

An Experimental Study on Children's Interpretation of Negation and *Because*-clauses

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Abstract This paper reports an experimental study on children's relative scope interpretation of negation and *because*-clauses. Conducting an experiment with a truth-value judgment task, we found that both children and adults exhibit a bias to interpret *because*-clauses outside of negation. This pattern contrasts with children's non-adult-like biases in negative sentences involving covert scope-shifting operations (e.g., QR, reconstruction), which have been extensively reported in the literature. Children's adult-like behavior in sentences with negation and *because*-clauses indicates that these non-adult-like biases cannot solely be attributed to difficulties with negation.

Key words Negation, *Because*-clauses, Scope, Attachment ambiguity, Language acquisition

1. Introduction

It is observed in the literature that some adjunct clauses such as *because*-clauses show scopal phenomena; their scope interacts with the scope of negation ([1], [2], among others). For example, sentences such as (1) are ambiguous between the two readings in (1)a and (1)b. (2)a and (2)b show the semantic representations for these two readings.

- (1) George doesn't starve his cat because he loves her.
- It is because he loves her that George doesn't starve his cat. (**BEC>NEG**)
 - It is not because he loves her that George starves his cat. (**NEG>BEC**)
- (2) a. **CAUSE** ([he loves her], [NOT [George starves his cat]])
- b. **NOT CAUSE** ([he loves her], [George starves his cat])

In the reading (1)a, negation stays within the main clause, and a causal relation holds between the *because*-clause and the negative proposition. In the reading (1)b, on the other hand, negation is interpreted outside of the scope of the *because*-clause; it negates the causal relation between the two propositions. We will call the reading in (1)a the

'BEC>NEG' reading, and (1)b the 'NEG>BEC' reading. This ambiguity is often attributed to the surface attachment ambiguity of *because*-clauses. [3] argues that the BEC>NEG reading arises when the *because*-clause attaches to IP ((3)a) and the NEG>BEC reading is yielded when it attaches to VP ((3)b).

- (3) a. [IP [IP George doesn't [VP starve his cat]] [because he loves her]]. (**BEC>NEG**)
- b. [IP George doesn't [VP [VP starve his cat] [because he loves her]]]. (**NEG>BEC**)

In this paper, we investigate into how young children deal with this type of ambiguity.

The relative scope of sentential negation and quantificational NPs has been extensively investigated in children. A locus of debate in this field is the availability of covert scope-shifting operations (e.g. QR, reconstruction) to preschoolers. For example, it is reported that English-speaking children show a non-adult-like bias to the isomorphic readings of sentences such as (4)a ([4], [5]) and (4)b ([6]): they strongly prefer every>Neg in (4)a and Neg>two in (4)b. This indicates that young children have difficulty in covert scope-shifting operations.

- (4) a. Every horse didn't jump over the fence.
(every>Neg, Neg>every)
b. Donald didn't find two guys.
(two>Neg, Neg>two)

The ambiguity with *because*-clauses and negation is different from the ambiguity of these examples in two respects. First, the ambiguity of (1) is not due to covert scope-shifting operations but due to the overt structural ambiguity. Second, the scope-bearing element we are considering (i.e. a *because*-clause) is an adjunct; the previous studies only consider the relative scope of arguments (the subject in (4)a and the object in (4)b) and negation. Examining the scope interaction between *because*-clauses and negation will thus add a new dimension to the research on children's knowledge of scope ambiguity.

2. Adults' interpretation bias for BEC>NEG

2.1. Frazier and Clifton (1996)

[7] report that English-speaking adults show a clear preference for the BEC>NEG reading for sentences such as (1). They used the test sentences in (5)a and (5)b, which pragmatically force the BEC>NEG reading and the NEG>BEC reading, respectively.

- (5) a. **BEC>NEG**
Test sentence: "The secretary didn't quit because of her large raise."
Question: Why didn't the secretary quit?
A. She DID quit B. Because of her large raise
- b. **NEG>BEC**
Test sentence: "The secretary didn't quit because of her low salary."
Question: Why didn't the secretary quit?
A. She DID quit B. Because of her low salary

The experiment employs a self-paced reading task, where the test sentences above are presented. If the subjects are sure that they understood the sentence, they proceed onto answering the question: Why didn't the secretary quit?¹ In (5)a, the reason why she didn't quit was because of the large raise (the BEC>NEG reading), so the correct answer to the question is B. (The NEG>BEC reading is pragmatically blocked because 'a large raise' should not be a reason for quitting.) In (5)b, on the other hand, it is presupposed that

¹ The percentage of the subjects that responded "I am sure I understood the sentence" was 97% in (5)a and 89% in (5)b, and there is no significant contrast between them.

the secretary quit and it is asserted that the reason for her quitting is not her low salary (the NEG>BEC reading). (Here, the BEC>NEG reading is unavailable because 'a low salary' usually cannot be a reason for *not* quitting.) Thus, the correct response to the question should be A, rather than B.

The percentage of the correct responses to the question was significantly lower in the NEG>BEC sentence (5)b, as shown in (6), which leads them to conclude that adult speakers have difficulty in the NEG>BEC reading.²

- (6) Correct answer to the Q
(5)a B = 96%
(5)b A = 11%

2.2. Hemforth and Konieczny (2004)

[8] (henceforth H&K) conducted experiments on German-speaking adults and show the same tendency as [7]. The preference for the BEC>NEG reading was always observed even when the context was biased towards the NEG>BEC reading.

They conducted experiments involving an off-line evaluation task. Subjects are given a pair of a target sentence and a reference sentence, and are asked to provide a numeric score to indicate the acceptability of the target sentence compared to the reference sentence, whose score is 1.00. (For example, if the target sentence is judged to be twice as good as the referent sentence, the subject gives it 2.00.)

In their second experiment, various contexts to bias subjects toward one reading were given. They used the two types of contexts exemplified in (7).

- (7) a. Context biased towards BEC>NEG
Everybody wondered whether the secretary had quit her job.
(A) **BEC>NEG**
The secretary didn't quit because she got a high salary.
(B) **NEG>BEC**
The secretary didn't quit because she got a low salary.

² We suspect there is another factor for the low percentage of the correct responses in (5)b. The question itself presupposes the proposition "the secretary didn't quit" and this contradicts with the NEG>BEC reading of (5)b. It might be the case that it is just difficult to override the presupposition and answer "she DID quit" to this question, even if (5)b pragmatically forces the NEG>BEC reading. The following experiment by [8] does not have this problem and therefore seems more convincing.

b. Context biased towards NEG>BEC

Everybody heard that the secretary had quit her job.

(A), (B): same as above

The context in (7)a is biased towards the BEC>NEG reading because the focus of everyone's attention is on "whether or not" she quit, and the next sentence should assert either "she quit" or "she didn't quit." The NEG>BEC reading of (7)a (B) presupposes (rather than asserts) the fact that "she quit", and it asserts that the reason was not because of her low salary. This is not compatible with the expectation from the context. On the other hand, the context (7)b is biased towards the NEG>BEC reading. It asserts that "the secretary quit her job." The BEC>NEG reading sentence (A) asserts the contrary statement that "she didn't quit" and it would be contradictory with the context.

The mean acceptability judgment scores are summarized in (8).

(8)	The mean acceptability judgment scores		
(7)a	(A) .26	(B) -.54	
(7)b	(A) .39	(B) -.38	

The results show that no matter what the context is, the BEC>NEG reading in (A) is always preferred to the NEG>BEC reading in (B).

2.3. Potential problems – towards TVJT

These adult offline experiments show that the BEC>NEG reading is always preferred regardless of the context. The potential concern about the previous experiments, however, is that their experiment settings were not rich enough to make the NEG>BEC reading felicitous.

First, H&K notes that the NEG>BEC sentence (7)(B) is inherently less informative than the BEC>NEG sentence (7)(A), because it only asserts that "the reason for her quitting is not her low salary," but it does not say what the real reason for her quitting was. They conjecture that the informativeness might be responsible for the preference for the BEC>NEG reading. If you make it obvious in the context that "the real reason is unspoken" but at least it is obviously NOT because of her salary, the NEG>BEC reading would be maximally informative in the context and this problem should not arise.

Second, generally speaking, negative sentences are most felicitously uttered when something expected fails to happen. If you make a context such that "everyone else is quitting because of the low salary, and people believe that the

secretary also quit because of her low salary," the NEG>BEC reading in (7)(B) might become more felicitous and the subjects might find it more acceptable.

With these concerns in mind, we conducted a new experiment on sentences with *because*-clauses and negation, using a truth-value judgment task (TVJT). We employed more detailed background stories before presenting the test sentences, so that each of the potential interpretations is felicitous and maximally informative in two different contexts. We thus examined (i) whether adults still show the bias for the BEC>NEG reading even when we elaborate on the background information, and further examined (ii) whether children also have the same type of bias as adults.

3. Experiment

3.1. Material

We employed four types of experiment conditions summarized below. Condition 1 is a story where the test sentence is true in the BEC>NEG reading. Condition 3 is a story where it is true in the NEG>BEC reading. Condition 2 and 4 are baseline conditions where the same test sentences are false in the relevant readings, respectively.

Condition 1: There is a swimming party at Mickey's house and there is a running party at Piglet's house. At first, everyone wants to go to the swimming party. Pooh, however, changes his mind and does not show up at the swimming party. Instead he is running at the running party. Later he explains to friends that he really wanted to run instead of swimming and it was a good workout.

Condition 2: There is a swimming party at Mickey's house and there is a running party at Piglet's house. At first, everyone wants to go to the swimming party. Pooh, however, changes his mind and does not show up at the swimming party. He wanted to see Piglet because they are best friends. Later he explains to friends that although he went to the running party, he hates running so he just cheered up Piglet while he was running.

Test sentence for Condition 1 and 2:

"Pooh said he didn't come to the swimming party because he wanted to run."

In Condition 1, Pooh did *not* come to the swimming party and the reason of his not coming was because he wanted to run at the running party. The test sentence is true in the BEC>NEG reading. In this story, the negation is

feliculously used because everyone else went to the swimming party and Pooh was expected to be there, but he eventually did *not* go. Condition 2 is minimally different from Condition 1 in that the reason of his absence is something else (i.e. because he wanted to see Piglet at the running party). Therefore Condition 2 is false in the BEC>NEG reading.

Note that the NEG>BEC reading would be equally infelicitous in both conditions. The NEG>BEC reading would presuppose the truth of the main clause (i.e. that Pooh came to the swimming party), but the presupposition is not met in these stories. Thus, if the subjects accept Condition 1 and reject Condition 2, it is a direct indication that they access to the BEC>NEG reading.

Condition 3: There is a swimming party at Mickey's house.

The other characters want to go to the swimming party because they like swimming. Pooh, however, doesn't like swimming and says he is not going to come. Later he changes his mind and shows up at the swimming party. He wanted to see Mickey because they are best friends. Later he explains to friends that although he came to the swimming party, he hates swimming so he just waited outside of the pool.

Condition 4: There is a swimming party at Mickey's house.

The other characters want to go to the swimming party because they like swimming. Pooh, however, feels too lazy to go because he lives far away, and says he is not going to come. But he changes his mind and shows up at the swimming party. Later he explains to friends that he really wanted to swim after all and came all the way down.

Test sentence for Condition 3 and 4:

"Pooh said he didn't come to the swimming party because he wanted to swim."

In Condition 3, Pooh *did* come to the swimming party but the reason for his coming was *not* because he wanted to swim; it is true in the NEG>BEC reading. In this story, too, the negation is felicitous because everyone else who came to the party wanted to swim, and it was unexpected for Pooh to come even though he hates swimming. Also, note that Pooh came to the swimming party for another reason (i.e. because he wanted to see Mickey) but he does not explain the real reason; all he said to friends was that the reason was *not* because he wanted to swim. In such a situation, "Pooh said he came to the party because he wanted to see Mickey,"

would be false (because he didn't *say* that), so 'not mentioning the real reason' does not make the test sentence less informative than possible; because of the clause "Pooh said...", it is maximally informative in this context. Thus, the two potential problems of the NEG>BEC reading in 2.3. do not arise in this context. This test sentence would be false in the BEC>NEG reading (because Pooh *did* come), so if the test sentence is accepted, that shows that the subjects have access to the NEG>BEC reading.

In Condition 4, too, Pooh came to the swimming party. But in this case, his reason for coming *was* because he wanted to swim. The negation in the test sentence would be false in both the BEC>NEG reading and the NEG>BEC reading.

3.2. Method

We tested 24 English-speaking preschoolers (Age: 3;11 - 5;9, Mean age 4;9) and 24 English-speaking adults. The experiment was conducted in University of Maryland, College Park. In the experiment, two experimenters played the roles of a story-teller and a puppet. The story-teller acts out the stories using small toys. After each story, the puppet says a sentence that describes the story and the subject judges if what the puppet said was right or wrong. For adult subjects, the story and the puppet utterance were played as video clips on a desktop monitor, and the subjects gave their judgments on an answer sheet.

We divided the subjects into two groups. The BEC>NEG group subjects (12 children and 12 adults) were tested on Condition 1 and 2, and the NEG>BEC group subjects (12 children and 12 adults) were tested on Condition 3 and 4. No subject gets both Condition 1 (which is felicitous in the BEC>NEG reading) and Condition 3 (which is felicitous in the NEG>BEC reading). This avoids the potential problem that the subjects are biased towards the reading that is felicitous in the first story they hear.

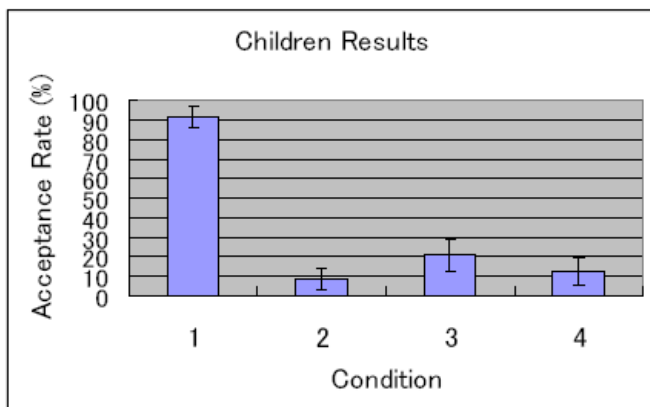
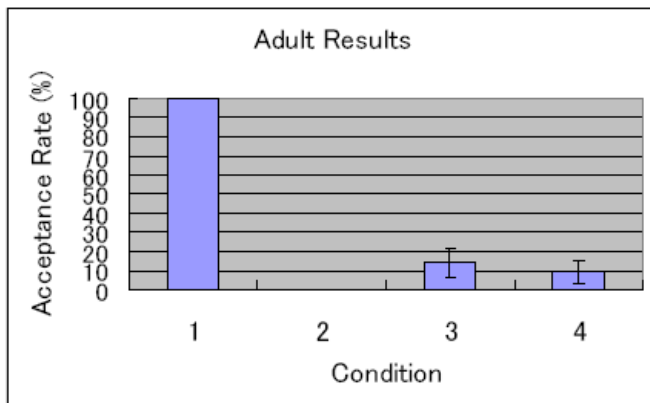
Each group was tested on four target stories (two stories each for two conditions) and four filler stories in a pseudo-randomized order. At the beginning of the experiment, we had two short warm-up sessions to make sure that the subjects understand the task.

3.3. Results

Overall, adults and preschoolers showed the same pattern of results. The BEC>NEG group adults and children both accepted the test sentence in Condition 1, where the BEC>NEG reading is true (Adults 100%, Children 91.6% acceptance). They rejected the same sentence in Condition 2

(Adults 0.0%, Children 8.3% acceptance). This indicates their ability to access the BEC>NEG reading. The rejection in Condition 2 also shows that the subjects were correctly paying attention to the adverbial clause (The main clause part ‘Pooh didn’t come to the swimming party’ is *true* in Condition 2). Thus, there is no potential concern that young children might only parse the main clause in the other conditions.

On the other hand, the NEG>BEC group adults and children rejected the test sentence in Condition 3 (Adults 14.2%, Children 20.8% acceptance). They did not have access to the NEG>BEC reading even though this reading is felicitous and true. The test sentence is false in both readings in Condition 4, which was correctly rejected by both adults and children (Condition 4: Adults 9.1%, Children 12.5% acceptance).



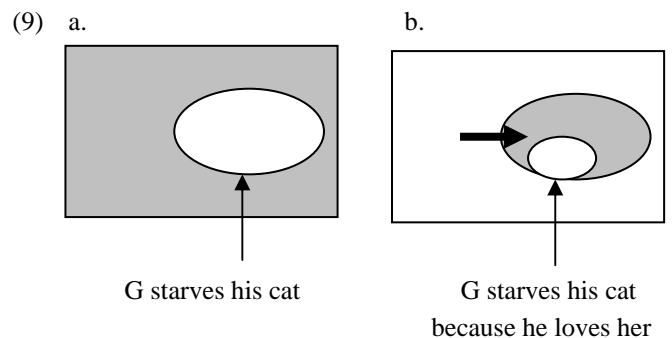
4. Discussion

Our results show that both adults and children accept sentences with negation and *because*-clauses only when the BEC>NEG reading is true. To summarize our findings, first, we replicated the previous observation that adults are biased towards the BEC>NEG reading and further showed that this bias stays even when we make the sentence maximally

informative and felicitous (See 3.1.). Second, we showed that the bias in this type of ambiguity is shared by both children and adults. It contrasts with children’s non-adult-like biases observed in ambiguous sentences with covert scope-shifting operations (See 1.).

Then what is the source for the bias for the BEC>NEG in adult/child grammar? H&K suggest the possibility related to prosodic information. A prosodic boundary tends to occur between the matrix clause and the adverbial clauses. This prosodic boundary might delimit the scope of negation; the scope of negation cannot go over the boundary to cover the adverbial clause.³

We speculate yet another possibility: the source of the preference might be related to semantic processing. Suppose that you have heard the sentence (1) up to the main clause. You have “George doesn’t starve his cat” and try to calculate the truth value of this sentence. At this point, you exclude the possibility that “George starves his cat” is true because the main clause is the negation of this proposition ((9)a).



However, if you hear the rest of the sentence and try to generate the NEG>BEC reading, you need to cancel the calculation in (9)a and switch to the worlds where “George starves his cat” is true, as in (9)b, because the NEG>BEC reading of (1) presuppose that George starved his cat.

In further research, we will try to (i) look for a way to detect the real reason for the preference for the BEC>NEG reading, and (ii) explain how, even if it is less preferred, the NEG>BEC reading is eventually acquired as a potential reading.

³ [9] also argue that the source for the preference is related to the intonational boundary. They show that, if the entire test sentence is embedded in a subordinate clause, the prosodic pattern changes and the preference for the BEC>NEG reading fades away. In our study, the native-speaker experimenters tried to use the prosody that they think is ‘most natural for the NEG>BEC reading’ in Condition 3/4. Especially, they tried not to put an intonational break between the main clause and the *because*-clause. In future experiments, we will try to fully control the prosody of the sentences in a systematic way.

5. Conclusion

In this paper, we reported our experiment to show that preschoolers have a preference for the BEC>NEG reading in ambiguous sentences with negation and *because*-clauses. Unlike children's non-adult-like biases observed in sentences with covert scope-shifting operations, the preference for the high attachment of *because*-clauses over negation is shared by both adults and children. The fact that children show adult-like behavior in this type of sentences indicates that their biases in covert scope-shifting operations cannot be attributed to the difficulty of negation itself.

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