Author(s): Kaylor Ng; Carol Kit Sum To; Sharynne McLeod

Title: Validation of the Intelligibility in Context Scale as a screening tool for preschoolers in Hong Kong

Journal: Clinical Linguistics and Phonetics

ISSN: 0269-9206 **Year:** 2014 **Pages:** 316 - 328

Volume: 28 **Issue:** 5

Abstract: The Intelligibility in Context Scale (ICS, McLeod, Harrison, & McCormack, 2012) is a parent report questionnaire for assessing childrenâ¿¿s speech intelligibility. The original version was developed in English and was based on Environmental Factors identified within the International Classification of Functioning, Disability and Health-Children and Youth Version (ICF-CY) (World Health Organization, 2007). The ICS has been translated into over 30 languages, including Traditional Chinese (ICS-TC). ...

Validation of the Intelligibility in Context Scale as a screening tool for preschoolers in Hong Kong

Kaylor Ng

Carol Kit Sum To

University of Hong Kong, Hong Kong SAR

Sharynne McLeod

Charles Sturt University, Australia

Abstract

The Intelligibility in Context Scale (ICS, McLeod, Harrison, & McCormack, 2012) is a parent report questionnaire for assessing children's speech intelligibility. The original version was developed in English and was based on Environmental Factors identified within the International Classification of Functioning, Disability and Health-Children and Youth Version (ICF-CY) (World Health Organization, 2007). The ICS has been translated into over 30 languages, including Traditional Chinese (ICS-TC). The aims of the current study were to examine the psychometric properties of the ICS-TC with Cantonese-speaking parent-child dyads and to identify speech measures that were more sensitive to the ICS-TC ratings. A total of 72 Cantonese-speaking preschoolers with (n = 39) and without speech sound disorders (SSD) (n = 33) were recruited. Native Cantonese-speaking parents completed the ICS-TC independently. The measure showed good internal consistency and test-retest reliability. Correlations with speech performance on the Hong Kong Cantonese Articulation Test, and significant difference in ICS-TC mean scores between the two groups provided preliminary support for the validity of ICS-TC and suggested that ICS-TC can differentiate between children with and without SSD with a large effect size of d = 0.74. The optimal cutoff was estimated using Receiver Operative Characteristic (ROC) curve analysis, giving a sensitivity of .70 and specificity of .59. ICS-TC mean scores showed a positive correlation with the percentage of initial consonants correct and negative correlation with frequency of atypical errors, and both were moderate in strength. Given the satisfactory psychometric properties of ICS-TC, it may be a valuable clinical tool for screening Cantonese-speaking preschool children's intelligibility.

Introduction

Traditional assessment of speech sound disorders (SSD) includes direct evaluation by speech-language pathologists (SLPs) using standardized assessment tools or speech sample analysis. SLPs often calculate the percentage of phonemes correct (PPC), size of phonetic inventory, and the numbers and types of phonological patterns observed from a child and compare the performance against normative data of the language (McLeod, 2012). Based on the results of the assessment, a clinical decision is made regarding whether children need intervention for their speech sound production. Most traditional assessments undertaken by SLPs address children's speech within the clinical context. However, it is also beneficial to consider a child's capacity when engaging in conversation outside of the clinical context. Consideration of children's intelligibility in context reflects the joint efforts of speakers and listeners (McLeod, 2004). From a speaker's perspective, age, articulatory ability, error consistency, language ability, and speaking style can affect speech intelligibility (Ferguson, 2004, McLeod, 2012; Weismer, 2008). From a listener's perspective, acceptability towards a speaker, familiarity with the speaker, language or dialect, and experience in listening to the child's speech also affect intelligibility (Beukelman and Yorkston, 1980, Flipsen, 1995, 2006; McGarr, 1983, Witzel, 1995). Other contextual factors that impact intelligibility include discourse types and availability of physical cues in the situation (Hustad, 2012; Platt, Andrews, Young, and Quinn, 1980). Consequently, speech intelligibility may be a holistic and ecologically valid construct to consider how well a child conveys his or her message to listeners outside (as well as inside) the clinical context.

Parents are children's primary communication partners during their early years. Therefore, they have skills to identify their child's communication performance across a wide range of social contexts and are expected to provide a valid description of children's speech

intelligibility (Hustad, 2012). To capitalize on parents' knowledge of children's functioning in context, McLeod, Harrison, and McCormack (2012) developed a parent questionnaire called Intelligibility in Context Scale (ICS). The ICS was designed to obtain parents' opinions about their child's speech intelligibility when talking to different communication partners. In the ICS, parents are asked to rate on how well their child's speech can be understood by seven different communicative partners using a 5-point Likert scale. The seven communicative partners were drawn from the Environmental Factors – Support and Relationships chapter in the International Classification of Functioning, Disability and Health – Children and Youth (ICF-CY, WHO, 2007). Specifically, the seven communicative partners are: the parents themselves, other immediate family members, extended family members, child's friends, child's teachers, acquaintances and strangers. The ICS consists of seven questions with the first one being "Do **you** understand your child?" and the last being "Do **strangers** understand your child?". The five Likert scale response options are "always – usually – sometimes – rarely – never". The ICS takes about 3 to 5 minutes to complete and mean score can be computed as the average rating of these seven items. The ICS is available at http//www.csu.edu.au/research/multilingual-speech/ics.

In developing the ICS, McLeod *et al.* (2012) conducted a validation study with a group of Australian English-speaking preschool children with (n = 109) and without (n = 11) parent- or teacher-identified concern about their speech sound production ability. They reported a moderate correlation between the ICS mean score and SSD severity measures PPC (r = .54, p < .01), percentage consonants correct (PCC) (r = .54, p < .01) and percentage vowels correct (PVC) (r = .36, p < .01). Moreover, a significant difference in the ICS mean scores was noted between the typical group and the group whose parents were concerned about their speech. Thus, McLeod *et al.* (2012) provided initial support for the potential clinical value of ICS for

screening SSD in young children.

Since the publication of the validation study of the English version of the ICS (McLeod *et al*., 2012), the ICS has been translated into over 30 languages (e.g., Arabic, Bulgarian, Korean, Spanish, Turkish). Parent report method has been a common practice in assessing preschool children in surveillance screening programmes as well as in preschool settings in Hong Kong. Parents often requested to judge their child's behavior and ability. Cantonese-speaking parents in Hong Kong are assumed to be able to rate children's intelligibility objectively. Therefore adapting ICS in Hong Kong context is culturally feasible. The translations have been undertaken in one of two ways. The majority have been undertaken by SLPs and researchers who work with children with speech sound disorders and are native speakers of the language. These translations have been checked via back translation by accredited translators who work for a professional translation company in Australia. When SLPs have not been available, forward translations have been undertaken by translators who work for the same professional translation company.

The first two authors of the current paper, who are both SLPs and whose first language is Cantonese, created two Chinese translations of the ICS: Traditional Chinese (ICS-TC) and Simplified Chinese (ICS-SC). Two Chinese translations were necessary, because Traditional Chinese is used by people in Hong Kong and Taiwan and Simplified Chinese is used by people in countries such as the Mainland China and Singapore. The ICS was translated to Chinese according to recommended standards of translation and guidelines for cross-culture test adaptation (Brislin, 1980; Su and Parham, 2002; WHO, 2012). The translators took into account the linguistic and cultural features of Chinese (Ferraro, 2002; WHO, 2012) and worked with a professional multilingual translator whose first language was Mandarin Chinese with proficiency in Cantonese and English. Back translation was independently

carried out by the Australian translation company that was used for each of the ICS back translations. Necessary modifications of ICS-TC were undertaken until there were no further enhancements to be made. As within the English version of the ICS, the ICS-TC consists of seven questions with the first one being "**您**能明白孩子的說話嗎?" [Do **you** understand your child?]. The five response options are "**總是**[always] – **通常**[usually] – **有時候**[sometimes] – **很少**[rarely] – **從不**[never]". The final versions of the ICS-TC and ICS-SC can be accessed from http://www.csu.edu.au/research/multilingual-speech/ics.

The Present Study

The overarching aim of the present study was to conduct the first validation study of the ICS in a language other than English. In order to test the robustness of the ICS, the context (culture, written, and spoken language) of the present validation study was selected to be extremely different from the Australian English-speaking context of the original validation study. For example, unlike English that uses a phonetic writing system Traditional Chinese uses a pictographic writing system. Furthermore, unlike English, Cantonese is uses lexical tones, and has a simple syllable shape (typically, CV) (To, Cheung, & McLeod, 2013; Zee, 1999). Additionally, Cantonese-speaking children were chosen as the target population for this first validation study because of the large number of Cantonese speakers throughout the world.

The first aim of this study was to examine the psychometric properties of the ICS-TC when used with Cantonese-speaking parents and children who lived in Hong Kong. To validate the use of the ICS-TC with Cantonese-speaking parents and children:

(1) Reliability of ICS-TC was examined in terms of internal consistency of the items and test-retest reliability,

(2) Validity was examined in terms of (a) the correlations between speech performance of

children and the corresponding ICS-TC mean score from their parents, and (b) the difference between the ICS-TC mean scores of children with and without SSD,

(3) Sensitivity and specificity of ICS-TC was estimated by identifying the best cutoff.

The second aim of the study was to investigate which speech dimensions (e.g., percentage of initial consonants correct) were more sensitive to the ICS-TC score, which in turn can indicate the areas of difficulty that can be identified by parents using the ICS-TC.

Method

Participants

Ninety four parent-child dyads were recruited from four community kindergartens and nurseries in Hong Kong. Teachers were invited to assist in participant recruitment. Two groups of children were requested, the first group consisted of children being considered as having unclear speech or parents showed concern for their speech development, and the other group consisted of children with typical speech ability. A total of 94 parent-child dyads were recruited with 46 boys and 48 girls as the child participants. Using teacher-identified concern instead of parent-identified concern for recruitment of child participants was an attempt to minimize sampling bias. Parents were invited to complete the ICS-TC at home and return it before their children's speech assessment. In addition to the ICS-TC, parents were requested to provide background demographic information via a brief questionnaire. Teachers assisted in distributing the ICS-TC, demographic questionnaire, and the consent form. They also collected the forms returned by the parents.

Two of the 94 parents failed to return the questionnaires. Another 20 parent-child dyads were excluded when 12 parents indicated their child had a diagnosis or concern of other developmental disabilities (e.g., autism spectrum disorders, and language delay), seven parents indicated that Cantonese was not the first language of themselves or their children,

and one parent reported both diverse linguistic environment and another diagnosis. These exclusion criteria were to ensure that the target sample only included children with SSD in the clinical group and that parents' ratings would not be affected by their perception of their children's speech (due to different linguistic background; e.g., Best 1995, Flege 1995, Iverson and Kuhl 1995).

Among the 72 preschoolers included in the study, there were 31 boys and 41 girls aged from 36 to 72 months old as shown in Table 1. The majority (n = 28, 38.9%) were the first-born and the only child, 17 (23.6%) were the first-born child with siblings, 18 (25.0%) was the younger of two, 3 (4.2%) were the middle child, 1 (1.4%) was the youngest of three and 5 (6.9%) parents did not respond to this question. Socioeconomic status (SES) was estimated based on their domestic income with reference to Hong Kong 2011 population census data (Census and Statistics Department, 2012). There were 11 (15%) children whose family income fell below 25th percentile, 49 (68%) between 25th and 75th percentile, 11 (15%) above 75th percentile, and one did not respond to this question. Among the 65 parents completing the questionnaire, 15 (23.1%) received post-secondary education, 50 (76.9%) received up to secondary education and none had only primary school education.

Table 1 is about here

Speech Measures

The reference standard to distinguish children with typical speech development and SSD was based on the child's performance on the standardized speech assessment, the *Hong Kong Cantonese Articulation Test* (HKCAT) (Cheung, Ng, and To, 2006). By applying the normative data from the HKCAT manual, children who scored at or below -1.33 SD from the

mean were considered to have SSD. In addition to the standard scores, the presence of atypical speech errors was also taken into consideration (Preston and Edwards, 2010). Atypical errors were defined as the phonological patterns or articulation errors in any segmental position exhibited by less than 5% of children at all age group in HKCAT normative data (Cheung *et al.*, 2006). A child with SSD in the present study was defined as having (1) standard score for initial consonants, vowels and diphthongs, or final consonants at or below -1.33 SD from the mean *and* (2) presence of atypical speech errors.

To examine which speech dimensions were more sensitive to ICS-TC ratings, correlations between ICS-TC mean scores and the following measures of the HKCAT (Cheung *et al.*, 2006) were calculated: percentage of phonemes correct (PPC), percentage of initial consonants correct (PICC), percentage of vowels/diphthongs consonants correct PV/VVC, percentage of final consonants correct (PFCC), and total number of occurrence of atypical speech errors. Cantonese has 19 initial consonants, six final consonants, 11 vowels, 11 diphthongs, and nine tones (To et al., 2013; Zee, 1999).

Procedures

Each parent received the ICS-TC, a demographic questionnaire, and a consent form from their child's preschool and the returned forms were collected via the teachers. Next, all the children were assessed using HKCAT (Cheung *et al.*, 2006) by the first author in a quiet room in their preschools. Speech samples were transcribed online, and were recorded using a Sony ICD-PX820 digital voice recorder. The audio recording was used by the first author to check transcription immediately after the testing and about 2-4 weeks later to determine intra-rater reliability. The investigator was blind to the ICS ratings and whether the child belonged to the typical or SSD group before the speech assessment. The parents also did not know the results of the standardized speech assessment when they filled in the questionnaire.

This was to ensure that reporting bias was minimized. To measure the test-retest reliability of ICS-TC, parents were invited to fill in the questionnaire again about 2-4 weeks after the first one. A total of 21 repeat questionnaires were returned.

Transcription Reliability

Both intra-rater and inter-rater reliability of speech transcription in HKCAT were established by random and independent review of 10 participants' audio recordings (total of 2,720 items) by the first and second authors. The item-by-item agreement for intra-rater and inter-rater reliability were 98.3% and 95.7% respectively, indicating a high level of reliability.

Statistical Analysis

A series of statistical analyses were conducted to address the aims of the study. Data were analyzed using SPSS Version 19.0. To demonstrate reliability of ICS-TC, inter-correlation coefficients of the seven items in ICS-TC were calculated to indicate the internal consistency. In addition, overall item-to-item agreement of the ICS-TC rating among the first and repeated measure and Intraclass correlation coefficients (ICC) of each item were calculated for test-retest reliability. To demonstrate the validity of ICS-TC, correlations between the ICS-TC mean scores and children's actual speech performance, as well as the difference in the ICS-TC mean scores between the typical and SSD group were examined. To determine the best cutoff that yielded satisfactory diagnostic accuracy, a Receiver Operating Characteristic (ROC) curve was drawn followed by cutoff adjustment. For the final objective, that is to investigate the speech dimensions (PPC, PICC, PV/VVC, PFCC, and the number of occurrence of atypical errors) that were most sensitive to ICS-TC ratings, correlations between these speech measures and ICS-TC mean scores were calculated.

Results

Speech Performance

The 72 children were divided into either the typical group or the SSD group based on the standard scores of HKCAT (Cheung et al., 2006), together with the existence of atypical speech errors. The HKCAT (Cheung *et al.*, 2006) provides normative data for initial consonants, vowels and diphthongs, final consonants, and lexical tones. The current study only focused on the first three measures, namely, initial consonants, vowels and diphthongs, and final consonants. According to the user's manual of HKCAT (Cheung *et al*., 2006), if a child scores lower than -1.25SD in any of the measure, the child could be diagnosed as having SSD. There were 39 children (54%) considered to be typical with mean age of 58 months (*SD* = 10.0) and 33 (46%) considered to be atypical with mean age of 48 months (*SD* = 11.5). Their speech performances in terms of different measures were summarized in Table 2. Equal variance of the two groups was not assumed in the Levene' s Tests for all the speech measures. Mann-Whitney *U* tests were conducted to examine if the group differences were significant. There were significant differences in PPC ($U = 115$, $p < .001$, $r = -.71$), PICC ($U = 233$, $p < .001$, $r = -.58$), PV/VVC ($U = 317$, $p < .001$, $r = -.55$) and the total number of occurrences of atypical errors ($U = 19.5$, $p < .001$, $r = -.92$) between the typical and SSD groups, while no significant difference was found in PFCC ($p = .018$). The typical group performed significantly better than the SSD group in all of the speech dimensions, except for final consonants.

Table 2 is about here

ICS-TC Ratings

Overall ratings. Parental perceptions of their preschoolers' speech intelligibility with different communication partners is shown in Table 3. Collapsing the two groups, most

parents completing ICS-TC reported they “always” (66.7%) understood their child’s speech, which was the highest percentage among all the communication partners. None of the parents rated “rarely” (0.0%), or “never” (0.0%) for themselves or for the immediate family members. Teachers (52.8%), the children’s friends (48.6%), acquaintances (45.8%), and strangers (44.4%) were mostly considered as “usually” understanding their children’s speech. Mean scores of all seven items showed that parents regarded themselves as understanding their child’s speech the best, followed by immediate family, with extended family similar to that of the child’s teachers, followed by the child’s friends, acquaintances, and then strangers.

Table 3 is about here

Inter-correlations of items in ICS-TC. ICS-TC mean scores of the seven items received by each child participant were calculated. Test of normality using Kolmogorov-Smirnov with Lilliefors was significant, suggesting normal distribution was not assumed. Spearman’s *rho* correlations among the items ranged from moderate ($r_s(70) = .56$, $p < .001$) to strong ($r_s(70) = .89$, $p < .001$) (see Table 4). The results demonstrated an overall satisfactory internal consistency for ICS-TC.

Test-retest reliability. Twenty one parents repeated ICS-TC after about 2-4 weeks. Item-to-item agreement was 71.4% among a total of 147 items. Table 5 illustrates the ICCs for the seven items in ICS-TC. The ICC values of all the items were at or higher than 0.70 except Item 6 which the parents rated for the child’s teachers’ perception. Overall, the item-to-item agreement and ICC demonstrated satisfactory test-retest reliability of the ICS-TC.

Tables 4 and 5 are about here

Correlations between ICS-TC mean scores and HKCAT scores. Spearman's *rho* was used to compare ICS-TC mean scores with various speech measures including PPC, PICC, PV/VVC, PFCC, and the total number of occurrence of atypical errors (see Table 6). Normal distribution was not assumed. ICS-TC mean scores showed a positive correlation with PICC ($r_s(70) = .41$, $p < .001$) and a negative correlation with total number of occurrence of atypical errors ($r_s(70) = -.41$, $p < .001$). Both correlations were moderate in strength (see Table 6). The other speech measures (PPC, PV/VVC, and PFCC) did not show significant correlations with ICS-TC mean scores.

Table 6 is about here

Comparison of ICS-TC mean scores between groups. The ICS-TC mean scores for the two groups fulfilled the assumption of equal variances. Results of a *t*-test showed significant difference in ICS-TC mean scores between the typical ($M = 4.56$, $SD = 0.48$) and SSD groups ($M = 4.14$, $SD = 0.65$) ($t(70) = 3.13$, $p < .01$). The results were entered into an on-line effect size calculator devised by Becker (1998) and Cohen's *d* was 0.74 suggesting that ICS-TC can differentiate children with and without SSD with a large effect size.

Diagnostic accuracy of ICS-TC. The optimal threshold value for sensitivity and specificity based on Euclidean distance was the coordinate point with sensitivity of .58 and specificity of .72. Given sensitivity and specificity should be at least .70 to .80 to be regarded satisfactory (Glascoe and Dworkin, 2008), the cutoff in the current study, from a mathematical perspective, was considered to have a low level of sensitivity but a satisfactory

specificity level. Considering the potential use of ICS-TC as a screening tool, a designated cutoff was therefore selected based on the principle that a satisfactory sensitivity level should be achieved for adequately identifying children with potential SSD. The adjusted cutoff yielded a satisfactory sensitivity level of .70 with a drop in specificity level to .59 as a tradeoff. ROC space in Table 7 displays the corresponding number of positive and negative cases using ICS-TC. The corresponding cutoff ICS-TC score for the adjusted pair of sensitivity and specificity was 4.29. That means, if the ICS-TC score of 4.29 was used as the cutoff, the number of children identified as having SSD and having typical speech development is the closest to the actual diagnosis based on the standardized assessment results. For the area under the ROC curve (AUC) which represents an overall accuracy, the value of .69 using the ICS-TC mean score indicated a borderline acceptability (Hosmer and Lemeshow, 2000).

Table 7 is about here

Discussion

The main objective of the study was to validate the use of the ICS-TC with parent child dyads who spoke Cantonese and lived in Hong Kong to determine its suitability as a screening tool within this context. Psychometric properties of the ICS-TC were evaluated. Reliability was investigated in terms of internal consistency and test-retest reliability. Evidence of validity was appraised based on the correlations between the ICS-TC mean scores and speech performance, and the significant difference between the ICS-TC mean scores of children with and without SSD. The secondary objective was to identify the speech measures that were more sensitive to the ICS-TC ratings.

Generally, parents completing the ICS-TC mostly reported themselves “always” or “usually” understood their child’s speech even for the SSD group. There appeared to be a ceiling effect in this self-rated item. Parent ratings on how well their child could be understood by strangers was rated with the lowest mean score among the seven items but most of the parents considered strangers could at least “usually” understand their child’s speech. There was a significant difference between the parents’ report of how well they understood their child (M = 4.65, SD = 0.51) compared with how well strangers understood their child (M = 4.13, SD = 0.82) ($t(72) = 6.68$, $p < .001$). Most parents were aware that strangers may find it difficult to understand their child’s speech. This highlighted the importance of considering the Environmental Factors in the ICF-CY model for a holistic evaluation of a child’s communication performance (WHO, 2007, McLeod *et al.*, 2012). Speech intelligibility was different with different communication partners.

Psychometric Properties of ICS-TC

Reliability. Internal consistency was demonstrated in the moderate to strong correlations among the seven items of ICS-TC. The correlation values were similar to the English version of the ICS reported by McLeod *et al.* (2012), in which moderate to high correlations were also reported. The moderate correlation between the first and second ratings by the same group of parents illustrated satisfactory test-retest reliability; however, it is acknowledged that there may be some sampling bias in this result, since not all of the parents repeated the ICS-TC.

Validity. The moderately strong correlations between ICS-TC mean scores and speech performance, as well as the significant difference in ICS-TC mean scores between the typical and SSD group supported the validity of the ICS-TC in capturing the children’s actual speech performance. The results indicate that parent perception towards their children’s speech

performance can generally represent their children's speech ability. In other words, ICS-TC was able to differentiate children with typical speech development from children with SSD, suggesting its clinical value.

Diagnostic accuracy. The adjusted cutoff point where ICS-TC mean scores was 4.29, yielded a satisfactory sensitivity level of .70 and a lower specificity level of .59 (Glascoe and Dworkin, 2008). This means that the ICS-TC can be used to identify children with SSD but may be too stringent and may over-identify some typically developing children with speech difficulty. Given the purpose of screening as to identify cases that might require a more detailed diagnostic assessment, the ICS-TC cutoff with acceptable sensitivity rate can be selected despite compromised specificity.

Speech measures sensitive to ICS-TC. Among the five speech measures (PPC, PICC, PV/VVC, PFCC, and the total number of occurrence of atypical errors), only PICC and the total number of occurrence of atypical errors showed significant correlations with ICS-TC mean scores. This suggests that children whose errors were in initial consonants or were atypical in nature tended to be more easily identified by their parents as having speech difficulties. This is consistent with Byers' (1973) findings that initial consonants are more intelligible to listeners given the same vowel environment at monosyllabic level than other positions, suggesting errors in producing initial consonants would compromise speech intelligibility to a greater extent. Lower PICC may be easier to identify by parents and consequently may be reflected in their ICS-TC ratings; particularly within Cantonese that has many more word-initial than word-final consonants (To et al., 2013). Also, the relationship between atypical phonological errors and lower speech intelligibility may explain why children with more atypical errors tended to be rated with lower speech intelligibility on the ICS-TC (Feldman and Messick, 2008). It is acknowledged that intelligibility in

conversational speech and performance on a single word test are different skills reflecting differences in children's capacity and performance. The difference between communicative contexts may be one reason for the moderate, rather than strong correlations between the ICS-TC and the PICC and presence of atypical errors. Thus, during a speech assessment it is important to consider both children's capacity (to produce words in single word contexts) and performance (to communicate intelligibly with different communication partners).

Summary of the psychometric properties of the ICS-TC. The ICS-TC met several features of a good screening test, including having satisfactory sensitivity (70%) to identify children at risk of SSD (Glascoe and Dworkin, 2008), low cost as it involves parents and not professionals, short administration time of 5 minutes, and easy scoring. However, there are some cautions when using ICS-TC in practice. Firstly, normative data have not been established for English or languages other than English (however, research is currently underway). Secondly, the current study did not consider the application to children and parents with diverse linguistic backgrounds, or children with diagnoses of intellectual impairment, autism spectrum disorders, or language disorders.

Future Research

The present investigation provided preliminary support for the use of ICS-TC as a screening tool; however, further validation and normative studies with larger samples of Cantonese-speaking parent-child dyads should be undertaken. Positive findings on future research could support the use of the ICS-TC to facilitate early identification of children with SSD to ensure better access to a detailed speech assessment and timely intervention. Factors that may affect ICS-TC accuracy also may be investigated to determine the conditions of ICS during application. For example, the education level of parents and duration of daily parent-child interaction time could be taken into account. Moreover, whether mothers and

fathers would rate differently using ICS-TC may be a potential issue to examine given that there is a maternal advantage of perceived intelligibility (Flipsen, 1995). In addition, ICS-TC ratings and speech measures of parent-child dyads with linguistically and culturally diverse background could be examined. For example, ICS-TC ratings between parents of a child, one being native Cantonese speaker and one non-native, can be compared. This may reflect the influence of the first language on Cantonese perception on ICS-TC ratings (Best, 1995, Flege, 1995, Iverson and Kuhl, 1995). Finally, ICS-TC ratings on preschoolers with other communication problems such as language delay, autism spectrum disorders, or with other comorbidities could be investigated, to examine if parents distinguish between the dimension of speech and other aspects of communication using ICS-TC.

Conclusion

The ICS is a quick parent report screening tool to describe children's intelligibility with different conversational partners. The ICS has been validated for use with Australian English-speaking preschool children (McLeod *et al*., 2012) and the current study provides preliminary validation for use with Hong Kong Cantonese-speaking preschool children. Both validation studies have included children who are typically developing and those with speech sound disorders. Additional studies are required to determine its validity with children who speak languages other than English and Cantonese, and to provide normative data. However, these initial studies provide preliminary support for the use of the ICS as a valid tool for screening preschool children's intelligibility.

References

Becker, L. A. (1998). *Effect size calculator*. Retrieved from http://www.uccs.edu/~lbecker/.

Best, C. T. (1995). A direct realist view of cross-language speech perception. In W. Strange (Ed.), *Speech perception and linguistic experience: Issues in cross-language research*

(pp. 171–204). Timonium: York Press.

Beukelman, D. R., & Yorkston, K. M. (1980). Influence of passage familiarity of intelligibility estimates of dysarthric speech. *Journal of Communication Disorders, 13*, 33-41.

Brislin, R. W. (1980). Translation and content analysis of oral and written material. In H. C. Triandis & J. W. Berry (Eds.), *Handbook of cross-cultural psychology* (Vol. 1, pp. 389-444). Boston: Allyn & Bacon.

Byers, V. W. (1973). Intelligibility of initial versus final consonants in monosyllabic words. *Journal of the Acoustical Society of America, 53*(1), 328.

Census and Statistics Department (2012). *Hong Kong 2011 population census - Main report: Volume I*. Hong Kong: Census and Statistics Department.

Cheung, P. P.-S., Ng, A. K.-H., & To, C. K.-S. (2006). *Hong Kong Cantonese Articulation Test.* Hong Kong: Language Information, Sciences & Research Centre, City University of Hong Kong.

Feldman, H. M., & Messick, C. (2008). Language and speech disorders. In M. Wolraich, P. H. Dworkin, & D. D. Drotar (Eds.), *Developmental-behavioral pediatrics: Evidence and practice* (pp. 467-482). Philadelphia, PA: Mosby Elsevier.

Ferguson, S. H. (2004). Talker differences in clear and conversational speech: vowel intelligibility for normal-hearing listeners. *Journal of the Acoustical Society of America, 116*(4), 2365-2373.

Ferraro, F. R. (2002). *Minority and cross-cultural aspects of neuropsychological assessment.* Lisse: Swets & Zeitlinger.

Flege, J. E. (1995). Second language speech learning: Theory, findings, and problems. In W. Strange (Ed.), *Speech perception and linguistic experience: Issues in cross-language*

research (pp. 233-277). Timonium, MD: York Press.

Flipsen, P., Jr. (1995). Speaker-listener familiarity: Parents as judges of delayed speech intelligibility. *Journal of Communication Disorders, 28*, 3-19.

Flipsen, P., Jr. (2006). Measuring the intelligibility of conversational speech in children. *Clinical Linguistics and Phonetics, 20*(4), 202-312.

Glascoe, F. P., & Dworkin, P. H. (2008). Surveillance and screening for development and behavior. In M. Wolraich, P. H. Dworkin, & D. D. Drotar (Eds.), *Developmental-behavioral pediatrics: Evidence and practice* (pp. 130-144). Philadelphia, PA: Mosby Elsevier.

Hosmer, D. W., & Lemeshow, S. (2000). *Applied logistic regression* (2nd ed.). New York: John Wiley & Sons.

Hustad, K. C. (2012). Speech intelligibility in children with speech disorders. *Perspectives on Language Learning and Education, 19*(1), 7-11.

Iverson, P., & Kuhl, P. K. (1995). Mapping the perceptual magnet effect for speech using signal detection theory and multidimensional scaling. *Journal of the Acoustical Society of America, 97*, 553-562.

McGarr, N. (1983). The intelligibility of deaf speech to experienced and inexperienced listeners. *Journal of Speech and Hearing Research, 26*, 451-458.

McLeod, S. (2004). Speech pathologists' application of the ICF to children with speech impairment. *Advances in Speech-Language Pathology, 6*(1), 75–81.

McLeod, S. (2012). Laying the foundations for multilingual acquisition: an international overview of speech acquisition. In M. Cruz-Ferreira (Ed.), *Multilingual norms* (pp. 53-71). Frankfurt am Main: Peter Lang.

McLeod, S., Harrison, L. J., & McCormack, J. (2012). The Intelligibility in Context Scale:

Validity and reliability of a subjective rating measure. *Journal of Speech, Language, and Hearing Research, 55,* 648-656.

Platt, L. J., Andrews, G., Young, M., & Quinn, P. T. (1980).Dysarthria of adult cerebral palsy: I. Intelligibility and articulatory impairment. *Journal of Speech and Hearing Research, 23*, 28–40.

Preston, J., & Edwards, M. L. (2010). Phonological awareness and types of sound errors in preschoolers with speech sound disorders. *Journal of Speech, Language, and Hearing Research, 53,* 44-60.

Su, C. T., & Parham, L. D. (2002). Case report: generating a valid questionnaire translation for cross-cultural use. *American Journal of Occupational Therapy, 56,* 581-585.

To, C. K. S., Cheung, P. S. P., & McLeod, S. (2013). A population study of children's acquisition of Hong Kong Cantonese consonants, vowels, and tones. *Journal of Speech, Language, and Hearing Research, 56*(1), 103-122.

Weismer, G. (2008). Speech intelligibility. In M. J. Ball, M. R. Perkins, N. Müller, & S. Howard (Ed.), *Handbook of clinical linguistics* (pp. 568-582). Malden, MA: Blackwell.

Witzel, M. A. (1995). Communicative impairment associated with clefting. In R. J. Shprintzen & J. Bardach (Eds.), *Cleft palate speech management: A multidisciplinary approach* (pp.137-166). St. Louis, MO: Mosby.

World Health Organization. (2007). *ICF-CY: international classification of functioning, disability and health: Children and youth version.* Geneva: WHO.

World Health Organization. (2012). *Process of translation and adaptation of instruments*. Retrieved from http://www.who.int/substance_abuse/research_tools/translation/en/

Zee, E. (1999). Chinese (Hong Kong Cantonese). *Handbook of the International Phonetic*

Association (pp. 58-60). Cambridge: Cambridge University Press.

Table 1

Demographic Information of the Participants (N = 72)

	Age (month)	Boy	Girl	Total
Grade	*M* (*SD*)	*N*	*N*	*N*
K1	41 (3.46)	16	11	27
K2	53 (2.82)	5	12	17
K3	66 (3.39)	10	18	28
Total		31	41	72

Table 2

Speech Performance Scores of Children in the Typical and SSD Groups from the Hong Kong Cantonese Articulation Test (N = 72)

	Typical (*n* = 39)		SSD (*n* = 33)	
Speech measure	*M*	(*SD*)	*M*	(*SD*)
PPC	98.2	(2.33)	89.4	(8.53)
PICC	98.3	(3.88)	85.1	(16.12)
PV/VVC	99.8	(0.77)	96.8	(3.65)
PFCC	94.9	(4.94)	89.2	(11.30)
z-IC	0.34	(0.40)	-0.44	(1.14)
z-V/VV	0.28	(0.50)	-0.25	(1.11)
z-FC	0.57	(0.59)	0.45	(0.85)
Atypical errors	0.0	(0.00)	3.3	(3.56)

Note. PPC = percentage of phonemes correct; PCC = percentage of consonants correct; PICC = percentage of initial consonants correct; PV/VVC = percentage of vowels and diphthongs correct; PFCC = percentage of final consonants correct; z-IC = standard score of initial consonants; z-V/VV = standard score of vowels and diphthongs; z-FC = standard score of final consonants; Atypical errors = total number of occurrence of atypical errors

Table 3

Parents' Ratings of Their Children's Intelligibility with Different Communication Partners (N = 72)

Ratings			Always	Usually	Sometimes	Rarely	Never
			5	4	3	2	1
Item	*M*	(*SD*)	%	%	%	%	%
1. Parent (self)	4.65	(0.51)	66.7	31.9	1.4	0.0	0.0
2. Immediate family	4.57	(0.53)	58.3	40.3	1.4	0.0	0.0
3. Extended family	4.39	(0.70)	50.0	40.3	8.3	1.4	0.0
4. Friends	4.29	(0.72)	41.7	48.6	6.9	2.8	0.0
5. Acquaintances	4.17	(0.80)	37.5	45.8	12.5	4.2	0.0
6. Teachers	4.36	(0.59)	41.7	52.8	5.6	0.0	0.0
7. Strangers	4.13	(0.82)	36.1	44.4	15.3	4.2	0.0

Table 4

Non-parametric Correlations among the seven items on the Intelligibility in Context Scale – Traditional Chinese (ICS-TC) (N=72)

Items	Parent (self)	Immediate family	Extended family	Friends	Acquain-tances	Teachers
Immediate family	.79	-				
Extended family	.75	.80	-			
Friends	.64	.65	.82	-		
Acquaintances	.59	.71	.80	.88	-	
Teachers	.64	.63	.81	.80	.77	-
Strangers	.56	.68	.81	.82	.89	.87

Note. *** $p < .001$ (two-tailed) for all the above correlations

Table 5

ICC between the First and Second Measure for Each Item (N = 21)

Item	ICC, absolute agreement *df* (20, 20)	95% Confidence Interval	*p*-value
1. Parent (self)	0.83	0.59 - 0.93	<.001
2. Immediate family	0.76	0.40 - 0.90	.002
3. Extended family	0.70	0.27 - 0.88	.005
4. Friends	0.82	0.55 - 0.93	<.001
5. Acquaintances	0.77	0.42 - 0.91	.001
6. Teachers	0.67	0.18 - 0.86	.004
7. Strangers	0.87	0.69 - 0.95	<.001

Table 6

Non-parametric Correlations between the Intelligibility in Context Scale – Traditional Chinese (ICS-TC)Mean Scores and Hong Kong Cantonese Articulation Test (HKCAT) Scores (N=72)

Speech measure	r_s	*p*-value
PPC	.27	.02
PICC	.41	***
PV/VVC	-.06	.61
PFCC	-.08	.53
Atypical errors	-.41	***

Note. *** = $p < .001$

Note. PCC = percentage of consonants correct, PICC = percentage of initial consonants correct, PV/VVC = percentage of vowels or diphthongs correct, PFCC = percentage of final consonants correct.

Table 7

Receiver Operating Characteristic (ROC) Space of Outcome Prediction using the Intelligibility in Context Scale – Traditional Chinese (ICS-TC)

		Reference standard		Total
		+	-	
ICS-TC (Prediction value)	+	23	16	39
	-	16	23	33
Total		33	39	

Note. "+" = SSD or failed in ICS-TC; "-" = typical or passed in ICS-TC