The Role of Task Characteristics in Children's Scalar Implicature Production

Leen Janssens (Leen.Janssens@ppw.kuleuven.be)
Laboratory of Experimental Psychology, Tiensestraat 102
3000 Leuven, BELGIUM

Walter Schaeken (Walter.Schaeken@ppw.kuleuven.be)
Laboratory of Experimental Psychology, Tiensestraat 102
3000 Leuven, BELGIUM

Abstract

In two experiments, we aimed to show the importance of task characteristics in scalar implicature production. In Experiment 1, we found that five-year-olds were significantly more pragmatic when given an Action-Based Task (ABT), in which they had to respond by performing an action than in a Truth-Value Judgement Task (TVJT), in which they had to evaluate the truth-value of statements. Experiment 2 showed that seven-year-olds were almost exclusively pragmatic on the same ABT and TVJT used in Experiment 1. However, we found a 22% drop in pragmatic responses when the TVJT contained world-knowledge statements (rather than statements about simple objects such as marbles). Together, these two experiments provide evidence that not only the nature of the task, but also its specific content is crucial in determining the extent to which young children produce scalar implicatures.

Keywords: scalar implicatures; task characteristics; ABT; TVJT.

Introduction

People communicate with each other to express what they feel, think, want, etc. Although this seems to happen effortlessly and automatically, the communication process is more than just the simple encoding and decoding of a message by a messenger and a receiver. Not only the literal meaning of a sentence is important, but also the implicit meaning that the speaker wants to communicate. The first systematic attempt to explain how these inferences are derived, belongs to Paul Grice. He offered a comprehensive framework of the mechanics of inferential communication (Grice, 1975). According to Grice, communication is a co-operative enterprise between people, governed by certain relational expectations about how a conversational exchange should be conducted. These relational expectations are called 'maxims' and Grice proposed four of these maxims: the Maxim of Quantity, the Maxim of Quality, the Maxim of Relation and the Maxim of Manner. These maxims respectively imply that interlocutors are always expected to offer contributions which are informative, truthful, relevant to the goals of the conversation and appropriately phrased. Grice introduced the term 'implicature', which refers to the meaning that is implied by the speaker but not explicitly stated.

Considerable experimental research has been devoted to *scalar implicatures,* i.e. implicatures based on the existence of ordered terms on a scale of informativity (e.g., <all, most, many, some>). The general consensus is that the weaker term (e.g., the quantifier *some*), while logically compatible with a stronger term from the same scale (e.g., *all*), prompts the inference that '*all*' is not the case because the speaker did not use the stronger term. Therefore, the scalar expression '*some*' can be interpreted in two ways: either in an inference-driven, pragmatic reading, which excludes '*all*', or in its literal, semantic meaning, which is compatible with '*all*'.

Recent experimental investigations into children's interpretation of scalar terms have concluded that preschool children are often insensitive to scalar implicatures in tasks involving language comprehension (Chierchia et al., 2001; Noveck, 2001). In these studies, children, although otherwise linguistically competent, were shown to attend only to the logical/semantic meaning of the scalar terms. For example, Noveck (2001) found that 89% of the seven-to-eight-year olds in his study agreed with statements such as 'Some giraffes have long necks.' Such behavior has led Noveck (2001) to conclude that "younger, albeit competent reasoners, initially treat a relatively weak term logically before becoming aware of its pragmatic potential", and that, in this respect, "children are more logical than adults" (Noveck, 2001, p. 165).

The availability of cognitive resources is often used to explain this typically found pragmatic delay in children. As suggested by Noveck (2001), a plausible explanation for this delay is that inferring scalar implicatures requires effort and that children have less cognitive resources available than adults. Two different theories make different predictions regarding this issue. According to the neo-Gricean theorists (e.g., Levinson, 2000), implicature production happens automatically and only its inhibition demands processing costs. Relevance Theory (Sperber & Wilson, 1995) in contrast, suggests that an implicature will only be produced if it is relevant in the context and they state that this production requires additional processing costs. Evidence in favour of Relevance Theory, regarding scalar implicatures, has been presented among others by Noveck and Posada

(2003). Their experiments indicated that pragmatic answers require more time than logical answers. Assuming that longer time is associated with more processing costs, this provides indirect evidence for Relevance Theory.

In contrast to research showing that children initially reason logically, there is also substantial experimental evidence that children are not incapable of drawing scalar inferences and that they are aware of the pragmatic potential of scalar expressions. In these kinds of studies, the prime interest is to discover what conditions facilitate implicature production for children. A key factor seems to be the nature of the task. For instance, Foppolo, Guasti, and Chierchia (2004) conducted experiments concerning the quantitative scale <all, some> using two different tasks: a Truth-Value Judgement Task (TVJT) (Crain & Thornton, 1998), in which participants had to decide whether (under-informative) statements were true or false, and a Felicity Judgement Task (FJT) (Chierchia et al., 2001). In the FJT, participants were presented with a pair of utterances with the same truth-value but different levels of appropriateness and were asked to choose the most felicitous description. When five-year-olds completed the FJT, the number of pragmatic responses was 95% while the number of pragmatic responses in the TVJT was only 50%.

Pouscoulous et al. (2007) also examined the role of the nature of the task. In their first experiment, they replicated earlier findings showing that nine-year-olds were more likely than adults to consider as true statements such as 'Some turtles are in the boxes' (uttered when all turtles are in the boxes) in a TVJT. In their second experiment, they presented an Action-Based Task (ABT), in which participants did not have to give a metalinguistic evaluation of statements but had to respond by performing an action. Children were presented with five boxes and five tokens. They were asked to adapt the situation to make it compatible with a statement. For example, if they were told "I would like all the boxes to contain a token" and two of the five boxes already contained a token, they were expected to put a token in every empty box. The results showed that, when children were asked to perform an action rather than give a metalinguistic truth evaluation, the number of implicatures made by the children increases.

In our own study we built on these experiments by Pouscoulous et al. (2007).

Experiment 1

Our primary goal was to directly test the role played by the nature of the task in implicature production by five-year-olds. We therefore made three important changes to the Pouscoulous et al. (2007) study.

First, we presented the same group of children with both a TVJT and an ABT: manipulating the nature of the task within subjects allowed direct comparison between the two tasks.

Second, there was an important difference in content between the ABT and TVJT used by Pouscoulous et al. (2007). Whereas the ABT in Pouscoulous et al. (2007) only used tokens and boxes, in the TVJT, the children were presented with three types of animals that remained in front of them throughout the task. For each statement, they had to focus on one type of animal and ignore the other animals. Since the statements were randomly ordered, they constantly had to switch their attention between the three types, which placed greater demands on information processing than in the ABT. To remedy this problem, we made the two tasks more similar in design.

Third, we measured children's working memory (WM) capacity and compared a group of low WM-span children with a group of high WM-span children. As Pouscoulous et al. (2007) suggested, cognitive resources are important in implicature production and may explain why easier tasks, that require less cognitive resources, lead to more pragmatic answers than more difficult tasks. In adults, it has been shown that burdening WM decreases implicature production by 10% (De Neys & Schaeken, 2007). Consequently, it can be assumed that people with less cognitive resources will be less pragmatic than people with more cognitive resources. But so far, no research has been conducted on children that directly investigated the role of cognitive resources. That is why we will measure WM-capacity in the children in our experiments and investigate whether children with a high WM-capacity produce more scalar implicatures than children with a low WM-capacity.

Method

Participants The sample comprised 48 five-year-olds (28 boys and 20 girls) between the ages of 5.2 and 6.1 with a mean age of 5.6 (SD=1.15), recruited from two different schools in Belgium. All were native Dutch speakers.

Action-Based Task (ABT) The ABT consisted of three scenarios, each involving five plastic boxes and five marbles. In the 'All-scenario', all five boxes contained a marble. In the 'None-scenario', all the boxes were empty. In the 'Subset scenario', two boxes contained a marble. In each scenario, a puppet, handled by the experimenter, was used to utter the same four requests: 'I would like all the boxes to contain a marble' ('Ik zou willen dat er in alle dozen een knikker zit'), 'I would like some boxes to contain a marble' ('Ik zou willen dat er in sommige dozen een knikker zit'), 'I would like none of the boxes to contain a marble' ('Ik zou willen dat er in geen van de dozen een knikker zit') and 'I would like some boxes not to contain a marble' ('Ik zou willen dat er in sommige dozen geen knikker zit'). This amounted to a total of 12 requests. The participants were instructed to make changes to the scenario to comply with the puppet's requests. For example, if the puppet said 'I would like all the boxes to contain a marble' in the 'Subset-scenario', the child was expected to put a marble in the three empty boxes.

There were two critical situations and 10 control statements. The first critical statement occurred in the 'All-scenario' when the puppet stated 'I would like some boxes to contain a marble'. If the child interprets '*some*' logically, he or she will make no changes to the scenario. However, if the child grasps the implicature, he or she will take at least one of the marbles away. The second critical statement occurred in the 'None-scenario' when the puppet uttered the statement 'I would like some boxes not to contain a marble'. In this case, if the child interprets the statement logically, no action should be taken. A pragmatic interpretation, on the other hand, would require an action (adding at least one marble to the boxes).

For the 10 control statements, there was no distinction possible between pragmatic and logic interpretations. An example is 'I would like all the boxes to contain a marble' in the 'None-scenario'. In this case the child is expected to put a marble in all 5 empty boxes.

Truth-Value Judgement Task (TVJT) The children were presented with five boxes and five marbles in the three same scenarios as in the ABT. In each scenario, a puppet made the same four statements (amounting to a total of 12 sentences): 'All the marbles are in the boxes' ('Alle knikkers zitten in de dozen), 'Some marbles are in the boxes' ('Sommige knikkers zitten in de dozen'), 'None of the marbles are in the boxes' ('Geen van de knikkers zit in een doos') and 'Some marbles are not in the boxes' ('Sommige knikkers zitten niet in de dozen'). After each statement, participants had to decide whether it was true or false. The two critical statements were '*Some marbles are in the boxes*' in the 'All-scenario' and '*Some marbles are not in the boxes*' in the 'None-scenario'. In both cases, 'true' would be the logical answer , whereas 'false' would be the pragmatic answer.

The other 10 statements were control statements (e.g. *'Some marbles are in the boxes'* in the 'Subset-scenario').

Working Memory Tasks The children performed three WM-tasks. First, the auditory (phonological loop) component was measured using the Digit Span Forward task in which subjects have to repeat an orally presented list of numbers. The list starts with a sequence of two numbers and keeps increasing until the child makes two errors within one block of the same digit-length. Second, the visual component (visuo-spatial sketchpad) was measured using the Corsi Block Span test. In this test, the children were presented with nine wooden blocks on which the experimenter tapped a pattern and the children were instructed to repeat the sequence. The sequence becomes longer until the child makes two errors within one block of the same difficulty level. The third WM task, which was intended to provide a 'central executive' measure, was the Digit Span Backward task. This task is identical to the Digit Span Forward, except that the subject needs to repeat the numbers in reverse order. The raw scores for each of these tasks (i.e. the total number of correct answers) were converted into z-scores, which were then added up to compute the WM span.

Procedure Each participant was interviewed individually for about 20 minutes. Participants first completed the three WM tasks. The order of the other two tasks was randomized, so that half of the participants started with the TVJT and the other half with the ABT. In both tasks, the experimenter used a puppet called Minnie. In the TVJT, the children were informed that the puppet sometimes says things that are correct and sometimes says things that are wrong. In the ABT, the children were told that the puppet would give instructions regarding the boxes and the marbles and that they would either have to remove marbles, add marbles, or make no changes. Before the start of the experiment, the children were given three practice questions in the ABT. These questions were very similar to the experimental sentences but employed numbers instead of quantifiers. The three training questions were: '*I would like two boxes to contain a marble*', when only one box contained a marble, '*I would like three boxes to contain a marble*', when three boxes contained a marble and '*I would like two boxes to contain a marble*', when three boxes contained a marble. These training questions were constructed so that the participants had to remove marbles, add marbles and change nothing. This way, they got acquainted with all types of actions they would have to perform during the experiment. If the children made errors on these training questions, the experimenter corrected them and explained their mistakes.

Results

We hypothesized that there would be differences in implicature production and performance between the TVJT and the ABT. Our hypothesis about the difference in performance was confirmed by the finding that the TVJT leads to significantly more errors than the ABT on the control statements (9% versus 5%, respectively. Wilcoxon Matched Pairs test, $n=23$; $T=57.5$; $p=.011$).

With regard to the critical sentences, we hypothesized that the ABT would lead to more pragmatic answers than the TVJT. Again, our hypothesis was confirmed. The children responded pragmatically to the critical sentences in 91% of the instances on the ABT, compared to 70% on the TVJT (Wilcoxon Matched Pairs test, $n=20$; $T=22.5$; $p=.002$). These results are shown in Table 1.

For both tasks, we compared a high WM-span group ($N=16$; $M=2.13$; $SD=0.82$) with a low WM-span group ($N=16$; $M=-2.37$; $SD=1.42$) with regard to the number of correct answers to the control sentences and the number of pragmatic responses. While there were no significant differences in pragmatic processing, the number of correct responses to the unambiguous control sentences differed significantly between the two groups. The high-span group was more accurate than the low-span group on both the ABT (98% vs 91% correct answers; Mann-Whitney U test,

Table 1: Percentage of logical responses in each scenario of the TVJT and ABT (Experiment 1).

Utterance	Task	All-scenario	None-scenario	Subset-scenario
(1) All the marbles are in the boxes.	TVJT	100%	100%	98%
(1) I would like all the boxes to contain a marble.	ABT	98%	100%	100%
(2) Some marbles are in the boxes.	TVJT	**23%**	100%	96%
(2) I would like some boxes to contain a marble.	ABT	**4%**	96%	98%
(3) None of the marbles are in the boxes.	TVJT	96%	85%	88%
(3) I would like none of the boxes to contain a marble.	ABT	98%	92%	98%
(4) Some marbles are not in the boxes.	TVJT	94%	**37%**	58%
(4) I would like some boxes not to contain a marble.	ABT	92%	**15%**	83%

Note: critical statements are in bold

n_1=16, n_2=16; U=96.5; z=-1.72 p=.04) and the TVJT (94% vs 87% correct answers; Mann-Whitney U test, n_1=16, n_2=16; U=76; z=-2.06; p=.02).

Discussion

The ABT led to significantly more pragmatic answers than the TVJT. In addition, the five-year-olds made fewer mistakes on the ABT control statements than on the TVJT control statements.
These results indicate that meta-linguistic tasks are harder than tasks that require no verbal response.

Our results show that even five-year-old children are competent pragmatic reasoners. Their competence is still 'vulnerable', but taking into account certain factors such as task complexity, task content, context, training, etc., they are capable of producing scalar implicatures on a high level. This confirms the findings of Pouscoulous et al. (2007). Moreover, the validity of our results was enhanced by manipulating the nature of the tasks within participants and by changing the design of the TVJT to make it more comparable to the ABT. This allows us to attribute the results to the task's cognitive demands and to conclude that the nature of the task is crucial in implicature processing in five-year-olds.

Our WM-measures revealed no significant differences in implicature processing between a group of low-span children and a group of high-span children. Although the high-span children made significantly fewer errors on the control statements, these WM-results do not allow us to draw firm conclusions about the role of WM in implicature processing.

Remarkably, the five-year-olds in our experiment produced a much higher percentage of pragmatic answers than the children tested in Pouscoulous et al. (2007). They were equally pragmatic on the ABT and more pragmatic on the TVJT than the seven-year-olds and the adults in Pouscoulous et al. (2007), who conclude that "Only 7-year-olds reveal behavior that approaches that of adults among the standard cases and even among them adultlike implicature performance is less likely when it concerns negative sentences" (Pouscoulous et al., 2007, p.371). Since we had only investigated one age-group (five-year-olds) and

since the age of seven is mostly found to be the age at which children really begin to demonstrate pragmatic skills (Guasti et al., 2005), we ran the same experiment with a group of seven-year-olds. We expected them to be even more pragmatic than the five-year-olds. In addition to the ABT and TVJT used in Experiment 1, we included a TVJT that is often used in experimental research on implicatures, i.e. the world-knowledge TVJT from Noveck (2001).

Experiment 2

Method

Participants Thirty-four seven-year-olds (18 girls, 16 boys) between the ages of 6.9 and 8.5 with a mean age of 7.5 (SD=.32) participated in this experiment. All participants were recruited from the same school and were native Dutch speakers.

TVJT, ABT and WM Tasks The same TVJT, ABT and three WM tasks were used as in Experiment 1.

World-knowledge TVJT In order to investigate whether the specific content of the task plays a role in implicature production, the seven-year-olds conducted a task based on Noveck (2001; Experiment 3). In this task, the children were presented with 30 statements (translated into Dutch) and were instructed to indicate whether or not they agreed with each statement. The sentences were based on three types of information: factually universal (that elephants have trunks is arguably best represented with the quantifier All), factually existential (that birds live in cages is arguably best represented with Some), and absurd (that stores are made of bubbles is arguably false with both kinds of quantifiers). The statements can be categorized in six subgroups:

(a) Five absurd *All* sentences (e.g. All birds have telephones.)
(b) Five absurd *Some* sentences (e.g. Some fish are made of leaves.)
(c) Five true *All* sentences (e.g. All elephants have trunks.)

(d) Five true (and felicitous) *Some* sentences (e.g. Some flowers are yellow.)

(e) Five false All sentences (e.g. All dogs have spots.)

(f) Five true (but pragmatically infelicitous) Some sentences (e.g. Some giraffes have long necks.)

We were particularly interested in the sentences from category (f). If children agree with such statements they are responding logically, while disagreeing implies a pragmatic response. If we look at the different types of statements, it is clear that switching quantifiers can make (c) interchangeable with (f) as well as (d) with (e). In this way, we created two versions of this task. In each version, both the All and the Some sentences were randomized, as were the different types of statements.

Procedure The procedure was exactly the same as in Experiment 1. However, an additional test was administered after all other tests were performed. All children received a paper with the 30 statements included in the world-knowledge TVJT. These statements were read out to them and they were asked to indicate, for each statement, whether they agreed or disagreed by circling the appropriate answer.

Results

The TVJT control statements led to 96% correct answers, compared to 99% for the ABT (Wilcoxon Matched Pairs test, n=11, T=66, p=.001). For the control statements of the world-knowledge TVJT, the number of correct answers was 94%, which differed significantly from the ABT (Wilcoxon Matched Pairs test, $n=3$, $T=42$, $p<.001$), though not from the other TVJT (Wilcoxon Matched Pairs test, $n=9$, $T=133$, $p=.11$). Regarding the critical sentences, there were no significant differences between the TVJT and the ABT in the number of pragmatic answers (91% versus 94%, respectively; Wilcoxon Matched Pairs test, $n=5$, $T=22.5$, $p=.48$). In contrast, the world-knowledge TVJT only yielded 69% pragmatic answers, which differed significantly from the other TVJT (Wilcoxon Matched Pairs test, $n=3$, $T=46.5$, $p=.005$) and from the ABT (Wilcoxon Matched Pairs test, $n=3$, $T=34.5$, $p=.003$). The results of the ABT and the TVJT

are shown in Table 2 whereas the results of the world-knowledge TVJT are shown in Table 3.

As in Experiment 1, we compared a group of high WM-span children ($N=11$; $M=2.32$; $SD=1.07$) with a low-span group ($N=11$; $M=-2.38$; $SD=1.06$). No significant differences were found between the two groups on any of the three tasks, neither in pragmatic responses, nor in performance on the unambiguous sentences.

General Discussion

The two studies reported in this article investigated the role of the task in scalar implicature production in young children. Our goal was to show that the kind of task and even the specific task content has an important impact on scalar implicature production. In Experiment 1, we investigated five-year-old children. We found, as expected, that a more difficult TVJT caused the children to be less accurate and less pragmatic than an ABT in which children did not have to answer verbally. Given our methodological improvements, this difference was not caused by a difference in task design but by a difference in task complexity. Manipulating the nature of the task is sufficient to show that, under the right circumstances, children as young as five years are capable of spontaneously producing implicatures.

In Experiment 2, we investigated a group of seven-year-olds whom we expected to be even more pragmatic than the five-year-olds in Experiment 1. This expectation was confirmed by the results: the pragmatic response rate was so high that it did not lead to a significant difference between the ABT and the TVJT. However, when the children performed a TVJT involving world-knowledge statements, pragmatic responses dropped by 22%. For the world-knowledge TVJT, the children need to rely on the knowledge they have stored in their memory, whereas in the simple TVJT, they just have to rely on the boxes and marbles in front of them, which is less demanding on memory resources.

Table 2: Percentage of logical responses in each scenario of the TVJT and ABT (Experiment 2).

Utterance	Task	All-scenario	None-scenario	Subset-scenario
(1) All the marbles are in the boxes.	TVJT	100%	100%	100%
(1) I would like all the boxes to contain a marble.	ABT	100%	100%	100%
(2) Some marbles are in the boxes.	TVJT	**0%**	100%	94%
(2) I would like some boxes to contain a marble.	ABT	**3%**	100%	100%
(3) None of the marbles are in the boxes.	TVJT	97%	94%	97%
(3) I would like none of the boxes to contain a marble.	ABT	100%	100%	100%
(4) Some marbles are not in the boxes.	TVJT	97%	**18%**	79%
(4) I would like some boxes not to contain a marble.	ABT	100%	**9%**	91%

Note: critical statements are in bold

Table 3: Percentage of logical responses on the world-knowledge TVJT (Experiment 2).

Sentence type	Correct Response	
Utterances expressed with All		
Absurd (false) (e.g. All birds have telephones)	No	97%
Appropriate (true) (e.g. All elephants have trunks)	Yes	94%
Inappropriate (false) (e.g. All dogs have spots)	No	92%
Utterances expressed with Some		
Absurd (false) (e.g. Some fish are made of leaves)	No	100%
Appropriate (true) (e.g. Some flowers are yellow.)	Yes	82%
Inappropriate (true though pragmatically infelicitous) (e.g. Some giraffes have long necks)	**Yes**	**31%**

Note: critical statements are in bold

Another difference between the two TVJT's is that the TVJT with the marbles and the boxes is based on visual input (the marbles and the boxes) whereas the world-knowledge TVJT is not based on visual input. The hypothesis that easier tasks lead to significantly more pragmatic answers than more difficult tasks is based on the assumption that cognitive resources are critical in implicature production (De Neys & Schaeken, 2007). As easier tasks require fewer cognitive resources than complex tasks, more cognitive resources remain available for producing implicatures.

Based on these assumptions, we hypothesized that children with a high WM-capacity would be more pragmatic than children with a low WM-capacity since they have more cognitive resources available. This hypothesis was not confirmed.

Even when we performed the WM-analyses on the combined sample from both experiments (with the highest scoring children in each experiment as the 'high-group' and the lowest scoring children as the 'low-group), we did not find a significant WM-effect. Although a certain trend can be observed in our WM-data, we are unable to find a single significant WM-effect. However, this is hardly surprising given that the significant WM-effect found in adults is small (De Neys and Schaeken, 2007), which ensures a smooth flow of communication.

In sum, the key finding of the present study is that the nature of the task and the specific task content are very important in scalar implicature production in young children: more cognitive tasks or more cognitive task content cause a decrease in implicature production. This factor has to be taken into account when investigating implicature production in children. Another factor that might need to be taken into account in future research is a measure of general language ability. Since it was found that metalinguistic tasks are harder than action-tasks, it is plausible that general language ability may account at least partly for these results.

References

Chierchia, G., Crain, S., Guasti, M. T., Gualmini, A., & Meroni, L. (2001). The acquisition of disjunction: evidence for a grammatical view of scalar implicatures. In A. H.–J. Do, L. Dominguez & A. Johansen (Eds.), *Proceedings of the 25th Boston University Conference on Language Development* (pp.157-168). Somerville, MA: Cascadilla Press.

Crain, S., & Thornton, R. (1998). Investigations in Universal Grammar. A Guide to Experiments on the Acquisition of Syntax and Semantics. The MIT Press, Cambridge, MA.

De Neys, W., & Schaeken, W. (2007). When people are more logical under cognitive load: Dual task impact on scalar implicature. *Experimental Psychology, 54*(2), 128-133.

Foppolo, F., Guasti, M. T., & Chierchia, G. (2004). *Pragmatic inferences in children's comprehension of scalar items*. (Talk presented at Second Lisbon Meeting on Language Acquisition, Lisbon, 2004).

Grice, H. P. (1975). Logic and Conversation. In P. Cole & J. Morgan (Eds.), Syntax and Semantics, Vol. 3. New York: Academic Press.

Guasti, M. T., Chierchia G. , Crain S., Foppolo F., Gualmini A., & Meroni L. (2005). Why Children and Adults Sometimes (But Not Always) Compute Implicatures. *Language and Cognitive Processes 20*, 667–696.

Levinson, S. (2000). *Presumptive meanings: The theory of generalized conversational implicature*. Cambridge, MA: MIT Press.

Noveck, I. A. (2001). When children are more logical than adults: experimental investigations of scalar implicature. *Cognition, 78*(2), 165-188.

Noveck, I. A., & Posada, A. (2003). Characterizing the time course of an implicature: An evoked potentials study. *Brain and Language, 85*(2), 203-210.

Pouscoulous, N., Noveck, I., Politzer, G., & Bastide, A. (2007). A developmental investigation of processing costs and implicature production. *Language Acquisition, 14*(4), 347-375.

Sperber, D., & Wilson, D. (1995). *Relevance: Communication and Cognition*. Cambridge, MA: Harvard University Press.