Quantifier Spreading by English and Korean Children[*]

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Abstract

This paper argues that the phenomenon of quantifier spreading by young children has to be analysed both cognitively and linguistically. Evidence comes from the fact that the visual input plays a key role in determining the children's conceptual representation, suggesting the need for the central integration of visual and linguistic elements. In contrast, the fact that spreading is commoner in the younger age groups and then gradually disappears is explicable in terms of the maturation of the linguistic system. It is claimed that children initially treat quantifiers as modifiers, rather than functional heads, and that quantifier spreading can be seen as one reason for the developmental delay of the relevant functional category, DP, in language acquisition.

1 Introduction

This paper investigates some aspects of the acquisition of children's quantification. It is well known that young children tend to give a different interpretation from adults to sentences with universal quantifiers such as *every*, *each* and *all* in certain contexts. For example, in a situation in which there are three agents and three objects such that each of the agents is holding a different object one by one, satisfying some form of visual symmetry, as depicted in (1):

(1)   Agent   -   Object
      Agent   -   Object
      Agent   -   Object

children give the same positive response "yes" as adults do to the following question (2):

(2)   Is every agent holding an object?

However, in the case where another extra object is added to the situation (1), as shown in (3):

(3)   Agent   -   Object
      Agent   -   Object
      Agent   -   Object
                  Object

they react to the same question (2) differently from adults. That is, they deny the fact that every agent is holding an object. They give a negative response "no" to the question, pointing to the remaining object which is not being held as the reason for their negative response.

   In the converse situation where there is an extra agent left without an object as in (4):

(4)   Agent   -   Object
      Agent   -   Object
      Agent   -   Object
      Agent

and confronted with the question in (5):

(5)   Is an agent holding every object?

children deny that an agent is holding every object because of the presence of the isolated agent.

   When we compare the above three different contexts, (1), (3) and (4), we get the strong impression that context might affect children's logical thinking about an input sentence containing a quantifier. The context (1) shows a one-to-one correspondence, with which children have no problem of interpretation. On the other hand, the contexts (3) and (4) do not satisfy "visual symmetry" so that children give a non-adult-like response. The presence of the odd entity is somehow salient in their comprehension.

Focusing on this fact, Philip (1995) claims that children prefer perfect one-to-one symmetrical interpretations with universal quantification, and further that they quantify over entire events rather than objects, suggesting that children and adults exploit different logical forms. In contrast to this hypothesis, Crain et al. (1996) argue that these children's symmetrical interpretations are errors due to flaws in experimental design, and claim that children have no difficulty with the interpretation of quantifiers if "felicitous" contexts are provided.

   The children's behaviour with regard to universal quantification is certainly erroneous from an adult standpoint. However, it is important to notice that these errors are observed consistently in a certain young age group and further are manifest crosslinguistically.[1] They cannot then be plausibly attributed to flaws in experimental design. Rather, we need to determine what causes this kind of error in children's but not in adults' interpretation. Something must be different in the development of their logical thinking or linguistic knowledge. To investigate this, I report here on comparable experiments carried out in English and Korean on the interpretation of universal quantifiers by four-to-seven year old children. To introduce the study, I first review Philip's (1995) event quantification hypothesis and Crain et al.'s (1996) experiments, and then give the details of the present experiments. The findings will be discussed in terms of a comparison of both Philip's and Crain et al.'s hypotheses.

2 Philip's (1995) Event Quantification Hypothesis

Philip (1995) tries to explain this peculiar behaviour by children with regard to universal quantification by introducing the event quantification hypothesis. This claims that children interpret universal quantifiers as quantifying over events rather than individual objects, in line with the Davidsonian (1967) thesis that natural language semantics is not limited to quantification over individual objects but also includes quantification over individual minimal events or situations. That is, to children, unlike adults, the domain of quantification consists of all minimal events which include the agent and the goal (or object) involved in the event. Let us briefly review Philip's test sentences with matching contexts or situations here:

(6)   a.   Is every boy riding a pony?
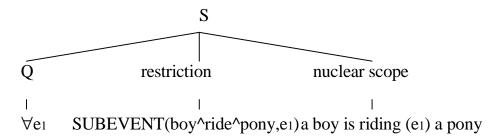   b.   Are the boys all riding a pony?

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[1] Several studies show that this error occurs in children acquiring French (Inhelder and Piaget (1958, 1964)), English (Donaldson and Lloyd (1974)), Japanese (Philip (1995)), Chinese (Lee (1991)), Dutch (Philip (1996), and Philip and Verrips (1994)), and Korean (the present work).

(7)   <Context A>   <Context B>

   Child: Yes   Adult: Yes   Child: No   Adult: No, not that boy

   boy1 rides pony1   boy1 rides pony1
   boy2 rides pony2   boy2 rides pony2
   boy3 rides pony3   boy3 rides pony3
   girl1   boy4

   <Context C>   <Context D>

   Child: No, not those ponies   Child: No, not that pony
   Adult: Yes   Adult: Yes

   boy1 ⌐   boy1 rides pony1
   boy2 ⌐ together ride pony1   boy2 rides pony2
   boy3 ⌐   boy3 rides pony3
                                              girl1
   girl1   pony2   pony4
             pony3

As we can see in the contexts C and D of (7), children give different responses from adults, pointing to the extra ponies as the reason for their negative responses. Philip explains this by saying that children quantify over the entire event 'a boy is riding a pony.' The extra ponies in the contexts C and D in (7) indicate a potential boy-ride-pony event, and because these ponies are not being ridden by a boy, that is, they are not involved in the event, it cannot be the case that, for all candidate boy-ride-pony-events, a boy is riding a pony. Children determine that the domain of quantification consists of all minimal events which involve a boy or a pony (or both) in the case of a sentence such as *Every boy is riding a pony*. All such events are possible component subevents of an event of 'a boy riding a pony.' Therefore, they respond in the negative.
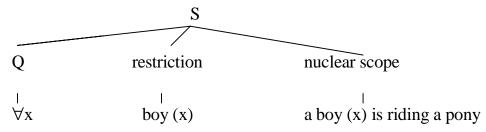
   Philip represents the different logical forms for children and adults for the sentence *Every boy is riding a pony*, by adopting the tripartite formalism of Heim (1982):

(8)   Child logical form for the sentence *Every boy is riding a pony*.

$$S$$

Q	restriction	nuclear scope
$\forall e_1$	SUBEVENT(boy^ride^pony,e_1)	a boy is riding (e_1) a pony

'All minimal events which are possible subevents of an event of a boy-riding-a pony are events in which a boy is riding a pony'
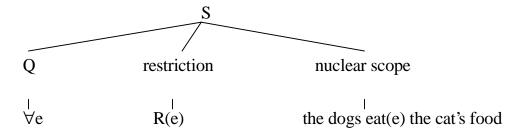
(9)   Adult logical form for the sentence *Every boy is riding a pony*.

$$S$$

Q	restriction	nuclear scope
$\forall x$	boy (x)	a boy (x) is riding a pony

'For all objects x, such that x is a boy, x is riding a pony'

Thus the child logical form (8) is argued to be similar to the adult logical form for adverbial quantification, as in (10):

(10) Adult logical form for the sentence *The dogs always eat the cat's food*.

$$S$$

Q	restriction	nuclear scope
$\forall e$	R(e)	the dogs eat(e) the cat's food

'All events in which R are events in which the dogs eat the cat's food'
(e.g. R=when the cat is fed in the house)

Philip claims that a child who gives a symmetrical interpretation does not apply Quantifier Raising, in the sense of May (1977), to a quantified DP, and consequently does not derive an adult-like object quantificational logical form, in which the restriction on the domain of quantification is determined syntactically.   The child rather assigns to a sentence such as *Every boy is riding a pony* the logical form which an adult assigns to a sentence containing a single adverb of quantification, e.g. *The dogs always eat the cat's food.*[2]

  This hypothesis assumes that each individual object is construed as representing an event as well as an individual and that children prefer perfect one-to-one correspondence between each subevent when interpreting universal quantifiers.   However, this hypothesis fails to explain why children, in particular the symmetrical interpretation children, have different representations for interpreting the quantifiers from the one adults do, and how children's logical form is changed ontogenetically into the adults'. Further, this hypothesis incorrectly predicts that children concentrate only on the objects which can be subevents of the event, but this is not always true.   The majority of children involved in my experiments show that they are also concerned about a third element, irrelevant to the event structure of the sentence.   For example, in the context which there are three bears holding a honeypot each, an extra honeypot and a third element, a piglet, the children responded "no" to the question *Is every bear holding a honeypot?*, mentioning both the remaining honeypot and the isolated piglet, not just the honeypot itself.   According to Philip (1995)'s event structure, the event of this sentence will be [x holding y: here x=bear, y=honeypot], composing the subevents as 'bear' and 'honeypot'. *A piglet* has nothing to do with the event, but the children are still concerned about it, mentioning, for example, "this honeypot is left out and a piglet has nothing," "the piglet will have this honeypot (pointing to the remaining honeypot)," "he is lonely," "he is going to get a honeypot," and so on.   That is, the presence of the isolated different

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[2] Crain et al. (1996) criticized Philip, saying that "this kind of mapping of syntactic and semantic principles, that is, the assignment of a semantics to the universal quantifier that is appropriate for a different type of quantificational element, an adverb of quantification, is not natural." They rather suggested that "both children and adults use 'skolem functions' in their semantic representations of sentences with both a universal quantifier and an indefinite NP." (p.106-107) According to their analysis, the sentence *Every boy is riding a pony* is assigned a representation like (1):

  (1) $f(\text{boy} \Longrightarrow \text{pony})$ $\forall(x)$ [boy $(x) \longrightarrow$ ride $(x, f(x))$]

where "$\Longrightarrow$" indicates that f is a function from individuals to individuals. They explained that "children assign the representation (1) to the question *Is every boy riding a pony?*, but interpret the question to be asking whether the function, f, is *onto* (i.e., if the range of the function is exhausted). In the adult grammar, however, the function is not required to be *onto*." (p. 107)

agent, here 'a piglet,' can also be a part of the reason why the children deny the question in the input sentence.

3 Crain et al's (1996)

Crain et al. (1996) criticize Philip's (1995) symmetrical account of children's behaviour with universal quantification and claim that children's symmetrical responses to universal quantification reported in previous research are due to the use of infelicitous contexts. To prove this, they carried out several experiments, of which one replicated those of previous experiments from Piaget to Philip, and the others used a different methodology, the Truth Value Judgement Task, which, they believe, satisfies 'the condition of plausible dissent.' The condition of plausible dissent asserts that the negation of the proposition in the question can also be a possible outcome so that it has to be presented explicitly in the context. They assume that if the condition is satisfied, the presence of an extra object in the context should not influence the interpretation children assign to the target test question. Experiments 1 and 2, from their seven experiments, are briefly introduced here.

The first part of Experiment 1 replicates previous research, using the same methodology with pictures corresponding to the Extra Object Condition in which, for example, three farmers are each feeding a different donkey and there is an extra donkey not being fed. Among 34 children ranged in age from 3;0 to 5;10 with a mean age of 4;4, there was found a group of 14 children who gave symmetrical responses 82% of the time, (compared to an overall incidence of symmetrical responses of 35%). This group of children answered "No" to questions like *Is every farmer feeding a donkey?* in the Extra Object Condition, pointing to the extra donkey as the reason for their negative responses.

Crain et al. used these 14 children in their second experiment, which used the Truth Value Judgement task, to find out whether the satisfaction of plausible dissent can reduce or eliminate the symmetrical interpretation. In this task, short stories are acted out with toys and props by one experimenter. The stories are watched by a child and a puppet, Kermit the Frog, which is played by a second experimenter. After each story, Kermit the Frog says what he thinks happened in the story. The child is asked to indicate whether Kermit's description of the story is true or false. If Kermit is correct, according to the child, the child pretends to feed him something tasty, but if Kermit says something that did not happen in the story, the child pretends to feed something nasty to remind him to pay closer attention. Whenever Kermit says the wrong thing, the child is encouraged to explain to him "what really happened" in the story. Here is the example of the story in Experiment 2 (Crain et al. (1996, p. 126)):

(11) *Characters and Crucial Props*:
      Three skiers (a mom and her two girls)
      Five bottles of soda and five cups of apple cider
      A Styrofoam mountain, with an arch to ski through

Protocol:

Exp: In this story, this mom and her two girls go skiing. They're going to ski down this mountain here and try to ski through this arch. Over here are the drinks at the ski lodge for when they've finished skiing. First, they all go on the ski lift to the top of the mountain. Then, this girl skis down the mountain.

Girl 1: This looks a bit scary. Here I go! Whee! Oops, here comes the arch. Yeah I made it! <first girl skis down the mountain, and safely through the arch>.

Girl 2: Now it's my turn. Whee! Oops, I nearly fell. But I made it. Yeah!<second girl skis down the mountain and safely through the arch>.

Mom: OK girls, watch me. Whee! Oh wow, I didn't realize this arch was so low, I'll have to really bend down to make it through <mom skis down mountain, but barely makes it through the arch>. Oh girls, that gave me a real fright. I almost banged into the arch. Let's go in now and get a drink <mom and girls go over to drinks set out on a table>. I'll have a cup of this nice hot apple cider. This will help calm me down <mom takes a cup of cider>.

Girl 1: Oh, look at these sodas. I want this bottle of orange soda.

Girl 2: I want this bottle of cola.

Mom: Girls, don't take a bottle of soda. You should have a cup of hot apple cider so you get nice and warm. You can have soda another time.

Girl 1: OK. I'll take this cup, it's full to the top.

Girl 2: I want a full cup too. Are any of these other cups of cider full? Oh, this one looks very full. I'll have this one. Mmm, it's good.

Kermit: That was a hard story, but I think I know something that happened. Every skier drank a cup of hot apple cider.

Child: Yes.

or   No, not these cups of apple cider. (symmetrical interpretation)

In the results, twelve of the 14 children who had consistently given symmetrical interpretations in Experiment 1 responded "Yes" on all four trials of this experiment. Even the remaining two children, who rejected the target sentences, are claimed to have

done so not because they assigned a symmetrical interpretation to the target sentences. The two children rejected Kermit's statements because of the use of *every* to refer to sets with three or fewer members. They are reported as insisting that Kermit should specify the exact number of individuals, for example, *Three skiers drank a cup of hot apple cider*, and in the follow-up session in which there were five characters corresponding to the quantified NP *every skier*, they accepted sentences with the universal quantifier.

From the contrasting results of Experiments 1 and 2, Crain et al. argue that when felicitous contexts are presented, the symmetrical interpretation by children is eliminated. In the story (11) the mother takes a cup of apple cider, but the children are tempted by the sodas. The mother persuades the children to drink apple cider instead, because it will help warm them up. The children each have a cup of apple cider. In this situation, Crain et al. argue that it is felicitous to say "Yes" to Kermit's description *Every skier drank a cup of hot apple cider* because the negation of the sentence was under consideration. Further they mention that the situation also falsifies the symmetrical interpretation of the test sentences because there were extra cups of hot apple cider left over at the end of the story and the extra cups were even highlighted in the story by the children checking that the cups of apple cider were filled to the top. Therefore they conclude that children have full grammatical knowledge of universal quantification and the non-adult-like responses with regard to universal quantification reported by previous research are due to flaws in the experimental design, that is, the non-satisfaction of felicitous contexts.

4 Experiments: English and Korean Children

Against this background I carried out comparable experiments in English and Korean with regard to children's interpretation of universal quantifiers. Experiment I included 59 English primary school children ranging in age from 4;5 to 7;5 with a mean age of 5;8 and Experiment II included 62 Korean kindergarten and primary school children in Korea ranging in age from 4;3 to 7;7 with a mean age of 5;6.

The aim of these experiments was to replicate the phenomenon of quantifier spreading which young children show in their comprehension of universal quantifiers such as *every*, *each* and *all* (and also their Korean equivalents *modun*, *kakkak* and *modun -tul*). Firstly, I investigated the effect of varying the relative order of quantified NPs and indefinite NPs in the simple sentences to see if there were directionality effects.[3] The

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[3] Philip and Aurelio (1991) tried to find out if there is any effect on the incidence of quantifier spreading of placing the universal quantifier *every* in syntactic object position as opposed to subject

phenomenon of right spreading (or forward spreading) with the order of universal quantifiers *every* (*modun*), *each* (*kakkak*) and *all* (*modun -tul*) in the subject position and *a singular noun* in the object position, and the phenomenon of left spreading (or backward spreading) with *a singular noun* in the subject position and universal quantifiers in the object position were controlled in this experiment. Secondly, the difference in children's performance between structures with a transitive verb and an intransitive verb with a prepositional phrase was examined. Finally, comparing the results from English and Korean experiments, I examined whether the same phenomenon is found in the interpretation by English and Korean children.

4.1 Test sentences and Control Contexts

All the test sentences were composed of simple structures with a transitive verb or an intransitive verb with a prepositional phrase. The test sentences were classified into four groups according to the variances:

Group 1 (RT):   Is *every* bear holding a honeypot? (E)[4]
modun kom-i kkultong-ul tulgo isseoyo? (K)[5]
Is *each* bear holding a honeypot?
kakkak-uy kom-i kkultong-ul tulgo isseoyo?
Are *all* the bears holding a honeypot?
modun kom-*tul*-i kkultong-ul tulgo isseoyo?[6]

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position. They found very high rates of spreading errors in both cases, *every/a* and *a/every*, but no significant difference between them : 84% spreading errors in the former and 90% in the latter.

[4] The same types of sentences were constructed for the different pictures by substituting the relevant words. For example, the sentence *Is every caterpillar carrying a ladybird?* was made for the picture [caterpillar-ladybird] and *Is every train pulling a coach?* for the picture [train-coach].

[5] Korean also has universal quantifiers with functions similar to the English quantifiers. It contains strong and weak quantifiers with semantic properties like English, and most quantifiers in Korean can be floated in a sentence like adverbials, such as *all* or *each* in English. The Korean equivalent of *every* is 'modun'; *each* 'kakkak'; and a*ll* 'modwu' (in the case of the use as an adverbial) or 'modun' (in the case of the use as a modifying adjective).

[6] *-tul* is the plural marker in Korean. However, in Korean both expressions with and without the plural marker are acceptable. Here the Korean equivalent of English *every* is spelt out as *modun* and that of *all* as *modun* (NP)-*tul*, though the contrast in Korean is one of preference rather than strict grammaticality.

Group 2 (RINT):   Is *every* ladybird on a caterpillar?
                  modun moodangbulle-ka ebulle-uye isseoyo?
                  Is *each* ladybird on a caterpillar?
                  kakkak-uy moodangbulle-ka ebulle-uye isseoyo?
                  Are *all* the ladybirds on a caterpillar?
                  modun moodangbulle-*tul*-i ebulle-uye isseoyo?

Group 3 (LT):   Is a bear holding *every* honeypot?
                  kom-i *modun* kkultong-ul tulgo isseoyo?
                  Is a bear holding *each* honeypot?
                  kom-i *kakkak*-uy kkultong-ul tulgo isseoyo?
                  Is a bear holding *all* the honeypots?
                  kom-i *modun* kkultong-*tul*-ul tulgo isseoyo?

Group 4 (LINT):   Is there a baby behind *every* mummy elephant?
                  aki khokkiri-ka *modun* umma khokkiri tuye isseoyo?
                  Is there a baby behind *each* mummy elephant?
                  aki khokkiri-ka *kakkak*-uy umma khokkiri tuye isseoyo?
                  Is there a baby behind *all* the mummy elephants?
                   aki khokkiri-ka *modun* umma khokkiri-*tul* tuye isseoyo?

RT: Right Spreading-Transitive
RINT: Right Spreading-Intransitive
LT: Left Spreading-Transitive
LINT: Left Spreading-Intransitive

Six different control contexts were prepared:

Context 1:   extra object & extra different agent
              (There are three bears holding a honeypot each, an extra honeypot not
              being held, and a piglet alone.)

Context 2:   different agent (visual symmetry)
              (Three bears are holding a honeypot each, and a piglet is also holding a
              honeypot.)

Context 3:   many to one, extra different agent

(There are three bears, among which just one bear is holding all three honeypots and the other two are not, just standing, and a piglet alone.)

Context 4:   extra agent
(There are four bears, among them three bears are holding a honeypot each, and a bear alone without a honeypot.)

Context 5:   different object (visual symmetry)
(There are four bears, in which three bears are holding a honeypot each and one bear is holding a bunch of flowers.)

Context 6:   many to one, extra object & extra different agent
(There are three bears, among them just one bear is holding three honeypots and the other two are not, just standing, a piglet alone, and an extra honeypot not being held.)

For the sentences belonging to Group 1, Contexts 1 and 2 have the positive (adult) response "yes," but Contexts 3, 4, 5 and 6 have the negative (adult) response "no." In contrast, in the case of the sentences of Group 2, Contexts 3, 4 and 5 yield "yes" as the right answer, but Contexts 1, 2 and 6 yield "no" as the right answer.   For the sentences of Group 3, Contexts 3, 4 and 5 yield "yes" as the right answer, but Contexts 1, 2 and 6 give the negative response "no."   Finally, for the sentences of Group 4, Contexts 1 and 2 have "yes" as the right answer, but Contexts 3, 4, 5 and 6 have "no" as the right answer.

4.2 Materials and procedures

Children were shown pictures individually and asked Yes/No questions via the use of a tape-recorder. There were 24 pictures corresponding to the six control contexts: the sets of [bear and honeypot]; [caterpillar and ladybird]; [train and coach]; and [baby and mummy elephant]. The same pictures were used in Experiments I and II.
   When the experimenter showed a picture, the child was encouraged to describe the picture by asking questions such as *What can you see here?*, *What are they doing?*, *How many bears are there?*, *How many honeypots are there?*, etc.. Children normally enumerated each item in the picture, for example, "this bear (pointing to each item with their finger) is holding a honeypot, this bear is holding a honeypot, this bear is holding a honeypot as well, but this honeypot has no bear, there is no bear on this honeypot, or nobody is holding this honeypot, and this piglet is alone, he is not holding a honeypot, he is lonely," etc.. Therefore it is clear that the children were conscious of the details of

the picture before they listened to the test question. In this respect, the negation of the proposition in the question, that is, "the condition of plausible dissent" which is suggested by Crain et al. (1996), can be said to be under consideration. That is, for the proposition 'every bear is holding a honeypot' of the sentence *Is every bear holding a honeypot?*, the Context 3, 4, 5 or 6 each provides the situation which demonstrates the negation of the proposition. When those contexts were shown to each child, s/he described them, using the negation, for example, "these two bears are not holding a honeypot, this bear is holding all the honeypots, and also this piglet is not holding a honeypot" for Context 3; "this bear is not holding a honeypot" for Context 4; and "this bear is not holding a honeypot, he is holding flowers" for Context 5, and so on. The children by themselves agreed with the fact that not every bear is holding a honeypot in those contexts. Then the other experimenter played the question on the tape recorder. When a child was not sure of the answer, the question was repeated. When a child answered 'no', the follow-up questions "Why not?" or "Why did you say "no"?" were asked. The responses were ticked 'yes' or 'no', and notes were jotted down on the blank side of the test paper. All the responses and comments by each child were also tape-recorded.

The interviews were carried out on two separate occasions with an interval of around one week between each session. Thirty-five simple questions, each with different pictures, were asked of a child in one session in the order of the sets [bear-honeypot], [caterpillar-ladybird], [train-coach] and [baby-mummy elephant]. Among the thirty-five questions, around ten questions were distracting sentences which were inserted into every two or three main test sentences. These were to prevent children from giving stereotyped responses to the test questions, and also by giving simple sentences which require general knowledge, to have an idea whether they were rational in their responses to the questions, for example, *How many red stars are there?*, *Which circle is the biggest?*, *What sign is this?*, etc..

4.3 Results

One of the general findings from both Experiments is that in the case where the right answer was "no," that is, in the case of pictures which did not correspond to the stimulus sentence, the majority of children responded correctly, giving the negative response "no." The use of "false pictures" induces clear negative responses. On the other hand, when the right answer was "yes," i.e. in the case of pictures which agree with the test sentence, high figures of quantifier spreading errors were found. The second general finding is that no distinction was found in the four different age groups (4, 5, 6 and 7), in sex (boy and girl), in the session (1st and 2nd) or in the four different picture sets: Bear-

Honeypot; Caterpillar-Ladybird; Train-Coach; and Baby-Mummy Elephant. In both Experiments I and II, 7 year old children who were the oldest in the experiments showed the same symmetrical and exhaustive interpretations of all types of test sentences as the younger 4, 5 and 6 years old children do.   Further, no significant difference was found between the quantifiers *every* (*modun*), *each* (*kakkak*) and *all* (*modun* NP-*tul*).

  Overall, children in both Experiment I (English) and Experiment II (Korean) showed high rates of quantifier spreading; with an average 71% errors in the former and   65% in the latter.   In Experiment I, 51% (59 out of 115 trials) right spreading errors were found in the case of transitive sentences; 72% (79/110) right spreading errors in the case of intransitive sentences; 73% (123/169) left spreading errors in the case of transitive sentences; and 86% (31/36) left spreading errors in the case of intransitive sentences. Similarly, in Experiment II, 38% (44/117) right spreading errors were found in the case of transitive sentences; 66% (75/114) right spreading errors in the case of intransitive sentences; 70% (124/176) left spreading errors in the case of transitive sentences; and 78% (28/36) left spreading errors in the case of intransitive sentences. The details are shown in Table 1:

<Table 1>   Overall rates of Experiments I and II

(Unit: %)

	RT	RINT	LT	LINT
Experiment I (English)	51	72	73	86
ExperimentII (Korean)	38	66	70	78

As shown in Table 1, in both experiments, left spreading errors were found significantly higher than right spreading errors: according to the p-values test using 'Binary Logistic Regression', p=.002 in Experiment I; and p<.001 in Experiment II.   Significantly higher spreading errors were also found in the case of the intransitive verb phrases than in the case of transitive verb phrases in both experiments: p=.002 in Experiment I; and p=.004 in Experiment II.   More interestingly, the pattern of significant difference between right/left and transitive/intransitive in Experiment I is parallel to the one in Experiment II, as shown in Table 2:

<Table 2>   Log odds: Right vs. Left and Transitive vs. Intransitive in Experiments I and II

	Experiment I (English)	Experiment II (Korean)
Right vs. Left	-1.12 (0.36) p=.002	-1.53 (0.40) p<.001
Trans vs. Intrans	-1.08 (0.35) p=.002	-1.13 (0.39) p=.004

The figures in Table 2 are log odds ratios, from the logistic regression analysis, for the right-left and transitive-intransitive comparisons, with their standard errors in brackets. That is, the first (second) row shows the natural log of the ratio of the odds of an error in a right spreading (transitive) case to the odds of an error in a left spreading (intransitive) case. This figures: left spreading gives more errors than right spreading, so the odds of an error for left are greater than for right, so the ratio of the odds (right/left) is less than 1, so its log is negative. Similarly intransitive gives more errors than transitive so the log odds ratio (trans/intrans) is also negative. They are not significantly different between the two experiments, as can be seen by comparing the differences with the standard errors: the differences in log odds ratios being -1.12-(-1.53)=0.41 (se 0.54, p=0.45); and -1.08-(-1.13)=0.05 (se 0.52, p=0.92) respectively. ('se' stands for the standard errors of difference calculated.)

4.4 Discussion

As argued by Crain et al. (1996), the context plays an important role in the phenomenon of quantifier spreading. However, we cannot explain away the (cross-linguistic) occurrence of the phenomenon simply on the ground that the context is infelicitous, as suggested by Crain et al. Rather, we have to concentrate on why young children make mistakes in certain contexts which adults do not. What causes the errors in children's interpretation? In other words, what factors give rise to the different interpretation with universal quantification between children and adults? Here I argue that the phenomenon is neither exclusively cognitive nor exclusively linguistic, but is dependent on contributions from the language faculty and from the central system of the child's mind in the sense of Fodor (1983). That is, a non-linguistic cognitive factor seems to be clearly operative in this phenomenon, and conceptual representations caused by this cognitive factor are closely involved in the linguistic representations computed by the language faculty. Then the difference between children's and adults' conceptual representations with universal quantification can be attributed to the interplay between their cognitive abilities and their linguistic abilities as these mature.

Children, like adults, understand the basic property of universal quantifiers: universal quantifiers such as *all*, *every* and *each* function like modifiers which quantify over the noun phrase which contains them. This is proved by children's adult-like affirmative responses to a context which depicts the symmetrical one-to-one correspondence between the agents and the objects, and also by Brooks and Braine (1996)'s experiment in which 4 to 10-year-old children are found to have little difficulty restricting the quantifier *all* to the noun it modifies. When a picture is presented to a child, however, prior to exposure to the test sentence, his or her mind focuses on the individual objects available in the picture, and is 'captured' by the scene or situation in it. He or she makes a quick guess and subconsciously predicts what will be in the test question. When he listens to the taped question, for example, *Is every bear holding a honeypot?*, the objects such as *bear* and *honeypot* and perhaps the verb *hold* are expected, that is, they can be viewed as constituting old information, which has engaged the child's imagination. On the other hand, the quantifier *every* is unpredictable, and so may be more salient to the child. Moreover, pictures in front of a child may have more effect, they may be more salient, than what is said. When the child finds that the picture is not symmetrical, that is, not every individual in the picture is matched, but that there is one 'odd' entity, he responds to the question in the negative without thinking further.

Children interpret the salient word *every* as covering each individual object available in the picture. In their conceptual representation the domain of quantification might be the set of objects (or arguments) available in both visual and auditory inputs. Here I try to analyze this phenomenon in terms of "individual (or argument) quantification" rather than Philip (1995)'s "event quantification," partly on grounds of theoretical parsimony (cf. Brooks & Braine (1996)) and partly on empirical grounds. Regarding the sort of representations the children form from the pictures, the entities such as [a bear], [a piglet] or [a honeypot][7] can be individually shown, but a relationship or an action such as [holding] cannot be shown without showing the individuals involved in that relationship or action. So the entities have some kind of priority over the action. Each of those entities in the picture seems to be treated by the children as having to be put into some sort of thematic relation with another. One problem with appealing to event quantification is that it fails to explain how and when children acquire quantification over individuals after they have acquired quantification over events. Further, it cannot predict children's concern with the extra possible agent, for example, *a piglet*, which is not a part of the whole event in the situation 'x (is) holding y'. As an example, let us

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[7] The bracket [ ] indicates that the items inside it represent concepts or images, distinguishing those from the natural language forms such as 'bear', 'honeypot' or 'piglet'.

look again at one of the pictures which was used as a visual input with the corresponding sentence as auditory input:

<Picture>   bear-honeypot   bear-honeypot
               bear-honeypot   honeypot
                         piglet

Sentence: Is every bear holding a honeypot?
Adult-like response: Yes.
Child response: No, not that honeypot. (and also the piglet has no honeypot)

As discussed above, the quantifier *every* is salient for children and so it plays a dominant role in their interpretation. They treat the quantifier as if it was uttered with heavy stress. Consequently, contrastive stress (note that the test questions do not include any special stress on the quantifier) is given to it so that the focused *every* is automatically raised to the highest position in the structure to be able to quantify over both the first and second arguments.[8]

This individual quantification analysis is supported by the children's reaction to the picture. The children involved in the present experiment generally enumerate the individual entities one by one. For example, to the question *What can you see here?*, they normally answer "a bear, a honeypot, and a piglet, three bears are holding a honeypot, (and pointing to each item and repeating) this bear is holding a honeypot, this bear is holding a honeypot and this bear is holding a honeypot, but this honeypot is not, nobody is holding this honeypot, this piglet is going to get it because he hasn't got it", etc.. This enumeration of each individual entity by children is also found in their responses to the second input, the test question, for example *Is every bear holding a honeypot?*. After their answers "yes" or "no" (they were asked to answer "yes" or "no" in the introduction of the experiment), children normally enumerate each item again, for example, "this bear, this bear, and this bear are holding a honeypot, but this honeypot is left out and a piglet too." Some children preferred to answer without the definite response of "yes" or "no", just saying "only three, three bears are holding a honeypot and one honeypot has nobody and a piglet has nothing."[9] When they are asked to answer with "yes" or "no," they responded as "yes, but" and enumerated the items again. From

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[8] The movement of the focused element to the FP is supported by Brody's (1990) analysis of Hungarian. More interestingly, he argues that universally quantified categories are marked <+f> inherently.

[9] Due to this property, Drozd (1998) argues that children interpret the strong quantifiers such as e*very, each* and *all* as weak quantifiers such as *a*, *many*, *a few*, etc.

their spontaneous reaction to the picture I got a strong impression of the existence of the exhaustive representation which is suggested by Brooks & Braine (1996) in child conceptual representation. They assign the exhaustive representation to the sentence with a universal quantifier so that the quantifier covers all the entities available in their conceptual representation in its scope.

Even though children and adults have access to the same cognitive mechanisms, and further the quantifier might be salient to both of them because of its intrinsic property (i.e. the quantifier as focused element), their conceptual representations could be different because their representations are affected by their different language faculty. That is, the interpretation with quantification might be done through the close interaction between the conceptual representation and the language faculty.[10] Then the difference between children's and adults' conceptual representations might be attributed to the role of the language faculty, i.e. their grammatical knowledge. Focusing on this fact, in the next section I specify the difference between children and adults in their grammatical knowledge with universal quantification and explain it with relation to crosslinguistic data.
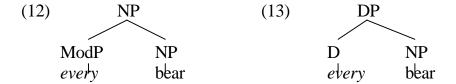
5 Universal quantifiers: from modifiers to functional heads

In this section I focus on the difference between children and adults in their grammatical knowledge of universal quantifiers. It is assumed that children know the grammatical function of the quantifier as a lexical category, i.e. a quantifier is a binder or a modifier, but they might be not yet aware of its syntactic function as a determiner, that is, as a functional head of the determiner phrase which influences the interpretation of universal quantifiers. Specifically, in adult grammar, the quantifier is treated as a functional head with its own complement within its own extended projection, at least in English.[11] The quantifier itself cannot be moved out of its extended projection and if it has to be moved, the whole quantifier phrase (Q+NP) has to be moved. However, in child grammar, the functional category DP seems not to be completely developed at this stage and thus the D-element is freely detached from the category which it belongs to and raised to the highest position to range over all arguments available in the sentence. Therefore it is claimed that young children seem to treat a universal quantifier such as *every*, *all* or *each*

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[10] See Kang (in prep.) for the details of the inner structure of mental comprehension and the inter-communication between the conceptual representation and the language faculty.

[11] Giusti (1991; 1997) argue that quantifiers are lexical categories, external to DP.

as a modifier which is dominated by the maximal projection NP as in (12), not as a functional head D of DP as in (13), as adults do:

(12)   NP   (13)   DP

    ModP   NP   D   NP
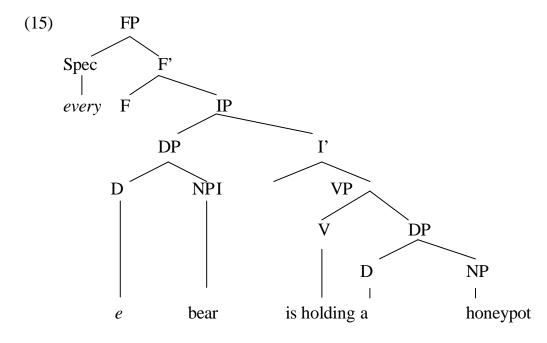   *every*   bear   *every*   bear

In (12) the quantifier *every* occurs in the adjoined position as a modifier, but in (13) it heads a functional projection DP. According to this modifier view, the relationship between *every* and *bear* is not one between a head and a complement, that is, *every* is not treated as a projecting head, but as a natural language binder which modifies the noun *bear.* Therefore, in the children's interpretation universal quantifiers can be separated from their complement and raised to the highest position of the sentence to get sentential scope.

  This kind of semantic detachment by children occurs everywhere: from the subject position, the object position, the adjunct position, and even from a position in an embedded sentence to take the whole matrix sentence in its scope. An example of each is shown in (14):

(14) a. *Every* bear is holding a honeypot.
      b. A caterpillar is carrying *every* ladybird.
      c. There is a baby behind *every* mummy elephant.
      d. There is a chair that *every* cat is sitting on.

As an example, the semantic representation of the sentence (14a) will be as in (15):

(15)

```
              FP
          ／      ＼
       Spec        F’
        |       ／    ＼
     every   F          IP
              ／        ＼
           DP              I’
         ／   ＼        ／    ＼
        D      NPI    VP
        |       |    ／  ＼
        |       |   V      DP
        |       |   |    ／  ＼
        |       |   |   D      NP
        |       |   |   |       |
        e      bear is holding a  honeypot
```

As we can see, the quantifier *every* is detached from its complement *bear* inside the subject DP *every bear* and raised to the Spec of FP. The movement of the focused element to the FP is supported by crosslinguistic data, for example, consider Brody's (1990) analysis of Hungarian. Brody assumes that an additional extended projection FP (Focus Phrase) exists and argues that F, F' and FP are present only in sentences that contain a focused element. That is, this projection is optional so that it does not have to be present when the sentence does not include any focused category. Further he argues that universal quantifier phrases are <+f> marked inherently, but this inherent <+f> marking for uq-phrases may only be optional. Therefore, when the uq-phrase appears in sentences without focus, it is not <+f> marked because <+f> categories can only appear in sentences with FP's where all <+f> categories must be in FP at LF. The present analysis with children's universal quantification supports these assumptions suggested by Brody.

  If the status of quantifiers in child grammar was as a functional head D of DP, this kind of subextraction could not be syntactically accounted for. Ross's Left Branch Condition, which specifies that movement of an element in the left-branch position is possible only by pied-piping the entire phrase, fails to explain this phenomenon. Further Huang (1982)'s CED (the Condition on Extraction Domains) which asserts that adverbial phrases and subject NPs constitute islands for extraction, since they are not L-marked, and Abney (1987)'s generalization about functional heads, that is, the impossibility of functional heads being detached from their complement by movement, cannot account for it. All standard linguistic conditions assert that if the item is to move,

the entire phrase in which it belongs has to be moved by pied piping. I am not here interested in proving the universality of these conditions. Rather, concentrating on evidence from natural language data, I am trying to explain our phenomenon within the framework of standard linguistic theory. Therefore, I assume that functional heads cannot be separated from their complements and, I argue that young children treat a universal quantifier as a modifier (a natural language binder), but not as a determiner, i.e. a functional head of the determiner phrase. It follows that the phrase *every bear* in the sentence *Every bear is holding a honeypot* is specified as an NP which includes a modifier *every* and a head noun *bear*, not as a DP.

This modifier view can be supported by crosslinguistic data which show the subextraction of a left-branch element out of its own extended projection: for example, Doetjes et al.'s (1998) analysis with regard to the migratory property of some degree expressions (such as *more*, *less* and *enough* as modifiers); the categorial status of demonstratives in Rumanian and Modern Greek in the analysis of Giusti (1997) and also in Korean (Kang (in prep.)) (demonstratives as modifiers of the noun); and children's naturalistic language data in their acquisition of Dutch (cf. van Kampen (1997) and Hoekstra and Jordens (1994)). They all show that the elements which belong to the left-branch of the extended projection can be stranded and moved to another position. Further, Corver (1990) points out that this kind of subextraction occurs even in adult languages such as Polish, Russian and Latin. For example, the following examples of wh-subextraction in Polish is a well-formed sentence in adult grammar (Corver (1990: p.330)):

(16)   jaki$_i$ wykreciles   [t$_i$ numer]?
         Which$_i$ (you) dialed   [t$_i$ number]?
         (Which number did you dial?)

He explains this by arguing that nominal arguments in Polish lack the DP-structure, and therefore allow wh-extraction. The subextracted wh-element is assumed to be an extractable adjunct in his analysis, not a head of a functional projection.

Even though this kind of syntactic detachment is not sufficient to explain the semantic interpretation that children provide for universal quantification, we have a strong impression that the migratory property of the degree expressions such as *more*, *less* and *enough*, the subextractions of wh-elements and topicalized arguments in Dutch child grammar, and the misplacement of expressions with special stress from naturalistic children's data (e.g. "*Only* I want this one" for the sentence "I want *only* this one") can be closely related to the unique interpretation of the sentences with universal quantifiers shown in child grammar. These are argued in detail in Kang (1999).

The delay in the emergence of functional categories in language acquisition has been well discussed in the relevant literature though this is generally at a much younger age. According to Radford (1990), the phrasal categories such as NP, VP, AP and PP emerge around 20 months after birth, and the use of functional words such as *a*, *the*, *this*, *that*, etc. starts around 24 months of age. Compared to these periods, the proper use (or interpretation) of phrases with a universal quantifier apparently seems to be delayed till much later. I assume that the delay is attributable to the intrinsic property of quantifiers, that is, because quantifiers are inherently focus marked, and this property influences children's interpretation with regard to universal quantification. On the other hand, for adults, their grammatical knowledge is precise enough to determine one particular interpretation and abstract away other irrelevant conceptual representations.

6 Conclusion

I conclude that the phenomenon of quantifier spreading has to be analysed from both cognitive and linguistic points of view. It can be counted as a clearly cognitive phenomenon because the visual input, the picture, plays a key role in the children's conceptual representation. At the same time, it has been argued that the phenomenon must be clearly linguistic, due to the fact that the spreading errors are only found in a certain young age group, putatively up to the age of 7 or 8 and disappear after then. It is naturally related to the debate on language development, specifically to the two main hypotheses of 'continuity' and 'maturation' regarding the (controversial) development of functional categories in child grammar. The functional category DP seems not to be completely developed at this stage and thus the D-element is freely detached from the category which it belongs to and raised to the highest position to range over all arguments available in the picture and the sentence.

In general, the disagreement in the literature on how to explain children's quantifier spreading can be attributed to a failure to integrate linguistic and non-linguistic aspects of the phenomenon. The current study, spelt out in more detail in Kang (in prep.), is a step towards such integration.

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