Children’s Knowledge of Conventional Implicatures: Evidence from the Mandarin lian...dou Construction

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1. Introduction

Children’s understanding of conversational implicatures, scalar implicature in particular, has been extensively investigated (see Papafragou & Skordos 2016 for a recent comprehensive review). It has been reported that children do not often have adult-like pragmatic inferences in dealing with tasks that involve information strength in uncontrolled experimental environments. However, little has been shown about children’s knowledge of conventional implicatures that arise from the semantic meanings of particular words, such as even. In Karttunen and Peters’ (1979) analysis, even can trigger two implicatures, one an existential implicature (that alternatives exist), and one a scalar implicature (that the mentioned alternative is the least likely).

This study focuses on the lian...dou construction in Mandarin, which can be used in two distinct contexts. In one context (the two-implicature context), it is equivalent to an English even-sentence, where even is considered to be the focus marker and the whole sentence sometimes indicates certain unexpectedness or surprise. In general, the comprehension of such unexpectedness or surprise requires the listener to generate both the existential implicature and the scalar implicature. In the other context (the one-implicature context), lian...dou only gives rise to the existential implicature. By comparing the two uses of lian...dou, the scalar implicature can be isolated from the existential implicature, and allows an investigation of their development in child language.

2. Previous studies on the acquisition of even

Two relevant studies have been conducted on the acquisition of even in different languages. Kim (2011) investigated the acquisition of even by children between age 4 and 5 with adults as the comparison group. The study consisted of two experiments. The first one tested sentences with even in the pre-subject position. In an example trial of experiment 1, a participant was asked to listen to a story while watching a series of pictures on a computer screen. In the story,
there are three bears of different height. Their mother asks them to reach the cookies on a shelf and bring them together. After all the bears have done this, the mother makes a statement using *even*: ‘Even Larry was able to reach the cookie’. The participant was asked to guess which of the three bears is Larry and provide a reason for his/her choice. The first experiment also includes negative sentences such as ‘Even Larry was not able to reach the cookie’. The second experiment was designed in a way to test children’s knowledge of *even* in the pre-object position. Based on children’s performance of scalar implicature, Kim divided them into three groups: the full knowledge group consisting of only 5-year-olds, the weak knowledge group consisting of both 4-and 5-year-olds, and the no knowledge group consisting of only 4-year-olds. For these reasons, Kim concluded that children begin to understand the scalar implicature at 4 and some could become adult-like at 5.

Ito (2012) investigated Japanese-speaking children’s understanding of the focus particle *datte*, which is equivalent to *even*. Ito’s study consisted of three experiments and the method used was an ‘appropriateness judgment task’. Participants were 4- to 6-year-old children. In experiment 1, children were asked to judge whether a stimulus sentence with *datte* was felicitous in both felicitous and infelicitous contexts. The results showed that children generally judged sentences as felicitous in both the felicitous and infelicitous conditions. In experiment 2, Ito investigated whether children’s performance could be improved by using the method of the focus-based Question Under Discussion (focus/ QUD), which has been reported to have improved adults and children’s pragmatic performance (Zondervan, 2007, 2009; Breheny, Katsos, & Williams, 2006; Papafragou & Tantalou, 2004; Verbuk, 2007). The results of experiment 2 showed that children’s understanding of the conventional implicatures of *datte* was not improved when the focus/QUD method was used. In experiment 3, Ito investigated whether the Felicity Judgment (FJ) task that is based on the Processing Limitation Hypothesis (PLH) (Chierchia et al., 2001; Chierchia et al., 2004) could improve children’s performance in similar environments of experiment 1. Different from experiment 1, children were not asked to judge the felicity of a *datte*-sentence. Instead, they were provided with two *datte*-sentences, one being felicitous and one being infelicitous and their task was to say which one fits better. The results showed that children’s poor performance in infelicitous conditions was improved significantly. This showed that presenting alternative representations of the *datte*-sentence to children can help to reduce the processing load, thus improving their success in doing pragmatic computation. The PLH, which was applied to SIs, could be equally applied to conventional implicatures.

The two studies examined children’s understanding of *even* in different languages with different experimental designs. The important finding from Kim’s study is that children were sometimes able to compute the scalar implicature at 4 years old and they get better at 5. Ito’s study did not emphasize any age effect in experiment 1 and 2 due to the small sample sizes, but the results of experiment 3 revealed that there was a difference in performance
between 4-year-olds and 5-and 6-year-olds. Ito’s more important finding was that the reason that children’s performance could improve in tasks that require less processing.

3. The Mandarin lian…dou construction

3.1. lian…dou in the two-implicature context

In the two-implicature context, the Mandarin lian…dou is equivalent to the English word even. An example is shown in (1):

(1) Lian Xiaoming dou bandong-le na-ge zhongzhongde xiangzi  
lian Xiaoming dou move -ASP that-CL heavy box 
‘Even Xiaoming lifted that heavy box.’

On Karttunen and Peters’ (1979) account, (1) has two conventional implicatures due to the use of lian…dou. In their paradigm of representation, the existential implicature of this sentence is there are other x besides Xiaoming such that x lifted the heavy box. The scalar implicature is that it is more likely for x to lift the heavy box than Xiaoming. If physical strength is the only factor in being able to lift the heavy box, then we can conclude that x is stronger than Xiaoming.

3.2. lian…dou in the one-implicature context

In the one-implicature context, the Mandarin lian…dou only has the existential implicature. For example, in an imperative sentence, it simply means that the action instructed by the speaker should also be applied to another object in the context. Consider (2) for example:

(2) Lian juzi dou na-zou ba.  
Lian orange dou take-away ba-PRT 
‘Take the orange away (where another object is in the scene, e.g., an apple).’

For this sentence to be felicitous, another object must exist that shares a relevant property with the orange, for example, an apple. Unlike the lian…dou in the first situation, this one doesn’t contribute any scalar implicature to the sentence. In such a situation lian…dou has the meaning ‘including’. What is asserted is that the orange should be taken away. But due to presence of lian…dou, the hearer is able to get the unsaid part which is the apple should also be taken away. Since the implicature invoked here is still due to the semantic meanings of the two words rather than the pragmatic need, it should be considered as conventional implicature. And because it indicates the existence of a contrast member (the apple in this example), we treat this implicature as existential implicature.
4. Experiment 1

The purpose of experiment 1 is to uncover L1 children’s knowledge of the Mandarin lian...dou construction in the two-implicature context. Previous researchers (Papafragou & Musolino, 2003; Papafragou & Tantalou, 2004; among others) on SIs that involve an entailment relation (such as some and all) pointed out that different experimental tasks could lead to different results. So, we designed different tasks from those used by Kim (2011) and Ito (2012). Also, in their experiments, the existential implicature was visually available to the children. Our experiments include tasks that test children on both implicatures. Our research questions are: 1) Do Mandarin-speaking children understand the existential implicature and the scalar implicature of the lian...dou construction when it is used in a context where it has the even-interpretation? 2) Are children better at one implicature than the other? and 3) Is there a developmental effect across the three age groups?

4.1. Method
4.1.1. Participants

Forty-Five Mandarin-speaking children between 4;0 and 6;11 were recruited. Four children were excluded from the study because they failed to understand the instruction or they were not cooperative throughout the experiment. Forty-one children (mean age 5;6) were included in the data analysis. Ten adults were also tested as the comparison group.

4.1.2. Materials

Video clips were used to test children’s knowledge in the target structure. In each clip, there are four characters: two students named Xiaoming and Xiaoliang (two common Chinese boy’s names) respectively played by two boys, the student monitor named Xiaohong (a common girl’s name) played by a girl, and their teacher played by a female adult. Each clip tells a story. At the end of the story, the teacher asks the student monitor a who-question and the student monitor uses one of the three test sentences (test sentence A, B and C) to answer the question. Test sentence A has both lian and dou in it as shown in (1). In test sentence B, lian is not pronounced, but its meaning is the same as test sentence A. The optionality of lian in pronunciation is a property of the lian...dou construction. We included text sentence B is our design because we wanted to explore if children’s understanding of the lian...dou construction will be affected when lian is not pronounced. The results and discussion of this investigation will be in our forthcoming work. Test sentence C differs from test sentence A by leaving out both lian and dou and it doesn’t trigger any implicature. An example of a story translated into English is presented in (3). In this example, the student monitor uses test sentence A (1) to answer the teacher’s question.
(3) Student monitor: Xiaoming, Xiaoliang! There is a heavy box over there. Please follow me and see who can lift the heavy box, OK?
Xiaoming and Xiaoliang: OK!
(The scene changes)
Teacher: Xiaohong, just now, Xiaoming and Xiaoliang, who lifted the heavy box?
Student monitor: Even Xiaoming lifted that heavy box.

There are nine short stories altogether, which constitute nine trials. All stories are similar and the targets in comparison involve physical properties, such as height, size, strength, etc. Each type of test sentence has three trials. In addition, there are four filler trials.

4.1.3. Procedures

Each participant was asked to watch the video clips of the nine test trials and the four filler trials. Unlike studies that administer test trials in a pseudorandom order, we adopted a block design. Each block has three trials with the same type of test sentence and the three blocks are sandwiched among filler trials. We arranged the order in this way because the three types of test sentences differ from each other by only one or two words. Grouping test trials with the same type of test sentence into one block could help children to notice the subtle difference among the three types of test sentences. After each test trial, the experimenter asked the participant two questions. The first one was a how-many question, such as ‘how many children moved the box’ and was used to evaluate children’s knowledge of the existential implicature. The second one was a comparison question, such as ‘Between Xiaoming and Xiaoliang, who is stronger’ and was used to evaluate children’s knowledge of the scalar implicature. The whole experiment procedure was recorded with a digital voice recorder.

4.2. Results and discussion

Table 1 shows the exact number of children who could get the existential/scalar implicature in test sentence A. The criteria that we adopted in judging a subject’s knowledge of the two implicatures was this: out of the three trials in each type of test sentence, if a child’s answers were correct at least twice we considered him/her to have successfully computed the corresponding implicature.
Table 1. Number of subjects who successfully computed the existential/scalar implicature in test sentence A.

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<thead>
<tr>
<th></th>
<th>Existential</th>
<th>Scalar</th>
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<tr>
<td>6-year-olds (n=13)</td>
<td>7 (53.8%)</td>
<td>2 (15.4%)</td>
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<tr>
<td>5-year-olds (n=13)</td>
<td>6 (42.9%)</td>
<td>2 (14.3%)</td>
</tr>
<tr>
<td>4-year-olds (n=14)</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>Total</td>
<td>13 (31.7%)</td>
<td>4 (9.8%)</td>
</tr>
<tr>
<td>Adults (n=10)</td>
<td>10 (100%)</td>
<td>10 (100%)</td>
</tr>
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As shown in table 2, seven 6-year-olds and six 5-year-olds were judged to have understood the existential implicature. This number was 0 for 4-year-olds. These numbers showed that around half of the children between 5-to 6-year old were able to compute the existential implicature and none of the 4-year old children could do so. Moreover, even 6-year-olds’ performance was different from the adults’ perfect performance (U=30, p<.05).

With respect to the understanding of the scalar implicature, children did very poorly in answering the comparison question. From table 2, we can see that only two children from age group 6 and two children from age group 5 were judged to have understood the scalar implicature. No one from age group 4 had this ability. These numbers showed that although some children developed the ability to understand the scalar implicature at age 5 or at age 6, the number was very small. For the majority of children between 5-to 6-years old, they did not have such ability. And this ability was not found in any 4-year-old child. Again, even 6-year-olds’ performance was different from adults’ (U=10, p<.05).

To discover the effect of implicature type, age, and whether lian is pronounced on children’s understanding of the two implicatures, we submitted the data to a three-way mixed ANOVA, using a 3 (3 age groups) x 2 (existential implicature or scalar implicature) x 2 (whether lian is pronounced) design, with the number of correct responses as the dependent variable. The results in figure 1 and figure 2 showed a significant main effect of age (F (2, 38) =6.07, p<.05) and of implicature type (F (1, 38) =15.48, p<.05). Again, the results and the discussion of whether lian is pronounced has an impact on children’s understanding of the two implicatures are included here.
Figure 1. Main effect of Age

Figure 2. Main effect of implicature type

The statistical analysis showed that children (4-year-olds excluded) did better in the existential implicature than in the scalar implicature. Does this indicate an acquisition order of these two types of implicatures? Is there any child who could understand the scalar implicature, but not the scalar implicature? In order to find the answers to these questions, we examined each individual child’s performance in test sentence A. Our data showed that a child either got both implicatures or got only the existential implicature. There was no case where a
child only got the scalar implicature. This seemed to indicate that children’s understanding of the existential implicature comes before that of the scalar meaning.

5. Experiment 2

The purpose of the second experiment is to test children’s knowledge of the lien…dou construction in the one-implicature context. We also wanted to compare the results of this experiment to the first one and see if a developmental trend of these two types of lien…dou constructions in terms of the existential implicature is represented in children’s knowledge. Our research questions in this experiment are: 1) What is children’s knowledge of the lien…dou construction in the one-implicature context? and 2) Do children understand the existential implicature of lien…dou in the two contexts at the same time or in a particular order?

5.1. Method
5.1.1. Participants

The same subjects from experiment 1 also participated in experiment 2.

5.1.2. Materials

Two types of test sentences were used in this experiment. Test sentence A uses the lien…dou construction with only the existential implicature as shown in (2). Test sentence B uses the BA-construction, which doesn’t trigger any implicature as shown in (4). To prevent subjects from guessing the test sentences and develop a pattern for his/her answers, we also designed some filler trials in which neither lien…dou or BA is used.

(4) BA juzi nazou ba
    Ba orange take-away ba-PRT.
    ‘Take away the orange.’

To test children’s knowledge of these two types of test sentences, we created a different set of video clips as our test material in this experiment. In each video clip, there are two characters, the mother and her son. The son first asks his mother for the permission to do something. Then, the mother gives one of the two types of test sentences as a response. After hearing the mother’s words, the boy either follows or does not follow what he has been told. An example trial translated into English is demonstrated in (5). In this example, the mother answers with test sentence A and the son does not follow her instructions.
(5) (The mother is sitting at a table, on which there is an apple and an orange. His son comes to talk to her.)
Son: Mother, Father is hungry. Can I take this apple to him?
Mother: Bring the orange to him (together with the apple).
(After hearing his mother’s words, the son takes only the orange and leaves.)

5.1.3. Procedures

After watching the video clip, the subjects were asked to judge whether the little boy followed his mother’s instructions or not. The subjects were also asked to provide a reason when their judgment was negative. Each subject was asked to complete two sessions. Each session has two trials with test sentence A and two trials of test sentence B. Each type of test sentence has a situation where the son follows the instruction and a situation where he doesn’t. Each test sentence is followed by a filler. Altogether there are 16 trials in the two sessions: 4 trials of test sentence A, 4 trials of test sentence B, and 8 fillers.

5.2. Results and discussion

The results of experiment 2 are summarized in table 2. We recorded the correct response rates of the existential implicature from all three age groups and adults. The numbers in parentheses are the numbers of correct answers versus the total number of test trials. The third column shows the number of children/adults who were judged to have the ability to compute the existential implicature in this context. The criterion was that if a participant could give the correct answer at least three times out of four, he/she was considered to have this ability. The results showed that even not at 100% accuracy, all children between 5 to 6 years old were judged to have understood the existential implicature. Some 4-year-old children (6 out of 14) were also judged to have such ability. By examining their answers to why the little boy did not follow his mother’s words, we found that all these children gave adult-like reasoning.

Table 2. Children’s performance in existential implicature in experiment 2

<table>
<thead>
<tr>
<th></th>
<th>Frequency of correct response (%)</th>
<th>Number of children who understood the existential implicature</th>
</tr>
</thead>
<tbody>
<tr>
<td>6-year-olds (n=13)</td>
<td>92.3 (48/52)</td>
<td>13</td>
</tr>
<tr>
<td>5-year-olds (n=14)</td>
<td>89.3 (50/56)</td>
<td>14</td>
</tr>
<tr>
<td>4-year-olds (n=14)</td>
<td>32.1 (18/56)</td>
<td>6</td>
</tr>
<tr>
<td>Total</td>
<td>70.7 (116/164)</td>
<td>33</td>
</tr>
<tr>
<td>Adults (n=10)</td>
<td>100 (40/40)</td>
<td>10</td>
</tr>
</tbody>
</table>
We also submitted the data to an ANOVA test. The results in figure 3 showed a significant effect of age, $F(2,38) = 10.69, p < .05$. The post hoc analysis revealed that both 5- and 6-year-old children performed better than 4-year-old children ($p < .05$). But there was no significant difference between 5- and 6-year-old children ($p > .05$). A Mann-Whitney test showed that only the 4-year-olds performed differently than adults in the existential implicature ($U = 20, p < .05$). So, the answer to our first question in this experiment is that some children as early as 4 years old have demonstrated the ability to compute the existential implicature in the one-implicature context. And by age 5, most children seem to have had an adult-like mastery.

![Figure 3. Age effect on the existential implicature](image)

One purpose of this study was to examine the same subject’s knowledge of the existential implicature of the *lian*. . . *dou* construction in the two contexts. Our data showed that, with all three age groups combined, 33 children could understand the existential implicature in experiment 2, but only 13 of them (39.4%) could also understand the existential implicature in experiment 1. We didn’t find a case where a child could understand the existential implicature in experiment 1 but not in experiment 2. This fact indicates that at the individual level a child might be able to understand the existential implicature of *lian*. . . *dou* in the one-implicature context earlier than that in the two-implicature context.
6. General discussion

In general, experiment 1 showed that even by 6 years old children’s ability to compute the two implicatures of *even* differ from that of adults. The participants could be divided into two groups. The 4-year olds could stand as one group as none of them could understand either of the two implicatures. The 5-year-olds and 6-year-olds could be grouped together because at either of these age levels there were children who could understand the existential implicatures or even both implicatures. This clear division of the two groups indicated that children at 4 years old did not show the knowledge of the conventional implicatures triggered by *lian…dou*. The earliest age for them to have such knowledge was at 5 years old, but it could be postponed to 6 or even later. In terms of the age effect, this finding is similar to those of studies on SIs (Noveck, 2001; Guasti et al., 2005; Pouscoulous et al., 2007; Reinhart, 2004 Pouscoulous & Noveck, 2009) that have shown that young children are not capable of making pragmatic inferences associated with scalar items to the same extent as adults. We speculate that children’s failures in computing the conventional implicatures of *even* and the SIs might have the same cause, their limited processing resources (Chierchia et al., 2001, 2004; Pouscoulous et al., 2007; Reinhart, 2004; Noveck, 2001; Guasti et al., 2005; Pouscoulous & Noveck 2009 and many others). After all, in both cases, they need to construe in their mind the meanings that have not been said. This process includes building an alternative to what has been mentioned and comparing them in terms of a scale. Such a process is even strenuous for adults (Bott & Noveck, 2004; Noveck & Posada, 2003; Breheny, Katsos, & Williams 2006; De Neys & Schaeken, 2007). Considering the heavy processing load for children and their limited cognitive resources, their failure is foreseeable.

Another finding from experiment 1 was that children’s knowledge of the existential implicature comes before that of the scalar implicature. We propose that this developmental order has something to do with the processing load involved in the computations of the two implicatures. To calculate the existential implicature, children only need to know that there exists a contrast group and it is associated with the singled-out member (the one that is focused) because of a shared property, for example, the successful achievement in moving the box. In terms of the number of members in the group, it is either irrelevant or can be easily figured out through the context. If a child can successfully establish the contrast group, answering the how many questions should not be a challenge for them. On the contrary, the processing load makes the computation of the scalar implicature much harder. In addition to establishing the contrast group, one also needs to create a mental scalar model and figure out a feature (for example the physical strength in the box moving story) that can position the members on the scale with the focused member on the extreme end.

Experiment 2 deals with the situation where *lian…dou* only triggers the existential implicature. Our results showed that by around age 5, children generally have already acquired the ability to compute the existential implicature.
in the one-implicature context. Then the question arises: why was the correct response rate of the existential implicature in experiment 2 much higher than that of the existential implicature in experiment 1? We propose several potential explanations. The first possible explanation is the Processing Limitation hypothesis proposed by Chierchia et al. (2004) to account for children’s failure with SIs. According to this hypothesis, conducting two tasks (maintaining two representations in memory and interpreting sentence recursively) led to children’s failure. In experiment 1, the addition of the scalar implicature might have imposed a cognitive burden and interfered with the process of computing the existential implicature. In experiment 2, children only needed to compute the existential implicature and all of their cognitive resources might be used on this task. This lightened processing load could lead to higher success rate. The second possible explanation is that the differences in the experimental tasks could lead to different results as have been argued for SIs (Papafragou & Musolino, 2003; Papafragou & Tantalou, 2004; Guasti, et al., 2005; Pouscoulous et al., 2007; among others). Unlike answering questions that involve some degree of reasoning in experiment 1, children in experiment 2 only needed to make a judgment based on what they saw. This helped to reduce their processing load. The third possible explanation is that the meanings of the two types of *lian...dou* are not the same and children do not learn these two meanings simultaneously. The third explanation works as follows: Guasti et al. (2005) hypothesized that children are not able to compute the SI of *some* because the lexical entry of *some* is not yet complete, the connection to *all* being missing. A similar view is shared by Barner and Bachrach (2010) and Foppolo, Guasti and Chierchia (2012) who proposed that the maturation of the lexicon is one of the three factors that have an effect on the derivation of scalar implicature. Pouscoulous et al. (2007) also proposed that lexical complexity itself plays a role in implicature production. Their study revealed that children were more successful in computing the implicatures with *quelques* than *certains* while both words mean ‘some’. The reason is that the latter is more complex and could have added processing cost for children. Adopting the reasoning behind this third possibility, we propose that the two linguistic contexts give rise to two meanings, which can be regarded as the two layers of lexical representation of *lian...dou*. The first meaning becomes the entry in children’s lexicon early and is triggered in the one-implicature context. The first meaning is associated with the ‘including’ and ‘all’ interpretations, which are the meanings of *lian* and *dou* as individual words. The second meaning of *lian...dou* is the one with the *even*-interpretation. In the two-implicature context, only the *even* meaning is triggered and the original meanings of *lian* and *dou* as individual words are blocked. In other words, children might have treated *lian...dou* as a unit and won’t have access to the ‘including’ and the ‘all’ meaning. They need to rely on the discourse and their pragmatic knowledge to figure out what this *even*-interpretation means to them and how to derive both the existential and the scalar implicature in the two-implicature context. Of these two layers of lexical meanings of *lian...dou*, the first meaning is less complex and takes less
cognitive resources to process. Hence, it is acquired earlier than the second meaning. However, we admit that the third reason we provided here is speculative.

7. Conclusion

For *lian*...*dou* with the *even*-interpretation, our results showed that even though age 5 might be the earliest age for children to learn to compute the two implicatures of *lian*...*dou*, it is generally true that most children by 6 years old lack such ability. By examining each individual subject’s performance, we found that for those who had some knowledge of *lian*...*dou*, they were better at the existential implicature than the scalar implicature. We propose that the intrinsic complexity of the computation of the scalar implicature might have required more cognitive resources. As for the *lian*...*dou* construction with only the existential implicature, we found that some children began to understand it as early as 4 years old and by age 5 they had acquired adult-like knowledge. This raises the question why children could understand the existential implicature in one experiment but not the other. Three possible reasons were advanced: the cognitive resource allotted for the computation of the existential implicature in the two experiments was different; task procedures might have played a role, and the entry of *lian*...*dou* into children’s mental lexicon takes more than one step.

This study has contributed to the limited studies on the acquisition of the conventional implicatures of *even*-sentences. Unlike previous studies, it looks into not only the scalar implicature, but also the existential implicature. Future studies might take into consideration of the linguistic properties of *lian*...*dou* and explore whether *lian* and *dou* can individually affect children’s computation of the two implicatures.

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