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Acquisition of Relevance implicatures: A case against a Rationality-based account of conversational implicatures

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ABSTRACT

In our L1 acquisition experiment, we tested between the Language-based and Rationality-based accounts of how Relevance implicatures are computed, and found support for the Language-based account but not the Rationality-based account. While on the Language-based account (e.g., Horn, 1984; Levinson, 2000), Relevance implicatures are situated within the language module, on the Rationality-based account (Kasher, 1991), they are not situated within the language module, and are interpreted as being derived by Rationality-based reasoning, which is also instrumental in deriving non-linguistic inferences.

We tested children aged 5;1–8;1 on computing Relevance implicatures and non-linguistic inferences that were parallel in nature. On the Language-based account, children were predicted to perform better on computing non-linguistic inferences than Relevance implicatures that are parallel in nature because in order to compute Relevance implicatures children need to master additional linguistic prerequisites. On the Rationality-based account, children were not predicted to perform better on computing non-linguistic inferences than Relevance implicatures.

We found that children performed significantly better on computing non-linguistic inferences than Relevance implicatures, which provided evidence for the Language-based account. We argue that reasoning about language, and specifically, about the role of seemingly irrelevant utterances in discourse, constitutes the main acquisition challenge with respect to Relevance implicatures.

1. Introduction

This paper focuses on investigating the interplay of linguistic and non-linguistic factors in first language development of conversational competence. We explore the borderline between linguistic and non-linguistic inferences from the standpoint of first language acquisition. To this end, we tested children on computing Relevance implicatures, which are linguistic inferences, and on making non-linguistic inferences that are parallel in nature to Relevance implicatures. Our experimental results provide support for the Language-based account[1] of Relevance implicatures, and by extension, conversational implicatures, and provide evidence against the competing Rationality-based account of these meanings. As was predicted by the Language-based account but not by the Rationality-based account, we found that computing Relevance implicatures was more challenging for children than computing non-linguistic

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[1] In this paper, the label ''Language-based'' refers to a version of a neo-Gricean account, which will be introduced in the course of the paper.

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counterparts. Our experimental results enabled us to isolate the linguistic component involved in computing Relevance implicatures.

One goal of this paper is to explore how children learn to compute Relevance implicatures, to identify the prerequisites that the child needs to master in order to compute these, and at the same time to identify the prerequisites the child needs in order to compute non-linguistic inferences that are parallel in nature. Another goal is to compare children's performance on computing different classes of conversational implicatures, specifically, scalar Quantity-based implicatures vs. Relevance implicatures. Quantity-based implicatures serve as a good benchmark for exploring children's performance on computing other types of conversational implicatures because they are the only class of conversational implicatures whose acquisition has been studied extensively. It has been shown that children demonstrate the ability to compute Quantity-based implicatures by the age of five (e.g., Papafragou and Tantalou, 2004), and, to date, it is not known if children master any other class of conversational implicatures prior to this age.

The central theoretical goal of this paper is to show that the pragmatic apparatus involved in generating and employed in computing conversational implicatures needs to be language-specific, as it was conceived of in Grice's (1975, 1989) proposals and in much of the theoretical work done within the framework of neo-Gricean pragmatics (e.g., Horn, 1984; Levinson, 2000) rather than applicable to cognitive processes in general. We will argue against the opposing claim (e.g., Kasher, 1991) on which the pragmatic apparatus relevant to conversational implicatures needs to be modified from being applicable to language to being applicable to all areas of cognition.

2. The Language-based and Rationality-based accounts of conversational implicatures

In his seminal (1975) article "Logic and Conversation," Grice observed that some assumptions behind his maxims of Quantity, Quality, Relation and Manner have analogues in non-linguistic human interactions and individual activity, and claimed that one of his aims was "...to see talking as a special case or variety of purposive, indeed, rational behavior..." (Grice, 1975:308). However, Grice's Cooperative Principle and the maxims are linguistic in nature, and their domain of application is limited to linguistic exchanges.

To remind the reader, Grice's Cooperative Principle is,

(1) "Make your conversational contribution such as is required, at the stage at which it occurs, by the accepted purpose or direction of the talk exchange in which you are engaged" (Grice, 1975:307).

Grice viewed the maxims of Quantity, Quality, Relation and Manner in (2) as being derived from the Cooperative Principle.

(2)

1. Quantity:

1.1. Make your contribution as informative as is required (for the current purposes of the exchange).

1.2 Do not make your contribution more informative than is required.

2. Quality:

2.1. Do not say what you believe to be false.

2.2. Do not say that for which you lack adequate evidence.

3. Relation:

Be relevant.

4. Manner:

4.1. Avoid obscurity of expression.

4.2. Avoid ambiguity.

4.3. Be brief (avoid unnecessary prolixity).

4.4. Be orderly.

(Grice, 1989:26–27).

One of the underlying assumptions of Grice's framework is that interlocutors follow the maxims or at least the Cooperative Principle in their conversational exchanges. The maxims are instrumental in generating conversational implicatures. Thus flouting a maxim is one of the mechanisms that interlocutors commonly employ in generating conversational implicatures. To illustrate, by flouting the maxim of Relevance, speaker B in (3b) generates the Relevance implicature in (3c).

(3) a. A: Where can I find a new cartridge?

b. B: There is a pharmacy around the corner.

c. Relevance implicature: A can buy a cartridge in the pharmacy.

The Relevance implicature in (3c) is derived by going (roughly) through the following steps of reasoning within the Gricean framework.

(4)
1. B said, "There is a pharmacy around the corner."
2. Given A's question, B's utterance flouts the maxim of Relevance, "Be Relevant."
3. There is no reason to suppose that B is not observing the maxims, or at least the Cooperative Principle.
4. B could not be doing so unless he thought that "A can buy a cartridge in the pharmacy."
5. B knows (and knows that A knows that B knows) that A can see that the supposition that B thinks that "A can buy a cartridge in the pharmacy" is required.
6. B has done nothing to stop A from thinking that "A can buy a cartridge in the pharmacy."
7. B intends A to think that "A can buy a cartridge in the pharmacy," and so B has implicated that "A can buy a cartridge in the pharmacy."

In effect, Grice's Cooperative Principle and the maxims put constraints on the content and style of the interlocutor's *conversational contribution*. Thus these principles themselves are unambiguously language-specific. There is a tension between Grice's claim that linguistic exchanges are a special case of rational behavior and the fact that his formulation of principles that he viewed as governing linguistic exchanges is language-specific.

One common criticism of the Gricean account of conversational implicatures, which stems from this tension, is that the reasoning involved in computing implicatures (Relevance implicatures in particular) need not be linguistic but rather is based on general assumptions about cognition. Thus Kasher (1976, 1991) reinterpreted the Gricean account of conversational implicatures by arguing that these meanings can be computed based on cognitive principles that are not specific to language. Kasher (1976, 1991) observes that humans follow the principle of effective means in (5), which applies to all areas of human activity, linguistic communication being only one of these.

(5) "Given a desired end, one is to choose that action which most effectively, and at least cost, attains that end, *ceteris paribus*" (Kasher, 1976:205).

All things being equal, given the task of painting a wall, one will normally prefer using a painting brush over using a toothbrush because doing the former will be more effective. One will also normally prefer using a painting brush over splashing the paint on the wall and spilling it in order to avoid using extra paint. Similarly, in a conversation, all things being equal, the principle of effective means will drive the interlocutor to produce an utterance that provides no more and no less than the required amount of relevant information.

Kasher (1976, 1991) argue that Grice's Cooperative Principle should be replaced with a more general Rationality Principle as in (6), which is based on the principle of effective means in (5).

(6) "Where there is no reason to assume to the contrary, take the speaker *s* to be a rational agent; *s*'s ends and beliefs in a context of utterance should be assumed to supply a complete justification of *s*'s behavior, unless there is evidence to the contrary" (Kasher, 1991:577).

It is also argued that analogues of Grice's maxims of Quantity, Quality, Relation and Manner can be derived from the Rationality Principle. Consequently, it is claimed that conversational implicatures as meanings defined in Grice's work (e.g., Grice, 1989) can be derived based on the Rationality Principle and non-linguistic maxims derived from it. Consider Kasher's (1982) analogue of Grice's maxim of Relevance.

(7) "When you put your means to use for attaining a given desired end, try to utilize processes, actions and states which are occurring anyway in the context of your action" (Kasher, 1982:38).

Crucially, Kasher's reinterpretations of Grice's maxims apply to all areas of human activity rather than specifically to language. Kasher claims that these principles are utilized in forming beliefs and planning action, and emphasizes that his principles of Rationality and effective means are not specific to processing language.

Thus Kasher (1982) claims that analogues of Grice's maxims are instrumental in our reasoning about works of art, specifically, reasoning about paintings, and further claims that this is evidence in support of the non-linguistic Rationality-based account of conversational implicatures.

(8) "We take a painting to be a product of a rational agent. Accordingly, we assume that no major detail of a painting is superfluous" (Kasher, 1982:41).

In (8), Kasher alludes to the application of an analogue of Grice's maxim of Quantity 2, which precludes speakers from providing superfluous information.

As was previously noted, Grice (1975) holds that the maxims are applicable to non-linguistic communication and other areas of human activity. However, the fact that analogies may be drawn between the application of the maxims to language and their application to other areas of human activity is not evidence to the effect that in their application to language, the maxims and, by extension, the Gricean pragmatic apparatus instrumental in computing conversational implicatures, are derivable from general cognitive principles, such as Kasher's Principle of Rationality.

2.1. The Language-based and Rationality-based accounts of conversational implicatures and the modularity of pragmatics

Next, we will introduce our own view of the place of conversational implicatures within a modular framework. First, a few introductory remarks about the modular framework are in order. We adopt the view that the human cognitive system is modular, which was first pioneered by Fodor (1983) (see also Pinker, 1997; Fodor, 2000; Sperber, in press). A thesis that is shared by most versions of the modularity framework is that the human cognitive system comprises modular and nonmodular systems.

One example of a nonmodular system is higher level cognitive functions such as scientific reasoning. What makes scientific reasoning nonmodular is that a scientist, say, a physicist, may utilize any aspect of her knowledge about the world when solving a scientific problem.

Some examples of modular systems are vision and language. The language module is further subdivided into submodules, such as syntax and phonology. A defining characteristic of a modular cognitive process is the fact that it is informationally encapsulated in the sense that its operation is not influenced by outside information or processes, other than their "bottom-up" inputs. The fact that modules are informationally encapsulated rules out the use of "top-down" input information. To make this concrete, consider what kinds of information can and cannot serve as an input to different submodules. Phonological information can serve as an input to the syntax submodule because this is a "bottom-up" input. However, pragmatic information is a "top-down" input in relation to the semantics and syntax submodules. As Fodor (1983) himself pointed out, however, modules are not informationally encapsulated in the absolute sense but only to a degree. By and large, we do not use "top-down" pragmatic input as a guide to arriving at a semantic interpretation of a sentence. However, there are instances where pragmatic information does provide input to the semantics. For example, Levinson (2000) discusses a variety of cases of "pragmatic intrusion" where pragmatic information about conversational implicatures serves as an input to the semantic interpretation of a sentence.[2]

The module that is most relevant to the present work is the Theory of Mind module, whose workings were explored by Baron-Cohen (1995), Leslie (1994), Scholl and Leslie (1999), and Sperber and Wilson (2002), among others. The Theory of Mind module as a whole is a module that, in a nutshell, enables us to infer people's emotions, desires, beliefs and knowledge, and to appreciate the fact that people have mental states.

We follow Sperber and Wilson (2002) in conceiving of conversational implicatures as being situated in a submodule of the Theory of Mind module, this submodule being specialized for processing and producing language. We hold that the language-oriented submodule of the Theory of Mind module interfaces, on the one hand, with UG, and, on the other hand, with more general cognitive competences. Chomsky commented on the existence of the communicative competence module as follows.

(9) "It could be that one of the systems that develops, either as a distinct module or a component of others, is the kind of 'communicative competence' that enables us to use language coherently and in ways that are appropriate to situations. This seems rather likely, for one reason, because of dissociations that have been discovered (limited communicative competence along with rich language competence, etc.)" (Stemmer, 1999:395).

Crucially, on the Language-based view, conversational implicatures are not a product of the general Theory of Mind module but, rather, a product of an interface. The fact that conversational implicatures are a product of a complex interface makes these meanings challenging for children.

According to the work that has been done on the acquisition of conversational implicatures to date, it is only around the age of five that children first begin to demonstrate the ability to compute conversational implicatures, specifically, scalar ones (e.g., Papafragou and Tantalou, 2004). Importantly, between the ages of four and five children also achieve mastery of verbal false-belief tasks that are used in testing their knowledge of the Theory of Mind. In work with autistic children, it was found that the child's mastery of the Theory of Mind is a good predictor of her success in interpreting conversational maxims (e.g., Surian et al., 1996). Bloom (2002:15) hypothesizes that the extent of a language deficit in an impaired individual, such as an autistic individual, is a direct function of his or her Theory of Mind deficit. Thus mastering the Theory of Mind is a prerequisite for being able to compute conversational implicatures. This research is evidence to the effect that, in the domain of conversational implicatures, the development of the child's Theory of Mind precedes the development of her language-decoding abilities.

[2] These are cases where the truth-conditions of a sentence depend on conversational implicatures of parts of the sentence. Hence, conversational implicatures contributed by parts of the sentence, which are a product of pragmatics, serve as an input to the semantics module.

We follow Sperber and Wilson (2002) in positing a dissociation between language-based reasoning and reasoning that is not tied to language. Sperber and Wilson (2002) argue against an account on which conversational implicatures are derived within the general Theory of Mind module, and propose that these meanings are derived within the specialized ''metacommunicative'' module, which has evolved for the purposes of processing language.

What of the place of non-verbal inferences within the modular framework? Here, we will consider non-verbal inferences that are parallel to conversational implicatures in terms of being intentionality-based in nature. In contrast to conversational implicatures, non-verbal inferences of this kind are a product of the general Theory of Mind module.

In our experiment, we compared children's performance on computing verbal and non-verbal inferences. Because typically developing children begin to demonstrate the ability to compute conversational implicatures at the age of five, and because they also demonstrate mastery of verbal false-belief tasks used to measure their knowledge of the Theory of Mind by the age of five, in our own experiment, we chose five-year-olds as the youngest age group.

Kasher's (1991) overall view of the place of pragmatics within the Fodorian modular framework is that ''core pragmatics'' is divided into two competences and an interface. One of the competences Kasher defines as the pragmatic *non-linguistic* (underlined by the authors) competence that produces conversational implicatures. This competence governs ''aspects of intentional action in general, including linguistic activity, which is intentional in nature'' (Kasher 1991:579). This claim concerning the place of conversational implicatures within a modular framework is of central relevance to the present paper.[3]

2.1.1. Language-based account: Relevance reinterpreted as relevance to the question-under-discussion

Grice's original remarks on Relevance implicatures (Grice, 1989) do not address the question of how it is determined what the utterance needs to be relevant to, and how the relevance of a given utterance is measured. Among others, Kasher (1982) voices this criticism of Grice's original (1975, 1989) concept of the maxim of Relevance. Recently, there has been a significant amount of work devoted to reinterpreting Grice's maxim of Relevance (e.g., Roberts, 1996; Rooij, 2003). Thus in Roberts (1996) and Verbuk (2007), the maxim of Relevance is reinterpreted as relevance to the question-under-discussion (QUD). Roberts (1996) argues that discourse may be conceived of as addressing a series of hierarchically structured questions, which she terms a QUD stack. These questions may be explicit or implicitly present in a discourse. This is the interpretation of the maxim of Relevance that we adopt in this paper.

3. The experiment

3.1. Acquisition predictions

Our version of the Language-based account of conversational implicatures and the Rationality-based account of conversational implicatures make different predictions concerning the way in which these meanings are mastered by children. On the Language-based account, the prerequisite that a child needs to master in order to compute conversational implicatures is being able to go through the steps of language-based pragmatic reasoning (e.g., the steps in (4)). On the Rationality-based account, the prerequisite for computing conversational implicatures that the child needs to master is Rationality-based reasoning based on comparing actions in terms of their potential to bring about a desired result. Rationality-based reasoning involved in computing conversational implicatures is not predicted to be any different from that involved in computing parallel non-linguistic inferences.

In order to decide between the Language-based and Rationality-based accounts, we chose to test children on the Relevance subclass of conversational implicatures, in part because very little experimental work has been done to date on the acquisition of these meanings.

The two accounts make different predictions concerning children's performance on computing Relevance implicatures and non-linguistic inferences that are parallel in nature. Examples of Relevance implicature test items and those of parallel non-linguistic inferences are provided in the Appendix.

On the Language-based account, Relevance implicatures are generated by exploiting the Relevance maxim. To derive these, the child needs to go through the steps of linguistic pragmatic reasoning instrumental in computing the implicature. In computing many Relevance implicatures, the child needs to reason that the interlocutor produced a seemingly irrelevant utterance in order to convey a given implicature; this presents a major challenge. The child also needs to assess the particulars of the situation at hand, and, in part based on these, draw the inference, like the one in (3c). To compute a non-linguistic inference, the child need not engage in linguistic reasoning concerning utterances and their place in discourse, which is instrumental in computing Relevance implicatures. Instead, the child needs to engage in non-linguistic reasoning concerning the particulars of the situation, which is the same as that involved in computing Relevance implicatures. In a nutshell, the child needs to master an extra prerequisite in

[3] The other competence Kasher defines as ''a pragmatic, purely linguistic competence, embodying first and foremost knowledge of certain speech act types'' (Kasher, 1991:579). Kasher also introduces an interface between a language module, a perception module and a central cognitive device; the interpretation of indexicals and presuppositions is claimed to belong to this interface.

order to compute Relevance implicatures, which is linguistic in nature. Thus the Language-based account predicts Hypothesis 1.

(10) H1: Children perform better on computing non-linguistic inferences than Relevance implicatures that are parallel in nature.

On the Rationality-based account, to compute Relevance implicatures, the child needs to engage in non-linguistic reasoning about situations. Taking the interlocutor to be a rational agent, the child needs to reason about the interlocutor's goals and the way he might accomplish them by means of uttering X in the situation at hand. In doing so, the child needs to use Kasher's Rationality Principle, which we reproduce below, as a premise in the argument employed in computing the implicature.

(11) "Where there is no reason to assume to the contrary, take the speaker *s* to be a rational agent; *s*'s ends and beliefs in a context of utterance should be assumed to supply a complete justification of *s*'s behavior, unless there is evidence to the contrary" (Kasher, 1991:577).

Consider an illustration of how a Relevance implicature may be computed on the Rationality-based account.

(12) a. A: Where can I find a new cartridge?
b. B: There is a pharmacy around the corner.
c. Relevance implicature: A can buy a cartridge in the pharmacy.

In (13), the derivation of the Relevance implicature in (12) is provided.

(13)
1. There is no reason to assume that speaker B is not a rational agent; B's ends and beliefs should be assumed to supply a complete justification of B's behavior in the context of the utterance.
2. Rational agents obey the maxim of Relevance, "When you put your means to use for attaining a given desired end, try to utilize processes, actions and states which are occurring anyway in the context of your action."
3. B's end is to help A find a cartridge.
4. B could not be a rational agent unless he thought that A can buy a cartridge in the pharmacy.
5. B knows (and knows that A knows that he knows) that A can see that the supposition that A can buy a cartridge in the pharmacy is required.
6. B has done nothing to stop A from thinking that A can buy a cartridge in the pharmacy.
7. B intends A to think, or is at least willing to allow A to think that A can buy a cartridge in the pharmacy; and so B has implicated that A can buy a cartridge in the pharmacy.

The implicature derivation in (13) is modeled on the implicature derivation schema in Kasher (1976).

On the Rationality-based account, in order to compute non-linguistic inferences, the child needs to go through the same Rationality-based reasoning. In computing both linguistic and non-linguistic inferences, the child will need to utilize the following version of Kasher's Rationality Principle in (6), which we propose below.[4]

(14) Where there is no reason to assume to the contrary, take speaker/agent a to be a rational speaker/agent; a's ends and beliefs in a context of the utterance/situation at hand should be assumed to supply a complete justification of a's behavior, unless there is evidence to the contrary.

There is no reason to expect that rationality-based reasoning instrumental in computing conversational implicatures should be more challenging than rationality-based reasoning instrumental in computing non-linguistic inferences. Thus the Rationality-based account predicts Hypothesis 2.

(15) H2: Children do not perform better on computing non-linguistic inferences than Relevance implicatures that are parallel in nature.

In addition to the Relevance implicatures condition and non-linguistic inferences condition, we included a (linguistic) scalar implicatures condition in order to compare children's performance on computing Relevance implicatures and Quantity-based scalar implicatures as classes of meanings. Since it is known that children begin to demonstrate the ability to compute

[4] We would like to emphasize that this is our own extension of Kasher's proposal to non-linguistic inferences.

scalar implicatures at the age of five, and since very little research has been done on Relevance implicatures, we wanted to compare children's performance on the two classes of implicatures.

Scalar implicatures are generated based on scales such as <all, some> and <the whole table, the left corner of the table>. By affirming the weaker member of the scale, e.g., *some* and *the left corner of the table*, respectively, the speaker implicates that the higher member of the scale does not hold, e.g., *all* and *the whole table*, respectively. Consider an example of a scalar implicature.

(16) a. A: Did you wash the whole table?
b. B: I washed the left corner of the table.
c. Scalar implicature: B did not wash the whole table.

In order to compute a scalar implicature, the child needs to infer the content of the scale, to infer the QUD in order to ascertain that the implicature is relevant in the given context, and to go through the steps of pragmatic reasoning instrumental in computing the implicature. While in order to compute most Relevance implicatures the child needs to reason about the implications of producing an irrelevant utterance, in order to compute scalar implicatures, the child need not reason about irrelevant utterances. At the same time, in order to compute a scalar implicature, one needs to infer the content of the scale which it is based on; this step is not required for computing Relevance implicatures.

3.2. Methods

We tested 28 English-speaking children aged 5;1–8;1 who attended kindergartens and schools in western Massachusetts. We chose to test children between the ages of five and eight for the following reasons. On the one hand, as we have mentioned above, children have not been shown to be able to consistently compute conversational implicatures prior to the age of five. On the other hand, in the study by Bernicot et al. (2007), it was found that children were able to compute one type of Relevance implicatures, which the authors refer to as semantic-inference implicatures, by the age of six, and that children were able to compute another type of Relevance implicatures, indirect requests, by the age of eight. In view of these experimental results, we decided to test children between the ages of five and eight in our experiment. A control group of 18 adults who are undergraduate and graduate students at McGill University in Montreal was tested as well.

All 28 children were tested on three experimental conditions: the Relevance implicatures condition, the non-verbal inferences condition and the scalar implicatures condition. The adult control group was tested on these three experimental conditions as well. All child and adult subjects were tested on three different, repeated-measures conditions.

Each subject received three experimental items per condition. Each Relevance implicature scenario had a non-verbal inference counterpart; the two scenarios constituted a minimal pair. Consider an example of a Relevance implicature/non-verbal inference minimal pair of items .

(17)
(1) Verbal.
[The child is shown picture one.]

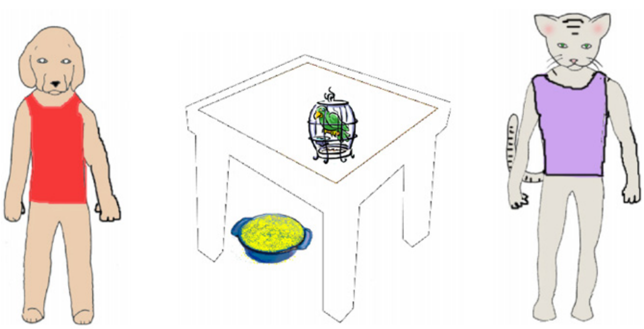

Fig. 1. Picture one of the Parrot scenario, verbal version.

Cat told Dog, "Now it's your turn to do something. Feed the parrot, please. I'll sit in the living room and read".
After a while, Dog came into the living room. Dog said, "I put the empty bowl back under the table."
Let's try to figure out what happened. Do you think Dog fed the parrot? Why?

(2) Non-Verbal.

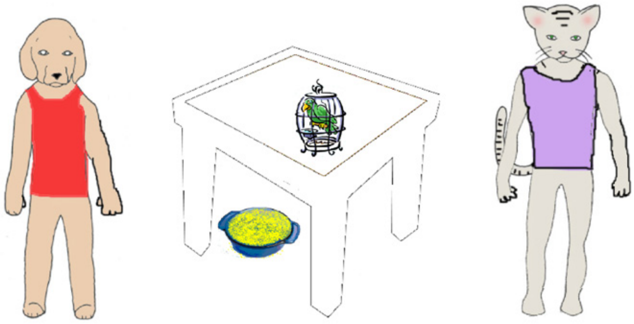

Fig. 2. Picture one of the Parrot scenario, non-verbal version.

[The child is shown picture one.]

Cat told Dog, "Dog, you start doing things, and I'll go next. Feed the parrot the birdseed,

please. I'll sit in the living room and read."

[Then the picture is removed].

After a while, Dog came into the living room. Let's see what happened.

[The child is shown picture two.]

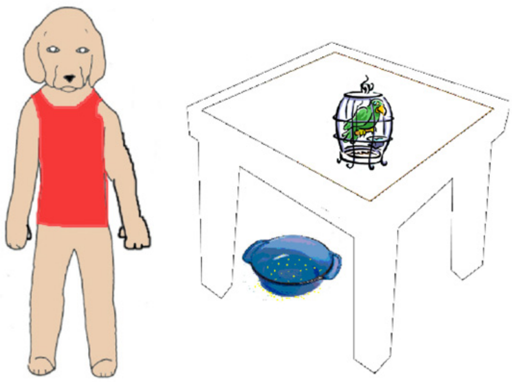

Fig. 3. Picture two of the Parrot scenario, non-verbal version.

Let's try to figure out what happened. Do you think Dog fed the parrot? Why? Each subject received only one member of the minimal pair of experimental items. For example, consider subject A; if subject A receives the verbal Relevance implicature version of the Feeding the Parrot scenario, he will not receive the non-verbal inference version of the Feeding the Parrot scenario but will receive a different non-verbal inference scenario instead.

Children's and adults' responses to these two conditions were scored in the following manner. After each scenario, subjects were asked a yes/no question (e.g., "Do you think Dog fed the parrot?"), and they were asked "why?," which was supposed to elicit a justification of their response. A subject's response was scored as correct iff the subject provided a target response to the yes/no question and also provided a response to the "why?" question which indicated that she computed the implicature. Thus in order for us to score the subject's response to the verbal version of (17) as correct, the subject should have responded "yes" to the question "Do you think Dog fed the parrot?" and also should have responded to the question "why?" along the lines of, "because Dog said the bowl was empty." In order for us to score the subject's response to the non-verbal version of (17) as correct, the subject should have responded "yes" to the question "Do you think Dog fed the parrot?" and also should have responded to the question "why?" along the lines of "because the bowl is empty on the picture." In effect, in order to score the subject's response as correct, we required them to provide a target pragmatic response to the yes/no question and also a target meta-pragmatic response to the "why?" question. This way, we could be sure that subjects whose responses were scored as correct actually computed the verbal implicatures and non-verbal inferences.

Also, each subject received the same three verbal experimental items in the scalar implicature condition. Consider an example of a scalar item.

(18)

[The child is shown a picture.]

Fig. 4. Picture one of the scalar implicatures Washing scenario.

Dog told Cat, "I haven't taken a bath today and I feel like taking a bath right now. I have some grass stuck in my fur and my tail is dirty because it always touches the ground.

Cat, wash my whole body with a sponge, please."

[The picture is removed.]

Cat washed Dog's right paw with a sponge.

Did Cat do everything Dog asked him to do? Why?

In the scalar implicature condition, subjects were also asked a yes/no question and a "why?" question. A subject's response was scored as correct iff she provided a target response to the yes/no question and also provided a target justification of her response in answering the "why?" question. To illustrate, in (18), the target response to the question, "Did Cat do everything Dog asked him to do?" is "no." The target response to the "why?" question should have been along the lines of "because Cat did not wash Dog's whole body with a sponge." As in the verbal and non-verbal Relevance implicature conditions, in the scalar implicature condition, we scored subjects' responses as target if they provided both a target pragmatic response to the yes/no question and a target meta-pragmatic response to the "why?" question. A detailed description of the experimental items is provided in the Appendix.

One objection that may be made to our experimental design is that in the Relevance implicature condition, the child is told a story in real time, and then asked a question about its content, whereas in the non-verbal inference condition, the child is shown the second picture and is looking at the picture while answering the question. One potential objection that may be raised is that the load on the child's working memory is heavier in the verbal condition because the child has to keep the test sentence that gives rise to the implicature in memory. However, the youngest subjects whom we tested were five, and five-year-olds are able to hold one sentence in memory. Many acquisition experiments presuppose five-year-olds' ability to hold an entire short story in memory, and children of this age successfully fulfill the experimental demands. For example, in the Papafragou and Tantalou (2004) experiment on the acquisition of scalar implicatures, children whose mean age was 5;3 were tested on computing scalar implicatures based on stories. Crucially, the child had to hold the test sentence in memory in order to compute the implicature. Children showed mastery of computing scalar implicatures in this experiment. The experiment by Papafragou and Tantalou is one of many examples showing that five-year-olds are able to successfully hold a test sentence in memory. Thus in the case of the present experiment, there was also no reason to expect that children aged five and older had trouble with holding the test sentence in memory, and that this is what caused them to perform worse in the verbal Relevance implicature condition than in the non-verbal inference condition.

One might still wonder why we chose not to let the child look at the picture and then remove it in the non-verbal condition in order to make it more parallel to the Relevance implicature condition. We chose not to do this because it was unclear how good children are at drawing inferences based on visual stimuli. While we know of experimental studies which have shown that five-year-olds are able to remember a test sentence, we are not aware of how five-year-olds (or even adults) fare on remembering details of visual stimuli and drawing inferences based on these. To avoid this problem, we chose to ask children test questions while they were looking at the picture.

In the Relevance implicature scenarios and their non-verbal inference counterparts, three of the scenarios had an outcome where a character performed the task successfully, and three an outcome where a character was unsuccessful on the task. This contrast was included in order to introduce diverse outcomes.

In our Relevance implicature scenarios, we chose not to introduce explicitly a question where one character would ask another concerning his having fulfilled the task in question. For example, in the Feeding the Parrot scenario, we chose not to have Cat explicitly ask Dog,

(19) "Did you feed the parrot?"

prior to Dog's utterance of,

(20) "I put the empty bowl back under the table."

Questions as in (19) were not included in the scenarios in order to avoid introducing a negative response bias, which may have arisen for the following reason. It would have been more economical to address such questions as "did you feed the parrot?" with a plain "yes" or "no."

Addressing these questions indirectly with a response as the one in (20) would have introduced some degree of pragmatic infelicity into the experimental contexts.

It is necessary to make another note on the methodology that we employed in our experiment. Our experiment focused on comparing children's performance on drawing linguistic inferences – Relevance implicatures – and that on computing non-linguistic inferences based on visual information. One question that arises within this experimental context is how children fare on processing language vs. processing visual stimuli. A number of studies have been done by psychologists to address this question. Thus Napolitano and Sloutsky (2004) in a series of 6 experiments tested three-five-year-olds on simultaneously processing auditory stimuli, which consisted of combinations of speech sounds, common non-speech sounds (e.g., a doorbell), non-speech computer-generated tones, and visual stimuli, which included pictures and photographs. Let us describe in some detail experiment 5, where speech sounds were employed, which makes it particularly relevant to the present study. In this experiment, children ($M = 4.45$ years) were presented with speech sounds that consisted of nonsensical sequences of three English vowels and with visual stimuli, which consisted of familiar geometric shapes in one of the conditions. In this condition, children were presented with a pair consisting of a vowel sequence and a geometric shape; subsequently, a pair consisting either of the identical vowel sequence and geometrical shape or a pair of a different vowel sequence and an identical shape or a pair of an identical vowel sequence and a different shape or a pair of a different vowel sequence and shape were presented. The child's task was to determine if the sound/shape pair presented second was identical to the one that was presented first. It was found that children were more likely to reject pairs where the same shape and a different sound were used than pairs where the same sound and a different shape were used. Thus children were more likely to process unfamiliar patterns of human speech than somewhat familiar geometric shapes. This preference is attributed to the fact that linguistic stimuli stem from a highly familiar source, i.e., the human speech.

On the basis of all 6 of their experiments, Napolitano and Sloutsky (2004) conclude that young children exhibit auditory dominance in the sense that when both auditory and visual stimuli are unfamiliar, young children tend to process auditory stimuli while failing to process visual stimuli, and that modality dominance is moderated by stimulus familiarity.

Robinson and Sloutsky (2004) also found that when auditory and visual stimuli are presented simultaneously, four-year-olds were more likely to exhibit auditory dominance, which decreased with age, while adults processed both the auditory and visual stimuli.

Thompson and Massaro (1994) tested four-year-old and nine-year-old children on verbal stimuli that consisted of object names vs. visual stimuli that consisted of pointing gestures directed toward objects. They found that the verbal stimuli had a greater influence on word comprehension than gestures did.

The main finding that all of these studies have in common is that, when presented with auditory and visual information simultaneously, children have a preference for processing auditory (either linguistic or non-linguistic) information. These experimental results suggest that processing auditory, and, specifically, linguistic information is not inherently more challenging than processing visual information for the children. Because of these experimental findings, there was no a priori reason to expect that children should do better on the visual than the verbal task in the present experiment.

3.3. Results

The child's numbers of correct answers were subjected to a one-way, repeated-measures analysis of variance (ANOVA), along with pairwise comparisons of means and a Sign test. Two research question that we were investigating were (i) children's performance on Relevance implicatures vs. that on non-verbal inferences; (ii) children's performance on Relevance implicatures vs. scalar implicatures.

For children's responses, the main effect of inference type was significant, indicating that children's performance varied across the three types, $F(2, 54) = 5.48$, $p < .01$. Means and SE bars are presented in Figure five.

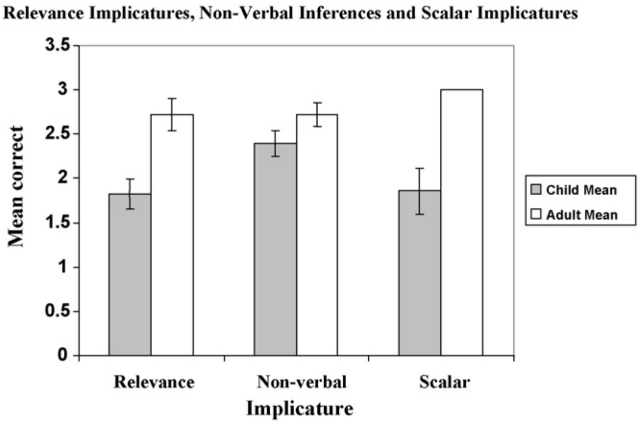

Fig. 5. Children's and adults' mean numbers correct on Relevance implicatures, non-verbal inferences and scalar implicatures, along with SE bars.

First, we compared children's performance on computing Relevance implicatures vs. that on computing non-verbal inferences. According to H1 predicted by the Language-based account,

(21) H1: Children perform better on computing non-linguistic inferences than Relevance implicatures that are parallel in nature.

According to H2 predicted by the Rationality-based account,

(22) H2: Children do not perform better on computing non-linguistic inferences than Relevance implicatures that are parallel in nature.

Pairwise comparison of the means indicated that the difference between children's performance on the Relevance implicature condition vs. the non-verbal inference condition was significant, $p < .001$. Children performed significantly better on computing non-linguistic inferences than verbal Relevance implicatures. This result supports H1 predicted by the Language-based account but not H2 predicted by the Rationality-based account.

We also compared children's performance on the Relevance implicature condition and the non-verbal inference condition by employing a Sign test, $p < .002$, which indicated that more children (17) did better on the non-verbal inference condition than on the Relevance implicature condition than the reverse (3). The remaining 8 children did the same on both conditions.

For the adult controls, there was no significant main effect of inference type, indicating that adults' performance did not vary across the three inference types, $F(2, 34) = 2.22$, $p = .12$. This finding obviated the need to perform pairwise comparisons for adults' results. We found that adults provided target responses in the Relevance implicature condition 90.7% of the time, and provided exactly the same number and percentage – 90.7% – of target responses in the non-verbal inference condition.

The second experimental question that we were interested in investigating was comparing children's performance on computing verbal Relevance implicatures and verbal scalar implicatures. The difference between children's performance on the Relevance implicature condition vs. the scalar implicature condition was not significant, $p = .885$. Adults provided 100% of target responses in the scalar implicature condition. As was previously mentioned, for adults, there was no significant main effect of inference type, hence their performance on the Relevance implicature and scalar implicature conditions did not differ significantly either.

In our statistical analysis, we treated five-eight-year-olds' results together in order to consider children's performance on the experimental conditions across an age span that includes an age where children begin to compute implicatures (the age of five) and an age when children have been shown to demonstrate mastery of Relevance implicatures in previous work (the age of six and older). The focus of the present study was comparing the level of difficulty posed by verbal and non-verbal inferences for children who are in different stages of acquiring these inferences.

3.4. Discussion

Our experimental results enabled us to isolate the linguistic component involved in computing Relevance implicatures. Our experimental findings provide strong evidence against the claim made by the Rationality-based account that conversational implicatures are produced by the pragmatic *non-linguistic* competence. At the same time, our experimental results provide evidence in support of the Language-based view of how these meanings are computed. On the version of the Language-based view that we adopt in this paper, conversational implicatures are situated within a submodule of the Theory of Mind module dedicated to language and its interfaces with UG, and more general cognitive competences. Conversational implicatures interface with UG in the sense that these principles are *linguistic universals*. The pragmatic skills that are part of the submodule in question enable one to create a link between the situation at hand and language.

Computing Relevance implicatures involves three (interrelated) components:

(23) 1. Reasoning about language;
2. Reasoning about the situation;
3. Considering the relevant piece(s) of world knowledge.

Reasoning about language requires considering what information is part of the Common Ground, determining the current topic(s) of the conversational exchange, in most cases, reasoning about the relevance of a given speaker's utterance to the question under discussion, and computing an implicature. In addition, one needs to consider the relevant piece of world knowledge and the particulars of the given situation. To illustrate what is meant by the relevant piece of world knowledge, in the verbal and non-verbal versions of the Feeding the Parrot scenario, the relevant piece of world knowledge is, "the emptying of a bowl may be an indication that the food was eaten." The particulars of the given situation include, roughly, information that is part of the Common Ground, the interlocutors' conversational goals, the means that they may (or do) employ in order to accomplish these goals and their success or failure to achieve these goals.

In contrast to computing conversational implicatures, computing non-linguistic inferences does not require one to utilize any language-related knowledge or skills. Computing non-linguistic inferences involves a proper subset of the components involved in computing Relevance implicatures – it involves the two components in (24).

(24) 1. Reasoning about the situation.
2. Considering the relevant piece(s) of world knowledge.

Next, we go on to the discussion of the acquisition challenges posed by Relevance implicatures and scalar implicatures.

3.4.1. Acquisition of Relevance implicatures

In recent work on the acquisition of conversational implicatures, researchers working within different theoretical frameworks and using different methodologies found that by the age of five children are able to compute Quantity-based scalar implicatures (e.g., Papafragou and Tantalou, 2004; Foppolo et al., in press; Verbuk, 2007). This provides evidence that five-year-olds can engage in pragmatic reasoning by computing at least some classes of conversational implicatures, specifically, Quantity-based ones.

To date, very little work has been done on the acquisition of Relevance implicatures. An acquisition experiment by Bernicot et al. (2007) in French, which included Relevance implicatures as one of the conditions, is one notable exception. Bernicot et al. reported that six-year-olds demonstrate command of Relevance implicatures.

Next, consider the type of reasoning that the child would go through in order to compute Relevance implicatures employed in the present experiment.

(25) a. Cat told Dog, "Now it's your turn to do something. Feed the parrot, please. I'll sit in the living room and read." After a while, Dog came into the living room. Dog said, "I put the empty bowl back under the table."

Let's try to figure out what happened. Do you think Dog fed the parrot? Why?

b. Relevance implicature: "Dog fed the parrot."

c. Implicit QUD: Did you feed the parrot?

The derivation of the Relevance implicature in (25) is provided in (26).

(26) 1. The speaker (the Dog character) is being cooperative (is obeying the maxims, including the maxim of Relevance, and the Cooperative Principle).
2. The speaker's utterance, "I put the empty bowl back under the table," on the face of it, is not relevant to the QUD, "Did you feed the parrot?"
3. The speaker's utterance must be relevant to the QUD on the level of what is said or on the level of what is implicated.
4. Because the speaker's utterance does not appear to conform to the Principle of Relevance on the level of what is said, the speaker must be observing the Principle of Relevance on the level of what is implicated.

5. Given that the Common Ground contains information X, "the emptying of a bowl may be an indication that the food was eaten," the hearer can infer that by uttering, "I put the empty bowl back under the table," the speaker Relevance-implicated (25(b)), "I = Dog fed the parrot."

One non-linguistic prerequisite for computing Relevance implicatures is having a piece of world knowledge utilized in computing a given implicature. In the present experiment, we controlled for this prerequisite by ensuring that the type of world knowledge used in the experiment was accessible to the youngest children tested, i.e., the five-year-olds.

The greatest acquisition challenge presented by computing Relevance implicatures is going through the steps of reasoning in (26(2–5)), which is specific to computing Relevance implicatures. In effect, the child needs to compute the QUD and pick up on the fact that the speaker's utterance is not directly relevant to it. Previous experiments on the acquisition of other types of conversational implicatures (e.g., scalar implicatures) provide evidence that children as young as five are able to determine what the QUD is. (Within the QUD framework that we adopt here, they would not have been able to compute these implicatures unless they were able to compute the QUD that the implicature was relevant to). Moreover, Verbuk (2007) found that children as young as four do not compute "irrelevant" scalar implicatures that are not computed by adults, thus demonstrating some nascent command of the maxim of Relevance.

In order to compute Relevance implicatures, the child generally needs to pick up on the fact that the speaker's utterance is not directly relevant to the QUD (26(2)).[5] This step of reasoning is unique to the computation of some but not all Relevance implicatures. In this paper, we concentrated on Relevance implicatures whose computation involves this step. Importantly, computing the non-linguistic test items that we employed does not require going through this step.

In the child's input, utterances that do not address the QUD directly are fairly common and include a variety of topic shifts. However, not every utterance that does not directly address the QUD generates a Relevance implicature that addresses the original QUD.

(27) a. A: Did you feed the dog?
b. [An obnoxiously loud fire alarm sounds].
c. B: Oh my god, another fire alarm, we have to leave the building again.

In (27), B's utterance is not relevant to A's QUD; however, it does not generate a Relevance implicature with respect to A's QUD.

(28) a. Child to Mother: Can I have another cookie?
b. Mother to Father: Oh, and don't forget to change the oil in the car today.

In (28), it is not clear that Mother's utterance generates any kind of a Relevance implicature with respect to Child's QUD.

Thus the child cannot assume that any utterance that is not directly relevant to the QUD automatically generates a Relevance implicature that addresses the QUD. In order to compute a Relevance implicature that addresses the QUD, the child, in effect, needs to classify the speaker's utterance as *seemingly* irrelevant, as in (25), rather than completely irrelevant, as in (27) and (28). Thus the child needs to distinguish overt topic shifts, as in (27) and (28), from utterances that are not intended as accomplishing a topic shift but as indirectly addressing the current QUD. Subsequently, the child needs to make the connection between a seemingly irrelevant utterance and a pertinent piece of world knowledge in order to compute the Relevance implicature.

Some of the six-year-olds tested in the present experiment were able to make these connections and computed Relevance implicatures. Below, we present some of the target and non-target responses to all of the test items, starting with the Relevance implicature (or verbal) items. Consider children's responses to a verbal test item.

(29) Verbal Item.

[The child is shown picture one.]

Cat told Dog, "Dog, now it's your turn to do something. It's chilly here. Start a fire in the fireplace, please. I'll go have something to eat in the kitchen."

[Picture one is removed.]

After a while, Cat returned to the living room. Dog said, "I put on a coat and brought you one."

Let's try to figure out what happened. Do you think Dog started a fire?

[Target answer: no].

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[5] It needs to be noted that not all Relevance implicatures involve producing a seemingly irrelevant utterance. Thus conveying Relevance implicatures as in (i), which constitutes a tacit request, does not involve producing such an utterance.

(i) a. A to B: I am freezing.
b. A's Relevance implicature: A wants B to close the window.

A. N. (6;1): No.

Experimenter: Why?

A. N.: He was getting a coat.

A. N's response was scored as correct because A. N. provided a target response to the question, "do you think Dog started a fire?" and also provided a satisfactory response to the "why?" question.

Next, consider an example of a non-target response.

T. H. (5;3): Yes.

Experimenter: Why?

T. H.: Cat told him to do it.

T. H's response was scored as non-target because he provides a wrong response to the question, "do you think Dog started a fire?" followed by a justification that shows that the child did not compute the implicature.

Next, consider how the child computes non-verbal counterparts of the Relevance implicature items that were employed in the present experiment.

(30) Non-verbal item.

[The child is shown picture one.]

Cat told Dog, "Dog, now it's your turn to do something. It's chilly here. Start a fire in the fireplace, please. I'll go have something to eat in the kitchen."

[Picture one is removed.]

After a while, Cat returned to the living room. Let's see what happened.

[The child is shown picture two where Dog is wearing a warm coat and holding an extra coat for Cat].

Let's try to figure out what happened. Do you think Dog started a fire?

To compute the inference in (30), the child needs to make use of the following piece of world knowledge, "putting on more clothes may be an indication that one feels cold." At the same time, the child needs to consider the situation depicted on picture one, where the fireplace is not working, and the one depicted on picture two, where Dog is wearing a coat. Based on these two situations and the mentioned piece of world knowledge, the child can compute the inference "Dog did not start a fire."

Next, consider some of the children's responses to the test item in (30).

V. E. (5;9): No. Instead of making the house warm, he made himself warm.

H. E. (7;5): No. He just put on some warm clothes.

Both V. E. and H. E. provided target responses. They correctly responded negatively to the question, "Do you think Dog started a fire?" and subsequently provided correct justifications of their responses.

Children demonstrate some mastery of Relevance implicatures by the age of seven (80% of the target Relevance implicatures were computed by the seven-year-olds). Six-year-olds begin to show mastery of non-verbal inferences (76% of target responses). The difference between six-year-olds' performance on computing Relevance implicatures vs. non-verbal inferences is dramatic; six-year-olds provided target responses in the Relevance implicature condition 42% of the time, while providing these in the non-verbal inference condition 76% of the time.

3.4.2. Acquisition of scalar implicatures

We found that children's performance on computing scalar implicatures vs. Relevance implicatures employed in the present experiment did not differ significantly. As was previously mentioned, the reason why we included the scalar implicatures condition in the present experiment was that we wanted to see how children's performance on computing scalar implicatures differed from that on computing Relevance implicatures. The scales that the scalar implicatures relied on in the present experiment were part/whole relation based pragmatic scales (e.g., <right corner of the window, window>). The child needed to infer the content of these scales from the context of the stories. Computing scalar implicatures based on pragmatic scales is more challenging than computing scalar implicatures based on scales that the child is more frequently exposed to (e.g., <all, some>). In previous work on the acquisition of scalar implicatures, it was found that children master computing scalar implicatures based on the quantifier scale by the age of five (e.g., Papafragou and Tantalou, 2004). However, in Verbuk (2007) and in the present experiment it was found that children master computing scalar implicatures based on pragmatic scales at the age of seven. In the present experiment, children demonstrated some mastery of Relevance implicatures at the age of seven. This variability in age of acquisition shows that children's performance on computing implicatures is not a function of broad implicature classes, such as Relevance implicatures vs. scalar implicatures. Rather, children's performance on computing implicatures is a function of specific challenges presented by individual small subclasses of implicatures.

4. Conclusion

Our experiment has provided evidence for the Language-based view of how conversational implicatures are computed; we have shown that, as predicted on this view, computing conversational implicatures is more challenging for the child than computing non-verbal inferences that are parallel in nature. Additional linguistic reasoning required to compute implicatures makes these inferences more challenging than their non-verbal counterparts. Our experimental results suggest that Kasher's (1991) claim that pragmatic *non-linguistic* competence, which governs aspects of intentional action, produces conversational implicatures is incorrect. It needs to be noted, however, that although the difference between the Relevance implicatures condition and the non-verbal condition was statistically significant, it was not overwhelming. In our analysis of the data, we collapsed results of five-, six-, seven-, and eight-year-olds; the next step would be to test if the difference between the two conditions will arise in children of each of these individual age groups. Based on how children of each individual age performed on the two conditions in our experiment, our prediction is that the difference between the two conditions will be found with larger groups of children of each individual age group.

At the same time, we have argued that children's mastery of conversational implicatures cannot be fruitfully explored by considering children's performance on broad classes of implicatures, such as Relevance implicatures and scalar implicatures. A more fruitful avenue of research is identifying specific challenges posed by more narrow classes of conversational implicatures.

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Appendix A

The general experimental set-up was as follows. The child is shown a picture depicting Cat, Dog and their house. "This is Cat and this is Dog. Cat and Dog are friends and live in the same house. One weekend, they decided to do a bunch of chores around the house. They decided that Cat would do half the chores, and Dog would do the other half of the chores. Cat and Dog had to do some cleaning, cooking, had to fix some furniture, and do some other stuff."

A.1. Verbal Items and their non-verbal counterparts

(1) Verbal.

Cat told Dog, "Now it's your turn to do something. Feed the parrot the birdseed, please. I'll sit in the living room and read." After a while, Dog came into the living room. Dog said, "I put the empty bowl back under the table."

Let's try to figure out what happened. Do you think Dog fed the parrot? Why?

(2) Non-verbal.

Cat told Dog, "Dog, you start doing things, and I'll go next. Feed the parrot the birdseed, please. I'll sit in the living room and read." After a while, Dog came into the living room. Let's see what happened.

Let's try to figure out what happened. Do you think Dog fed the parrot? Why?

(3) Verbal.

Cat told Dog, "Dog, now it's your turn to do something. It's chilly here. Start a fire in the fireplace, please. I'll go have something to eat in the kitchen." After a while, Cat returned to the living room. Dog said, "I put on a coat and brought you one."
Let's try to figure out what happened. Do you think Dog started a fire? Why?

(4) Non-verbal.

Cat told Dog, "Dog, now it's your turn to do something. It's chilly here. Start a fire in the fireplace, please. I'll go have something to eat in the kitchen." After a while, Cat returned to the living room. Let's see what happened.

Let's try to figure out what happened. Do you think Dog started a fire? Why?

(5) Verbal.

Dog told Cat, “Cat, you start doing things, and I’ll go next. Fix our television stand, please. I’ll go outside and sit on the grass.” After a while, Cat asked Dog to come back into the house. Cat said, “I put the television on our big rug.”

Let’s try to figure out what happened. Do you think Cat fixed the television stand? Why?

(6) Non-verbal.

Dog told Cat, “Cat, now it’s your turn to do something. Fix our television stand, please. I’ll go outside and sit on the grass.” After a while, Cat asked Dog to come back into the house. Let’s see what happened.

Let’s try to figure out what happened. Do you think Cat fixed the television stand? Why?

(7) Verbal.

Dog told Cat, “Cat, now it’s your turn to do something. Make some lemonade for us, please. I’ll go outside and sit on the grass.” A while later, Cat told Dog to come back to the kitchen. Cat said, “I left the squeezed out lemons on a plate.”

Let’s try to figure out what happened. Do you think Cat made lemonade? Why?

(8) Non-verbal.

Dog told Cat, “Cat, now it’s your turn to do something. Make some lemonade for us, please. I’ll go outside and sit on the grass.” A while later, Cat told Dog to come back into the kitchen. Let’s see what happened.

Let’s try to figure out what happened. Do you think Cat made lemonade? Why?

(9) Verbal.

Dog told Cat, “Cat, now it’s your turn to do something. Fix our watering can, please. I’ll go and read a magazine in my room.” After a while, Cat told Dog to come outside. Cat said, “I watered the grass from our sprinkler.”

Let’s try to figure out what happened. Do you think Cat fixed the watering can? Why?

(10) Non-Verbal.

Dog told Cat, “Cat, now it’s your turn to do something. Fix our watering can, please. I’ll go and read a magazine in my room.” After a while, Cat told Dog to come outside. Let’s see what happened.

Let’s try to figure out what happened. Do you think Cat fixed the watering can? Why?

(11) Verbal.

Cat told Dog, “Dog, now it’s your turn to do something. Paint this chair, please. I’ll go outside and sit on the grass.” A while later, Dog found Cat sitting on the grass. Dog said, “I got green paint on my right paw.”

Let’s try to figure out what happened. Do you think Dog was painting the chair? Why?

(12) Non-Verbal.

Cat told Dog, “Dog, now it’s your turn to do something. Paint this chair, please. I’ll go outside and sit on the grass.” A while later, Dog found Cat sitting on the grass. Let’s see what happened.

Let’s try to figure out what happened. Do you think Dog was painting the chair? Why?

A.2. Scalar implicature items

(1) Dog told Cat, “I haven’t taken a bath today and I feel like taking a bath right now. I have some grass stuck in my fur and my tail is dirty because it always touches the ground.

Cat, wash my whole body with a sponge, please.” Cat washed Dog’s right paw with a sponge.

Did Cat do everything Dog asked him to do? Why?

(2) Cat told Dog, “The window in the living room is really dirty, we haven’t cleaned it since last year. Dog, clean the window, please.” Dog cleaned the right corner of the window.

Did Dog do everything Cat asked him to do? Why?

(3) Dog told Cat, "I haven't cut my nails in a while, and they've grown really long. When you have long nails, they break easily, and I don't like that. Cat, cut my nails, please." Cat cut the nails on Dog's pinky fingers.

Did Cat do everything Dog asked him to do? Why?

Appendix B. Supplementary data

Supplementary data associated with this article can be found, in the online version, at doi:10.1016/j.pragma.2010.01.005.

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