The Acquisition of Cardinal and Ordinal Numbers in Cantonese

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1. Introduction

Ordinal number expressions are often morphologically derived from the corresponding cardinal number expressions (Hurford 1987: 167). In English, for example, except for the first three “irregulars”, ordinal numbers are generally formed by adding the suffix –th to the cardinal numbers, as in the derivation of the ordinal four-th from the cardinal four, or ten-th from ten. The ordinals are, however, different from the cardinals in not referring to a plural set of objects but an individual entity or object ranked in an ordered, context-given sequence (Hurford 1987: 168).

The acquisition of ordinal numbers has to rely on an understanding of the relevant concepts of cardinality, but also requires knowledge that goes beyond and is independent of the cardinal numbers. Knowledge of counting is, for instance, necessary on one hand, but is subject to a couple of constraints that are not applicable to the cardinal cases on the other (Fuson and Hall 1983: 88). Most importantly, whereas counting in a cardinal context adheres to the Order Irrelevant Principle (Gelman and Gallistel 1978), that the order in which the entities are counted is irrelevant, one has to identify the relative position of an ordinal in a contextually-defined set of entities with reference to a “specified initial point” when counting in an ordinal context (Fuson and Hall 1983: 88).
Knowledge of ordinality must therefore include an understanding of: (i) ordinals as referring to a singular entity (The Ordinality Principle), and (ii) counting in the right direction with respect to where the starting point is and how the entities are ordered (The Order Relevant Principle) (see Meyer, Barbiers, and Weerman 2018: 395). The referent of the third car, for instance, can be regarded as the car whose ordinal position matches with the cardinality of a contextually-defined set of cars as counted from a given starting point.

2. Previous studies on the acquisition of ordinal numbers

Only a few studies have examined children’s acquisition of ordinal numbers, including English (Fischer and Beckey 1990; Miller et al. 2000; see also Matthei 1982 and Hamburger and Crain 1984 on the acquisition of complex ordinals), Mandarin Chinese (Miller et al. 2000), French (Colomé and Noël 2012), German (Trabandt et al. 2015), and Dutch (Meyer, Barbiers, and Weerman 2018).

The ordinals are generally acquired later than the corresponding cardinals (see Fischer and Beckey 1990 on English; Colomé and Noël 2012 on French; Meyer, Barbiers, and Weerman 2018 on Dutch). This phenomenon, known as the “cardinal advantage” (Meyer, Barbiers, and Weerman 2018: 395), can presumably be attributed to the greater complexity involved in the interpretation of the ordinals (Hurford 1987: 173).

In a recent study on Dutch (cf. Meyer, Barbiers, and Weerman 2018), it is reported that children (N=77; age range=2;11-6;4) always gave a singular object in the ordinal trials even when they made errors. Only two of them incorrectly gave multiple items each on two of the ordinal trials. As suggested by the authors, children’s early awareness of the Ordinality Principle, that an ordinal always refers to a singular entity, may be accounted for by the fact that the nominals in Dutch are morphologically marked for the singular-plural distinction. In addition, lower ordinals tended to be acquired earlier than higher cardinals, except for the irregular ones such as derde ‘third’ in Dutch, which cannot be transparently linked to the corresponding cardinal drie ‘three’.

How regular a number system is in the language also plays an important role in the acquisition process. Miller et al. (2000) reported that Mandarin-speaking children performed at ceiling in both the production and comprehension of the ordinal numbers under investigation by the age of six, whereas their English-speaking peers performed significantly poorer on the same tasks. One should note that a major difference between the number systems of the two languages is that the Chinese ordinals are morphologically more regular than their English counterparts.

In the next section, we discuss how the ordinal numbers are formed in Cantonese.
3. The ordinal numbers in Cantonese

In Cantonese as in Mandarin Chinese, ordinal numbers are systematically formed by the combination of the prefix 第 dai6 (or dì in Mandarin) and a cardinal number like 三 saam1 ‘three’. As shown in (1), the ordinal 第三 dai6-saam3 ‘(the) third’ in the (b) example can be derived from the corresponding cardinal 三 saam3 ‘three’ in the (a) example, with the same bare form of the noun tong4 ‘candy’ used in both of the examples as there is no singular-plural distinction in the language. Table 1 provides the first twenty cardinal and ordinal numbers in Cantonese.

(1) a. 三 粒 糖
saam1 nap1 tong4
three CL candy
‘three candies’

b. 第三 粒 糖
dai6 saam1 nap1 tong4
rank.number three CL candy
‘(the) third candy’

As the only study on Chinese children’s knowledge of ordinal numbers, reported in Miller et al. (2000), examined only children in the age range between six and ten, how the early knowledge of ordinality develops among the young preschool children acquiring a morphologically transparent ordinal number system remains to be ascertained. In addition, whether the lack of a singular-plural distinction in the language may pose any learning challenge to children in their understanding of the Ordinality Principle also deserves our attention.

4. The present study

We conducted an experiment using a story-based “Give X” act-out task (Wynn 1992; Meyer, Barbiers, and Weerman 2018) to examine Cantonese-speaking preschool children’s knowledge of the cardinal and ordinal numbers. The following research questions are addressed:

(i) Do Cantonese-speaking children exhibit the same “cardinal advantage”, as reflected in a better understanding of the cardinals over the ordinals?
(ii) Are children aware of the singularity requirement imposed on the ordinal numbers (i.e. the Ordinality Principle)?
(iii) Do children understand the meaning of the ordinals as referring to an individual ranked in a specific position in a sequence (i.e. the Order Relevance Principle)?
4.1. Participants

We tested sixty-five children between the ages of 3:0 and 6:2: 28 three-year-olds, 18 four-year-olds, and 19 five-year-olds (see Table 2 for details). They were native speakers of Hong Kong Cantonese recruited from a kindergarten in Hong Kong.

<table>
<thead>
<tr>
<th>Rank</th>
<th>Cardinal</th>
<th>Ordinal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>一 jat1 ‘one’</td>
<td>第一 dai6-jat1 ‘first’</td>
</tr>
<tr>
<td>2</td>
<td>二 ji6 ‘two’ (counting) / 兩 loeng5 ‘two’ (cardinality)</td>
<td>第二 dai6-ji6 ‘second’</td>
</tr>
<tr>
<td>3</td>
<td>三 saam1 ‘three’</td>
<td>第三 dai6-saam1 ‘third’</td>
</tr>
<tr>
<td>4</td>
<td>四 sei3 ‘four’</td>
<td>第四 dai6-sei3 ‘fourth’</td>
</tr>
<tr>
<td>5</td>
<td>五 ng5 ‘five’</td>
<td>第五 dai6-ng5 ‘fifth’</td>
</tr>
<tr>
<td>6</td>
<td>六 luk6 ‘six’</td>
<td>第六 dai6-luk6 ‘sixth’</td>
</tr>
<tr>
<td>7</td>
<td>七 cat1 ‘seven’</td>
<td>第七 dai6-cat1 ‘seventh’</td>
</tr>
<tr>
<td>8</td>
<td>八 baat3 ‘eight’</td>
<td>第八 dai6-baat3 ‘eighth’</td>
</tr>
<tr>
<td>9</td>
<td>九 gau2 ‘nine’</td>
<td>第九 dai6-gau2 ‘ninth’</td>
</tr>
<tr>
<td>10</td>
<td>十 sap6 ‘ten’</td>
<td>第十 dai6-sap6 ‘tenth’</td>
</tr>
<tr>
<td>11</td>
<td>十一 sap6jat1 ‘eleven’</td>
<td>第十一 dai6-sap6jat1 ‘eleventh’</td>
</tr>
<tr>
<td>12</td>
<td>十二 sap6ji6 ‘twelve’</td>
<td>第十二 dai6-sap6ji6 ‘twelfth’</td>
</tr>
<tr>
<td>13</td>
<td>十三 sap6saam1 ‘thirteen’</td>
<td>第十三 dai6-sap6saam1 ‘thirteenth’</td>
</tr>
<tr>
<td>14</td>
<td>十四 sap6sei3 ‘fourteen’</td>
<td>第十四 dai6-sap6sei3 ‘fourteenth’</td>
</tr>
<tr>
<td>15</td>
<td>十五 sap6ng5 ‘fifteen’</td>
<td>第十五 dai6-sap6ng5 ‘fifteenth’</td>
</tr>
<tr>
<td>16</td>
<td>十六 sap6luk6 ‘sixteen’</td>
<td>第十六 dai6-sap6luk6 ‘sixteenth’</td>
</tr>
<tr>
<td>17</td>
<td>十七 sap6cat1 ‘seventeen’</td>
<td>第十七 dai6-sap6cat1 ‘seventeenth’</td>
</tr>
<tr>
<td>18</td>
<td>十八 sap6baat3 ‘eighteen’</td>
<td>第十八 dai6-sap6baat3 ‘eighteenth’</td>
</tr>
<tr>
<td>19</td>
<td>十九 sap6gau2 ‘nineteen’</td>
<td>第十九 dai6-sap6gau2 ‘nineteenth’</td>
</tr>
<tr>
<td>20</td>
<td>二十 ji6sap6 ‘twenty’</td>
<td>第二十 dai6-ji6sap6 ‘twentieth’</td>
</tr>
</tbody>
</table>
Table 2. Number and age range of the child participants in each age group

<table>
<thead>
<tr>
<th>Age group</th>
<th>Age range</th>
<th>Number of participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Three-year-olds</td>
<td>3;0.4-3;11.25</td>
<td>28</td>
</tr>
<tr>
<td>Four-year-olds</td>
<td>4;1.7-4;11.13</td>
<td>18</td>
</tr>
<tr>
<td>Five-year-olds</td>
<td>5;0.1-6;2.2</td>
<td>19</td>
</tr>
</tbody>
</table>

4.2. Test materials and procedure

We tested five cardinal numbers jat1 ‘one’, loeng5 ‘two’, saam1 ‘three’, sei3 ‘four’, and baat3 ‘eight’, and the corresponding ordinals, namely dai6-jat1 ‘first’, dai6-ji6 ‘second’, dai6-saam1 ‘third’, dai6-sei3 ‘fourth’, and dai6-baat3 ‘eighth’. The cardinal and ordinal numbers were presented in classifier-containing nominals, in the form of [numeral-classifier-noun] (for the five cardinal numbers) or [rank.number-numeral-classifier-noun] (for the five ordinal numbers), embedded in test sentences as exemplified in (2) (for the cardinal trials) and (3) (for the ordinal trials) respectively. Each of the cardinal and ordinal numbers was tested twice, yielding a total of 20 test trials [(5 cardinal numbers + 5 ordinal numbers) * 2 trials].

(2) Nei5 fong3 saam1 nap1 tong4 jap6 go3 doi2 dou6.
You put three CL candy into CL bag LOC
‘Put three candies into the bag.’

(3) Nei5 fong3 dai6 saam1 gaa3 fo2ce1
You put rank.number three CL train
‘Put (the) third train into the suitcase.’

The child participants were tested individually in a classroom at their kindergarten. They were first introduced a toy puppet named Little Frog (played by the assistant experimenter) who was a little kid. At the beginning of the trials on cardinal numbers, the child was told that Little Frog was going to do some shopping, and would need the child’s help to put things into the shopping bag because its arms were too short. On a typical trial, the principal experimenter placed a paper-made shopping bag in front of Little Frog, and then an array of

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1 We followed the experimental paradigm used in Meyer, Barbiers, and Weerman (2018).
identical objects one by one, presented in the form of color images printed on cardboard papers, starting from the one closest to the shopping bag. The child was first asked to identify the object. If s/he could not provide the correct object label, the experimenter would introduce it to the child to ensure that s/he knew the correct name of the object. The child was then asked to help Little Frog by putting a certain object or collection of objects into the shopping bag, following an instruction that contained the designated cardinal number word (i.e. the test sentence), as in (2). An illustration of the test situation for a cardinal trial is given in Figure 1.

![Figure 1. Test situation of a cardinal trial corresponding to test sentence (2)](image)

As for the trials on ordinal numbers, the child was told that Little Frog was going to go on vacation, and would need the child’s help to pack things into the suitcase. On a typical trial, the principal experimenter placed a paper-made suitcase in front of Little Frog, and an array of identical toy animals or toy vehicles one by one, presented in the form of color images printed on cardboard papers, starting from the one closest the suitcase.²

The child was first asked to identify the animal or vehicle. If s/he could not provide the correct label, the experimenter would introduce it to the child to ensure that s/he knew the correct name of the animal or vehicle. Next, the child was asked to point out the objects that were at the front and at the back of the line respectively. Finally, the child was asked to help Little Frog by putting a certain object or collection of objects into the suitcase, following an instruction that contained the designated ordinal number word (i.e. the test sentence), as in (3). An illustration of the test situation for an ordinal trial is given in Figure 2.

Participants also received two training trials and six filler trials. All of the test items were presented in a pseudo-randomized order. The whole experiment for each child lasted around 10 minutes.

² The animals and vehicles chosen for the ordinal trials all had clear faces or fronts, so as to make the direction of the lineup transparent.
4.3. Results

We analyzed the overall correct rates on each of the five cardinal and ordinal numbers that were tested in our experiment.

4.3.1. Cantonese-speaking children’s knowledge of the cardinal numbers

A child’s response on a certain cardinal number was considered to be correct if s/he gave a collection of object(s) that was equal to the cardinality of the number word being tested. As shown in Figure 3, the three age groups of children, namely the three-, four-, and five-year-olds, all performed virtually perfectly on the two trials testing the smallest cardinal number word jat1 ‘one’, suggesting that Cantonese-speaking children understood the cardinal meaning of ‘one’ as early as three years of age. The four-year-olds and the five-year-olds also performed at ceiling on the next three cardinals, namely loeng5 ‘two’, saam3 ‘three’, and sei3 ‘four’, showing that the meaning of these three cardinals were acquired by the age of four. As for the largest cardinal number included in the current study, i.e. baat3 ‘eight’; the five-year-olds had a high overall correct rate of 94.7%, whereas the three-year-olds were only 21.4% correct and the four-year-olds 77.8%, indicating that children only came to acquire the meaning of larger cardinals such as baat3 ‘eight’ until the age of five.

4.3.2. Cantonese-speaking children’s knowledge of the ordinal numbers

Children’s understanding of the ordinal numbers was in general much poorer than that of the corresponding cardinal numbers. As shown in Figure 4, the three-year-olds had low correct rates on all of the five ordinals: 66.1% on dai6-jat1 ‘first’, 25% on dai6-jii6 ‘second’ and dai6-saam3 ‘third’, 21.4% on dai6-sei3 ‘fourth’, and only 8.9% on dai6-baat3 ‘eighth’, showing that they had not
acquired any of the ordinals at this stage. The four-year-olds had no problem with the lowest ordinal *dai6-jat1* ‘first’, achieving an overall correct rate of 91.7%. Their performances on the next three ordinals were fair, scoring between 86.1% and 88.9% on *dai6-ji6* ‘second’, *dai6-saam3* ‘third’, and *dai6-sei3* ‘fourth’. They, however, were only 55.6% correct on the highest ordinal *dai6-baat3* ‘eighth’. The five-year-olds were 100% correct on all of the ordinals except for the highest one, *dai6-baat3* ‘eighth’, which was only 78.9% correct, demonstrating that children had not fully acquired the meaning of higher ordinals such as *dai6-baat3* ‘eighth’ by the age of five.

![Figure 3. Percentage of correct responses on the Cantonese cardinals jat1 ‘one’, loeng5 ‘two’, saam1 ‘three’, sei3 ‘four’, and baat3 ‘eight’ by age group](image)

We next examine the types of errors that children made on the Cantonese ordinals. As shown in Table 3, for the ordinals *dai6-ji6* ‘second’, *dai6-saam1* ‘third’ and *dai6-sei3* ‘fourth’, over half of children’s errors involved giving multiple items that either matched or did not match with the cardinality of the number word. The same type of error also constituted nearly half of the errors children made on the highest ordinal *dai6-baat3* ‘eighth’. This is in striking difference from the errors made by the Dutch-speaking children reported in Meyer, Barbiers, and Weerman (2018), whose errors were predominated by the giving of a singular item from an incorrect position, and very rarely involved the giving of multiple items.
Figure 4. Percentage of correct responses on the Cantonese ordinals dai6-jat1 ‘first’, dai6-ji6 ‘second’, dai6-saam1 ‘third’, dai6-sei3 ‘fourth’, and dai6-baat3 ‘eighth’ by age group

Table 3. Error patterns on the interpretation of the Cantonese ordinals dai6-ji6 ‘second’, dai6-saam1 ‘third’, dai6-sei3 ‘fourth’, and dai6-baat3 ‘eighth’

<table>
<thead>
<tr>
<th>Error pattern</th>
<th>dai6-ji6 ‘2nd’</th>
<th>dai6-saam1 ‘3rd’</th>
<th>dai6-sei3 ‘4th’</th>
<th>dai6-baat3 ‘8th’</th>
</tr>
</thead>
<tbody>
<tr>
<td>Giving a singular item from an incorrect position in the sequence</td>
<td>38.3%</td>
<td>26.1%</td>
<td>32.7%</td>
<td>53.3%</td>
</tr>
<tr>
<td>Giving multiple items that matched with the cardinality of the number word</td>
<td>34%</td>
<td>34.8%</td>
<td>22.4%</td>
<td>13.3%</td>
</tr>
<tr>
<td>Giving multiple items that did not match with the cardinality of the number word</td>
<td>27.7%</td>
<td>39.1%</td>
<td>44.9%</td>
<td>33.3%</td>
</tr>
</tbody>
</table>

5. General discussion and conclusions

Our experimental findings confirmed the reality of the “cardinal advantage” that have been previously reported on children acquiring other languages. Cantonese-speaking children understood the meaning of the cardinal number jat1 ‘one’ virtually perfectly at the age of three, loeng5 ‘two’ through sei3 ‘four’ at age four, and baat3 ‘eight’ at age five. The corresponding ordinal numbers were acquired much later, with dai6-jat1 ‘first’ at age four, and dai6-ji6 ‘second’ through dai6-sei3 ‘four’ at age five.
Cantonese-speaking children’s overall correct rates on the ordinal numbers were generally higher than what were found on children acquiring languages with an ordinal number system that was morphologically less transparent and regular, such as English (Fischer and Beckey 1990) and French (Colomé and Noël 2012), suggesting that the extent of morphological transparency and regularity in a language’s ordinal number system is important in the development of ordinal concepts.

Cantonese-speaking children, however, produced a lot more multiple-item errors on the ordinals than their Dutch counterparts (cf. Meyer, Barbiers, and Weerman 2018). This may be accounted for by the fact that number marking on the nominals is required in Dutch but not so in Cantonese, which may guide the Dutch children in recognizing the singularity requirement imposed on the ordinals during the early stages of grammatical development.

References


