In this paper, we investigate the emergence of two types of logical elements in child language, nominal quantifiers and focus particles. Quantifier noun phrases such as those in a sentence like *A nurse looks after every child* exhibit both the subject wide scope and inverse scope readings which are represented by means of operator-variable structures subject to conditions on binding. The relative scope of quantifiers is determined not only by syntactic structure, but by quantifier type and thematic roles. Focus particles like *also* and *only* partition the semantic structure of the sentence into a presupposition and an assertion. They induce bound variable structures by creating a variable in the focus position, resulting in an open sentence. First, we examine the availability of scope-dependent interpretations in Mandarin-speaking children, as well as their

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sensitivity to the scopal effects of quantifier type and thematic hierarchy. Clear theta role effects were found among all age groups, beginning from the four-year-olds, in accordance with the thematic hierarchy. Children were sensitive to the distinction between *mei* ("every") and *suoyou* ("all") in their assignment of inverse scope. Our data can be interpreted as evidence in support of approaches to scope that crucially incorporate quantifier type into the structural representation. Secondly, we explore the use of focus particles in two-to three-year-old children whose first language is Cantonese, with both additive and restrictive focus signaled by means of preverbal adverbs and sentence final particles. It was found that additive focus particles were not produced before two years of age, but began to be used before three years old. Restrictive focus markers did not begin to be used spontaneously and productively until shortly after 3;0, emerging later than the additive focus markers, confirming the greater complexity of universal quantification relative to existential quantification. The two studies point to the early emergence of logical structures in children's language.

1. Introduction

Sentences involving quantifier noun phrases, such as (1), and sentences involving focus particles, such as (2), introduce quantificational or logical structures in that operator-variable links such as those in (1’a), (1’b) and (2’) are created in the representation of their meanings. The wide scope reading of the subject quantifier *Every man* is represented in (1’a), whereas the wide scope reading of the object quantifier *a bucket* is given by (1’b). In (2) the focus adverb *also* partitions the sentence into a presupposition that contains existential quantification and an assertion, shown in (2’).
(1) Every man carried a bucket.
(1'a) ∀ x=man, ∃ y=bucket, x carried y.
"Every man carried a possibly distinct bucket"
(1'b) ∃ y=bucket, ∀ x=man, x carried y.
"The same bucket was carried by every man"
(2) John also laughed.
(2') Presupposition: ∃ x≠ John, laughed (x).
"Someone other than John laughed"
Assertion: Laughed (John).
"John laughed"

In the spirit of Minimalist theory (Chomsky 1995, 2000), operator-variable representations can be viewed as instruction formats accessed by the conceptual-intentional performance system. These instructions specify how the variables are to be understood with respect to the operators that bind them, and how the variables depend on one another. The acquisition of these natural language logical structures is of interest to linguistics and cognitive science for a number of reasons. They are to the best of our knowledge a species-specific property that has emerged in the course of human evolution. No other animal species has a communication system that is anything close to propositional logic or predicate calculus. All human languages have them. Operator-variable structures are closely tied to the ability to handle number, which exhibits the property of 'discrete infinity,' considered to be also the most elementary property of the language faculty (Chomsky 1988, Chomsky 2000). Understood as instructions to performance systems, these representations are accessed by the conceptual-intentional system, which handles such things as thematic roles and their ranking hierarchy, or knowledge states such as what is counted as background or presupposed knowledge. How these logical structures interface between the syntax of the language faculty and performances systems and at what point children acquire these interface properties should add to our understanding of the overall architecture of language. From the point of view of knowledge acquisition, the learning of
these logical structures highlights the classic problem of poverty of stimulus (cf. May 1985, Aoun and Li 1993). Given the abstractness and complexity of these structures, it is unlikely that positive data will serve as an inductive basis for their acquisition. The logical structures are conceivably present in blueprint form as part of the child's initial state.

In this paper, I present acquisition data from Mandarin Chinese and Cantonese on two kinds of logical structures. First, I demonstrate Mandarin-speaking children's sensitivity to quantifier type and thematic roles in their understanding of inverse scope for sentences such as (1), suggesting that young children are sensitive to constraints of the conceptual-intentional system on quantifier scope interpretation. Second, I show that Cantonese-speaking children use focus structures such as those in (2) at an early age, and that additive focus structures involving particles that signal the meaning of also appear earlier than restrictive focus structures involving particles that signal the meaning of only.

2. Mandarin-speaking children's comprehension of inverse scope
2.1 Inverse scope, quantifier type and thematic roles
In our study of Mandarin, we examined children's understanding of scope using sentences such as the Mandarin equivalent of (3-4), in which the subject quantifier is a numeral phrase, and the object quantifiers is either a numeral phrase or a universal quantifier. Sentences such as (3) differ from sentences like (4) in that while the former consist of examples in which the subject is agent and the object is theme, the latter contain examples in which the subject is theme and the object is goal or location.

(3) Agent-theme sentences
(3a) Two men are carrying three water buckets.
(3b) Two men are carrying all the water-buckets.
(3c) Two men are carrying every water-bucket.
(4) Theme-location/goal sentences
(4a) Two blankets are hanging from three bamboo poles.
(4b) Two blankets are hanging from all the bamboo poles.
(4c) Two blankets are hanging from every bamboo pole.

(5) Scope-dependent and scope-independent interpretations of (3a)
(5a) Subject wide scope

(5b) Inverse scope (object wide scope)

Sentences such as (3-4) can have a number of scope interpretations. For example, sentence (3a) may have a subject wide scope reading in which two men are both carrying three water buckets, giving a total of six buckets. It can have an object wide scope reading, in other words an inverse scope
reading, in which three water buckets are each carried by two men, giving a total of six men. These are the scope dependent meanings in which the choice of the reference set of one quantifier is dependent on that of the other quantifier. These readings of (3a) are illustrated in (5a) and (5b).

(5c) Each-all reading (scope-independent)

(5d) Cumulative reading (scope-independent)

In addition, the sentence may have scope independent readings or branching readings in which each quantifier takes its referential set independent of the other, and full or partial connections are set up between the two sets (Scha 1984, Sher 1990, Liu 1990). Thus, in addition to subject and object wide scope readings, one may have an each-all reading in which two men are both holding the same set of three water buckets, as well as a cumulative reading in which two men each are holding only some but not
all of the set of three water buckets, but together they are holding all of
them. These are illustrated in (5c) and (5d).

Several aspects of these interpretations relevant to our experimental work
are worth noting. First, the subject wide scope and the inverse scope
interpretations reflect the properties of scope par excellence in that they
display the property of referential dependency in which the choice of one
set of referents is made dependent on that of another. Second, as has been
remarked in previous literature and demonstrated in recent studies, inverse
scope is clearly sensitive to the type of quantifier that is inducing the scope
dependency (McCawley 1977, Gil 1982; Beghelli 1992, Beghelli and
Stowell 1997; Lee, Yip and Wang 1999a, 1999b). Thus, both adult English
and adult Chinese speakers are predicted to find it easier to assign inverse
scope to sentences such as (3c), in which the object quantifier is a
distributive universal quantifier (every water-bucket) than to sentences such
as (3a), in which the object quantifier is a numeral phrase (three
water-buckets). Thirdly, it has also been shown that inverse scope is
sensitive to thematic hierarchy, so that it is easier for the object to have
wide scope if it bears the role of goal/location than if it carries the role of
theme (cf. Ioup 1975, Kurtzman and MacDonald 1993). Thus generally, if
we hold the quantifier constant, it would be easier to obtain an inverse
scope reading for the sentences in (4) than for its counterparts in (3). For
example, the inverse scope reading in (4c) would be stronger than that in
(3c).

The effect of thematic role on quantifier scope is best observed through
inverse scope, ie how the thematic role increases or decreases the
availability of object wide scope. This is because in a canonical SVO
sentence, where the subject NP bears the agent role, the noun phrase is both
structurally and thematically prominent. It has long been observed that
there is a stronger tendency for the subject NP rather than the object NP to take wide scope (cf. Ioup 1975; Reinhart 1978, 1983). Further, an agent theta role will have priority over other thematic roles in receiving wide scope (Ioup 1975, Jackendoff 1983). It is thus not easy to identify the independent effect of thematic role on quantifier scope by observing the subject NP. On the other hand, in the situation where the object NP bears a goal/location role, and the subject NP has theme role, a conflict between thematic role and sentence structure arises: thematic considerations favor object wide scope, whereas the subject should receive wide scope on the basis of syntactic structure.¹

A further reason for observing the effects of quantifier type and thematic role through inverse scope is that Chinese generally follows an isomorphic principle in mapping scope from surface syntax to logical form. If a quantifier phrase c-commands another quantifier phrase in overt syntax, the former will have scope over the latter (cf. Huang 1982, Aoun and Li 1993). In other words, unlike English, Chinese restricts inverse scope to a much greater extent than English. The possibility and range of inverse scope varies from one language to another. If inverse scope is found to exist in early child Mandarin, and is subject to semantic constraints, such findings should point to logical knowledge whose origins may go beyond adult input.

2.2 Mandarin acquisition data based on a picture verification task
When do children become sensitive to these factors affecting scope, in

¹ One can compare the wide scope tendencies of agentive subject NPs to experiencer subject NPs, as has been done in Kurtzman and MacDonald (1993), but as they showed, the effect of thematic role was not pronounced in the case of an agent/experiencer contrast.
particular the effects of thematic hierarchy? We tested four- to eight-year old Mandarin-speaking children as well as an adult control group using a picture verification task, with 12-14 subjects in each group. In each test sentence, a numeral phrase in subject position is paired with a quantifier in object position, which may be a numeral phrase, the distributive universal quantifier *mei* "every", or the universal quantifier *suoyoude* "all*. Each quantifier ordering was paired with two thematic arrangements: agentive subject and theme object, or theme subject and location/goal object, giving a total of 6 sentence types. Three verbs were used for each sentence type, giving a total of 18 test sentences. Each test sentence was matched to three interpretations depicted by pictures, including an inverse scope reading, an each-all reading and a cumulative reading. Sample test sentences and pictures are given in (6-7).

(6a) Sample test sentence (Agent-theme)

You liangge shushu tiaozhe sange/suoyoude/meige shuitong.

Have two-CL uncle carry-asp three-CL/all/every-CL water-bucket

"Two men are carrying three/all the/every water-bucket(s)"

2 Previous studies of children's acquisition of scope have examined the nature of their semantic representations, for example, whether their bound variable structures involve binding of individual or event variables (H. Lee 1990, Philip 1995, Crain et al 1996). In the context of Chinese, scholars have investigated the extent to which children obey the isomorphic principle in interpreting scope (Chien and Wexler 1989, Lee 1997).

3 A truth-judgment task based on comprehension was considered a more appropriate method than elicitation production, as sentences involving two quantifiers do not occur frequently in child speech. Further, only a comprehension task would allow one to have systematic control of thematic roles and quantifier types. For example, it would be difficult to bias the child to use *all* instead of *every* in an elicitation production task.

4 In this paper, the following abbreviations and notations are used: asp=aspect marker, sfp=sentence final particle, CL=classifier, Excl=exclamation; CHI=child, INV=investigator, MOT=mother, xxx=unintelligible speech, #:pause, 'm,n,p' indicates age in year, month and days.
(6b) Sample test sentence (Theme-goal/location)

You liangtiao tanzi liangzai sangen/suoyoude/meigen zhuganrshang. Have two-CL blanket hang-on three-CL/all /every-CL bamboo-pole-on "Two blankets are hanging from three/all the/every bamboo pole(s)"

(7a) Picture verification task (agent-theme sentences)

Inverse scope                          Each-all

Cumulative reading

(7b) Picture verification task (theme-goal/location sentences):

Inverse scope                          Each-all
The findings on inverse scope are given in Table 1A and Table 1B. Table 1A shows the percentage of an age group that accepted inverse scope readings on agent-theme sentences and theme-goal/location sentences, for three types of object quantifiers. Table 1B shows the percentage of age group that consistently accepted inverse scope on a particular test sentence type, that is, accepting inverse scope on two or more out of three trials.

Table 1A. Percentage of acceptance of inverse scope readings by Mandarin-speaking children and adults.

<table>
<thead>
<tr>
<th>Sentence type</th>
<th>Object Q-type</th>
<th>Agent-theme</th>
<th>Theme-location/goal</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Numeral</td>
<td>Suoyou &quot;all&quot;</td>
<td>Mei &quot;every&quot;</td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 year-olds (N=12)</td>
<td>22.2</td>
<td>33.3</td>
<td>44.4</td>
</tr>
<tr>
<td>5 year-olds (N=14)</td>
<td>21.4</td>
<td>33.3</td>
<td>45.2</td>
</tr>
<tr>
<td>6 year-olds (N=14)</td>
<td>16.7</td>
<td>26.2</td>
<td>35.7</td>
</tr>
<tr>
<td>7 year-olds (N=12)</td>
<td>2.8</td>
<td>16.7</td>
<td>38.9</td>
</tr>
<tr>
<td>8 year-olds (N=12)</td>
<td>0</td>
<td>2.8</td>
<td>8.3</td>
</tr>
<tr>
<td>Adults (N=13)</td>
<td>5.1</td>
<td>0</td>
<td>20.5</td>
</tr>
</tbody>
</table>

Table 1B. Percentage of age group that accepted an inverse scope reading
of a particular sentence type for at least two of the three test sentences.

<table>
<thead>
<tr>
<th>Age</th>
<th>Type of Q-object</th>
<th>Agent-theme</th>
<th>Theme-location/goal</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Numeral</td>
<td>Suoyou</td>
<td>&quot;all&quot;</td>
</tr>
<tr>
<td>4 year-olds</td>
<td>16.7</td>
<td>25</td>
<td>33.3</td>
</tr>
<tr>
<td>(N=12)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 year-olds</td>
<td>21.4</td>
<td>28.6</td>
<td>42.9</td>
</tr>
<tr>
<td>(N=14)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 year-olds</td>
<td>14.3</td>
<td>28.6</td>
<td>35.7</td>
</tr>
<tr>
<td>(N=14)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7 year-olds</td>
<td>0</td>
<td>8.3</td>
<td>33.3</td>
</tr>
<tr>
<td>(N=12)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8 year-olds</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>(N=12)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adults</td>
<td>0</td>
<td>0</td>
<td>15.4</td>
</tr>
<tr>
<td>(N=13)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

As can be seen from Table 1A, Mandarin-speaking adult controls generally rejected inverse scope for numeral objects and suoyoude "all" objects, accepting these sentences only zero to 15.4 percent of the time. If one considers the percentage of adults who accepted inverse scope on sentences with an object numeral phrase or an object suoyoude ("all") phrase two or more times out of three trials, the percentage was between 0 and 7.7 percent (see Table 1B). This pattern confirms the isomorphic principle for scope interpretation in Chinese, which says that scope order is directly mapped from surface structure constituent relations, so that generally the subject quantifier will have scope over the object quantifier, and the object wide scope reading is considered unavailable (Huang 1982, Aoun and Li 1993). However, one should note that the two tables also indicate that adults permitted inverse scope for mei ("every"), to a small extent in agent-theme sentences, and quite noticeably for theme-location/goal sentences. Table 1A shows that adults accepted an inverse scope reading on a mei ("every") phrase 20.5 percent of the time if the object quantifier bears
the role of theme, and did so 59% of the time, when the object quantifier has the role of location/goal. The percentage of adults who consistently accepted an inverse scope on the object quantifier mei ("every") was 15.4 when the object was theme, and 53.8 when the object was goal/location.

Quantifier type and theta role are both significant factors for inverse scope for Mandarin-speaking adults. They accepted inverse scope on object NPs with mei "every" as determiner significantly more than on numeral phrase objects or on suoyoude "all" objects (F(2,11)=9.85, p=0.004). This effect was found in both agent-theme and theme-location/goal sentences (F(1,12)=8.99, p=0.011). Adults accepted inverse scope significantly more for location/goal objects than for theme objects, whether the quantifier was suoyoude "all" or mei "every".

Turning to the children's performance on the experimental task, one can see from Table 1B that between 14.3 and a 42.9 percent of the 4-, 5- and 6-year-olds accepted inverse scope consistently on agent-theme sentences, and between 21.4 and 75 percent of these young children accepted inverse scope on theme-location/goal sentences. Acceptance of inverse scope declined thereafter. By age 8 they rejected inverse scope completely on agent-theme sentences, though about one-third accepted it on theme-goal sentences for numeral and mei "every" object phrases. Development of quantificational competence in Chinese is reflected in suppression of inverse scope.5

5 Our findings differ from the conclusions of Lidz and Musolino (2002), which argues for isomorphism as a default strategy of children. These differences seem to indicate that children's knowledge of the relative scope of nominal quantifiers may not be the same as that of the relative scope of a QNP and negation, the latter being the focus of Lidz and Musolino's study.
As with the adults, quantifier type was a significant factor for acceptance of inverse scope, for all children except 8-year-olds. Children aged between 4 and 7 accepted inverse scope on *mei* "every" objects significantly more than on numeral objects. More variability was seen with *suoyoude* "all" objects, with 6-year-olds accepting inverse scope on *mei* 'every' objects significantly more than *suoyoude* 'all' objects. Seven-year-olds showed a clear differentiation between the three quantifier types, accepting inverse scope significantly more on *mei* "every" objects than for *suoyoude* "all" objects, with the latter in turn inducing reliably more inverse scope than numeral phrases. The ANOVA values showing quantifier type to be a significant factor are as follows for the four age groups: 4-year-olds: F(2, 10)= 5.97, p=0.02; 5-year-olds: F(2, 12)=6.93, p=0.01; 6-year-olds: F(2,12)=6.95, p=0.01; 7-year-olds: F(2,10)=39.63, p=0.000.

Thematic role was a significant factor affecting inverse scope for children of all age groups. Children accepted inverse scope significantly more on theme-location/goal sentences than on agent-theme sentences. This effect was seen in children's interpretation of inverse scope on numeral phrase objects and either objects with the determiner *mei* "every" or objects with the determiner *suoyoude* "all". The ANOVA values showing thematic role to be a significant factor underlying children's scope interpretation are as follows: 4-year-olds: F(1, 11)= 11.19, p=0.007; 5-year-olds: F(1, 13)=14.44, p=0.002; 6-year-olds: F(1,13)=8.55, p=0.012; 7-year-olds: F(1,11)=7.75, p=0.018.

3. Cantonese-speaking children's use of additive and restrictive focus particles

We now turn to children's knowledge of focus structures, which represent another type of operator-variable representations. Focus particles in natural language, such as *also* or *only*, serve two important functions. First, they introduce bound variable structures by creating a variable in the focus
position, to be bound by a quantifier. Second, they partition the semantic structure of a sentence into two representations, one corresponding to the presupposition of the sentence and another corresponding to its assertion. Focus particles differ from one another in the quantificational structures they induce, and how these structures are differentiated as presupposition and assertion (Krifka 1992, von Stechow 1991).

Take sentences such as (8) and (9), in which the focused elements are *mahjong* and *play mahjong* respectively. The additive focus particle *also* creates a variable in the focus position, forming the open sentences or functions *John played x* and *John x* respectively. The presupposition for (8), given in (8'), is a statement of existential quantification such that there is something distinct from x and John played x; that is, John played something other than mahjong. The assertion for (8) is the sentence formed when the open sentence *John played x* is satisfied by the focused element, giving rise to *John played mahjong*. Likewise, the presupposition for (9), as in (9'), is a statement of existential quantification such that there is some action or event distinct from x and John did x; that is, John did something other than mahjong-playing. The assertion for (9) is the sentence that results from the focused element satisfying the function *John x*, i.e. *John did mahjong-playing* or *John played mahjong*.

(8) John *also* played *mahjong*.
(9) John *also* played *mahjong*.
(8') Presupposition: There is x ≠ mahjong, such that John played x.  
Assertion: John played mahjong.
(9') Presupposition: There is x ≠ mahjong-playing, such that John did x.  
Assertion: John played mahjong.

Restrictive focus particles work in analogous ways, except that the quantificational structures they create involve exclusivity rather than inclusiveness, and the presuppositions and assertions are structured differently than in the case of additive focus. Parallel to (8) and (9), the
open sentences or functions introduced by the focus operator only in (10) and (11) are *John played x* and *John x* respectively. The presuppositions for these two sentences result from the focused elements satisfying these two functions, i.e. *John played mahjong* and *John did mahjong-playing*. The assertion in either sentence is a statement of exclusivity such that no member of the set of alternatives to the focused element in the relevant discourse satisfies the function. Expressing this informally, what is asserted in (10) is that John played mahjong and nothing else, and what is asserted in (11) is that John did nothing else than playing mahjong. One can express the condition of exclusivity alternatively as a statement of universal quantification. Thus one way of conceptualizing the difference between additive focus and restrictive focus is to think of the former as involving existential quantification and the latter as consisting in universal quantification.

(10) John *only* played *mahjong*.
(11) John *only* played *mahjong*.

(10’)* Presupposition: John played mahjong.
Assertion: There is no=x, x ≠ mahjong, such that John played x.
(For all x=thing, if John played x, then x=mahjong)

(11’)* Presupposition: John played mahjong.
Assertion: There is no=x, x ≠ mahjong-playing, such that John did x.
(For all x=activity, if John did x, then x=mahjong playing)

3.1 Additive and restrictive focus in Cantonese
Cantonese is a language rich in devices of A-quantification (Partee 1991). Additive and restrictive focus can be signaled not only by means of preverbal adverbs but also by means of sentence final particles. These different devices have varying scope.6

6 Romanization of Cantonese morphemes is based on the Linguistic Society of Hong Kong Jyutping Romanization system (1997). The numbers at the end of romanizations indicate the tones of the morphemes concerned. Except for the focus particles, sentence final particles and interjections, the
Additive or inclusive focus ("also") is signaled primarily by means of four particles: preverbal *dou1*, focusing the subject (as in 12); preverbal *zung6* and final *tim1*, both of which focus on the VP (as in 13-14); and preverbal *jau6*, having sentential scope (see 15). Each of these additive focus particles has other non-focus uses, the details of which I will not go into here.

Tones of Cantonese morphemes have been left out in the example sentences.

7 Preverbal *jau6* can also focus on time, conveying repetition of events. Thus (15) may mean "John bought three books again."

8 Thus, *dou1* can also function as a universal quantifier quantifying leftward, like its cognate in Mandarin Chinese. It can also be used as a strong denial of the interlocutor’s presupposition. The preverbal particle *zung6* occurring in imperfective sentences can function as an aspectual operator signaling continuation of an activity or state, meaning "still". The final particle *tim1* has the additional function of indicating new information (Kwok 1984, Leung 1992). The preverbal particle *jau6* can be used to mark an unexpected situation. See Lee (1995) for discussion of the emergence of the preverbal particles in child language.
Restrictive focus ("only") is encoded with three particles: a preverbal particle *zinghai*, a sentence final particle *zaa3*, and a particle *dak1*. The final particle *zaa3* has sentential scope, able to associate with any constituent in its c-command domain, including the subject, as shown in (16). The exact focus is determined by context and intonation. The particle *zinghai* has VP scope when in preverbal adverbial position (as in 17) but can only have scope over the subject when preceding the latter (see 18). The two restrictive focus particles can co-occur (19), but are distinguished from one another in that while *zaa3* has both scalar and non-scalar uses, *zinghai* is limited to non-scalar quantification (cf. König 1991). The third restrictive particle *dak1* can function as a verb compound signaling restrictive possession, as shown in (20), but can also be used before the subject to focus on it (see 21).

(16) *Aa John mai zo saambun syu *zaa3*.
    *John buy asp three-CL book only*
    "John only bought THREE BOOKS (and bought nothing else)"
    "John only BOUGHT three books (and did nothing else)"
    "Only JOHN (and no one else) bought three books"

(17) *Aa John *zinghai* mai zo saambun syu.
    *John only buy asp three-CL book*
    "John only bought THREE BOOKS (and bought nothing else)"
    "John only BOUGHT THREE BOOKS (and did nothing else)"

(18) *Zinghai/dak1 Aa John mai zo saambun syu.*
    *Only John buy asp three-CL book*
    "Only JOHN (and no one else) bought three books"

(19) *Aa John *zinghai* mai zo saambun syu *zaa3*.
    *John only buy asp three-CL book only*
    "John only bought THREE BOOKS (and bought nothing else)"
    "John only bought THREE books (and not more than three)"
    "John BOUGHT THREE BOOKS only (and did nothing else)"

(20) *Aa John *dak1* saambun syu (*zaa3*).

---

9 This means that sentence (17) does not have the meaning "John bought just three books (and not more than three books)", whereas sentences (19) and (20), which contain the particle *zaa3*, can have this interpretation.
3. 2. Focus markers in the speech of Cantonese-speaking children

In experimental studies of children’s knowledge of focus, children are known to interpret restrictive focus differently than adults (cf. Crain, Ni and Conway 1994; Yang 2000). For focus particles that interface with pragmatic scales, children may not attain adult-like competence until seven or eight years old (Yang 2001). However, a cursory glance at naturalistic child speech suggests spontaneous use of focus particles, indicating that children may acquire focus particles at different stages, with different levels of mastery of them. Experimental tasks may have underestimated children’s knowledge of focus particles. It is therefore worth investigating this issue using longitudinal production data.

The longitudinal data for the study were drawn from CANCORP, the Hong Kong Cantonese Child Language Corpus (Lee and Wong 1998). The five subjects included CKT, a boy observed in 25 sessions from 1 year 5 months to 2 years 7 months; MHZ, a boy observed in 26 sessions from 1 year 7 months to 2 years 8 months of age; CGK, a girl observed in 19 sessions from 1 year 11 months to 2 years 8 months; LTF, a girl observed in 16 sessions from 2 years and 2 months to 3 years and 2 months old; and LLY, the oldest child of the group, studied in 20 sessions from 2 years 8 months to 3 years 8 months old. The data contain mostly conversations between the children and the investigators, and sometimes conversations between the children and their parents or siblings, all taking place in a home setting. To facilitate examination of longitudinal development, the figures are divided into three periods. Period 1 covers the period before the child is 2 years old.
Period II spans the entire two year old range, whereas Period III covers the months after 3:0. Table 3 shows the basic facts about the subjects and the number of sessions of recording for the three periods.

In the analysis of the focus particles all the utterances containing these particles, produced either by children or adults, were extracted, together with contextual data, for each of the sessions. An utterance was considered imitative if it was identical to an adult utterance or a sub-string of it occurring in the preceding two conversational turns. The data from CKT, MHZ, CGK, and LTF were used in the analysis of additive focus. Data on restrictive focus were drawn from the speech corpora of CKT, MHZ, LTF and LLY.

Table 3 Number of sessions of observation for the Cantonese-speaking children studied: CKT, MHZ, CGK, LTF and LLY.

<table>
<thead>
<tr>
<th>Name of child</th>
<th>Period observed</th>
<th>Period I (before 2:0)</th>
<th>Period II (2:0 - 2;11)</th>
<th>Period III (3;0 and later)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>CKT (male)</td>
<td>1:05:22-2:07:22</td>
<td>12</td>
<td>13</td>
<td>0</td>
<td>25</td>
</tr>
<tr>
<td>MHZ (male)</td>
<td>1:07:00-2:08:06</td>
<td>10</td>
<td>16</td>
<td>0</td>
<td>26</td>
</tr>
<tr>
<td>CGK (female)</td>
<td>1:11:01-2:08:08</td>
<td>4</td>
<td>15</td>
<td>0</td>
<td>19</td>
</tr>
<tr>
<td>LTF (female)</td>
<td>2:02:10-3:02:18</td>
<td>0</td>
<td>13</td>
<td>3</td>
<td>16</td>
</tr>
<tr>
<td>LLY (female)</td>
<td>2:08:10-3:08:09</td>
<td>0</td>
<td>8</td>
<td>12</td>
<td>20</td>
</tr>
</tbody>
</table>

Children's use of the additive focus markers is summarized in Tables 4. As can be seen from the table, the additive particle zung6, which has VP scope, and the particle jau6, having sentential scope, emerged at around 2;2 or 2;3 for all four children. The emergence of the other two particles showed some variation. The additive particle dou1, which has only subject scope,
emerged around the same time as the VP particles for MHZ and CKT. However, it appeared later, at around two and a half years old for the other two children CGK and LTF. As for the additive final particle \textit{tim1}, which also has VP scope, the youngest two children MHZ and CKT did not show any command of the particle, whereas the two older children CGK and LTF began to use it at 2;4 and 3;1 respectively. The table also gives the frequencies of occurrence of the additive focus particles in the speech of the four children.

Table 4 : Age at which the additive focus particles \textit{dou1, zung6, jau6, tim1} first occurred in the speech of four Cantonese-speaking children, and the number of spontaneous occurrences of the particles.

<table>
<thead>
<tr>
<th></th>
<th>dou1</th>
<th>zung6</th>
<th>jau6</th>
<th>tim1</th>
</tr>
</thead>
<tbody>
<tr>
<td>MHZ</td>
<td>2:03;28</td>
<td>2:03:09</td>
<td>2:02:26</td>
<td>---</td>
</tr>
<tr>
<td>no. of tokens</td>
<td>6</td>
<td>9</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>CKT</td>
<td>2:02:15</td>
<td>2:03:03</td>
<td>2:01:08</td>
<td>---</td>
</tr>
<tr>
<td>no. of tokens</td>
<td>3</td>
<td>89</td>
<td>11</td>
<td>0</td>
</tr>
<tr>
<td>CGK</td>
<td>2:07:11</td>
<td>2:02:21</td>
<td>2:03:25</td>
<td>2:04:30</td>
</tr>
<tr>
<td>no. of tokens</td>
<td>30</td>
<td>22</td>
<td>30</td>
<td>4</td>
</tr>
<tr>
<td>LTF</td>
<td>2:06:01</td>
<td>2:02:10</td>
<td>2:03:02</td>
<td>3:01:21</td>
</tr>
<tr>
<td>no. of tokens</td>
<td>51</td>
<td>31</td>
<td>58</td>
<td>3</td>
</tr>
</tbody>
</table>

Children's uses of various additive particles to focus on the subject, the object, and the VP are illustrated below. Example (22) illustrates subject focus. In such a use, a property encoded in a verb phrase had been predicated of an entity in the preceding discourse. The child uttered a sentence containing a focus particle asserting that the property encoded by the same verb phrase is predicated of a different entity represented by the subject of the sentence.

(22) (LTF tells investigator what she is afraid of. LTF at 2:08;24).
CHI: Ngo geng moupo gaa3 ngo.
I fear witch sfp I
"I am afraid of witches"
INV: Ngo m geng gaa3.
I not afraid sfp
"I am not afraid (of witches)"
CHI: Mami *dou1* m geng.
    "Mom also not afraid
"Mommy is also not afraid (of witches)"

Example (23) is an instance of focusing on the object. In this situation, an event had occurred in which an agent had carried out an action on a theme object. The child uttered a sentence containing a focus particle, asserting that the same agent represented by the subject of the sentence had carried out or was carrying out the same action (indicated by the verb) on another theme object.

(23) (LTF and investigator are playing with toy babies. Child is taking the toys to eat various things. LTF at 2;02;10).
INV: Nei daai bibi heoi sik matje aa3?
    "What are you taking the baby to eat?"
CHI: &ei6, syutgou, *zung6* jau gwozap, syutiu, hai m hai?
    "(Eat) icecream, also have juice, icecream-stick be not be"

An instance of verb phrase focus is exemplified in (24). In this type of situation, an event had occurred in which an agent had performed an action signified by a verb phrase. The child uttered a sentence containing a focus particle, asserting that the same agent had performed or was performing another action signified by a different verb phrase.

(24) (Investigator describing a story based on a picture of a boy kicking a ball at another boy. LTF at 2;11;16).
CHI: Daa laamkau zicin *feizai* lo keoi go bo.
    "Before playing basketball, the fat boy took his ball"
INV: &m6, gam keoi dimjoeng tek keoi gaa3?
    "So he how kick him sfp"
CHI: Gam *feizai* daa keoi go tau.
    "So fat-boy hit he CL head"
INV: &haak6.
Nineteen tokens of restrictive focus particles were found in the speech of the children. These were not evidenced in the youngest child CKT. One isolated token was found in MHZ at two years six months. The data from the two older children, LTF and LLY, indicate that beginning from around 3;1, children were using the restrictive focus markers productively. Thus, in naturalistic speech, restrictive focus markers emerged shortly after children turned three years old. A typical use of the restrictive focus particle was found in two contexts of exclusivity, in denials of specific alternatives and in comments on residues.

According to the exclusivity clause given in the semantic representation of "only", shown in (9') and (10'), all the alternatives should be denied as appropriate for the predicate description. However, in children's use of restrictive focus particles, typically what are denied were one or more specific alternatives rather than the entire set of alternatives, as illustrated in (25). The denial of a specific alternative was either explicitly mentioned or implicit in the prior discourse. In this episode, the investigator asked the child whether there were 'moles' on her arms, as there were on the investigator's arms. The child denied that there were 'moles' on her own arms implicitly by saying that there were 'moles' only on her legs.

(25) Exclusive use (denial of specific alternatives) by LLY

(LLY at 3;3;26. The investigator is showing the child the mosquito bites on her arms. The child comments that these are moles. Then they start counting the 'moles' on their legs.)

*INV: Tai haa nei go zek sin, nei bei ngo tai haa nei go zek.
  Look-at asp you that CL first, you let me look-at asp you that CL
  "Look at your (leg) first; you let me look at yours"

*INV: Jau mou mak?
A type of restrictive focus that came close to the adult semantics was seen when children talked about the residue of a set. In these situations, the expected existence of some members of a set was denied, and the remainder or residue of the set was asserted. This can be seen as a special case of exclusivity in that the utterance denied the existence of alternative objects to the one designated by the focused element. In other words, the alternatives excluded were limited to objects and did not consist of actions.

In the episode in (26), the child is looking for some food bearing the label of a tiger, which is gone. The child then comments on what remains of food bearing other animal labels, using the preverbal focus particle *zinghaidak1*.

(26) Exclusive use (residue) by MHZ

(MHZ, at 2;6; 04. Earlier, the child was acting the role of a fireman; he is looking for food that bears various animal labels; the one for tiger is gone, and only the one for chickens and another object are left).

*CHI:  Mgin  zo.
      Disappear asp
      "(Something) disappeared"
*INV:  Mgin zo matje aa3?
      Disappear what sfp
      "What has disappeared?"
*CHI:  Maamaa.
      Mother
      "Mom"
*MOT:  Mat si?
      What matter
      "What's the matter?"
*CHI:  xxx baabaa xxx gogo daai gaa # gaa loufu aa3,
To sum up, additive focus markers in Cantonese emerged shortly after 2;0, whereas restrictive focus markers appeared after two and a half years of age. For each of the three children whose longitudinal data covered the two-year period (MHZ, CKT and LTF), there was a lag of at least four months in the development of restrictive focus markers relative to additive particles (see Table 5).

Table 5: Age at which the additive and restrictive focus particles first occurred in children’s speech.

<table>
<thead>
<tr>
<th></th>
<th>Age of first occurrence of additive particles</th>
<th>Age of first occurrence of restrictive particles</th>
</tr>
</thead>
<tbody>
<tr>
<td>MHZ</td>
<td>2;02;26</td>
<td>2;06;04</td>
</tr>
<tr>
<td>CKT</td>
<td>2;01;08</td>
<td>nil</td>
</tr>
<tr>
<td>LTF</td>
<td>2;02;10</td>
<td>2;11;16</td>
</tr>
</tbody>
</table>

Since on one semantic analysis, additive focus involves existential quantification, while restrictive focus involves universal quantification, the temporal precedence of additive focus reflects the ontogenetic priority of existential quantification over universal quantification. This generalization is additionally supported by the fact that for each of the four children studied (MHZ, CGK, CKT, LTF), if they have learned to use dou1 as a universal quantifier, this use is always preceded by the use of dou1 as an
additive focus marker.¹⁰

4. Conclusions
In this paper we have examined Chinese children's understanding and use of two types of logical structures: those involving relative scope of quantifier noun phrases and those consisting of additive and restrictive focus.

We tested Mandarin-speaking children's understanding of quantifier scope, controlling for quantifier type and thematic roles. It was found that beginning from four years old, children are sensitive to quantifier type and thematic hierarchy. Children's sensitivity to thematic roles suggests that constraints of the conceptual-intentional system on logical representations at the interface are available to young children. Children's sensitivity to quantifier type indicates that features of distributivity that distinguish numeral phrases and universal quantifiers such as all on the one hand, and distributive universal quantifiers like every on the other, are also present in the linguistic knowledge of young children.

We have also documented the early use of additive and restrictive focus markers in two- to three-year-old children using longitudinal data from Cantonese. The findings suggest that these focus structures, which are operator-variable structures that interface with the conceptual-intentional system in their encoding presupposition and shared knowledge, emerge early in child speech. Further, additive focus structures, which involve existential quantification, appear earlier than restrictive focus structures, which can be analyzed as involving universal quantification.

¹⁰ For empirical data in support of this point, please refer to Lee (2003).
References


Lee, T. (2003) "The acquisition of additive and restrictive focus in Cantonese", manuscript, City University of Hong Kong.


