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The Topography of Stuttering in Cantonese

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Stuttering topography · Stuttering · Cantonese · Lidcombe behavioral data language

Abstract
Objective: This is the first study to investigate the behavioral nature (topography) of stuttering in Cantonese. Cantonese, a Sino-Tibetan language, is both tonal and syllable-timed. Previous studies of stuttering topography have mainly been in Western languages, which are mainly stress-timed. ***Methods:*** Conversational speech samples were collected from 24 native Cantonese-speaking adults who stuttered. Six consecutive stuttering moments from each participant were analyzed using the Lidcombe behavioral data language (LBDL). A complexity analysis based on the LBDL was developed to indicate the proportion of multiple-behavior stuttering moments for each participant. ***Results:*** There was no significant difference in the frequency of the 7 LBDL behaviors. Almost half the stuttering moments across participants were reported as complex, containing more than 1 stuttering behavior, and stuttering complexity correlated significantly with stuttering severity. ***Conclusions:*** These preliminary findings require replication because of their important theoretical and clinical implications. Differences in topography across languages have the potential to contribute to our understanding of the nature of stuttering. Clinically, the recognition of such differences may assist practitioners in identifying stuttering, for example when screening for early stuttering. The LBDL complexity score developed in this study has the potential to be used in other languages.

Introduction

Theoretical and Clinical Reasons for Studying the Topography of Stuttering

Stuttering appears in all languages and cultures. However, most research about stuttering has been conducted in Western countries, with few studies involving non-Western languages [1–5]. Specifically, there has been very little research published in peer-reviewed journals into

Preliminary findings of this study were reported at the 30th World Congress of the International Association of Linguistics and Phoniatrics, in Dublin, in 2016.

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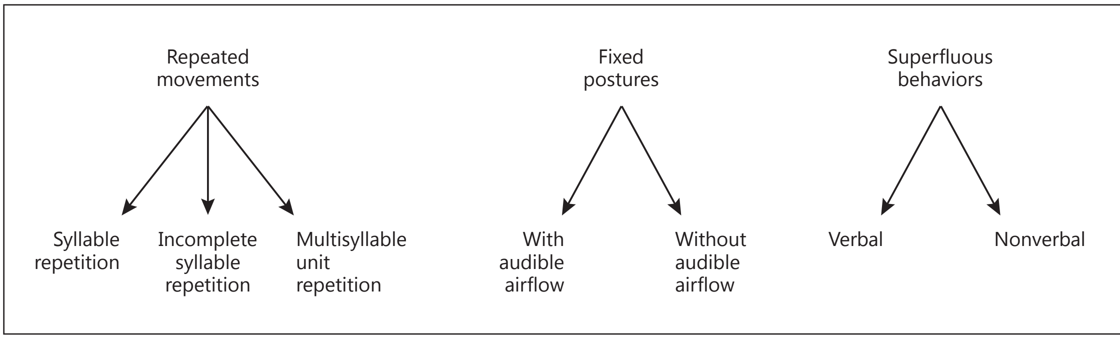

Fig. 1. The Lidcombe behavioral data language.

stuttering in tone languages, such as Mandarin and Cantonese. The latter is also a syllable-timed language.

To date, there has been no published research into the topography (behavioral features) of Cantonese-speaking adults who stutter and that is the topic of this report. Understanding the topography of stuttering in different languages has the potential to generate new knowledge, with possible theoretical and clinical implications. From a theoretical perspective, differences in topography across different languages have the potential to contribute to our understanding of the nature and cause of stuttering. A number of theories and models have implicated linguistic factors in the cause of stuttering [6–8]. Such theoretical propositions are certainly justified, because many linguistic variables are associated with stuttering, such as prosody, phonology, and word class [7, 9–17]. Clinically, should there be a difference in stuttering topography between languages, this may be important for distinguishing between stuttering and normal disfluency [18]. This could be important for screening for early stuttering and also for assessing the outcomes of stuttering treatments.

The Lidcombe behavioral data language (LBDL) is a way of describing stuttering topography, and is used in this study. This taxonomy is presented in the next section.

Describing Stuttering Topography: The LBDL

The LBDL [19, 20] is used to describe speech events that have already been identified as moments of stuttering. As its name suggests, the LBDL taxonomy is based on observable behaviors. It has been shown to be reliable and valid when used by experienced observers.

The LBDL comprises 7 behaviors (behavioral descriptors), under 3 categories: *repeated movements*, *fixed postures*, and *superfluous behaviors*. The category *repeated movements* comprises the behaviors *syllable repetition*, *incomplete syllable repetition*, and *multisyllable unit repetition*. The category *fixed postures* comprises the behaviors *fixed posture with audible airflow* and *fixed postures without audible airflow*. Finally, the category *superfluous behaviors* comprises the behaviors *verbal superfluous behavior* and *nonverbal superfluous behavior*. The LBDL is overviewed in Figure 1 and English examples of these behaviors are given in Table 1. Since the LBDL captures both audible and visual behaviors of stuttering, the speaker must be visible to the observer. This is particularly the case for fixed postures without audible airflow and nonverbal superfluous behaviors.

The LBDL allows the observer to assign more than 1 behavior to any stuttering moment. Frequently, a stuttering moment requires several behavioral terms to describe it fully [21]. The LBDL, then, can describe the behavioral complexity of stuttering moments. An example of a complex stuttering moment containing more than 1 stuttering behavior is given in Table 1.

The face validity of the LBDL has been shown in a number of studies. Lim et al. [4] applied the LBDL to stuttering in Mandarin and English and the LBDL has also been used to describe the disfluencies of Parkinson disease [22].

Stuttering Topography in Asian Languages

Given the theoretical and clinical importance of studying stuttering topography in languages that are structurally different from Western languages, two studies reporting stuttering topography in Asian languages are of interest [4, 5]. This is because many Asian languages are tonal, where lexical meaning is changed with changes in the fundamental frequency contour of a syllable [23], and have a language rhythm different from those of Western languages.

Lim et al. [4] reported on the stuttering features of Mandarin-English bilingual speakers from Singapore,

Table 1. English examples of the 7 stuttering behaviors in the LBDL and an example of a complex stuttering moment

Category	Behavior	Example
Repeated movements	Syllable repetition Incomplete syllable repetition Multisyllable unit repetition	… down- down the road … d-d-down the road … down the- down the road
Fixed postures	With audible airflow Without audible airflow	I fffffound it I … (articulatory position for /f/ but no sound) found it
Superfluous behaviors	Verbal Nonverbal	I well I ah ah saw … Associated facial and/or body movements
Complex behavior		It's o-o- (repeated movement)-ah (verbal superfluous behavior) o- (fixed posture) over there

aged between 12 and 44 years. The LBDL was used to describe the stuttering behaviors when they spoke in Mandarin and in English. Results showed that stuttering topography was similar in both languages. Regardless of the participants' language dominance, *repeated movements* were the predominant behaviors, followed by *fixed postures*, then *superfluous behaviors*. However, since most of the participants in their study were either English-dominant or balanced bilinguals, the findings could have been influenced by interaction between the two languages. Another Asian language study that focused on stuttering topography was conducted in Japanese [5]. However, the LBDL was not used in this study. Three types of stuttering behaviors were reported, with *repetition* being the most frequent, followed by *blocks* and *prolongations*.

Cantonese as a Syllable-Timed Tone Language

Cantonese belongs to the Sino-Tibetan language family. It is mainly spoken in the southern part of China and in many Chinese communities around the world. Cantonese is estimated to be spoken by approximately 62 million people worldwide [24].

Cantonese is a syllable-timed language. Traditionally, languages have been classified into different rhythmic groups: stress-timed, syllable-timed, and mora-timed [25]. However, the consensus now is that all languages could be placed on a rhythm continuum with one end being stress-timed and the other being syllable-timed [26, 27]. In languages that are considered more stress-timed, such as English and German, the duration between two stressed syllables is fairly regular but the syllable duration varies. In more syllable-timed languages, the duration between syllables is approximately the same. According to a recent study comparing the language rhythm across a number of languages that are considered to be more syllable-timed, including Mandarin, French, and Italian, Cantonese had the strongest syllable-timed rhythm [28]. In Cantonese, each written character comprises one syllable.

Cantonese is also a tone language. It has 6 contrastive tones, comprising 3 level tones, 2 rising tones and 1 falling tone. Tone 1 is a "high level" tone; tone 2 is a "high rising" tone; tone 3 is a "mid-low level" tone; tone 4 is a "mid-low falling" tone; tone 5 is a "mid-low rising" tone; and tone 6 is a "low level" tone [23]. Varying a tone for a syllable can change its meaning. Given the uniqueness of Cantonese, especially its syllable-timed nature, it is logical to predict that the topography of stuttering in Cantonese may differ from that of other languages.

The Present Study

This is the first study of the speech behaviors of stuttering in Cantonese. The aims of the present study were to (1) describe the behavioral features of stuttering in Cantonese using the LBDL, (2) document the dominant stuttering behavior in Cantonese, (3) explore the complexity of stuttering in Cantonese, and (4) document the relationship between stuttering complexity and stuttering severity.

Approval to conduct the study was obtained from the Joint Chinese University of Hong Kong-New Territories East Cluster Clinical Research Committee (CRE-2012.164) and the Human Ethics Committee of The University of Sydney.

Method

Participants

A total of 24 adults who stutter were recruited using the mass mailing list of all the tertiary institutions in Hong Kong, the speech therapy clinic at the Chinese University of Hong Kong, and advertisements through 4 of the local district councils in Hong Kong. The sample size for this study was calculated a priori at 22 participants based on assumptions of a medium effect size of 0.25, level of significance at 0.05, power of 0.8, each participant contributing 6 stuttering moments, and assuming an interparticipant correlation of 0.4 for measures.

Inclusion criteria were (1) age 18 years or above, (2) presence of stuttering as judged by a speech-language pathologist experienced in stuttering, (3) native speaker of Cantonese, and (4) no history of neurological disorder. All participants reported themselves to be stuttering and this was confirmed by one of the Cantonese-speaking authors. Participants were 18 men and 6 women, with a mean age of 22 years (range 18–33 years). Seven had received previous treatment for their stuttering and 17 had not. None were currently receiving treatment. Of the 7 participants who had received treatment, 5 had received treatment at least 4 years prior to this study. The remaining 2 participants had received treatment within 12 months of this study; however, the treatment received did not focus on their speech fluency. A summary of the participants' characteristics is presented in Table 2.

All participants spoke Cantonese as their dominant language and Cantonese was the main language used in their everyday speaking situations. At assessment, the mean percentage of syllables stuttered (%SS) was 7.0, ranging from 1.5 to 30.4%SS. These %SS scores were made by the first author, in real time using a dual-button counter, from video recordings of conversational speech. To establish the reliability of these measures, an experienced and blinded Cantonese-speaking speech-language pathologist who was independent of the study measured %SS scores from 7 (29%) of the recordings, randomly selected. Interrater agreement for these recordings was calculated with ICC (2, 1) as 0.77, which is acceptable [29].

Table 2. The characteristics of the participants, including age in years, sex, and percent syllables stuttered (%SS)

Participant	Ages	Sex	%SS
1	27	Male	6.6
2	21	Male	3.2
3	22	Male	30.4
4	23	Female	2.0
5	18	Female	12.9
6	20	Male	4.4
7	33	Male	1.6
8	30	Male	6.5
9	21	Male	2.6
10	19	Male	4.1
11	26	Female	22.6
12	18	Male	2.9
13	20	Female	2.6
14	20	Male	8.6
15	20	Male	3.5
16	28	Male	11.6
17	23	Male	4.1
18	22	Female	12.7
19	23	Male	1.8
20	22	Male	3.5
21	18	Male	4.2
22	30	Female	1.5
23	23	Male	8.5
24	23	Male	4.7
Mean	22		7.0

Speech Sampling

Speech samples for the topography analysis were subsequently recorded in a quiet room using a high definition video camera (Panasonic HDC-DS9) on a tripod placed 2 m directly in front of the participant. Each participant engaged in a conversation with a Cantonese-speaking speech-language pathologist until at least 1,000 syllables were collected. Nine standard questions about hobbies, occupation, schooling, leisure activities, and favorite foods were used as conversation topics and were presented randomly. The first 300 syllables of the each speech sample were excluded and the following 600 syllables were used for analysis.

Analyses

Identification of Stuttering Moments

The perceptual definition of stuttering [30] was used to identify moments of stuttering. The first 6 stuttering moments for each participant were identified for the LBDL analysis. For a total of 24 participants, this resulted in 144 moments of stuttering. Two native Cantonese-speaking speech-language pathologists experienced in stuttering were involved in identifying the stuttering moments. They could review the video recording as often as they wished. The first observer (the first author) viewed all the video samples and identified the first 6 stuttering moments in each sample. Each stuttering moment embedded in surrounding speech was then made into 144 individual video files. The duration of each of these video files was approximately 5 s.

To determine intraobserver agreement, 20% of the video files were randomly and independently selected and presented 1 week later to the first observer. To determine interobserver agreement, another 20% of the video files were randomly and independently selected and presented to a second observer (an experienced Cantonese-speaking speech-language pathologist, independent of the study). The intraobserver and interobserver agreement for stuttering identification were 95 and 90%, respectively.

LBDL Analysis

An advertisement was distributed by the Hong Kong Association of Speech Therapists for Cantonese-speaking speech-language pathologists with experience in stuttering and a basic understanding of the LBDL. However, no suitable candidates were recruited after 3 months of advertising. Hence, the first author, a native Cantonese-speaking speech-language pathologist, used the LBDL to analyze all speech samples in this study. This author was trained by the second author, one of the developers of the LBDL. The first author decided whether each stuttering moment comprised 1 or more of the 7 LBDL behaviors, and identified those behaviors. Twenty percent of the stuttering samples were random-

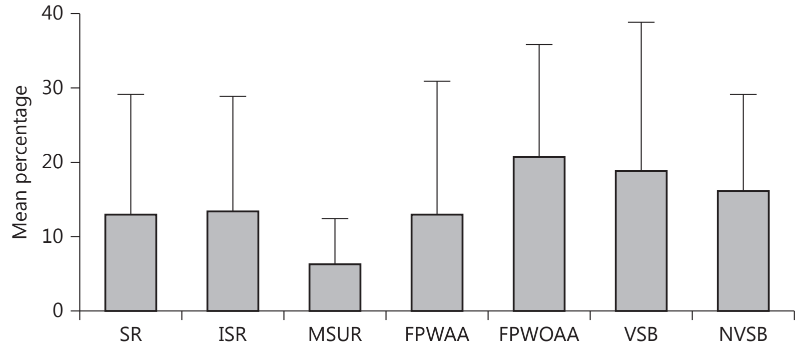

Fig. 2. The mean percentage of stuttering moments, pooled across the 24 participants, to which each of the LBDL categories was assigned: SR, syllable repetition; ISR, incomplete syllable repetition; MSUR, multisyllable unit repetition; FPWAA, fixed posture with audible airflow; FPWOAA, fixed posture without audible airflow; VSB, verbal superfluous behavior; NVSB, nonverbal superfluous behavior.

ly selected and re-analyzed by the original observer. Intraobserver agreement was 86.3%, which is comparable to the experienced observers reported by Teesson et al. [20].

Descriptive statistics were used to report the distribution of stuttering features. Paired *t* tests were used to compare the difference between stuttering moments containing 1 LBDL behavior and stuttering moments containing more than 1 LBDL behavior. Repeated-measures analysis of variance (ANOVA) with Bonferroni adjustment for post hoc analyses was used to examine the differences across all LBDL behaviors.

Stuttering Complexity

A topography complexity analysis based on the LBDL was developed for the purposes of this study. This enabled further exploration of the topography of stuttering. For each participant, each moment of stuttering was coded as either simple or complex. A simple moment of stuttering comprised just 1 of the 7 LBDL behaviors, while a complex moment of stuttering comprised more than 1 LBDL behavior. A score of "0" was given to each simple moment of stuttering and a score of "1" was given to each complex moment of stuttering. Thus, with 6 stuttering moments analyzed for each participant, the LBDL complexity score for each participant could range from 0 to 6. To further illustrate the calculation of the LBDL complexity score, if a participant has 6 simple moments and no complex moments of stuttering, this will attract a score of "0" for that participant; if there are 5 simple moments and 1 complex moment of stuttering, this will attract a score of "1" for that participant; if there are 4 simple moments and 2 complex moments of stuttering, this will attract a score of "2" for that participant; hence, for no simple moments and 6 complex moments of stuttering, a score of "6" will be assigned to that participant. Spearman correlation was calculated for the LBDL complexity score and %SS for the 24 participants.

Correlation of Stuttering Behaviors

A correlation analysis was conducted to examine the relationships of stuttering behaviors in complex moments of stuttering. That is, whether certain types of stuttering behaviors are more likely to co-occur in any particular stuttering moment. Since a correlation matrix for all 7 LBDL behaviors will result in small numbers of stutters under each behavior which will reduce the validity of the result, the correlation was conducted for the 3 categories [19, 20], namely *repeated movements*, *fixed postures*, and *superfluous behaviors*. A Pearson correlation was calculated for the co-occurrence of the stuttering behaviors under the 3 categories of the LBDL stuttering taxonomy.

Results

LBDL Analysis

Figure 2 shows the mean percentage of stuttering moments to which each of the LBDL behaviors was assigned, across the 24 participants: *syllable repetition*, 12.8%; *incomplete syllable repetition*, 13.3%; *multisyllable unit repetition*, 6.0%; *fixed posture with audible airflow*, 12.8%; *fixed posture without audible airflow*, 20.6%; *verbal superfluous behavior*, 18.7%; and *nonverbal superfluous behavior*, 15.8%. There were no significant differences in percentage between the 7 stuttering features ($F[4.51, 103.66] = 1.98$, $p = 0.10$).

Stuttering Complexity

Figure 3 shows the LBDL complexity scores for the 24 participants. Of the 24 participants, 11 had fewer than 3 complex (multiple-behavior) stuttering moments. The remainder of the participants ($n = 13$) had 3–6 complex stuttering moments. The complexity analysis showed that the mean percentage of stuttering moments comprising a single LBDL behavior was 54.2% and the mean percentage of complex stuttering moments comprising more than 1 LBDL behavior was 45.8%. There were no significant differences between the stuttering moments containing 1, or more than 1, LBDL behavior ($t[23] = 0.80$, $p = 0.43$). There was a significant positive correlation between complexity scores and %SS ($r = 0.67$, $p \leq 0.01$, $R^2 = 0.45$).

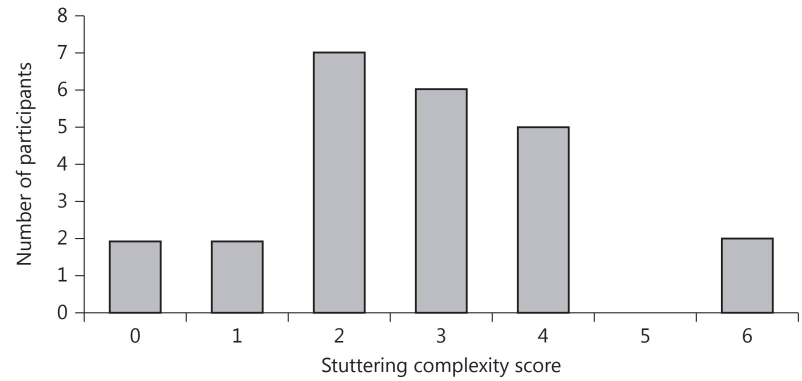

Fig. 3. LBDL complexity score for the 24 participants.

Correlation of LBDL Categories

There were highly significant correlations among the 3 LBDL categories. The correlations between the 3 categories are as follows: *repeated movements* and *fixed postures*, $r = 0.98$, $p < 0.01$, $R^2 = 0.96$; *repeated movements* and *superfluous behaviors*, $r = 0.98$, $p < 0.01$, $R^2 = 0.96$; *fixed postures* and *superfluous behaviors*, $r = 0.99$, $p < 0.01$, $R^2 = 0.98$.

Discussion

This is the first study to document the topography of stuttering in Cantonese, a syllable-timed and tone language. In particular the study aimed to determine if there is dominant stuttering behavior in Cantonese, and to explore the relationship between the complexity of stuttering and stuttering frequency.

Stuttering Behaviors

Results revealed that stuttering in Cantonese consists of a range of behaviors and behavioral complexity. However, there were no significant differences in frequency across the participants for the 7 stuttering behaviors of the LBDL taxonomy. The significantly positive correlation among the 3 categories of stuttering behaviors in complex stuttering moments indicated that no category of stuttering behavior is more likely to co-occur with another category of stuttering behavior. In other words, in complex stuttering moments, *repeated movements*, *fixed postures* and *superfluous behaviors* co-occurred without any distinctive pattern. It is of interest that this differs from the findings of Lim et al. [4] who reported that *repeated movements* were much more prominent than other LBDL behaviors in both Mandarin and English, although this difference was not analyzed for significance, as this was not of particular interest in this study. Mandarin is also a Chinese language, but is less rhythmic than Cantonese [28]. It is interesting to speculate that the marked syllable-timed nature of Cantonese may account for this profile of stuttering behavior found in the present study. That is, this may be why *repeated movements* (the repetition of syllables, parts of syllables, and multisyllable units) do not predominate in Cantonese, at least in this first study of Cantonese, as appears to be the case in the less rhythmic Mandarin. This will be an interesting issue to explore in future research. Other than Cantonese and Mandarin, future research could consider comparing stuttering topography across a number of languages with similar and different characteristics, including language-rhythm and tones. These cross-language comparisons allow researchers and clinicians to further understand the nature and characteristics of stuttering in different languages, which may facilitate our understanding of the linguistic triggers of stuttering as well as clinical assessment and management.

Behavioral Complexity

We developed the LBDL complexity score to indicate each participant's stuttering complexity. Scores range from 0 to 6, with "0" indicating only 1 LBDL behavior identified in each of the 6 stuttering moments in a participant's sample and "6" indicating more than 1 LBDL behavior identified in all 6 stuttering moments. Interestingly, over half of the participants (13 of 24 or 54%) had a LBDL complexity score of 3 or above, indicating that

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most participants had quite complex stuttering. Of further interest, there was a strong positive correlation between stuttering complexity and stuttering severity (as measured by %SS). This suggests that the LBDL complexity score has face validity.

The complexity findings also suggest that the LBDL complexity score has the potential for use in other languages, not just Cantonese. Regardless of language, 6 consecutive stuttering moments in a speech sample would be analyzed with the LBDL and a score of "0" to "6" allotted to that speaker, for that speech sample.

The LBDL complexity score has a number of possible uses, for example, to assess whether complexity of stuttering varies across communication contexts, such as talking in a meeting at work compared to talking with family members in the home environment. It may have particular value in clinical settings to supplement the traditional frequency-based measure of %SS and perceptual-based severity rating scales. This could be extremely helpful for aiding the transfer of the benefits of behavioral treatments beyond the clinical setting. It might be of interest, also, to see if/how the complexity of stuttering changes as a result of behavioral treatments and also treatments designed to reduce the social anxiety associated with stuttering, such as cognitive behavior therapy. The changes of stuttering behaviors during treatment may assist us to predict treatment progress and outcome.

The LBDL complexity score may also have value in adding to our understanding of the nature of stuttering. It could be used, for example, to explore the complexity of stuttering behaviors across languages. It would also be interesting to see if the complexity of stuttering topography changes for an individual across a day, or to document whether the complexity of stuttering changes from onset in early childhood to much later in life. However, all this can only be determined with future research, in Cantonese and in different languages.

Conclusion

A finding from this first study of the topography of stuttering in Cantonese is that there is reason to think that the behavioral manifestation of the disorder in Cantonese, at least as measured by the LBDL, differs from that of both English and Mandarin. It is interesting to speculate that this is due to the fact that Cantonese is the most syllable-timed of all languages. However, it must be stressed that this speculation is based on very preliminary findings in these languages. In particular, the finding for stuttering complexity in Cantonese in this study requires replication because of its theoretical and clinical implications. A future line of research will be to now use the LBDL complexity score in other languages.

If it should prove to be the case that in Cantonese stuttering topography, including behavioral complexity, differs from that in Western languages, and indeed even from that in the Chinese language of Mandarin, this has theoretical implications for the nature and cause of stuttering. It will now also be critical to study behavioral complexity of stuttering in young Cantonese-speaking children, given that in Western languages, *repeated movements* are considered to be prominent at, and soon after, the onset of stuttering [31, 32]. Moreover, being of theoretical interest, this research is needed clinically, so that practitioners can be confident in screening and assessing for stuttering in young Cantonese-speaking children.

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