0895-4356\(96\)00363-0](https://doi.org/10.1016/S0895-4356(96)00363-0)
- Dean, M., Harwood, R., & Kasari, C. (2017). The art of camouflage: Gender differences in the social behaviors of girls and boys with autism spectrum disorder. *Autism*, 21(6), 678–689. <https://doi.org/10.1177/1362361316671845>
- Director of Bureau: Secretary for Education. (2017). *Replies to initial written questions raised by Finance Committee Members in examining the Estimates of Expenditure 2017–18*. Retrieved from <https://www.edb.gov.hk/attachment/en/about-edb/press/legco/replies-to-fc/17-18-EDB-2-e1.pdf>.
- Duckworth, A. L., & Seligman, M. E. P. (2006). Self-discipline gives girls the edge: Gender in self-discipline, grades, and achievement test scores. *Journal of Educational Psychology*, 98(1), 198–208.

- Dworzynski, K., Ronald, A., Bolton, P., & Happé, F. (2012). How different are girls and boys above and below the diagnostic threshold for autism spectrum disorders? *Journal of the American Academy of Child & Adolescent Psychiatry*, 51(8), 788–797. <https://doi.org/10.1016/j.jaac.2012.05.018>
- EDB Educational Psychology Service (NTW) Section. (2018). Whole-school approach to tiered support for students with ASD. Hong Kong: Educational Psychology Service (NTW) Section, Education Bureau of the Hong Kong SAR.
- Edelen, M. O., & Reeve, B. B. (2007). Applying item response theory (IRT) modeling to questionnaire development, evaluation, and refinement. *Quality of Life Research*, 16(1), 5–18. <https://doi.org/10.1007/s11136-007-9198-0>
- Embretson, S. E., & Reise, S. P. (2000). *Item response theory for psychologists*. Mahwah, NJ: Lawrence Erlbaum Associates Publishers.
- Fabes, R. A., & Eisenberg, N. (1998). Meta-analyses of age and sex differences in children's and adolescents' prosocial behavior. *Handbook of Child Psychology*, 3, 1–29.
- Gresham, F. M., & Elliott, S. N. (1990). *Social skills rating system: Manual*. Circle Pines, MN: American Guidance Service.
- Gresham, F. M., & Elliott, S. N. (2008). *Social skills improvement system: Rating scales manual*. Minneapolis, MN: NCS Pearson.
- Halladay, A. K., Bishop, S., Constantino, J. N., Daniels, A. M., Koenig, K., Palmer, K., ... Szatmari, P. (2015). Sex and gender differences in autism spectrum disorder: Summarizing evidence gaps and identifying emerging areas of priority. *Molecular Autism*, 6(1), 36. <https://doi.org/10.1186/s13229-015-0019-y>
- Henry, S., & Smith, M. B. (2007). *The comprehensive autism planning system (CAPS) for individuals with Asperger syndrome, autism, and related disabilities*. Shawnee Mission, KS: Autism Asperger Publishing Company.
- Hu, L., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling: A Multidisciplinary Journal*, 6(1), 1–55. <https://doi.org/10.1080/10705519909540118>
- Koenig, K. P., Bleiweiss, J., Brennan, S., Cohen, S., & Siegel, D. E. (2009). The ASD nest program: A model for inclusive public education for students with autism spectrum disorders. *Teaching Exceptional Children*, 42(1), 6–13. <https://doi.org/10.1177/004005990904200101>
- Lai, M.-C., Lombardo, M. V., Auyeung, B., Chakrabarti, B., & Baron-Cohen, S. (2015). Sex/gender differences and autism: Setting the scene for future research. *Journal of the American Academy of Child & Adolescent Psychiatry*, 54(1), 11–24. <https://doi.org/10.1016/j.jaac.2014.10.003>
- Leekam, S. R., Prior, M. R., & Uljarevic, M. (2011). Restricted and repetitive behaviors in autism spectrum disorders: A review of research in the last decade. *Psychological Bulletin*, 137(4), 562–593. <https://doi.org/10.1037/a0023341>
- Perner, D. E., & Delano, M. E. (2013). *A guide to teaching students with autism spectrum disorders*. Arlington, VA: Council for Exceptional Children.
- Prizant, B. M., Wetherby, A. M., Rubin, E., Laurent, A. C., & Rydell, P. J. (2005). *The SCERTS[TM] model: A comprehensive educational approach for children with autism spectrum disorders*. Baltimore, MD: Brookes Publishing Company.
- Revelle, W. (2018). *psych: Procedures for psychological, psychometric, and personality research*. Evanston, IL: Northwestern University. Retrieved from. <https://CRAN.R-project.org/package=psych>
- Rosseel, Y. (2012). lavaan: An R package for structural equation modeling. *Journal of Statistical Software*, 48(2), 1–36.
- Sansosti, F. J., Powell-Smith, K. A., & Cowan, R. J. (2010). *High-functioning autism/Asperger syndrome in schools: Assessment and intervention* (p. xiv). New York, NY: Guilford Press.
- Wanless, S. B., McClelland, M. M., Lan, X., Son, S.-H., Cameron, C. E., Morrison, F. J., ... Sung, M. (2013). Gender differences in behavioral regulation in four societies: The United States, Taiwan, South Korea, and China. *Early Childhood Research Quarterly*, 28(3), 621–633. <https://doi.org/10.1016/j.ecresq.2013.04.002>