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<thead>
<tr>
<th><strong>Title</strong></th>
<th>Phonological awareness abilities of Cantonese-speaking children with down syndrome</th>
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</thead>
<tbody>
<tr>
<td><strong>Author(s)</strong></td>
<td>Yau, Sze-mei, Tracy; 邱詩媚</td>
</tr>
<tr>
<td><strong>Citation</strong></td>
<td>Yau, S. T. [邱詩媚]. (2012). Phonological awareness abilities of Cantonese-speaking children with down syndrome. (Thesis). University of Hong Kong, Pokfulam, Hong Kong SAR.</td>
</tr>
<tr>
<td><strong>Issued Date</strong></td>
<td>2012</td>
</tr>
<tr>
<td><strong>URL</strong></td>
<td><a href="http://hdl.handle.net/10722/237887">http://hdl.handle.net/10722/237887</a></td>
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</tbody>
</table>
Phonological Awareness Abilities of Cantonese-speaking

Children with Down Syndrome

Yau Sze Mei, Tracy

A dissertation submitted in partial fulfilment of the requirements for the Bachelor of Science (Speech and Hearing Sciences), The University of Hong Kong, June 30, 2012.
Abstract

This study investigated the phonological awareness abilities of Cantonese-speaking children with Down syndrome. The phonological awareness abilities of 16 children with Down syndrome (DS) aged between 7;03 to 14;09, 16 children with intellectual disability of unknown origin (ID) aged between 7;09 to 14;06 and 16 children with normal intelligence (NI) aged between 3;6 to 9;0, matched on mental age and gender, were compared.

Phonological awareness abilities were evaluated by eight tasks. The results showed that the children with DS scored lower than the children with NI in all tasks except for phoneme identification task. It was found that phoneme awareness preceded rhyme awareness in the children with DS. It is concluded that although children with DS were able to develop partial phonological awareness, the acquisition pattern was developmentally atypical. The findings offer information for speech therapists to make reasonable expectations and integrate the training of phonological awareness into therapy accordingly.
Introduction

Phonological awareness refers to an understanding and manipulation of the sound structure of spoken words (Bernthal, Bankson & Flipsen, 2009). It ranges along a continuum from a more shallow level to a deeper level (Anthony, Lonigan, Driscoll, Philips, & Burgess, 2003). In normal developing children, awareness of larger sound units in words such as syllables and rime is developed before individual phonemes. It is reported that younger children first showed sensitivity to sound patterns across words then demonstrated more awareness in a word’s phonological structure (Carroll, Snowling, Hulme, & Stevenson, 2003; Anthony & Francis, 2005). The development of phonological awareness can be influenced by family interactions and home environment (Stadler & McEvoy, 2003). By talking to and engaging in story-telling with adults, children’s growth in phonological awareness can be enhanced as they are more aware of the phonological structure of adult’s spoken words.

Cantonese is monosyllabic and tonal in nature. Each Chinese character is pronounced as a syllable with a fixed grouping of onset, rime and tone. Phonological awareness in Cantonese have been widely studied in typical developing children (Ho & Bryant, 1997), children with language impairment (Wong, 1997), developmental dyslexia (Ho, Law, & Ng, 2000), phonological disorder (So & Dodd, 2007), bilingual Chinese-English children (Jackson, Holm, Dodd, 1998) as well as children with hearing impairment (Tse, 2009). However, little is known about the phonological awareness abilities of Cantonese-speaking
DS is caused by the presence of an extra 21st chromosome. It is the most common chromosomal condition associated with intellectual disability (Carothers, Hecht, & Hook, 1999). The most prominent communication characteristic of this population was reported to be low speech intelligibility (So & Dodd, 1994). According to So & Dodd (1994), speech problems presented in DS were at cognitive-linguistic level. Individuals with DS had difficulties in achieving an accurate phonological representation and generating a correct blueprint for a spoken production. The nature of phonological deficits in children with DS is controversial. Some researchers believed that children with DS showed a developmental but delay pattern of speech acquisition (Smith and Stoel-Gammon, 1983; Bleile & Schwarz, 1984; Kumin, Councill, & Goodman, 1994; Roberts, et al., 2005) while some believed phonological acquisition in children with DS followed a non-developmental pattern (So & Dodd, 1994; Dodd & Thompson, 2001).

It was found that children with DS speaking in different languages had poor phonological awareness abilities. Cossu, Rossini, & Marshall (1993)’s study found that Italian children with DS had only partial phonological knowledge. In three different phonemic awareness measures of phoneme deletion, segmentation and blending, the children with DS performed significantly poorer than the children with typical development.

Consistent with Cossu, Rossini, & Marshall (1993)’s research, Evans (1994), Fletcher &
Buckley (2002) and Snowling, Hulme, & Mercer (2002) also reported reduced phonological awareness in English-speaking participants with DS. They had lower scores on rhyme recognition and syllable deletion tasks. However, relatively preserved phonological awareness was found in syllable blending, syllable recognition and phoneme recognition, showing that these children were able to acquire partial phonological awareness abilities.

There was evidence showing some basic difference in the phonological system of children with DS compared to that of children with normal development. Snowling, Hulme, & Mercer (2002) revealed that children with DS had specific deficit in rime. Children with DS acquired awareness in phoneme before the awareness of rime. This pattern of performance contradicted with the traditional view that larger phonological units were perceived before smaller phonological units (Anthony et al., 2002; Carroll, Snowling, Hulme, & Stevenson, 2003).

Phonological awareness was considered as one of the influential variables on early reading achievement (Ehri, et al., 2001, Verucci, Menghini & Vicari, 2006). It is a powerful causal determinant of efficiency of learning to read (Cupples & Iacono, 2000). Deficits in phonological awareness increased the risk of having reading disabilities (Lyon, Shaywitz, & Shaywitz, 2003). The strong relationship between phonological awareness and reading ability has been supported by many studies in different languages including Chinese (Huang and Hanley, 1995; Ho & Bryant, 1997; Chow, McBridge-Chang, & Burgess, 2005). Longitudinal
studies have also showed that Chinese children’s performance on phonological awareness tasks was a strong predictor of their later reading development (Kumin, Councill, & Goodman, 1994 and Huang & Hanley, 1997). Investigating the phonological awareness abilities in children with DS in this study allows us to predict their future reading development and make reasonable expectations accordingly.

The inclusion of children with intellectual disability of unknown origin aims at determining whether the deficits in phonological awareness in children with DS are effects of intellectual disability or are specific to this syndrome. If children with DS perform significantly poorer in the phonological awareness tasks than those children in ID group, then reduced phonological awareness may be a unique characteristic of the syndrome. It can also provide an insight on whether poor phonological awareness abilities are universal in children with Down syndrome irrespective of the language being acquired.

This study proposed to investigate the phonological awareness abilities of children with DS. It was hypothesized that the children with DS would perform poorer than the children with intellectual disability with unknown origin and children with normal intelligence. The two control groups would perform similarly as they were mental-age matched.

Methods

Participants

The study recruited 48 participants whose chronological age ranged from 3;6 to 14;9. They
included 16 children with Down syndrome (DS); 16 children with intellectual disability of unknown origin (ID) and 16 children with normal intelligence (NI). Each child with DS was matched with an ID and a NI participant on the basis of mental age and gender. Table 1 showed the age and gender distribution of the participants. An one-way analysis of variance (ANOVA) showed that the three groups were well matched in terms of mental age ($F(2, 45) = 0.35, p = 0.966, \text{NS}$). All Children with intellectual impairment were recruited from mild grade, mild-to-moderate grade special schools for the intellectually impaired children in Hong Kong. Children with normal intelligence were from local kindergartens and primary schools which use Cantonese as the main teaching medium. None of the children included had other concomitant problems such as hearing loss, visual impairment, physical impairment and Autism Spectrum Disorders, etc. All children were monolingual speakers of Cantonese.

Table 1

Age and gender distribution of participants

<table>
<thead>
<tr>
<th>Group</th>
<th>n</th>
<th>Number of</th>
<th>Number of</th>
<th>Mean mental age (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>male</td>
<td>female</td>
<td>(year; month)</td>
</tr>
<tr>
<td>DS</td>
<td>16</td>
<td>7</td>
<td>9</td>
<td>5;09 (1;8)</td>
</tr>
<tr>
<td>ID</td>
<td>16</td>
<td>7</td>
<td>9</td>
<td>5;10 (1;7)</td>
</tr>
<tr>
<td>NI</td>
<td>16</td>
<td>6</td>
<td>10</td>
<td>5;10 (1;7)</td>
</tr>
</tbody>
</table>

Notes: DS = Down syndrome; ID = Intellectual disability; NI = Normal intelligence
Procedure

**Language screening.** Language screening was used to ensure the children have adequate language abilities to perform the tasks involved in assessing phonological awareness. The language abilities of the children were assessed informally during the free play session. For expressive language ability, all children recruited were able to name daily objects across different categories and express in at least 3-element utterances. For receptive language, all children were able to comprehend concepts (e.g. colours, comparison and locatives), answer binary choice, ‘A-not-A’, and ‘What’ questions and follow 3-element verbal commands involving locatives.

**Phonological awareness.** All participants were assessed individually in a 45-minute session. All sessions were carried out either in a quiet room in the participant’s school or in the participant’s home. In the first 10 minutes, free play was used to build rapport and assess the participant’s language ability. Each participant performed eight informal phonological awareness tasks, adapted and modified from So & Dodd (2007). The phonological awareness tasks were presented randomly to the participants to avoid the effect of task order and participants’ fatigue. The length and linguistic complexity of test instructions were short and simple to ensure the participants’ comprehension. For the rhyme detection task, phoneme detection task and phoneme identification task, items were presented both verbally and visually (in photo format) to reduce memory load of participants. At the beginning of each
task, clear instructions followed by demonstrations were given to the participants. To ensure the participants’ understanding of the task, two practice trials were given before test trials. Specific feedback was given after practice trials and neutral feedback was given for each test trial. The phonological awareness tasks were as follows:

**Syllable counting.** The participant was first given four car pictures to count. This was to ensure the participant had acquired counting concepts. The examiner would then present words with different syllables to the participant verbally. The participant was asked to calculate the number of syllables in each word.

**Syllable deletion.** Disyllabic or trisyllabic words were presented to the participant verbally. The participant was asked to delete one or two syllable(s) in each word and tell the remaining syllable(s) to the examiner.

**Phoneme detection.** The examiner presented three words and pointed to their corresponding pictures to the participant. The participant was asked to identify the word that did not share the same initial consonant with the other two words.

**Phoneme identification.** Three picture cards (i.e. cow, snake and wind) which represented three different initial consonants (i.e. /m/, /s/ and /f/) were shown to the participant. The participant was asked to imitate the phonemes after the examiner. Then, the examiner presented the words verbally and asked the participant to select the picture that represented the initial phoneme of the word.
Phonological awareness abilities

Rhyme detection. The examiner presented four words verbally and, at the same time, pointed to their corresponding pictures to the participant. Then, the participant was asked to match the picture name that rhymed with the target picture name.

Tone detection. The examiner presented a pair of words verbally to the participant. Two words had the same segmental features but with different or same tone(s). The participant had to judge whether the two words had the same tone or not.

Judgment. The examiner presented six utterances with 5-7 syllables to the participant both verbally and with the corresponding pictures. In four of the pictures, the utterances ended with a non-word. In the remaining two pictures, the utterances ended with a common noun. The participant was asked to judge whether the examiner had said anything wrongly.

Repair. The participant was asked to correct the errors identified in the judgment tasks.

Each correct response in the phonological awareness tasks scored one mark. The marks would be then converted to percentage correct for data and statistical analysis.

Results

General comparison

A two-way ANOVA of 3 (groups) x 8 (tasks) for repeated measure was done to determine if the three groups performed differently overall and if the tasks had different level of difficulties. Significance level was set at 0.05. Table 2 showed the summary table for the two-way ANOVA results.
Table 2
Two-way analysis of variance (ANOVA) of Group x Task

<table>
<thead>
<tr>
<th>Independent variables</th>
<th>df</th>
<th>sum of square</th>
<th>mean square</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group</td>
<td>2</td>
<td>296.266</td>
<td>148.133</td>
<td>66.138</td>
<td>*** &lt; .001</td>
</tr>
<tr>
<td>Task</td>
<td>7</td>
<td>230.560</td>
<td>32.937</td>
<td>14.706</td>
<td>*** &lt; .001</td>
</tr>
<tr>
<td>Group * Task</td>
<td>14</td>
<td>19.151</td>
<td>1.368</td>
<td>0.611</td>
<td>.856</td>
</tr>
</tbody>
</table>

Notes: * p < .05; ** p < .01; *** p < .001

There was a significant task effect, $F(7, 384) = 14.70, p < .001$. It indicated that the participants performed differently on the eight phonological awareness tasks. This suggested that the tasks had different level of difficulties. There was also a significant group effect, $F(2, 384) = 66.138, p < .001$. The performance of three groups was significantly different.

Post-hoc Tukey showed that there were significant differences between the NI and ID group ($p < .001$), NI and DS group ($p < .001$) and ID and DS group ($p < .001$). However, there was no significant interaction effect between groups and tasks, $F(14, 384) = 1.343, p = .215$. Therefore, there was no group difference on various tasks with different level of difficulty.

The performances of phonological awareness in different levels among three groups were compared. Figure 1 shows the three groups’ mean performance percent scores on eight phonological tasks.
As shown in Figure 1, the mean percentage correct for the two syllable awareness tasks (i.e. syllable counting and syllable deletion) of the three groups was the highest. The mean percentage of accuracy in the tasks of phoneme awareness (i.e. phoneme detection and phoneme identification) was lowest among all tasks. By comparing the performance among three groups, the children with DS showed the lowest accuracy in all tasks among the groups.

**Between Group comparison**

**Multivariate analysis of variance (MANOVA).** To determine whether the three groups performed differently, a MANOVA was conducted. It showed a significant difference among the groups, $F(21, 360) = 4.036, p < .001$. 

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**Figures**

*Figure 1.* Mean percentage correct of the three groups in eight phonological awareness tasks.
**Analysis of variance (ANOVA).** Performance of three groups in each individual task was evaluated. Results of one-way ANOVA indicated significant differences among the performances of three groups in all tasks except in phoneme identification task. Table 3 showed the statistical summary of the performance of the three groups in each phonological awareness task.

Table 3

*Statistical summary of the phonological awareness performance of the three groups*

<table>
<thead>
<tr>
<th>Task</th>
<th>sum of square</th>
<th>standard error</th>
<th>$F_{2,45}$</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Syllable Counting</td>
<td>32.667</td>
<td>0.546</td>
<td>6.849</td>
<td>** &lt;.01</td>
</tr>
<tr>
<td>Syllable Deletion</td>
<td>56.625</td>
<td>0.696</td>
<td>7.296</td>
<td>** &lt; .01</td>
</tr>
<tr>
<td>Phoneme Detection</td>
<td>19.542</td>
<td>0.490</td>
<td>5.087</td>
<td>* &lt; .05</td>
</tr>
<tr>
<td>Phoneme Identification</td>
<td>14.042</td>
<td>0.591</td>
<td>2.510</td>
<td>0.093</td>
</tr>
<tr>
<td>Rhyme Detection</td>
<td>47.167</td>
<td>0.480</td>
<td>12.815</td>
<td>*** &lt; .001</td>
</tr>
<tr>
<td>Tone Detection</td>
<td>45.125</td>
<td>0.447</td>
<td>14.126</td>
<td>*** &lt; .001</td>
</tr>
<tr>
<td>Judgment</td>
<td>56.625</td>
<td>0.475</td>
<td>15.693</td>
<td>*** &lt; .001</td>
</tr>
<tr>
<td>Repair</td>
<td>43.625</td>
<td>0.460</td>
<td>12.884</td>
<td>*** &lt; .001</td>
</tr>
</tbody>
</table>

Notes: *$p < .05$; **$p < .01$; ***$p < .001$*

Since the results of one-way ANOVA indicated significant differences among the performances of three groups in all tasks except phoneme identification task, post-hoc Tukey tests were used to show the significance levels between different groups in each task, as shown in table 4.
Table 4

*Comparison of significance levels of post-hoc Tukey Test between groups*

<table>
<thead>
<tr>
<th>Task</th>
<th>Significance level</th>
<th>DS &amp; NI</th>
<th>DS &amp; ID</th>
<th>ID &amp; NI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Syllable Counting</td>
<td>** &lt; .01</td>
<td>.068</td>
<td>.363</td>
<td></td>
</tr>
<tr>
<td>Syllable Deletion</td>
<td>** &lt; .01</td>
<td>.05</td>
<td>.378</td>
<td></td>
</tr>
<tr>
<td>Phoneme Detection</td>
<td>** &lt; .01</td>
<td>.232</td>
<td>.286</td>
<td></td>
</tr>
<tr>
<td>Phoneme Identification</td>
<td>No post-hoc test</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rhyme Detection</td>
<td>*** &lt; .001</td>
<td>.272</td>
<td>** &lt; .01</td>
<td></td>
</tr>
<tr>
<td>Tone Detection</td>
<td>*** &lt; .001</td>
<td>** &lt; .01</td>
<td>.283</td>
<td></td>
</tr>
<tr>
<td>Judgment</td>
<td>*** &lt; .001</td>
<td>** &lt; .01</td>
<td>.13</td>
<td></td>
</tr>
<tr>
<td>Repair</td>
<td>*** &lt; .001</td>
<td>** &lt; .01</td>
<td>.15</td>
<td></td>
</tr>
</tbody>
</table>

Notes: DS= Down syndrome; ID= intellectual disability; NI= normal intelligence
*p < .05; **p < .01; ***p < .001

**Comparison between the DS group and the NI group.** Post-hoc Tukey tests indicated the

NI group was significantly different from the DS group in all tasks except in phoneme

identification task. The DS group scored significantly lower than the NI group in the seven
tasks. The differences were more significant in rhyme and tone detection, as well as in

judgment and repair task.

**Comparison between the DS group and the ID group.** Post-hoc Tukey tests indicated the
DS group was significantly different from the ID group in tone detection, judgment and repair tasks. The DS group scored significantly lower than the ID group in these three tasks.

**Comparison between the ID and the NI group.** Post-hoc Tukey tests indicated the ID group was significantly different from the NI in rhyme detection task only. ID group scored significantly lower than the NI group in this task.

**Within group comparison**

**Performance in different tasks of each group.** In order to compare the performance in different levels of phonological awareness, tasks with similar nature were grouped together. Syllable counting and syllable deletion were grouped as syllable awareness. Phoneme detection and phoneme identification were grouped as phoneme awareness. Judgment and repair could be regarded as knowledge of phonological constraints. For the NI group, they performed best in judgment and repair tasks, followed by syllable awareness, tone awareness, rhyme awareness and lastly phoneme awareness. Participants with ID showed a slightly different pattern from the NI group, in that they performed better in syllable awareness than in knowledge of phonological constraints. The sequence of DS group was different from the above two control groups. They scored highest in syllable awareness tasks, followed by tone awareness, phonological constraints awareness, phoneme awareness and did worst in rhyme awareness.
Further analysis of the error pattern in the phoneme detection task. All the three groups showed the lowest percentage accuracy in the phoneme detection task among all the phonological awareness measures. Percentage of correct responses was 28.1% for the DS group, 41.7% for the ID group and 55.2% for the NI group. In the phoneme detection task, the errors types could be classified into choosing mouth shape distracter or unrelated distracter. Table 5 showed the percentages of each error type in the task. Analysis of the error pattern revealed that NI group tended to choose a response related to the mouth shape of the target word. The difference in the number of two type of errors were non-significant ($p = .889$).

Table 5

Percentages of error types of the three groups in phoneme detection task

<table>
<thead>
<tr>
<th>Group</th>
<th>% mouth shape distracters</th>
<th>% unrelated distracter</th>
</tr>
</thead>
<tbody>
<tr>
<td>DS</td>
<td>34.4</td>
<td>37.5</td>
</tr>
<tr>
<td>ID</td>
<td>28.1</td>
<td>30.2</td>
</tr>
<tr>
<td>NI</td>
<td>26</td>
<td>18.8</td>
</tr>
</tbody>
</table>

Notes: DS = Down syndrome; ID = intellectual disability; NI = normal intelligence

Further analysis of the error pattern in the phoneme identification task. Phoneme identification task was the only task that had no significant difference among the three groups. The incorrect responses were higher than 25% in all of the three groups. Percentage of correct responses was 50% for the DS group, 63.5% for the ID group and 74% for the NI group.
Table 6 showed the percentage of each error type in the task. Analysis of the errors in the task revealed that ID group and NI group were more likely to choose a phonological-related response. There were significant difference between the number of the two types of errors in NI (\(**p < .01\)) and ID group (\(*p < .05\)), but not in DS group (\(p = .394\)).

Table 6

<table>
<thead>
<tr>
<th>Error Type</th>
<th>Group</th>
<th>% Intra-manner errors</th>
<th>% Unrelated errors</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>DS</td>
<td>28.1</td>
<td>21.9</td>
</tr>
<tr>
<td></td>
<td>ID</td>
<td>24.0</td>
<td>12.5</td>
</tr>
<tr>
<td></td>
<td>NI</td>
<td>21.9</td>
<td>4.2</td>
</tr>
</tbody>
</table>

Notes: DS= Down syndrome; ID= intellectual disability; NI= normal intelligence

Discussion

The purpose of the study was to evaluate the phonological awareness abilities of Cantonese-speaking children with DS. It was hypothesized that children with DS would have more difficulties in the phonological awareness tasks than the other two groups. The data of the present study found that the DS group scored significantly lower than both the ID group and the NI group. One unexpected result was that the ID group performed significantly lower than the NI group although they were mental age-matched, indicating that intellectual disability or the different education system the two groups received might affect normal acquisition of phonological awareness.
Phonological awareness abilities of children with Down syndrome

Compared with the mental-age matched NI participants, the children with DS performed poorer in all tasks except for phoneme identification task. This finding was consistent with the previous findings about the difficulties in phonological awareness of children with DS in alphabetic language population children (Cossu, Rossini, & Marshall, 1993; Fletcher & Buckley, 2002; Cardoso-Martins et al., 2002; Snowling, Hulme, & Mercer, 2002). The data in this study showed that children with DS had partial phonological awareness abilities. Adams (1990) and Morris (1993) supported that the development of phonological awareness was not an all-or-none trait. The children with DS were able to perform the phonological awareness tasks, but they were found to be impaired. They performed relatively better in syllable and tone awareness but worse in rhyme awareness and repair task. One interesting finding in this study was that the DS group and the NI group exhibited no significant difference in the phoneme identification task. According to Ball (1993), awareness of phonemes was not exhibited with mastery until 7 years of age since it involved a syllable’s phonological structure which represents a deeper level of sensitivity. Therefore participants in this study with normal intelligence (mean age of 5;10 years old) should be still developing phonemic awareness gradually. This accounted for their relatively lower score in this phonological awareness measure.

When compared with the ID group, participants with DS scored significantly lower in
three tasks which were tone detection, judgment and repair tasks. This suggested that the difficulty in phonological awareness in children with DS may not directly due to reduced intellectual functioning in general but was idiosyncratic to the syndrome.

Tone is a suprasegmental and is a unique feature of the Chinese language. It appeared to be particularly difficult for children with Down syndrome since it was abstract and difficult to represent mentally in isolation (Li & Ho, 2011). The weak representation of the tone information in children with DS might be due to the insensitivity to the organization of suprasegmental elements of a word, inaccuracy in generating mental representation for phonological components (Swan & Goswami, 1997) and the difficulty in storing tonal information in working memory (Taft & Chen, 1992).

In the judgment and repair tasks, participants were asked to judge the accuracy of a word production and replace the incorrect consonants. This task could reflect the individual's underlying phonological knowledge. It required underlying phonological representations and strategies to first perceive the word and compare the input with the internal phonological representation of the target word (Sutterland & Gillon, 2005). According to So & Dodd (1994), speech problem presented in Down syndrome was at cognitive-linguistic level. Knowing what sound to produce instead of articulating the actual sound was particularly difficult for children with Down syndrome. This may explain why children with Down syndrome had particular impairment in judgment and repair task.
Acquisition of phonological awareness in children with Down syndrome

Snowling, Hulme & Mercer (2002) suggested that children with Down syndrome had specific deficit in rime awareness and followed a different pattern in phonological awareness acquisition from children with normal development. They were more sensitive to initial sounds than sounds at the end of the words.

In this study, the children with NI showed their best performance in syllable awareness, followed by tone awareness and rhyme awareness. They scored lowest in phoneme awareness task. Their performance was consistent with the developmental sequence of phonological awareness abilities. For the children with DS, the findings in this study were consistent with the atypical development of phonological awareness (Snowling, Hulme & Mercer 2002). They scored higher in phoneme awareness tasks than in rhyme awareness tasks whereas for the two control groups, they both performed better in rhyme awareness. Since rhyme is a bigger unit than phoneme, awareness in rhyme should be acquired first. This confirmed that there was some basic difference in the nature in the phonological system of children with DS.

Error Patterns of children with Down syndrome

Error patterns in the phoneme identification tasks were analyzed for the three groups since all participants performed relatively poorer in this particular phonological awareness measure. The scores among the three groups had no significant differences. However, further analysis in the error patterns showed that participants with NI made significantly more
intra-manner errors (words begin with /s/ were identified as /f/, vice versa) than unrelated errors (words begin with /s/ and /f/ were identified as /m/, vice versa), indicating that they were aware of the phonological nature of the sounds although they gave incorrect responses. For the children with DS, there was no difference between the two errors types, showing that they were not aware of the same manner between the distracter and the target answer.

**Possible explanation for poor performance of intellectual disability group**

Children with intellectual disability were believed to show a developmental but delayed pattern of phonological acquisition. It was therefore hypothesized that the performance of the children with ID would be similar to that of the mental-age matched children with NI. However, the children in ID group scored significantly lower in rhyme detection. There was a possible explanation for this. It was believed that exposure to nursery rhymes promoted the awareness of rhyme in young children (MacLean, Bryant & Bradley 1987). Children with normal development are frequently exposed to nursery rhymes in kindergartens as well as in home environment. But for children with intellectual disability, since they received preschool education in Special Child Care Centers, their training mainly focused on independent daily life functioning. Therefore, their experience in early education may hinder the awareness of rhyme (Cardoso-martins, Michalick & Pollo, 2002)

**Limitation and further study**

This cross-sectional study gave some general ideas on the phonological awareness
abilities of children with Down syndrome. However, it cannot show the exact developmental pattern of their phonological awareness abilities. It is suggested a longitudinal study can be conducted to show the developmental trend of children with Down syndrome. This provides an insight on the development of phonological awareness abilities across age.

The strong relationship between reading skills and phonological awareness in Cantonese has been confirmed by numerous studies (Huang, & Hanley, 1997; Ho & Bryant, 1997; Ehri, et al., 2001). Reading disabilities associated with deficits in phonological awareness had been identified in the population of DS in other languages (Cupples & Iacono, 2000; Verucci, Menghini & Vicar, 2006; van Bysterveldt, Gillon & Moran, 2006). In this study, children with DS were to have reduced phonological awareness abilities. A study on the relationship between literacy and phonological awareness abilities of children with DS is needed so that the role of phonological awareness in Chinese reading in children with DS can be identified.

Clinical implications

The result in the present study revealed that Cantonese-speaking children with DS had reduced phonological awareness abilities. Recent studies (Gillon, 2005; McNeill, Gillon, & Dodd, 2009) suggested an integrated speech and phonological awareness intervention for children with speech impairment, including in the Down syndrome population (van Bysterveldt, Gillon & Foster-Cohen, 2010). Since children with DS had difficulties in achieving and assembling the phonological representation of a word (So & Dodd, 1994),
enhancing explicit awareness of the underlying mental representation of a word through phonological awareness training tasks, in addition to traditional articulatory training may improve the child’s speech sound production. Traditional approach alone that focuses on practicing correct articulatory patterns may not address the nature of speech disorder in children with Down syndrome. The studies revealed that an integrated phonological awareness approach was effective in reducing speech errors for children with DS. This may provide an alternative for speech therapists in treating the speech production errors for children with Down syndrome.

**Conclusion**

This study found that the Cantonese-speaking children with Down syndrome were less phonologically aware than their mental age-matched controls with normal intelligence and intellectual impairment due to unknown cause in syllable, phoneme, rhyme and tone awareness, as well as knowledge of phonological constraints. The results also showed that children with Down syndrome had an atypical phonological awareness acquisition pattern in that they showed better phoneme awareness than rhyme awareness. The study confirmed the previous studies that children with Down syndrome possessed a qualitatively different pattern of phonological development.
References


Acknowledgements

I would like to express my sincere gratitude to my supervisor, Dr. Lydia So, and other staffs in the division for their advice and support at various stage of this study. I am grateful to the principals and parents in different schools to allow their children to participate in the study. Special thanks are also dedicated to my family members, my classmates April Cheng and Joanna Chan for their support and encouragement.
Appendix A – Phonological awareness tasks

I. Syllable Counting

Practice Trials
1. 椅 /tuŋ21/ (Chair)
2. 超級市場 /tsʰiu55 kep5 si23 tsʰeŋ21/ (Supermarket)

Test trials
1. 香蕉 /hœŋ55 tsiu55/ (Banana)
2. 杯 /pui55/ (cup)
3. 士多啤梨 /si22 ts55 pɛ55 leu35/ (Strawberry)
4. 朱古力 /tsy55 ku55 lik5/ (Chocolate)
5. 巴士 /pa55 si35/ (Bus)
6. 麥當勞 /mæk2 tɔn55 lœu21/ (McDonald)

II. Syllable Deletion

Practice Trials
1. 波板糖 - 糖 /pɔ55 pan35 tsʰœŋ35/ (lollipop) to delete / thœŋ25/
2. 西瓜 - 西 /sœi55 kwa55/ (watermelon) to delete / sœi5/

Test Trials
1. 火車 - 車 /fœ35 tsʰɛ55/ (train) to delete / tsʰɛ55/
2. 漢堡包 - 漢 /hœn33 pou55 pœ55 (hamburger) to delete / hœn33/
3. 電話 - 電 /tœn22 wa55/ (telephone) to delete / tœn22/
4. 公園 - 園 /kuœŋ55 jœn25/ (park) to delete / jœn25/
5. 公仔面 - 面 /kuœŋ55 tsi35 min22/ (doll) to delete / min22/
6. 蛋糕 - 蛋 /tan22 kœu55/ (cake) to delete / tan22/

III. Phoneme Detection

Practice trials
1. /p/ 波 /pœ55/ (ball) 杯 /pui55/ (glass) 車 /tsʰe55/ (car)
2. /s/ 杉 /sam55/ (clothes) 狗 /kœu35/ (dog) 書 /sy55/ (book)

Test trials
1. /f/ 火 /fœ35/ (fire) 花 /fa55/ (flower) 龜 /kœi55/ (tortoise)
2. /t/ 貓 /tip35/ (plate) 梳 /sa55/ (comb) 燈 /tœŋ55/ (light)
3. /ts/ 豬 /tsy55/ (pig) 遮 /tsœ55/ (umbrella) 天 /tʰin55/ (sky)
4. /ph/ 盤 /phœn21/ (basin) 褲 /fu33/ (trousers) 婆 /pʰœ21/ (grandma)
5. /kw/ 龜 /kœi55/ (tortoise) 葉 /jœp2/ (leaf) 骨 /kwœt5/ (bone)
IV. Phoneme Identification

Practice Trials
1. 媽 /ma55/ (mother)
2. 星 /sin55/ (star)
3. 花 /fa55/ (flower)

Test Trials:
1. 水 /sœy25/ (water)
2. 襪 /met2/ (sock)
3. 火 /fa35/ (fire)
4. 面 /min22/ (face)
5. 肥 /fei21/ (fat)
6. 手 /sɐu35/ (hand)

VI. Rhyme Detection

Practice trials
1. 車 /tsʰɛ55/ (car)  梳 /sɔ55/ (comb)  裁 /tsɛ55/ (umbrella)  一 /jut5/ (one)
2. 水 /sœy35/ (water)  咀 /tsœy35/ (mouth)  狗 /kɐu25/ (dog)  鼓 /ku35/ (drum)

Test trials
1. 口 /hɐu35/ (mouth)  雲 /wen21/ (cloud)  魚 /jy35/ (fish)  手 /sɐu35/ (hand)
2. 木 /muk2/ (wood)  六 /luk2/ (six)  葉 /jip2/ (leaf)  石 /sék2/ (rock)
3. 檯 /tʰi35/ (table)  狗 /kɐu25/ (dog)  袋 /tɕi35/ (bag)  車 /tsʰɛ55/ (car)
4. 蛋 /tʰan35/ (egg)  拼 /kan35/ (choose)  梨 /lei35/ (pear)  豆 /tou35/ (bean)
5. 花 /fa55/ (flower)  刀 /tou55/ (knife)  筆 /pɐt5/ (pen)  又 /tsʰa55/ (fork)
6. 書 /sy55/ (book)  波 /pɔ55/ (ball)  豬 /tsy55/ (pig)  葉 /jip2/ (leaf)

VI. Tone Detection

Practice trials
1 詩 /si55/ (poem)  詩 /si55/ (poem)
2 張 /tsæn55/ (Cheung, a surname)  勵 /tsæŋ35/ (reward)

Test trials:
1 日 /jut2/ (sun)  日 /jut2/ (sun)
2 耀 /jiu22/ (light)  要 /jiu33/ (want)
3 開 /hɔi55/ (open)  害 /hɔi22/ (harm)
4 妮 /nei21/ (girl)  妮 /nei21/ (girl)
5 誕 /tan33/ (born)  單 /tan55/ (odd)
6 畸 /kʰei55/ (abnormal)  畸 /kʰei55/ (strange)
Phonological awareness abilities

7 泥 /lɐi21/ (mud) 泥 /lɐi21/ (mud)
8 飯 /fan22/ (rice) 帆 /fan21/ (junk)
9 病 /pəŋ22/ (sick) 餅 /pəŋ35/ (biscuit)
10 水 /søy35/ (water) 碎 /søy33/ (bit)
11 周 /tsəu55/ (Chau, A surname) 酒 /tsəu35/ (wine)
12 淡 /tʰam23/ (tasteless) 淡 /tʰam23/ (tasteless)
13 厚 /hɐu23/ (thick) 後 /hɐu22/ (back)
14 褲 /fu33/ (trousers) 褲 /fu33/ (trousers)
15 檯 /tsʰeŋ33/ (table) 檯 /tsʰeŋ35/ (table)
16 唱 /tsʰœŋ33/ (sing) 場 /tsʰœŋ21/ (ground)
17 使 /si35/ (make) 試 /si23/ (try)
18 免 /min23/ (free) 免 /min23/ (free)

IX. Judgment and X. Repair

Procedure:
Say the stimulus, then ask 1. 有沒有怪怪嘅 (Did I say something silly?)
if say yes 2. 你幫我改番啱佢啦 (Help me to fix it.)

Practice Trials
1. 電視機入面有米奇老鼠 /tin22 si22 kei55 jɐp22 min22 jɐu23 mei23 kʰɐi21 lou23 sy35/ (There is a Mickey mouse in the television.)
2. 煙通出好多 /sin55/ /jin55 tshœt 55 hɔu35 tɔ 55 sin55/ target: 煙 /jin55/ (There is much smoke come out of the chimney.)

Test Trials
1. 落雨要擔 /tᵉ55/ /lʊk22 jy23 jiu33 tam55 tᵉ55/ target: 詭 /tse55/ (When it is raining, must take an umbrella.)
2. 熊人係度洗 /tsəu35/ /hʊŋ33 jɐn25 hɐi35 tou22 sɐi25 tsəu35/ target: 手 /səu25/ (Bear is washing hands.)
3. 天空有白雲 /tʰin55 hʊŋ55 jɐu23 pak22 wɐn21/ (There is cloud in the sky.)
4. 手上面有糖 /pʰœŋ35/ /səu35 sœŋ22 min22 jɐu23 lɐp55 pʰœŋ35/ target: 糖 /thɔŋ35/ (There is sweet on the hand.)
5. 個碗裝住啲飯 /kɔ33 wʊn35 tɕœŋ55 tsy22 tii55 fɐn22/ (There is rice in the bowl.)
6. 個女仔紮住孖 /kɔ33 lɐy23 tɕɐi25 tʃat33 tsy22 ma55 kin55/ target: 辮/pin55/ (The girl is tying two braids.)
Appendix B – Letters for recruiting participants

[Date]
Dear Principal,

As part of my Bachelor of Science in Speech and Hearing Sciences degree, I am required to conduct a small-scale study on evaluating the phonological awareness skills of children with Down Syndrome. This provides information for the speech therapists on their intervention of children with Down Syndrome.

The study therefore will involve twenty Cantonese-speaking children with Down Syndrome and twenty Cantonese-speaking children with intellectual impairment of unknown origin. The participants should be Primary One to Primary Six students with mild intellectual impairment. They should have no known concomitant problems such as ADHD, Autism, visual or hearing impairment. The participants will be required to attend a 45-minute session individually in a quiet room in the school. Each subject will be asked to perform ten phonological tasks. In order to prevent fatigue and boredom, breaks will be provided whenever necessary. The study will be carried between December, 2011 and February, 2012.

According to the University’s policy on the ethical conduct of research, I am writing to ask your consent for these procedures. I will make sure that the information students provide to me will be treated with the utmost confidentiality and anonymity. Students’ participation is voluntary. They have the right not to be included in my analysis, and if I find out that a student does not wish to be included, I will act according to that wish and not include the student. They can also choose to withdraw from the study at any time without negative consequences. The information collected will only be used for the dissertation and will be destroyed or returned to the school after the dissertation grade has been approved. All the information will be stored in a locked cabinet.

If you agree to these procedures, please sign one copy of this letter and return it to me. If concerns arise about this aspect of my work, please feel free to contact Tracy Yau (tel. phone number). If you have questions about your rights as a research participant, please contact the Human Research Ethics Committee for Non-Clinical Faculties, HKU (tel. 2241-5267).

Yours sincerely,
Yau Sze Mei, Tracy
Division of Speech and Hearing Sciences
Faculty of Education
The University of Hong Kong
Appendix C- Parents/ Guardians Consent Form

Dear Parents,

I am Yau Sze Mei Tracy, a year 4 student of Division of Speech and Hearing Sciences at the University of Hong Kong. I will conduct a research project on Phonological Awareness of Cantonese-Speaking Children with Down Syndrome and would like to invite primary children with Down Syndrome and children with pure intellectual impairment to participate. The study will contribute to the understanding of children’s awareness towards speech sounds and will help planning for future speech therapy training.

Students who participate in this research will complete a 45-minute assessment session. The students will be asked to perform some phonological awareness tasks. Breaks will be provided whenever necessary to prevent fatigue and boredom. Please complete the reply slip below to indicate whether you would allow your child to participate in this research soon. Participation is entirely voluntary, students can choose to stop at any time without negative consequences. All information obtained will be used for research purposes only. If you have any questions about the research, please feel free to contact Tracy Yau (phone number). If you want to know more about the rights as a research participant, please contact the Human Research Ethics Committee for Non-Clinical Faculties, the University of Hong Kong (2241-5267).

Your help is very much appreciated.

Yours sincerely,
Yau Sze Mei, Tracy
Division of Speech and Hearing Sciences
The University of Hong Kong