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# Quantifier Acquisition: Presuppositions of “every” \*

Kazuko Yatsushiro  
Zentrum für allgemeine Sprachwissenschaft

yatsushiro@zas.gwz-berlin.de

## Abstract

Three components of determiner meanings – truth conditions, implicatures, and presuppositions – have been identified. One of the major findings in acquisition, related to the truth conditions of the quantifiers, has been that children go through at least two stages of non-adult interpretation of the quantifier *every* (Philip, 1995). More recently, researchers (Noveck, 2001; Gualmini *et al.*, 2001; Chierchia, 2001b; Papafragou & Musolino, 2003) have shown that children understand quantifiers logically in a context where adults derive scalar implicatures (for example, *some* vs. *all*). In this paper, I focus on the third component of the determiner meaning, presupposition. Using Felicity Judgment Task, I argue that children acquire the lexical presupposition earlier than the implicated presupposition, and that the acquisition path of implicated presupposition resembles more closely that of scalar implicatures.

## 1 Introduction

If I said the following sentences in (1), and if you know that I have no horns, just one nose, and two hands (rather than three), you might find my utterances strange.

- (1) a. Every horn on my head is sharp.  
b. Every nose of mine is red in this picture.  
c. Every hand of mine is dirty.

A “better” way of expressing (1-b) and (1-c) would be the following (there is no better way of talking about how sharp my non-existent horn is):

- (2) a. My nose is red in this picture.  
b. Both hands of mine (=Both of my hands) are dirty.

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\*I would like to thank Uli Sauerland Francesca Foppolo, Orin Percus, and the audience at *Sinn und Bedeutung*, especially Irene Heim, for useful suggestions and discussions. All the remaining errors are, of course, my own.

I assume that the reason adults feel that the sentences in (1) are strange is because these sentences violate presuppositions. What we try to find out in this paper is whether children also perceive the awkwardness of the sentences as in (1).

The topic of this paper is children’s first language acquisition of presuppositions associated with determiners, in particular *every*. Three components of determiner meaning have been identified in semantics: truth conditions, implicatures, and presuppositions. The acquisition of truth conditions of determiners, mostly on the universal quantifier, has been investigated since 1960s (Inhelder & Piaget 1964; Roeper & Matthei 1974; Philip 1995; Crain & Thornton 1998, among others). One of the main findings in this area is that children go through at least two stages, where the comprehension of “every” is non-adult: In stage 1 approximately up to age 4, children would accept sentence (3) in both scenarios in (4). In stage 2 (approximately age 5 to 7), children reject sentence (3) as a description of either scenarios.

(3) Every circle is black.

(4)



As for implicatures, Noveck (2001) observed that children give “logical” responses much more frequently than adults do, when given a sentence with a scalar implicature items, such as *some*, and the results of other researchers’ have corroborated his result (Papafragou & Musolino 2003; Chierchia 2001b; Gualmini *et al.* 2001 among others).

One remaining area that has not so far received much attention is the acquisition of presuppositions. It has been observed that the use of the definite determiner by children is not adult-like (Karmiloff-Smith (1979); Schaeffer & Matthewson (2005)), but not much else has been discussed so far. The main focus of this paper is to discuss the missing part, hoping to shed a new light on our understanding of children’s acquisition of determiner meanings.

## 2 Two types of presuppositions

This paper bases its theoretical background on a theory of presupposition proposed by Heim (1991). Heim (1991) proposes that there are two types of presuppositions: lexical and implicated. According to her theory, lexical presuppositions are part of lexical meaning of a lexical item. Implicated presuppositions, on the other hand, are derived in much the same way as implicatures. Let us quickly review her theory, using definite and indefinite determiners.

Heim (1991) proposes that an expression of the form [*the*  $\zeta$ ] is associated with the following two presuppositions, shown in (5).

- (5) a. Existence presupposition: There exists  $\zeta$ .  
 b. Uniqueness presupposition: There is a unique  $\zeta$ .

A clause of the form [*the*  $\zeta$ ] $\xi$  has truth value just in case these two presuppositions are satisfied. That is, the use of the expression [*the*  $\zeta$ ] is limited to contexts where (i) there exists  $\zeta$ , and (ii) there is a unique  $\zeta$ .

This contrasts with the indefinite determiner *a*. Consider the contrast in (6). As marked by #, (6-a) is perceived strange by adult speakers. It sounds as if there are more than one biological father of the victim, and the speaker merely interviewed one of them. As our world knowledge tells us that this cannot be the case, the sentence is perceived strange.

- (6) a. #I interviewed a biological father of the victim.  
 b. I interviewed the biological father of the victim.

It seems, then, that the use of the expression [*a*  $\zeta$ ] is compatible with a context where there is no unique  $\zeta$  (and not compatible with a context where there is a unique  $\zeta$ ).

One way to explain the oddness perceived from (6-a) is to say that the indefinite determiner has a non-uniqueness presupposition, as shown in (7).

- (7) [*a*  $\zeta$ ] $\xi$  is:  
 a. true, if there are at least two  $\zeta$  and at least one  $\zeta$  is  $\xi$ .  
 b. false, if there are at least two  $\zeta$  and neither  $\zeta$  are  $\xi$ .  
 c. undefined, if there are less than two  $\zeta$ .

This hypothesis, however, predicts that for the expression [*a*  $\zeta$ ] $\xi$  to have a truth-value, there has to be at least two  $\zeta$ , which is not in accord with our intuition, as Heim (1991) points out. It might well be that after surveying the matter further, it turns out that there is only one  $\zeta$  in the world after all, and the use of [*a*  $\zeta$ ] allows this possibility.

Following Hawkins (1981), Heim proposes that the effect that we observe regarding the indefinite determiner can be explained by assuming that the indefinite determiner does not have any lexically specified presuppositions. The effect that we observe, that the expression [*a*  $\zeta$ ] cannot be used in a context where it is known that there is only one  $\zeta$ , can be derived in much the same way as the scalar implicature, using a novel pragmatic maxim called *Maximize Presupposition*. Roughly speaking, Maximize Presupposition forces a speaker to use the expression that is associated with the strongest presuppositions possible that are compatible with the speaker’s knowledge.

Between the definite and indefinite determiners, the definite determiner makes stronger presuppositions. This is so because the definite determiner is associated with two pre-

suppositions, while the indefinite determiner is not associated with any. When both presuppositions of the definite determiner are satisfied, therefore, the definite determiner *must* be used.

The contrast we observe in (6), therefore, is due to Maximize Presupposition. The definite determiner has two lexical presuppositions. Therefore, the use of the definite determiner is forced whenever these two presuppositions are met. That is, the expression [*the*  $\zeta$ ] must be used whenever there exists a  $\zeta$  and there is a unique  $\zeta$  in the context. When a speaker uses the indefinite determiner, on the other hand, it shows that at least one of the presuppositions of the definite determiner must not be met, according to the speaker’s knowledge.

Let us now turn to the universal quantifier of English *every*, and German *jeder*. *Every* and *jeder* have the following three presuppositions (Sauerland (to appear)):

- (8)    a. Existence Presupposition  
        b. Anti-uniqueness presupposition  
        c. Anti-duality presupposition

The existence presupposition requires that the first argument of *every* not to be an empty set. This is why (1-a), repeated here in (9), is judged strange: in (9), the argument of *every*—a set formed by *a horn of mine*—would be an empty set, although the sentence presupposes that it should not be.

- (9) #Every horn on my head is sharp.

The anti-uniqueness presupposition, on the other hand, is satisfied when the first argument of *every* is not a singleton-set. This is why (1-b), repeated here in (10-a), is perceived odd: there will be only one member in the set *a nose of mine*. The anti-duality presupposition prohibits the argument of *every* to be a set containing only two members, and hence, the awkwardness of (10-a). When these presuppositions are not met, the sentences are perceived odd.

- (10)    a. #Every nose of mine is red in this picture.  
        b. #Every hand of mine is dirty.

A sentence is either true or false only when these three presuppositions are satisfied.

Among the three presuppositions associated with *every*, only the existence presupposition is a lexical one. The other two, the anti-uniqueness and anti-duality presuppositions, are implicated presuppositions. That is to say that the anti-uniqueness and anti-duality presuppositions are not part of lexical meaning of *every*.

Recall that the definite determiner *the* has two lexical presuppositions: the existence and uniqueness presuppositions. This is why the use of *every* in (11-a) is strange, compared to (11-a), which is with the definite determiner *the*.

- (11) a. #I interviewed every biological father of the victim.  
 b. I interviewed the biological father of the victim.

In a context where there is/can be only one biological father of the victim, the use of (11-a) is perceived strange, because its use implicates that the sentence that makes stronger presuppositions, (11-b), is not compatible with the actual world (because of the Maximize presupposition).

### 3 Scalar implicatures and their acquisition

Let us compare how scalar implicatures arise and how the implicated presuppositions are derived. Consider the following examples. It has been assumed that *some* and *all* are scalar alternatives. The use of the expression [*some* ζ] implicates that the use of [*all* ζ] is not compatible with the actual world. This is because the situations that are compatible with a sentence with *some* are a subset of the situations that are compatible with a sentence with *all*, and because of Gricean reasoning (Maxim of Quantity), a speaker has to use *all* over *some*, if the actual world is compatible with the statement with *all*. Hence, if a speaker utters (12-a), the hearer concludes that (12-a) must not be compatible with the actual world, since if it were, the speaker would have used (12-a) instead of (12-a). Because of this reasoning, the speaker concludes that (12-c) must be true.

- (12) a. Some children are 6 years old.  
 b. All the children are 6 years old.  
 c. Not all children are 6 years old.

This operation is reminiscent of what we have seen with the presuppositions. In fact, Heim (1991) proposes that they use at least partially the same mechanism.

Studies on the first language acquisition of scalar implicatures, therefore, are important precedent. In the language acquisition literature, Noveck (2001) was one of the first to report about children’s acquisition of scalar implicatures.<sup>1</sup> Noveck (2001) observed that when asked to judge whether they agreed with the “underinformative” sentences, use of “some” when “all” is compatible with the actual world, children were more likely to give logical responses, agreeing to statements that are underinformative. Underinformative sentences are truth-conditionally true statements, although they are pragmatically infelicitous because more informative sentences are actually compatible with the actual world. Some example sentences are shown below.

- (13) a. Some giraffes have long necks. (cf. All giraffes have long necks.)

<sup>1</sup>Earlier studies include Braine & Rumain (1981) and Smith (1980)). Braine & Rumain (1981) have shown that children tended to use the disjunction *or* inclusively, while adults used it exclusively, which is the more pragmatic use of the disjunction. Smith (1980) showed that children treat *some* as being compatible with the situation where *all* must be used.

- b. Some elephants have trunks. (cf. All elephants have trunks.)

While adults accepted underinformative sentences only 41% of time, children of ages 7-8 and 10-11 did so 89% and 85% of the time, respectively.<sup>2</sup>

If, in fact, the reason why children tend to give more logical responses than the adults do, accepting underinformative sentences more frequently, has something to do with the use of pragmatic mechanism, used for the calculation of the scalar implicatures, we predict that children should have the same kind of difficulties with the implicated presuppositions. With the result from the acquisition of scalar implicatures and Heim’s theory of presupposition, we make the following predictions about the acquisition of presuppositions:

- (14) a. The two types of presuppositions may be acquired differently. Specifically, we predict that lexical presuppositions are acquired earlier than the implicated ones.  
 b. The acquisition path of implicated presuppositions should correlate that of scalar implicatures.

The goal of the experiment that is presented in the next section is to find out whether these predictions are borne out.

## 4 Experiment: Felicity Judgment Task

In this experiment, we tested children’s understanding of presuppositions associated with *every* and scalar implicature associated with *some* (some = not all), using Felicity Judgment Task.

### 4.1 Felicity Judgment Task

In Felicity Judgment task, the subject is first shown a context in the form of an acted out scenario or a picture. After the context is presented, two experimenters, each manipulating a puppet, offers different ways of depicting the context. The two alternative sentences are truth-conditionally equivalent, both being true. One of the sentences is more felicitous in the given context than the other, however. This task was designed to find out children’s understanding of the felicity of a sentence within a given context (Gualmini *et al.* (2001); Chierchia (2001b))

This task was designed to find out children’s understanding of the felicity of a sentence within a given context. The two sentences, therefore, are both truth-conditionally true, although one of the sentences is more felicitous in the given context than the other (Gualmini *et al.*, 2001; Chierchia, 2001b).

<sup>2</sup>Subsequent works by Gualmini *et al.* (2001); Chierchia (2001a) and Papafragou & Musolino (2003) all corroborate Noveck’s result, although they show that different methodologies lead to varying results.

## 4.2 Goals

There were two goals with this experiment. One is to test whether children acquire implicated presuppositions differently from the lexical ones. Recall that our hypothesis is that children would acquire these two types of presuppositions differently. Furthermore, we hypothesize that children acquire lexical presuppositions earlier than the implicated ones. Our goal is to find out whether these two predictions are borne out. The second goal is to compare the acquisition path of the scalar implicature and that of implicated presupposition. As mentioned above, it has been observed that children do not derive the scalar implicatures as often as adults do. If this is due to the pragmatic mechanism required to derive scalar implicatures, and if the same mechanism is used in deriving implicated presuppositions, it is predicted that the acquisition paths of scalar implicatures and implicated presuppositions correlate.

## 4.3 Participants

Total of 120 children (30 children each from four different age groups, 6 (6;1–6;11, mean age=6;5), 7 (7;0–7;11, mean age=7;5), 8 (8;0–8;11, mean age =8;5), and 9 (9;0–9;9, mean age=9;4) years old) participated in this study. Children were recruited from two different public schools and one private school in Berlin, Germany. In addition, 21 adults (undergraduate student taking Introduction to Linguistics at Humboldt Universität zu Berlin) participated as control.

## 4.4 Materials and Procedure

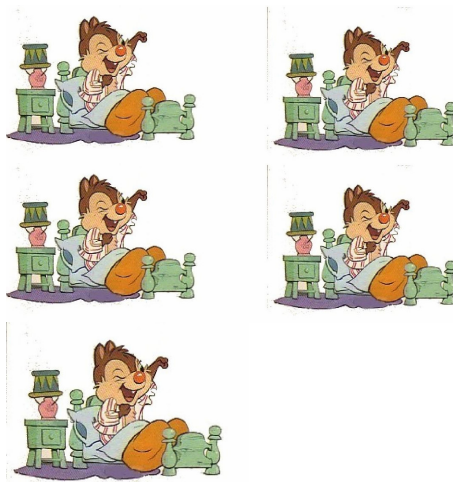
In the present experiment, participants were presented with a series of 23 pictures, shown on a computer screen. For each picture, two alternative sentences were offered to the subject by two puppets that were manipulated by the experimenters. The alternative sentences described the context depicted in the pictures. After each puppet uttered its sentence, the subject was asked to reward the puppet who said it better by placing a bead in a box in front of each puppet. There were five items each of the three types of target constructions. Two lists were prepared, and subjects were randomly assigned to one of the lists. The lists were created in the following fashion: As there were 21 pictures (excluding two warm up items/pictures), we divided the pictures into two groups (10 and 11 pictures in each group). In one of the lists, the Experimenter 1 uttered the more felicitous sentences for the first group of pictures, and in the other lists, she uttered the more felicitous sentences for the second group of pictures. The order of the pictures remained constant.

The three conditions, as described in section 4.2, are scalar implicature, implicated presupposition, and lexical presupposition. To test the acquisition of scalar implicature, we used the contrast between *einige* ‘some’ and *alle* ‘all’. One of the pictures used for this condition and the sentences presented for this picture is shown in (15).<sup>3</sup> In (15),

<sup>3</sup>The pictures were originally created and used by F. Foppolo (2006), in Italian. I thank Francesca

there are five chipmunks in the context, and all five of them are waking up. The sentence with *einige* ‘some’ and the one with *alle* ‘all’ are both truth conditionally true, but the sentence with *alle* is more informative than the sentence with *einige*. As the sentence with the more informative alternative, *alle*, is compatible with the actual world (the picture), the speaker must choose/utter the sentence with *alle* over the one with *einige*. That is, the sentence with *alle* is the more felicitous alternative between the two. If the subject is capable of calculating the scalar implicatures, he/she should reward the puppet which uttered the sentence with *alle*.

- (15) a. Alle Streifenhörnchen wachen auf.  
 all chipmunks wake up  
 ‘All the chipmunks are waking up.  
 b. Einige Strefenhörnchen wachen auf.  
 some chipmunks wake up  
 ‘Some chipmunks are waking up.



To test the acquisition of implicated presuppositions, we used one of the implicated presuppositions associated with *jeder* ‘every’, namely, the anti-uniqueness presupposition. A sentence with *jeder* and the one with the definite determiner, *der/die/das* ‘the’, were

Foppolo for letting me use her pictures. The sentences, which were originally in Italian, were translated into German.



presented as the two alternative sentences. The reason *der/die/das* is the alternative for *jeder* in this condition is because *der* has the lexical existence and uniqueness presuppositions, while the only lexical presupposition of *jeder* is the existence presupposition. Hence, when both of the presuppositions are satisfied, a speaker has to use *der*, rather than *jeder* because of Maximize Presupposition.

One of the pictures used for this condition and the alternative sentences presented for this picture are shown in (16). There is a girl playing soccer in the picture. Both of the presuppositions associated with the definite determiner *das*—the existence and uniqueness presuppositions—are satisfied in the context, and hence, the sentence in (16-a) must be used over the one in (16-a). That is, while both (16-a) and (16-a) are truth-conditionally true, (16-a) is more felicitous than (16-a), and therefore, a speaker must use (16-a) in the context in (16).

- (16) a. Das Mädchen hier spielt Fussball.  
           the girl       here plays soccer  
           ‘The girl here is playing soccer.’  
       b. Jedes Mädchen hier spielt Fussball.  
           every girl       here plays soccer  
           ‘Every girl here is playing soccer.’



To test the acquisition of lexical presupposition, we used the lexical presupposition associated with *jeder*, the existence presupposition. Subjects were presented with a sentence with *jeder* and its alternative sentence with *kein* ‘no’.

The alternative sentence that was offered contained the lexical item *kein* ‘no’. *Kein*  $\zeta$  denies the existence of  $\zeta$ , therefore, is the relevant alternative to *jeder* with respect to the existence presupposition. We did not use a minimal pair for this paradigm, however, but instead, used *kein* in a construction with an expletive. This construction was chosen because it seems that *kein*  $\zeta$  has an existence presupposition when it is in the sentence initial position, as in (17-a), compared to non-sentence initial position as in (17-a), or in a construction with an expletive, as in (17-c). (17-c) was chosen because (17-c) more clearly denies the existence, compared to (17-a).

- (17) a. Keine Frau sitzt auf dem Stuhl.  
no woman sits on the chair  
'No woman is sitting on the chair.'
- b. Hier sitzt keine Frau auf dem Stuhl.  
here sits no woman on the chair  
'No woman is sitting on the chair.'
- c. Hier gibt es keine Frau, die auf dem Stuhl sitzt.  
here exists it no woman who on the sofa sits  
'There exists no woman who is sitting on the chair here.'

An example from this condition and the sentences for the picture are shown in (18).

- (18) a. Hier gibt es kein Mädchen, das im Sandkasten spielt.  
here exists there no girl that in-the sandbox plays  
'There is no girl here that is playing in the sandbox.'
- b. Jedes Mädchen hier spielt im Sandkasten.  
every girl here plays in-the sandbox  
'Every girl here is playing in the sandbox.'



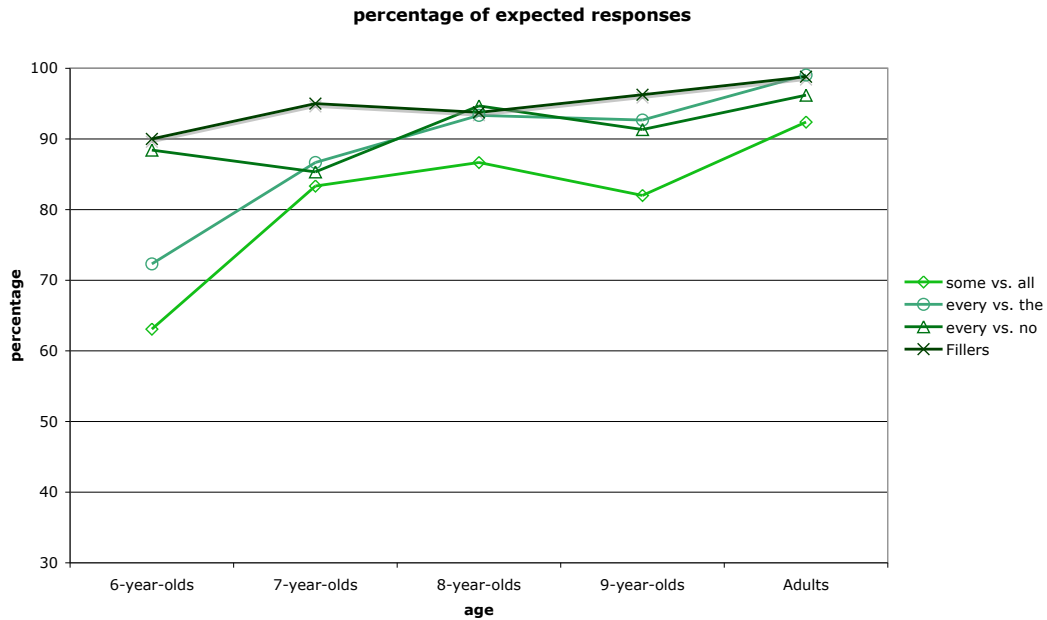
There were 5 pictures for each of the three types of target conditions. There were two warm-up items at the beginning of the experiment for familiarization purposes. There were 6 filler items.

#### 4.5 Result

The graph in (19) shows how often a subject gave an “expected response”. An expected response here is to choose the more felicitous alternative between the two sentences presented for the picture.

As can be seen in (19), the rate of expected responses is lower for the items for *einige vs. alle* ‘some vs. all’ and for *jeder vs. der* ‘every vs. the’ for the six-year-olds than that for *jeder vs. kein* ‘every vs. no’. The rate of expected responses for both conditions go up,

however, for the seven-year-olds. Statistical analysis (Wilcoxon test) showed that the differences between the rate of expected responses for six-year-olds and seven-year-olds were statistically significant for *einige vs. alle* and *jeder vs. der*, but not for *jeder vs. kein* ( $P=0.0002$  for *einige vs. alle*,  $P=0.0016$  for *jeder vs. der*, but  $P=0.12$  for *jeder vs. kein*. A second test, Friedman-Test, confirmed this result as well.)



Recall that one of the predictions was that children acquire lexical presuppositions earlier than implicated presuppositions. According to the result shown above, the prediction seems to be borne out.

#### 4.6 *Beide* ‘both’-responses

There were a number of children who expressed that both alternatives were fine for the given context (henceforth, *beide*-responses). Following is a list that shows how many items per age and condition were responded as both alternatives being acceptable for the given context.

type of items	6-yr-olds	7-yr-olds	8-yr-olds	9-yr-olds	total
some vs. all	35/150	11/150	11/150	7/150	64
every vs. the	29/150	10/150	7/150	3/150	49
every vs. no	0/150	0/150	2/150	0/150	2
Fillers	2/240	1/240	1/240	0/240	4
total	66	22	21	10	119

There were total of 24 subjects (11 6-year-olds, four 7-year-olds, six 8-year-olds, three 9-year-olds) who gave the *beide*-response to at least one of the items. Among the three target conditions, 53.8% of the *beide*-responses were obtained with the scalar implicature items, and 41.2% of them occurred with the implicated presupposition items. There were only two trials from the lexical presupposition items in which a subject gave the *beide*-responses (only one subject)<sup>4</sup>.

It should be noted that choosing both alternatives to be acceptable was not an option offered to the subjects. We introduced the experiment as a game called *Wer hat es besser gesagt?* (‘who said it better?’), encouraging the subjects to choose only one of the puppets who “said it better”. It suggests, therefore, that for those subjects who gave the *beide*-response, the two alternative sentences were equally felicitous in the given context.

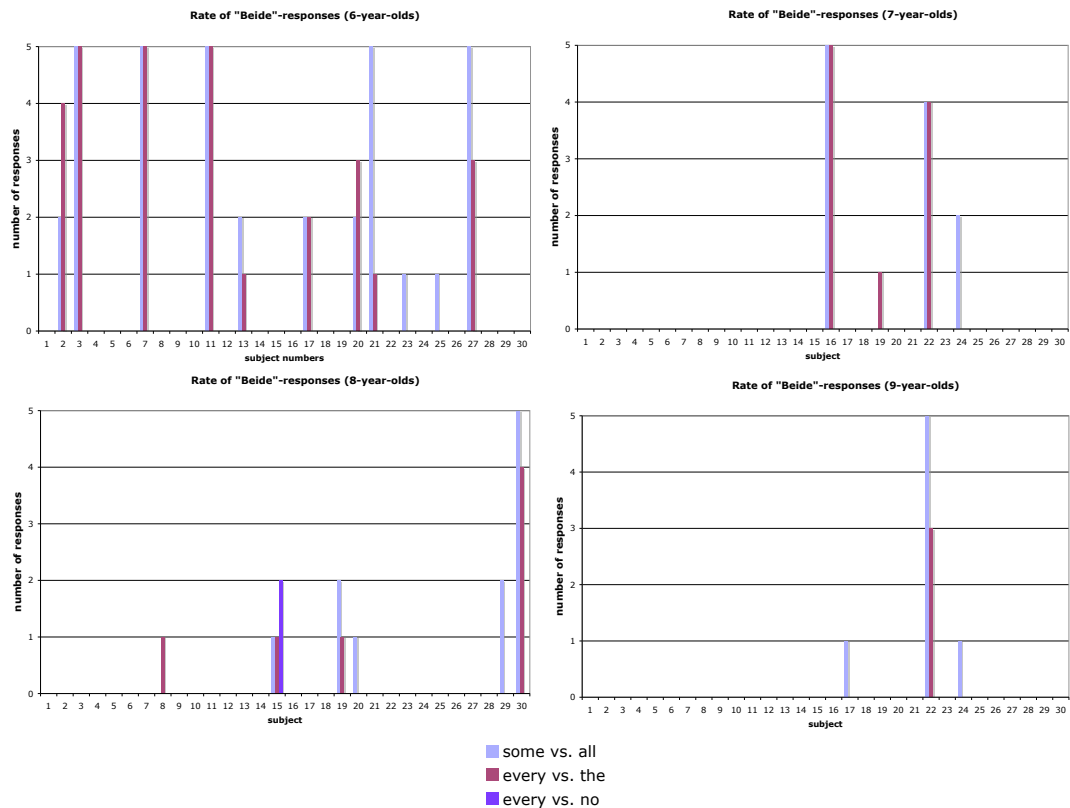
Although further investigation is necessary to explain why some of the subjects gave *beide*-responses at all, I would like to point out that 95% of the *beide*-responses occurred with the *scalar implicature* and *implicated presupposition* items. As discussed in earlier sections, one difference between the existence presupposition on the one hand and the anti-uniqueness presupposition and scalar implicature, on the other, is that the former is a part of lexical meaning of the lexical item *jeder*, while the latter arises due to pragmatic mechanisms (Maximize Presupposition and Maxim of Quantity). It may be that children have difficulties with these pragmatic maxims.

Let us discuss about the subjects who gave the *beide*-response to at least one of the items. The general trend is that many of the subjects who gave the *beide*-response to the implicated presupposition did so to the scalar implicature items as well. Consider 6-year-olds as an example. There were 11 6-year-olds who gave the *beide*-response to at least one of the items. Among these 11 children, nine of them gave the *beide*-response to both scalar implicature and implicated presuppositions. Two of them gave the *beide*-response only to a scalar implicature item. It seems, therefore, that there is some kind of dependency between the *beide*-responses for the implicated presupposition conditions and that for the scalar implicature conditions.

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<sup>4</sup>There were two adult control subjects who gave the *beide*-response to one of the *einige vs. alle* condition items.

(19)



Statistical analysis (two-tailed Fisher Exact Test) reveals that the significance of the association between the *beide*-response for the anti-uniqueness presupposition and that for scalar implicature (independent of age) is statistically significant ( $P=4.3e-12$ , Phi coefficient=0.73).

## 5 Conclusion

What we tried to do in this paper is to investigate whether we find support for Heim’s (1991) theory of presuppositions from the first language acquisition of presuppositions associated with the universal quantifier. We have designed an experiment to test following two hypotheses: (1) the Lexical presupposition of an item is acquired earlier than the implicated presupposition of the same item; (2) the acquisition of implicated presuppositions take similar path as that of scalar implicatures.

Using Felicity Judgment task, it was shown that the lexical presupposition associated with *jeder*, the existence presupposition, is acquired earlier than the implicated one, the anti-uniqueness presupposition, confirming the first prediction.

Although we do not have concrete evidence for the second hypothesis, there are a couple of phenomena that group the implicated presupposition and scalar implicature acquisi-

tion together. One is how the rate of expected responses go up from the age 6 to age 7. The statistical analysis showed that the difference between the rate we obtained from the 6-year-olds and that from the 7-year-olds are significant only for the scalar implicature items and implicated presuppositions, and not for the lexical presupposition.

The second is the *beide*-responses. It was shown that children accepting both alternatives for a given context occurred mostly with the scalar implicature and implicated presupposition items, only one subject gave this type of response to the lexical presupposition item. Statistical analysis confirmed that the association between the *beide*-response for the anti-uniqueness presupposition items and that for the scalar implicature items was significant.

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