Phonological Short-Term Memory and Relative Clause Comprehension in Cantonese-Speaking Children with SLI

OOI, CARMEN CHIA-WEN
WONG, ANITA MEI-YIN
Disclosure

I have no relevant financial or nonfinancial relationship(s) within the products or services described, reviewed, evaluated or compared in this presentation.
Specific Language Impairment (SLI)

Phonological Short-Term Memory (pSTM)

Relative Clause (RC)

Conti-Ramsden & Botting 2001; Montgomery & Evans, 2009; Roberts, et al., 2007
PSTM deficit in SLI

- Children with SLI have poorer pSTM (Conti-Ramsden & Botting, 2001; Gathercole & Baddeley, 1990)
- Mixed result in Cantonese speaking children
  - Wong et al., (2010) - SLI weaker
  - Stokes et al., (2006) - SLI not weaker
RC comprehension difficulty in SLI

Subject-gapped Relative Clause (Subj-RC)

This is the girl$_i$ that $\_\_$_i$ draws grandmother.

Object-gapped Relative Clause (Obj-RC)

This is the girl$_i$ that grandmother draws $\_\_$_i$. 
In normal language children

1) **Structure-based Account**  

Hawkins, 2004; O’Grady, 2005; in & Bever, 2006
2) **Usage-based Account**  
Diessel, 2009; Diessel & Tomasello, 2000

**Word Order Strategy**  
Bever, 1970

**Copular Phrase**

That’s the girl

The teacher kisses the girl

The girl that draws the grandmother

The teacher kisses the girl that draws the grandmother.
3) Extralinguistics Account

Dependency Locality Theory  
Gibson, 1998

Subject-gapped Relative Clause

This is the girl$_i$ that [$_i$ draw grandmother].

Object-gapped Relative Clause

This is the girl$_i$ that [grandmother draws $_i$].

Role of pSTM

Filler-Gap Hypothesis  
Ford, 1983; Berwick-Weinberg, 1984
Subject-gapped Relative Clause

This is the girl\(_i\) that [\_\_i draw grandmother].

[\_\_i画紧婆婆]嘅女仔
draw-PF    grandmother    that    girl

Object-gapped Relative Clause

This is the girl\(_i\) that [grandmother draws \_\_i].

[婆婆画紧\_\_]啲個女仔
grandmother    draws-PF    that-CL    girl
In children with SLI

- **Computational Deficit**  
  - Argument Movement
  - Thematic Role Assignment

- **Representational Deficit in Dependent Relationship**  
  - Number of nodes
  - Economic Principle

- **Extralinguistic Account**  
  - Weak pSTM and difficulty in learning of lexicon and grammar

---

- Specific Language Impairment
- Phonological Short-Term Memory
- Relative Clause
Research Aim

Specific Language Impairment

Phonological Short-Term Memory → Relative Clause
Study 1
PSTM Characteristic in children with SLI

- Children with SLI have poorer pSTM than normal developing peers?
## Participants

<table>
<thead>
<tr>
<th></th>
<th>SLI</th>
<th>Age-matched controls (AM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of participant</td>
<td>18 (Boy= 15)</td>
<td>18 (Boy= 9)</td>
</tr>
<tr>
<td>Age (month)</td>
<td>65.67 (7.45)</td>
<td>64.50 (6.67)</td>
</tr>
<tr>
<td>Place of recruitment</td>
<td>Early Intervention Programme</td>
<td>Kindergarten</td>
</tr>
<tr>
<td>Language status</td>
<td>SLI (diagnosis from speech therapist)</td>
<td>Normal language (report from teacher)</td>
</tr>
<tr>
<td>RDLS-Cantonese-comprehension</td>
<td>53.61 (3.27)</td>
<td>59.67 (3.27)</td>
</tr>
<tr>
<td>CMMS (nonverbal cognition)</td>
<td>107.11 (14.45)</td>
<td>110.33 (11.33)</td>
</tr>
<tr>
<td>Other aspect of development</td>
<td>Normal (diagnosis from speech therapist)</td>
<td>Normal (report from teacher)</td>
</tr>
</tbody>
</table>

**RDLS** - Reynell Development Language Scale  
**CMMS** - Columbia Mental Maturity Scale
1. Nonword Repetition

NWR subtest in Hong Kong Cantonese Oral Language Assessment Scale  T’sou et al., 2006

<table>
<thead>
<tr>
<th>Nonword</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>(\text{p}^\text{h} \text{un}_1)</td>
<td>/1</td>
</tr>
<tr>
<td>(\text{mai}_1 \text{ hit}_9)</td>
<td>/2</td>
</tr>
<tr>
<td>(\text{p}^\text{h} \text{i} \text{ng}_5 \text{ t}^\text{h} \text{yn}_1 \text{ lai}_3)</td>
<td>/3</td>
</tr>
<tr>
<td>....</td>
<td>/4</td>
</tr>
<tr>
<td>....</td>
<td>/5</td>
</tr>
<tr>
<td>....</td>
<td>/6</td>
</tr>
<tr>
<td>....</td>
<td>/7</td>
</tr>
<tr>
<td>....</td>
<td>/8</td>
</tr>
<tr>
<td>....</td>
<td>/9</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
</tr>
</tbody>
</table>
2. Digit Reconstruction

Majerus et al., 2009

Measure serial order pSTM

Hear the digits

Presented the digit cards

Arrange the digit cards

<table>
<thead>
<tr>
<th></th>
<th>3-digit</th>
<th>4-digit</th>
<th>5-digit</th>
<th>6-digit</th>
<th>7-digit</th>
</tr>
</thead>
<tbody>
<tr>
<td>231</td>
<td>2314</td>
<td>53241</td>
<td>624531</td>
<td>7316425</td>
<td></td>
</tr>
<tr>
<td>321</td>
<td>4132</td>
<td>21354</td>
<td>536142</td>
<td>6354172</td>
<td></td>
</tr>
<tr>
<td>123</td>
<td>2413</td>
<td>31452</td>
<td>412635</td>
<td>5324176</td>
<td></td>
</tr>
<tr>
<td>213</td>
<td>3241</td>
<td>13254</td>
<td>265143</td>
<td>4716253</td>
<td></td>
</tr>
<tr>
<td>132</td>
<td>1423</td>
<td>41325</td>
<td>124536</td>
<td>3154672</td>
<td></td>
</tr>
</tbody>
</table>

Score: + + + + + = Total
3. Delay Item Repetition  Majerus et al., 2009

Measure item information pSTM

10 words and 10 nonwords
Q1: Do children with SLI have poorer pSTM than normal developing peers?

Independent Sample T-Test
Results

<table>
<thead>
<tr>
<th>Task</th>
<th>SLI</th>
<th>AM</th>
<th>t-value</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nonword Repetition</td>
<td>t(34)=-4.269</td>
<td>p&lt;.001</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Digit Reconstruction</td>
<td>t(34)=-2.913</td>
<td>p=.006</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Delay Item Repetition</td>
<td>t(34)=-2.541</td>
<td>p=.016</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Study 2
Relative Clause Comprehension in children with SLI

- Children with SLI exhibit Obj-RC over Subj-RC acquisition?
- Children with SLI have poorer RC comprehension than normal language peers?
## Participants

<table>
<thead>
<tr>
<th></th>
<th>SLI</th>
<th>AM</th>
<th>Language-matched controls (AM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of participant</td>
<td></td>
<td>18 (Boy= 12)</td>
<td></td>
</tr>
<tr>
<td>Age (month)</td>
<td></td>
<td>52.22 (4.51)</td>
<td></td>
</tr>
<tr>
<td>Place of recruitment</td>
<td></td>
<td>Kindergarten</td>
<td></td>
</tr>
<tr>
<td>Language status</td>
<td></td>
<td>Normal (report from teacher)</td>
<td></td>
</tr>
<tr>
<td>RDLS-Cantonese-comprehension</td>
<td></td>
<td>53.83 (6.02)</td>
<td></td>
</tr>
<tr>
<td>CMMS (nonverbal cognition)</td>
<td></td>
<td>109.50 (10.19)</td>
<td></td>
</tr>
<tr>
<td>Other aspects of development</td>
<td></td>
<td>Normal (report from teacher)</td>
<td></td>
</tr>
</tbody>
</table>

- Significantly younger than SLI & AM
- Significantly poorer than AM
Material

RC comprehension  Chan et al., (2011)

Subject RC
~ point to the pig that kisses the dog

Object RC
~ point to the pig that the dog kisses

8 Subject RC, 8 Object RC
Q1: Is there Obj-RC over Subj-RC acquisition?

Q2: Children with SLI have poorer RC comprehension than normal language peers?

Two-way repeated ANOVA
RC type (Subj-RC & Obj-RC) x Group (SLI, AM & LM)
Results

- **SLI = AM** ($p=1.000$)
  No significant difficulty in learning RC.

- **LM < SLI & AM** ($p=.011$)
  Language experience

- **Subj-RC = Obj-RC**
  No higher demand of pSTM

**RC type**

\[
F(1, 51)=2.506, \ p=.120, \ \eta \ square=.047
\]

**Group**

\[
F(2, 51)=4.879, \ p=.012, \ \eta \ square=.161
\]

**Interaction**

\[
F(2,51)=1.214, \ p=.305, \ \eta \ square=.045
\]
Error Analysis

Target Subj RC

Target Obj RC

Frequency of error

Subj RC error A  Subj RC error B  Subj RC error C  Obj RC error A  Obj RC error B  Obj error C
- Always pointed to an agent
- First animate in the sentence as the agent

**The pig that kisses the dog.** (Subject RC)

<table>
<thead>
<tr>
<th>Cantonese:</th>
<th>Verb + Theme + RC marker + Agent</th>
<th>V O S</th>
</tr>
</thead>
<tbody>
<tr>
<td>English:</td>
<td>Agent + RC marker + Verb + Theme</td>
<td>S V O</td>
</tr>
</tbody>
</table>

**The pig that the dog kisses.** (Object RC)

<table>
<thead>
<tr>
<th>Cantonese:</th>
<th>Agent + Verb + RC marker + Theme</th>
<th>S V O</th>
</tr>
</thead>
<tbody>
<tr>
<td>English:</td>
<td>Theme + RC marker + Agent + Verb</td>
<td>O S V</td>
</tr>
</tbody>
</table>
Q1: Is there Obj-RC over Subj-RC acquisition?

Answer: No

Q2: Children with SLI have poorer RC comprehension than normal language peers?

Answer: No
Study 3
Recall RC from memory

- Children with SLI exhibit difficulty in remembering RC?
- What is the relationship between ability to remember RC, pSTM and RC comprehension?
**Participants**
Participant from Study

**Material**
Changes Detection

a. **Distanced-swap**
   - 豬仔錫緊嘅狗仔
   - 狗仔錫緊嘅猪仔

b. **Adjacent-swap**
   - 豬仔 錫緊嘅狗仔
   - 錫緊 豬仔嘅狗仔

c. **Single Item change**
   - 豬仔錫緊嘅狗仔
   - 豬仔踢緊嘅狗仔

d. **Negative probe**
   - 豬仔錫緊嘅狗仔
   - 豬仔錫緊嘅狗仔
Q1: Children with SLI exhibit difficulty in remembering RC?

Mann-Whitney’s U test
## Results

### Task score

<table>
<thead>
<tr>
<th></th>
<th>Median</th>
<th>Mean rank</th>
<th>U</th>
<th>Z</th>
<th>p</th>
<th>Effect size (z/√N)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CD Subj RC</strong></td>
<td>SLI</td>
<td>12.5</td>
<td>14</td>
<td>81</td>
<td>-2.6</td>
<td>.009**</td>
</tr>
<tr>
<td></td>
<td>AM</td>
<td>14.5</td>
<td>23</td>
<td></td>
<td></td>
<td>.61</td>
</tr>
<tr>
<td><strong>CD Obj RC</strong></td>
<td>SLI</td>
<td>12</td>
<td>17.28</td>
<td>140</td>
<td>-.707</td>
<td>.480</td>
</tr>
<tr>
<td></td>
<td>AM</td>
<td>12</td>
<td>19.72</td>
<td></td>
<td></td>
<td>.17</td>
</tr>
</tbody>
</table>
Q2: What is the relationship between ability to remember RC, pSTM and RC comprehension?

Pearson Correlation
<table>
<thead>
<tr>
<th>Changes Detection</th>
<th>Nonword Repetition</th>
<th>Digit Reconstruction</th>
<th>Delay Item Repetition</th>
<th>Relative Clause Comprehension</th>
</tr>
</thead>
<tbody>
<tr>
<td>SLI</td>
<td>-.023</td>
<td>.186</td>
<td>.251</td>
<td>-.078</td>
</tr>
<tr>
<td></td>
<td>(.927)</td>
<td>(.475)</td>
<td>(.315)</td>
<td>(.758)</td>
</tr>
<tr>
<td>AM</td>
<td>.463</td>
<td>.594**</td>
<td>.570*</td>
<td>.123</td>
</tr>
<tr>
<td></td>
<td>(.053)</td>
<td>(.009)</td>
<td>(.014)</td>
<td>(.627)</td>
</tr>
</tbody>
</table>
Q2: What is the relationship between ability to remember RC, pSTM and RC comprehension?

Answer: Ability to remember RC is not related to RC comprehension
Specific Language Impairment (SLI)

Has deficit in

Phonological Short-Term Memory (pSTM)

Not related to

Relative Clause (RC)

no deficit in
THANK YOU

chiawen@hku.hk
3. Delay Item Repetition

Majerus et al., 2009

Measure item information pSTM

- Hear the word
- Repeat the word
- Verbal suppression
- Repeat the word

10 words and 10 nonwords