Young children understand *some* implicatures

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1 Introduction

Various recent studies have claimed that children have difficulty using contrastive stress in language comprehension (Solan, 1980; Gualmini et al., 2003; McDaniel et al., 1992; Reinhart, 1999, 2004) and that failure to access alternatives generated by focus may create problems for interpreting sentences with *only* (Paterson et al., 2003). Other researchers have shown that children also have difficulty with scalar implicatures (Noveck 2001, Papafragou and Musolino 2003, Musolino 2004). In this paper we demonstrate that children are correctly able to access a quantity implicature associated with focused *some*, while correctly not associating such an implicature when *some* is non-presuppositional. However, children do not always behave in an adult-like manner, by failing to enforce a scalar implicature with unstressed *some* in presuppositional contexts.

2 Conversational Implicatures

Grice 1975 introduced the notion of a *conversational implicature* to account for the fact that sentences can imply things that are not directly encoded as part of their meaning. Instead, the implicatures are computed as a relation between what is said and what could have been said based on general principles of cooperation between participants in a conversation. For our purposes, the conversational maxim of Quantity given in (1) is relevant. This essentially states that a speaker will not use a weaker statement when he or she has knowledge that the stronger statement is true.

(1) *Maxim of Quantity*
Give no more and no less information than is required.

An important class of implicatures discussed by Horn 1972 is that of *scalar implicatures*. Scalar implicatures are quantity implicatures that arise out of elements that can be placed on some scale of informativenes. Quantifiers, numerals and disjunction are common examples which give rise to scalar implicatures, as shown in (2).

(2) *Context:* Did John eat some cookies?
   a. He ate some.
      (implicates he did not eat all of the cookies.)
   b. He ate 4.
      (implicates he did not eat more than 4.)
   c. He ate the chocolate one or the lemon one.
      (implicates he did not eat both the chocolate and the lemon cookie.)

Since implicatures on the (neo-)Gricean view are not part of 'what is said', then all of the sentences in (2) are *consistent* with contexts in which the stronger statement is true, although generally infelicitous. Because of this, implicatures are defeasible, thus (2a) could be continued with *In fact he ate all of them.*

Scalar implicatures can also be made more salient by contrastive focus on the quantifier, since the implicature is part of the alternative set generated by the focus (Rooth 1992). Thus

It should be noted that the neo-Gricean view of scalar implicatures has come under certain scrutiny in recent years. Particularly, Landman (1998, 2000) and Chierchia 2001 have argued based on the fact that implicatures are preserved in embedded sentences, that implicatures must be calculated in parallel with the core meaning, rather than as a conversational inference on (root) sentences.

3 Child Difficulty with Implicatures

3.1 Experimental evidence

Various researchers have shown that children have difficulty with scalar implicatures (Smith 1980, Chierchia, et al. 2001, Noveck 2001, Papafragou & Musolino 2003, Musolino 2004), namely, they accept weaker statements as true given a context where the stronger statement would be more felicitous. We briefly review (parts of) two relevant studies here.

Smith 1980 (in English) and Noveck 2001 (in French) examined children's acceptance of sentences like (3a/b) compared to (3c/d). Since it is generally true that all cars have motors, and all cats have ears, the a/b sentences should be judged as infelicitous due to the scalar implicature of 'not all' associated with *some*. In contrast, sentences like c/d should be judged as felicitous, since they are 'factually existential' (in Noveck's terms.) Noveck found that older children (aged 7-11) routinely accept sentences like (3a/b) as felicitous (~87%) compared to adults, who accepted them only 41% of the time. This is consistent with children being able to access the core meaning of a sentence, but not being able to infer the correct scalar implicature.

(3) a. Some cars have motors.
b. Some cats have ears.
c. Some flowers are yellow.
d. Some dresses have pockets.

Papafragou and Musolino 2003 tested Greek children on sentences similar to (3) in a context where all of the horses jumped over the fence. Using a Truth Value Judgment task (Crain and Thornton 1998) they found that 5 year old children rejected the examples like (4) only 12.5% of the time, compared to a 92.5% rejection rate for adults. However, they also found that changing the task changed the results towards a more adult-like pattern.

(4) Some of the horses jumped over the fence.

3.2 Proposals to account for child behavior

There are three proposals to account children's non-adult behavior with scalar implicatures. Noveck 2001 proposes that there is a delay in pragmatic development. Children first learn the core meanings and then later learn the pragmatic aspects calculating implicatures.

Chierchia et al. 2001, following Reinhart 1999 propose (in line with Chierchia's 2001 proposal that implicatures are calculated in parallel with the core meaning of a sentence) that children do not lack knowledge of scalar implicatures, but rather are unable to perform comparisons between the core meaning and the computed implicature due to processing limitations.

More recently, Papafragou and Tantalou (in press) have shown that task demands may be a more adequate account of most of the reported results. They note that previous experiments used Truth Value Judgment tasks to test children's sensitivity to implicatures, which require children to rate a truth-conditionally accurate statement as pragmatically infelicitous. They suggest that children may not have realized that the researcher wanted "appropriateness" instead of "truth". Papafragou and Tantalou used an alternative method for testing implicatures. Their task involved asking the child to reward a puppet based on its performance of a particular task. If the task was to "eat the oranges" and the puppet says that he "ate some", then the children should fail to reward the puppet, if they understand the scalar implicature. Five year old Greek children tested on this task correctly failed to reward the puppet in this situation 70-90% of the time.

3.3 Acquisition of Contrastive Stress

It has also been reported that children do not use contrastive stress to resolve semantic ambiguities in language comprehension (Solan, 1980; McDaniel et al., 1992; Halbert et al. 1995; Reinhart, 2004; Gualmini et al.,

2002; Szendrói 2003). Gualmini et al. 2002 tested preschool children on their ability to use contrastive stress to associate a focused phrase to *only* in sentences like (5). Since *only* changes the truth conditions of the sentence depending on what it associates with, (5a) and (5b) can be true under different situations. Gualmini et al. found that while children were correctly able to associate focus to the indirect object in (5a) they gave the same interpretation to the direct object condition (5b). This result seems to show that when stress is the only factor, children are not able to use it to disambiguate a sentence.

(5) a. The farmer only sold a banana to SNOW WHITE.
b. The farmer only sold a BANANA to Snow White.

Different proposals have been made to account for this pattern of results. Gualmini 2003 argues that children have a default interpretation which corresponds to the indirect object. Reinhart 2004 following Szendrói 2003 argues that children are guessing because they have difficulty maintaining alternative representations of sentences in working memory.

4 Present Study

The purpose of the present study was to further examine children's ability to deal with scalar implicatures in the contexts where NP containing the weak quantifier is either presupposed or not, and also to test whether task demands could also affect the results. To simplify the task we used a Direct Instruction Task and a Picture Matching Task. We were also interested in whether children can use stress on *some* to get the scalar implicature associated with it.

4.1 Some linguistic background

Our experiment is designed around a syntactic manipulation that brings out two different meanings of the verb *make*. Verbs of creation do not have an existence presupposition for their object (Diesing 1992). Since they do not have an existence presupposition, there is no scalar implicature associated with a weak quantifier in their scope. On the other hand, verbs of change of state do have an existence presupposition for their object, and therefore weak quantifiers have a scalar implicature.

Syntax can affect this distinction with similar verbs, in particular, the verb *make,* as shown in (6). In (6a), *make* takes a DP object, and is a verb of creation. In (6b), *make* takes a small clause and is a verb of change of state. In the latter case, there is an existence presupposition on the subject of the small clause, and therefore a quantity implicature associated with *some.*

(6) a. Make some happy faces. Non-presuppositional
b. Make some faces happy Presuppositional

The contrast between (6a) and (6b) allows us to construct minimal pairs of sentences which both contain a weak quantifier, but which differ in the presence or absence of a quantity impicature.

Furthermore, in (6b), if *some* is stressed, the scalar implicature effect seems to be enforced more strongly, since focus on the quantifier induces the scale as the alternative set (Rooth 1992). This allows us to test whether children are sensitive to contrastive stress in this context.

4.2 Experiment 1

In Experiment 1 we used a Direct Instruction Task to test English Child comprehension of *some* in the context of sentences like (6). There were three conditions as in (7).

(7) C1: Make some faces HAPPY (unstressed/presuppositional)
C2: Make SOME faces happy (stressed/presuppositional)
C3: Make some HAPPY faces (unstressed/non-presuppositional)

Subjects We tested 36 children ages 4;1 to 5;5 in a between subject design (12 children per condition). 31 Michigan State University undergraduates (10 for C1, 12 for C2, 9 for C3) were used as adult controls.

Methods All subjects were presented with pictures like those in Fig. 1, and then received the following instructions from the experimenter: "Look at these faces. They don't have any mouths. They've just got eyes and noses. Use the red crayon and *make some faces HAPPY/make SOME faces happy/make some HAPPY faces*". (Each group received only one of the conditions.) Experimenters were trained on stress placement, and all sessions were recorded so that stress placement could be verified. Audio files were randomized and stress placement was confirmed by two raters and a duration analysis using PRAAT software.

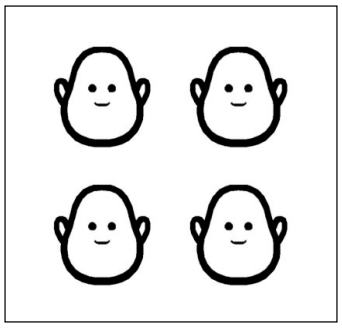

Figure 1

Materials There were 4 target sentences, 4 control sentences and 10 filler sentences. Depending on the target sentences, children had to either draw on the picture or use a stamp on the picture.

(8) 4 Target Sentences:

Make some faces happy/ happy faces	(drawing)
Make some faces sad/ sad faces	(drawing)
Make some men fat/ fat men	(stamping)
Make some women skinny/ skinny women	(stamping)

(9) 4 Control, 3 Practice sentences

Make all the circles red (2x)
Make some of the circles red, but not all (2x)
Make N circles red (3x)

Results The dependent measure was the number of partitive responses (i.e. those in which children did NOT draw on *all* of the faces, thus corresponding to the quantity implicature *some* → ¬*all*). The results are shown in Table 1.

Table 1: Percentage of partitive responses

	Unstressed Presuppositional	**Stressed presuppositional**	**Unstressed non-presuppositional**
Child	50% (24/48)	90% (43/48)	10% (5/48)
Adult	96%	100%	17%

An Analysis of Variance showed a main effect for condition ($F(1,67)=59.263$, $p < .01$), a main effect for age ($F(1,67)=9.059$, $p < .01$) and no significant interaction ($F(1,67)=2.073$, $p = .135$).

Discussion Both children and adults treat the non-presuppositional condition as not having a quantity implicature, and they overwhelmingly chose to color all four figures in the picture. They also treat this condition differently from the presuppositional conditions, showing that they are sensitive to the presuppositional/non-presuppositional verbal contrast. In the stressed presuppositional condition, children behave like adults, which shows that they are able to correctly calculate the scalar implicature associated with stressed *some*. The fact that the number of partitive responses is reduced for the children in the unstressed condition also shows that children are sensitive to contrastive stress and that it facilitates calculation of the implicature.

4.3 Experiment 2

In order to show that the Direct Instruction Task was not responsible for the results in Exp. 1, we used a Picture Matching Task for Experiment 2. In this task, a puppet named Pete drew on 3 sets of pictures modeled after the pictures in Exp. 1 (for example, faces missing their mouths), and children were asked to

respond to one of two conditions: the stressed and unstressed presuppositional sentences (C1 and C2 from Exp. 1.)

(10) C1: Show me where Pete made some faces HAPPY (unstressed)
C2: Show me where Pete made SOME faces happy (stressed)

Subjects 16 preschool children (3;6-5;10) participated in a between-subjects design. 8 children received C1 and 8 children received C2. In addition, 24 MSU undergraduate students participated as adult controls (11 for C1, 13 for C2).

Methods Experimental stories for Target trials and Control trials were always the same. A puppet named Pete colored all of the objects on the first sheet of paper, none on the middle sheet and three out of the four on the last sheet of paper. In addition, Pete always indicated that one object was not colored in the last sheet of paper by saying, "but not this one". An example of the final coloring is given in Fig. 2.

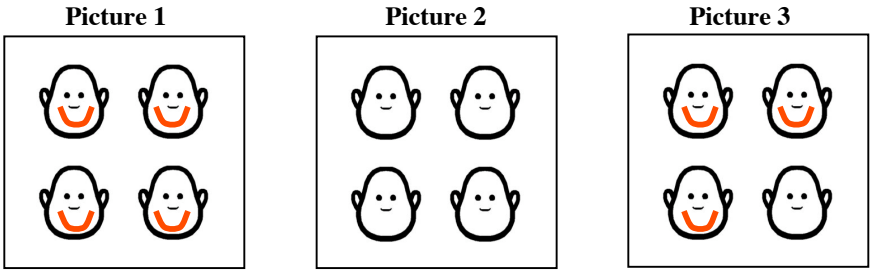

Figure 2

Methods As in Exp. 1, experimenters were trained on stress placement and recorded during all sessions. Audio files were randomized and stress placement was confirmed by a duration analysis using PRAAT software.

Materials There were 4 target sentences per condition, and 6 controls as shown in (11)

(11) 4 Target Sentences:
Show me where Pete made some faces happy
Show me where Pete made some faces sad
Show me where Pete made some men fat
Show me where Pete made some women skinny

(12) 6 Controls
Show me where Pete made all the circles red (2x)
Show me where Pete made some of the circles red (2x)
Show me where Pete made no circles red (2x)

(13) 4 Practice Trials
Show me where Pete made N squares red (4x)

Results The dependent measure was the number of times that ONLY Picture 1 was chosen (i.e. those in which not all the faces were changed, thus corresponding to the quantity implicature *some* → ¬*all*). The results are shown in Table 2.

An Analysis of Variance showed a main effect for Condition ($F(1,40)=23.833$, $p < .01$). There was no main effect for Age ($F(1,40)=.471$, $p =.497$) and no significant interaction ($F(1,40)=.721$, $p =.402$).

Table 2: Percentage of pictures chosen

	Picture 1	**Picture 2**	**Picture 3**	**Both 1 & 3**
C1	28%	0%	25%	47%
some	(9/32)	(0/32)	(8/32)	(15/32)
C2	6%	0%	84%	9%
SOME	(2/32)	(0/32)	(27/32)	(3/32)

Discussion The results of Exp. 2 show that 3;6-5;10 year old children treat stressed *some* differently from unstressed *some*. This shows that they are sensitive to contrastive stress and understand that stressed *some* has a quantity implicature associated with it.

5 Supporting Evidence from Spanish

The results of Experiments 1 and 2 show that young English speaking children are able to calculate the scalar implicature associated with stressed *some* in two different tasks. In this section we provide some supporting evidence from child Spanish reported in Miller and Schmitt 2004.

As part of a studying involving the comprehension of plurality in Chilean Spanish, Miller and Schmitt tested child comprehension of *algunos* 'some', using a directed instruction task using sentences like (14).

(14) Pon algunas bolitas en la tapa
Put some+PL marbles in the tray
"Put some marbles in the tray"

Subjects 15 younger children (4;6-5;11) and 15 older children (6;0-7;6) participated in the study along with 10 adults. As participants were tested by a native Spanish speaker in Punta Arenas, Chile.

Methods Children were presented with 2 sets of 6 miniature toys each (*bolitas* (marbles), *arañas* (spiders), *monos* (monkeys), *autos* (cars)) and then asked to perform an action like (14) on the toys.

Materials There were 4 target sentences, 8 controls and 3 practice sentences as shown in (15)-(17).

(15) 4 Targets:

Pon algunas bolitas en la tapa	(some marbles)
Pon algunas aranas en la tapa	some spiders)
Pon algunos monos en la tapa	(some monkeys)
Pon algunos autos en la tapa	(some cars)

(16) 8 Controls

Pon *algunas de las …*	(some of the) (4x)
Pon *todas las …*	(all of the) (4x)

(17) 3 Practices:

Pon N …	(Put N in the tray) (3x)

Results The dependent measure was the number of partitive responses given (i.e. those in which children did NOT place all the objects in the tray, thus corresponding to the quantity implicature some → ¬all). The results are given in Table 3. In this task, children overwhelmingly gave partitive responses to the directions, showing that they had a preference for the reading in which the scalar implicature was enforced. Analysis of Variance showed that there was no significant difference between responses on ALGUNOS for the three groups (4-5 year olds, 6-7 year olds, adults) $F(1,37)=1.189$, $p=.316$.)

Table 3: Percentage of Partitive responses

	algunos **some+PL**
Child (4-5)	97% (58/60)
Child (6-7)	88% (53/60)
Adult	100%

6 General Discussion

This study set out to test whether children can calculate the implicature of *some* → ¬*all*. Previous studies have concluded that children could not (Noveck 2001, Smith 1980). To do this, we used simpler tasks: (1) a Direct Instruction Task, that matched more closely the contexts in which scalar implicatures are calculated in naturalistic conversations and (2) a Picture Matching Task, that provided both contexts (Context 1: consistent with the truth conditions vs. Context 2: consistent with the pragmatics) so that children could indicate their preferred reading of the target sentence. The results of both Experiments 1 and 2 show that English-speaking children by 3;6 years of age are clearly able to calculate the quantity implicature associated with *some*. They are better at calculating this implicature when *some* carries contrastive stress, indicating that at least for sentences involving *some*, they are sensitive to contrastive stress.

These results are not consistent with Noveck's (2001) proposal of delay in pragmatic development. The results of Exp. 1 may be compatible with Reinhart's (1999, 2004) or Chierchia et al.'s (2001) processing limitation hypothesis, if children would not have to choose between two competing meanings to correctly perform the task. In fact, the contrast between the stressed and non-stressed presuppositional *some* in Exp. 1 might support this idea.

The Results of Exp. 2, however, may be consistent with this hypothesis because it is possible that children did not have to *build* the alternative representations for the target sentence since they were presented through the picture choice.

Overall, our results support Papafragou & Tantalou's (in press) proposal that the demands of previous experimental tasks appear to have been responsible for children's difficulty with implicatures.

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