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1 Introduction

This paper investigates the interaction of prosodic information and discourse principles in child language, taking sentences with the focus operator *only* as a case study. For adults, prosodic information alone can influence the truth-conditional interpretation of (otherwise) ambiguous sentences. However, the findings of two experiments demonstrate that children are not able to use prosodic information alone to resolve certain ambiguities involving the focus operator *only*. The next section reviews the semantic properties of the focus operator *only*. Then we review the relevant prior literature on child language, before turning to our own experimental studies.

2 The Semantics of *only*

Spoken sentences are accompanied by specific rhythmic patterns and the use and interpretation of utterances are constrained by their rhythmic pattern. A clear instance of this phenomenon can be seen in the question-answer pair in (1), where the main stress falls on the noun phrase *strawberries*.

- (1) Q: Does John like bananas?
A: No, John likes *strawberries*.

Consider the answer in (1). The stress pattern of English assigns prosodic prominence to the rightmost noun phrase *strawberries*, making the utterance perfectly felicitous in the dialogue above. The same prosodic pattern makes the sentence infelicitous, however, in the following question-answer pair.

- (2) Q: Does Paul like strawberries?

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#A: No, John likes *strawberries*.

Interestingly, in order for the addressee to communicate that John likes strawberries in response to the question in (2), the prosodic prominence must shift from the noun phrase *strawberries* to the noun phrase *John*, as in (3), where capital letters indicate prosodic prominence.

(3) Q: Does Paul like strawberries?

A: No, JOHN likes strawberries.

Based on the contrast between (2) and (3) one can conceive focus as the effect of prosodic prominence in constraining the (conversational) contexts in which a sentence can be uttered felicitously.

Discourse congruence is only one of the consequences of focus, however. As observed by Jackendoff (1972), prosodic information also affects the truth-conditional interpretation of sentences containing the adverb *only*. The relationship between words like *only* and focus is known as association with focus. Consider (4).

(4) John only introduced Bill to Sue.

When asked to read (4), we favor a different interpretation depending on the particular stress pattern we assign to it. Three readings of (4) are paraphrased in (5) - (7).

(5) The only thing that John did is introducing Bill to Sue.¹

(6) The only person that John introduced to Sue is Bill.

(7) The only person to whom John introduced Bill is Sue.

Suppose the conversational context supports both (6) and (7).² For example, suppose that there are two persons (e.g., Bill and Fred) that John could have

¹ In the remainder of the paper we will ignore the interpretation in (5), in which the focus element *only* is associated with the entire VP. This choice is dictated by the weaker role of prosodic prominence in selecting this interpretation. In particular, one can think of a stress pattern that would make such an interpretation less prominent, but one cannot think of any stress pattern that would make only this interpretation available.

² It bears noticing that (4) does not allow the interpretation in which *only* is associated with the proper noun *John* (i.e., John is the only person who introduced Bill to Sue). This interpretation is not licensed, because the associate of *only* must be in its scope. As a consequence, the interpretation according to which John is the only

introduced to his friends (e.g., Sue and Laura). In this context, both (6) and (7) are felicitous readings of (4); one could interpret (4) as meaning that John introduced Bill but not Fred to Sue or that John introduced Bill to Sue but not to Laura. The ambiguity between these two readings of (4) is resolved by contrastive stress: the associate of the focus operator *only* tends to be the linguistic expression (in the scope of *only*) that bears prosodic prominence, as illustrated in (8) - (9).

(8) John only introduced BILL to Sue.

(9) John only introduced Bill to SUE.

Example (8) unambiguously means that Bill is the only person that John introduced to Sue. By contrast, (9) unambiguously means that Sue is the only person to whom John introduced Bill. In short, the use of contrastive stress in (8) or (9) resolves the ambiguity observed in (4).

The role of prosodic information in determining the associate of the focus element *only* has received considerable attention in semantic research. Theories of focus are traditionally classified into Structured Meaning approaches and Alternative Semantics (see Rooth 1996 and Kadmon 2001 for a review and Herburger 2000 for another view). Structured Meaning approaches assume that focus effects can only be accounted for if the semantic component of the grammar has access to the inner structure of a proposition (Jackendoff 1972). To illustrate, consider again the pair in (10) and (11).

(10) John introduced BILL to Sue.

(11) John introduced Bill to SUE.

According to the Structured Meaning approaches to focus, the utterances in (10) and (11) have the same denotation, namely the proposition that John introduced Bill to Sue. The same proposition is derived in two different ways, however. Specifically, (10) results from attributing to Bill the property of being introduced by John to Sue, whereas (11) results from attributing to Sue the property of being the culmination of John's introduction of Bill.³

person who introduced Bill to Sue is available only if the focus operator *only* c-commands *John*.

³ In formal terms, this amounts to deriving the same proposition through two different applications of λ -abstraction. More precisely, one can derive the proposition 'John introduced Bill to Sue' as $\lambda(x)[\text{John introduced Bill to } x]\text{Sue}$ or $\lambda(x)[\text{John introduced } x \text{ to Sue}]\text{Bill}$.

According to Alternative Semantics the contribution of focus is computed in parallel with the meaning of an utterance (see Rooth 1985, 1992). On this view, the utterances in (10) and (11) share the same meaning but differ in their focus semantic value, so that (10) is placed against the background of the possible answers to the question "Who did John introduce to Sue?", whereas (11) must be placed against the background of the possible answers to the question "Who did John introduce Bill to?". Advocates of either view can then account for the truth-conditional effects of focus by providing a semantics of *only* that makes reference to the underlying structured meaning or the focus semantic value of the sentence (see Kadmon 2001 for a review).

A common assumption to all accounts of focus effects is that the marking of a constituent as focused yields consequences for the phonological and the interpretive components of the grammar. Both the Structured Meaning approaches and the Alternative Semantics approaches assume that the position of focal accent directly singles out the associate of the focus operator *only*. On the basis of the pervasive co-occurrence of phonological and semantic consequences of focus-marking, these approaches posit a common trigger to the phonological and interpretive consequences of focus. This assumption has been recently challenged by Schwarzschild (1997). According to Schwarzschild (1997), the relationship between prosodic prominence and focus is not direct, as traditionally assumed. The dialogue in (12) illustrates a mismatch between contrastive stress and association with focus (due to Partee 1991 and discussed by Schwarzschild 1997).

(12)A: Eve *only* gave Xerox copies to the GRADUATE STUDENTS.

B: No, PETER *only* gave Xerox copies to the graduate students.

Consider B's felicitous reply to A. The focus operator *only* is associated with *graduate students*, despite the fact that contrastive stress marks the proper noun *Peter*. This example shows that contrastive stress is not a *necessary* condition for an expression to be associated with the focus operator *only*. In order to determine whether it is a *sufficient* condition for an expression to be associated with the focus operator *only*, Schwarzschild (1997) considers a case in which an element bearing contrastive stress occurs in the scope of *only*, like (13).

(13)No, she *only* gave ORIGINALS to the graduate students.

Sentence (13) seems to require the association of the focus operator *only* with the noun phrase *originals*, which bears contrastive stress.⁴ On the basis of (13), Schwarzschild (1997:16) argues that (12) "does not show that focus is irrelevant to the setting of the domain of quantification for *only*. It only shows that focus is not necessary for the setting of the domain. However... when focus is present, it must associate."⁵

This concludes our review of the main properties of the focus operator *only* in English. With this background in mind, the present study sought to determine whether the same kind of interaction between properties of discourse and prosodic prominence is at play in child language (see Section 4). Before we turn to our experimental investigations with children, we review previous research on children's use of prosodic information.

3 Children's Use of Prosodic Information

Many researchers in child language have argued that prosodic information plays an essential role in grammar formation (Morgan 1986). However, recent research has uncovered evidence of children's inability to use contrastive stress in language comprehension.⁶ For instance, Solan (1980) conducted an act-out task with English speaking children. The experimental stimuli included sentences shown in (14) and (15).

(14) The camel hit the lion, and then he hit the elephant.

(15) The camel hit the lion, and then HE hit the elephant.

The most natural interpretation of (14) is that the camel hit both the lion and the elephant, whereas (15) suggests that the camel hit the lion and then the lion hit the elephant. Based on the experimental findings, Solan (1980:694)

⁴ In this case, it is not entirely clear what the associate of the focus element *only* is. In particular, it seems that (13), just like (12), would be false in situations in which Eve gave originals to anybody other than the graduate students. If this intuition is correct, one could argue that the focus operator *only* is in fact associated with the noun phrase *graduate students*, which does not bear contrastive stress, and that contrastive stress alone conveys the interpretation that Eve gave originals, and nothing else, to the graduate students.

⁵ Kadmon (2001) also discusses examples of a complete dissociation between focus and the focus operator *only* due to Rooth (1992) (e.g., *People who GROW rice only EAT rice*).

⁶ By contrast, children's use of contrastive stress in production seems to be adult-like from the earliest stages of language development (see Baltaxe 1984 and Nederstigt 2001).

concludes that "although children have some idea of the effect of contrastive stress on the interpretation of pronouns, this awareness is at first superficial." This result is even more surprising, if we consider that Solan (1980) did not test any children younger than 5 and that he employed an Act Out task, a task that only determines the subject's preferred interpretation of a given linguistic construction.⁷

Children's limited use of prosodic information was also shown by McDaniel and Maxfield (1992). These researchers found that even 5-year olds did not manifest adult-like use of contrastive stress in interpreting sentences like (16) and (17).

(16) Goofy is whispering to Grover. Now YOU whisper to him.

(17) Grover is petting Bart. Now YOU pet HIM.

Most adult speakers of English would fulfill the instruction in (16) by whispering to Grover, and they would fulfill (17) by petting Grover, despite the fact that the noun phrase *Grover* occurs in different structural positions in (16) and (17). By contrast, McDaniel and Maxfield (1992) conclude that children as old as 5 fail to use the difference in contrastive stress to distinguish between (16) and (17).

Research on children's use of contrastive stress in the interpretation of sentences containing the focus operator *only* has reached similar conclusions.⁸ In a study by Halbert, Crain, Shankweiler, and Woodams (1995) children were presented with sentences containing the focus operator *only* in the two different stress patterns shown in (18) and (19).

(18) Cinderella *only* gave a cookie to SUPERMAN.

(19) Cinderella *only* gave A COOKIE to Superman.

In (18) contrastive stress falls on the indirect object, whereas in (19) it falls on the direct object. The experimental findings showed that only half of the children used contrastive stress to derive the intended meanings of these test sentences.

⁷ As pointed out by Crain and Thornton (1998), the Act-Out task presents severe limitations. In particular, the Act-Out task provides evidence that children's grammar allows one interpretation, namely the interpretation underlying children's behavior. The results from Act-Out tasks, however, cannot be used to infer that the child's grammar fails to generate other interpretations.

⁸ Previous research on children's understanding of the focus operator *only* extends beyond children's use of contrastive stress. We refer the reader to Crain, Ni and Conway (1994) and Philip (2000) for a complete review of the topic.

To explain children's inability to use contrastive stress in resolving structural ambiguities, Reinhart (1999) argues that children's limited working memory prevents them from maintaining alternative representations of sentences in memory. As a consequence of this computational limitation, Reinhart (1999) argues, children should resort to a guessing pattern. In the remainder of this paper we take children's inability to exploit prosodic information as a starting point. In light of Reinhart's proposal, we raise two questions. First, we ask whether children resort to a default or a guess pattern in interpreting sentences containing contrastive stress (see Reinhart 1999). Second, if a default response pattern is found, we ask whether discourse information can be used by children to arrive at the intended semantic interpretation of a sentence.

4 Experimental Investigations of *only* Sentences in Child Language

To determine whether English-speaking children are sensitive to contrastive stress in the interpretation of sentences containing the focus operator *only*, we conducted two experiments using the Truth Value Judgment task (Crain and McKee 1985; Crain and Thornton 1998). Two experimenters participated in the task. One acted out a short story in front of the child, using toys. The second experimenter manipulated a puppet who watched the story along with the child. At the end of each trial, the puppet described what happened in the story. The child was asked to reward the puppet if the puppet's statement was a correct description of the story, or to correct the puppet if the puppet's statement was not right. The child's acceptance of the target sentence is interpreted as showing that such a sentence can receive an interpretation which is true in the context under consideration. By contrast, the child's rejection of the target sentence is interpreted as showing that the child's grammar does not readily license an interpretation that makes such a sentence true in the context under consideration.

The present study involved a minor modification to the basic design of the Truth Value Judgment task. Since intonation plays a crucial role in the experiment, we had to ensure that the target sentences were always presented with the same stress pattern. An adult native speaker of English with linguistics training recorded the target sentences on audiotape. Children were told that the puppet had a sore throat and could not talk. We explained that the puppet had heard the stories the previous day and its answers to each story had been recorded. The child was then asked to watch the story, and then to reward or correct the puppet on the basis of what it had said on the audiotape.

Experiment 1 replicated the Halbert et al. study we reviewed earlier. Fifteen English-speaking children participated. Each child was presented with eight target trials containing the focus operator *only*, divided in two sessions. In the first session, children were presented with four target sentences with contrastive stress on the indirect object. We call this the *Indirect Object Condition*. In the second session, the same children encountered four target sentences containing contrastive stress on the direct object. This is the *Direct Object Condition*. Examples of test items in the *Indirect Object Condition* and in the *Direct Object Condition* are given in (20) and (21) respectively.

(20) The Troll only brought an onion ring to SUPERMAN

(21) The Troll only brought an ONION RING to Superman

Both sessions were preceded by two warm-up trials to ensure that the child could complete the task, and included various filler trials to balance the number of 'yes' and 'no' responses. The same verbs were used in the test sentences of both sessions: *give*, *bring*, *throw* and *sell*.

Here is a typical trial from the *Indirect Object Condition*.

(22) "This is a story about Snow White, Winnie the Pooh and Barney. Snow White has to buy a birthday cake for one of the dwarves, so she decides to go to the bakery, which is run by Barney. On her way to the bakery, Snow White runs into Winnie the Pooh and says: 'Hey Winnie! I am going to buy a cake at Barney's bakery. Do you want to come along?' Winnie the Pooh says: 'Sure, I am a bit hungry, maybe I can buy a snack for myself.' They enter the bakery and Snow White buys a big birthday cake from Barney, while Winnie the Pooh buys a freshly baked cookie. When they are about to leave, Winnie the Pooh says: 'Wow! these cookies are delicious, I want to try one of Barney's cakes!' and he tells Barney that he also wants to buy a cake. Barney says: 'Oh I'm sorry! See, I have only one more cake left, and somebody already placed an order for it, so I am afraid I can't sell it to you.' Winnie the Pooh gets very sad. He is about to leave the store when Barney says: 'Well, wait a second, I just remembered that I have another cake in the oven and it should be ready in a few minutes, so I guess it won't be a problem if I sell you this one.' So Winnie the Pooh buys the cake, and then leaves with Snow White."

At the end of the story, the child sees Snow White with her cake and Winnie the Pooh with his cake and the cookie. Then, one experimenter played the

audiotape, and the child heard the sentence in (23), which bears contrastive stress on the indirect object, *Snow White*.

(23) Barney only sold a cake to SNOW WHITE.

The experimental context was constructed so that the target sentence receives a different truth-value, depending on whether the focus operator *only* is associated with the direct or the indirect object. If the focus operator *only* is associated with the indirect object, the sentence can be paraphrased as (24) below and is false in the context under consideration, because Snow White is not the only person to whom Barney sold a cake - Winnie the Pooh bought a cake too. However, if the focus element is associated with the direct object, the sentence can be paraphrased as (25) and is true in the context.

(24) Snow White is the only person to whom Barney sold a cake.

(25) A cake is the only thing that Barney sold to Snow White.

Let us take a look at the results. The 15 children we interviewed ranged in age from 4;3;1 to 5;8;19 (mean age: 4;9;26). These children rejected the target sentence 87% of the time (52 rejections out of 60 trials). A control group of 8 English-speaking adults always rejected the target sentences. Importantly, when children were asked to explain what really happened in the story, they consistently said that the puppet was wrong because Barney had also sold a cake to Winnie the Pooh.

The findings show that children interpret sentences containing *only* with contrastive stress on the indirect object in the same way as adults do. In short, in the *Indirect Object Condition* children and adults take the associate of the focus element to be the noun phrase that bears stress. However, the results from the *Indirect Object Condition* alone do not allow us to conclude that children are relying on contrastive stress to figure out the associate of the focus operator *only*. It is possible that they are resorting to a default interpretation of sentences with *only*. To determine whether contrastive stress was responsible for children's responses, we tested children on the target items where contrastive stress fell on the direct object. The following story illustrates a trial of the *Direct Object Condition*.

(26) "This is a story about Snow White and Grumpy who went to the farmers market to buy some food. Grumpy says he is really strong and can carry a lot of food, so he buys a huge banana and a huge carrot. Snow White says: 'Well, I have to buy a lot of food because the dwarves are always very hungry, so I guess I'll buy this big banana.' Then, Snow White

asks Grumpy if he would be willing to share the food he bought with the other dwarves, but Grumpy says: 'No way! I am so hungry that I am going to eat all of this' so Snow White asks the farmer if he has anything else to sell and he offers her a big strawberry. Snow White considers buying the strawberry in addition to the banana, but then she says: 'That is going to be too much stuff for me to carry, I am not going to buy the strawberry'."

At the end of the story, Snow White has a banana and Grumpy has a banana and a carrot. Then, the child is asked to evaluate the sentence in (27), which bears contrastive stress on the direct object, *banana*.

(27) The farmer only sold a BANANA to Snow White.

Again, the experimental context ensures that the target sentence differs in truth-value depending on whether the focus operator *only* is associated with the direct or the indirect object. If the focus operator *only* is associated with the indirect object, the sentence is false in the context, whereas it is true if the focus operator *only* is associated with the direct object.

A control group of 10 adult speakers of English accepted the target sentence 97% of the time. However, the child subjects accepted the target sentences only 35% of the time (21 acceptances out of 60 trials).⁹ When children were asked to justify their rejection of the target sentence by telling "what really happened," they said that the puppet was wrong because the farmer had also sold a banana to Grumpy.

The overwhelming majority of children, therefore, responded to sentences containing the focus element *only* in the same way in both the *Indirect Object Condition* and in the *Direct Object Condition*. This invites the conclusion that children do not make use of prosodic prominence to determine the associate of the focus operator *only*. Moreover, children preferred the indirect object interpretation despite the fact that it made the target sentence false in the context under consideration (see Grimshaw and Rosen, 1990 on children's bias to provide affirmative responses). The present experimental results replicate the findings reported by Halbert et al. (1995), and show that contrastive stress does not constitute a reliable cue in resolving semantic ambiguity for English-speaking children as old as 5.

Notice, however, that children do not resort to a guessing pattern; they resort to a default interpretation which, for most children, is the

⁹ When children participated in the *Direct Object Condition*, their age ranged from 4;3;2 to 5;9;3 (mean age: 4;10;1).

interpretation in which the focus operator *only* is associated with the indirect object. It remains to find out what determines children's preference for this particular reading. At the present stage, many factors could be responsible for this preference: the animacy of the denotation of the indirect object, the salience of this character in the story, etc. To address this question, a follow-up experiment was designed to determine whether children even have access to the interpretation in which the focus operator *only* is associated with the direct object.

Experiment 2 was designed to determine whether children are able to access the interpretation in which the focus operator *only* is associated with the direct object in sentences like those used in Experiment 1. To evoke the direct object association, we decided to present children with a linguistic antecedent that would make the indirect object reading contradictory. Here is a typical trial of Experiment 2.

- (28) "This is a story about Tarzan, who is an animal trainer. He has spent all morning training a dolphin and a penguin, and now he wants to give a reward to his animals. He knows that the penguin and the dolphin are very hungry, so he throws a fish to each of them. Then, the dolphin asks for something to play with, and Tarzan throws him a boat, so that the dolphin can chase it in the water. He also has a marble that he considers throwing to the penguin, but in the end he decides to keep it for himself.

At the end of the story, the child sees that the dolphin received a fish and a boat and the penguin only received a fish. At this point, the child is asked to evaluate the sentence in (29), which bears contrastive stress on the direct object, *fish*.

- (29) Tarzan threw a fish and a boat to the dolphin, but he only threw a FISH to the penguin.

The experimental design is similar to that of Experiment 1 – *Direct Object Condition*. The child was asked to evaluate a sentence containing the focus operator *only* with contrastive stress on the direct object in a context that makes the sentence true on the interpretation in which *only* is associated with the direct object (i.e., a fish is the only thing that Tarzan threw to the Penguin) but makes the sentence false on the interpretation in which *only* is associated with the indirect object (i.e., the penguin is the only animal to whom Tarzan threw a fish). The findings from the *Direct Object Condition* of Experiment 1 suggest that children are more likely to access the second

reading. Notice, however, that this interpretation of the target sentence would contradict the assertion contained in the linguistic antecedent.

- (30) Tarzan threw a fish and a boat to the dolphin, he threw a fish to the penguin and the penguin is the only animal to whom Tarzan threw a fish.

The paraphrase in (30) constitutes a contradiction, because it asserts that Tarzan threw a fish to the dolphin and that the penguin is the only animal to whom Tarzan threw a fish. Consistent with this intuition, the following utterance is infelicitous.

- (31) #Tarzan threw a fish and a boat to the dolphin, but he only threw a fish to the PENGUIN.

Given the infelicity of the indirect-object interpretation, children who can access the interpretation in which the focus operator *only* is associated with the direct object should access it. As a consequence, children should accept the target sentence in (29) on the grounds that a fish is indeed the only thing Tarzan threw to the Penguin.

The results confirmed the experimental hypothesis. The same 15 children who had participated in Experiment 1 participated in this experiment. Their age ranged from 4;4;8 to 5;9;4 and their mean age was 4;10;20. The child subjects accepted the target sentence 85% of the time (50 times out of 59 trials). In addition, they provided the right reasons for their answers. They consistently explained that the puppet's answer was right because Tarzan had thrown a fish and nothing else to the penguin.

The experimental findings support two conclusions. First, the results show that sentences containing the focus operator *only* are ambiguous. Children, like adults, can access an interpretation in which the focus operator *only* is associated with the direct object. Second, children make use of contextual information in resolving ambiguity. In particular, children can access the interpretation that they would disfavor if the target sentence were presented in the absence of the linguistic antecedent.

To conclude, the results show that children can access the interpretation in which the focus operator *only* is associated with the direct object. However, children apparently only access this interpretation under specific circumstances. Taken together, the results of Experiments 1 and 2 support two further conclusions. First, prosodic information is not a sufficient source of information for children to access the direct object interpretation of sentences containing the focus operator *only*. Second, prosodic information

and discourse manipulation do suffice for children to access the direct object interpretation of sentences containing the focus operator *only*. The experimental findings of Experiment 2, however, do not allow us to determine whether prosodic information had any role in determining children's response.

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