

The effect of intonation on the illocutionary force of declaratives in child comprehension¹

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Abstract. We report on a novel experimental paradigm that investigates preschoolers' interpretations of clause types, with a focus on the distinctions between polar interrogatives, falling declaratives, and rising declaratives. Prior research demonstrates that by about age three, children have acquired the links between the main clause types and their canonical speech acts, and shows that they are also aware of indirect requests. But as of yet, there is no work exploring their comprehension of rising declaratives. Our results suggest that children possess an adult-like understanding of pragmatics and prosody that allows them to uncover the intended illocutionary force of speakers' utterances.

Keywords: acquisition, speech acts, clause types, prosody, intonation, rising declaratives.

1. Introduction

Rising declaratives have garnered a lot of attention in the formal semantics/pragmatics literature over the last two decades (see e.g. Gunlogson, 2003, 2008; Truckenbrodt, 2006, 2012; Malamud and Stephenson, 2015; Farkas and Roelofsen, 2017; Krifka, 2017; Westera, 2017; Jeong, 2018; Rudin, 2018). Consider a typical example of a rising declarative in (1):

- (1) S is in her office. A has just arrived holding a wet umbrella and raincoat.
a. S: Hey! It's raining?
b. S: Hey! Is it raining? (based on Gunlogson 2003: 96)

In (1a), S utters a declarative with a rising intonational contour similar to the contour that is typically used with polar interrogatives such as (1b). Also like the polar interrogative in (1b), (1a) seeks information about whether it is raining, and in the context of (1), this is in reaction to contextual evidence in favor of the proposition *that it is raining* in the form of A's wet umbrella and raincoat.

However, unlike polar interrogatives, rising declaratives seem to require this contextual evidence in favor of the proposition denoted by the declarative clause. To see this, compare (1) with (2):

- (2) S is in her office. A has just arrived, and exhibits no evidence whatsoever about the weather outside.
a. S: # Hey! It's raining?
b. S: Hey! Is it raining? (based on Gunlogson 2003: 95)

Only the polar interrogative (2b) is acceptable in the context of (2). (2a) is unacceptable, and by comparing (1) with (2), we can infer that the lack of contextual evidence in (2) is the culprit.

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This is why rising declaratives are often claimed in the above literature to convey an *evidential bias*: the rising declarative requires there to be some contextual evidence that speaks in favor of the truth of the declarative clause, so to a first approximation, S's use of the rising declarative leads to the inference that the proposition denoted by the declarative clause is likely to be true (further empirical nuance will be discussed in section 2.2 below).

In this paper, we report on an experiment that explores preschoolers' understanding of rising declaratives as compared to falling declaratives, polar interrogatives, and imperatives.² Prior research shows that children understand the canonical links between interrogatives and questions, declaratives and assertions, and imperatives and requests by at least age three (e.g. Shatz, 1979; Frazier et al., 2009; Rakoczy and Tomasello, 2009; Grosse and Tomasello, 2012). Other work shows that children understand indirect requests by age three as well (e.g. Shatz, 1978; Spekman and Roth, 1985; Lewis, 2013). But it remains unclear whether they know by that age that questions can be asked via other clause types, such as rising declaratives.

Our results suggest that children understand that questions can be asked via both interrogatives and rising declaratives in our experimental context, thus providing evidence that by at least age 3;6 to 4;6, children are aware that declaratives can be used to convey questions, despite that the canonical clause type linked to questionhood is the interrogative. Moreover, our results suggest that children, like the adults we tested, distinguish rising declaratives from polar interrogatives in a way that is in line with the pragmatic distinctions discussed above.

The rest of the paper is organized as follows: In section 2, we discuss relevant background on clause types and speech acts, the pragmatics of rising declaratives, the adult input data available to the child, and why rising declaratives provide a critical test case for child comprehension of the mapping between clause type and speech act, and exceptions to it. In section 3, we describe the experimental methods. Section 4 reports the results, which are then discussed in section 5. In section 6, we will discuss future directions, including ideas for investigating the acquisition of clause types and speech acts in even younger children.

2. Background

2.1. Clause types and speech acts

Crosslinguistically, there are three main clause types that are canonically linked to three speech acts when used as the root clause of the sentence (Sadock and Zwicky, 1985; König and Siemund, 2007; Portner, 2018). These links are displayed in Table 1 with examples in English.

Table 1: The three main clause types and the three speech acts that they usually express in their root uses.

<i>Clause type</i>	<i>Canonical speech act</i>	<i>Example</i>
Declarative	Assertion	Zebra went to the school.
Interrogative	Question	Did Zebra go to the school?
Imperative	Request	(Zebra,) Go to the school!

²Data collection for the experiment is ongoing.

While all languages seem to have three distinct clause types for the same basic speech acts, the particular form that these clauses take differ from language to language. This means that every child, whatever language they are learning, needs to distinguish the different clause types from one another, as well as identify their canonical functions or speech acts. Adding to the acquisition challenge is the fact that the canonical links between clause type and speech acts are not without exception. One well known example is the case of interrogatives used to make requests (Searle, 1975).

- (3) Can you (please) put Zebra in the school?

Rising declaratives like those discussed above are another example of a mismatch between clause type and speech act. Thus, apart from distinguishing clause types and identifying each one's canonical speech act, the child must also realize that these canonical links are not inviolable. When and how do children accomplish each of these acquisition tasks? Our study focuses on the links between polar interrogatives and questions, falling declaratives and assertions, and the special case of rising declaratives and questions. We will show that preschoolers understand that questions can be asked not just with interrogatives, but also with declaratives. We will further show that children, like adults, distinguish rising declaratives from polar interrogatives.

2.2. The intonation and pragmatics of rising declaratives

Rising declaratives are utterances of declarative clauses that bear an utterance final rise of the sort that typically occurs in an utterance of a polar interrogative. For example, compare the following two pitch tracks in fig. 1, one from a rising declarative and the other from a polar interrogative, both taken from the stimuli of our experiment.

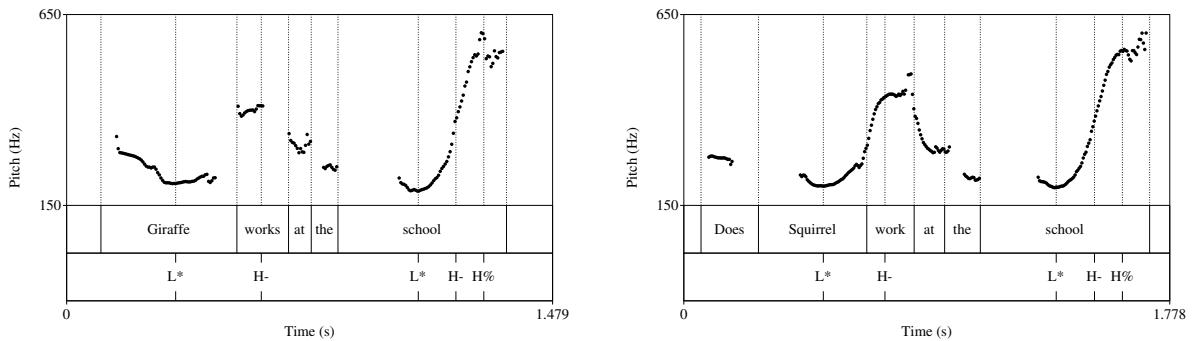


Figure 1: Pitch tracks of two stimuli from the experiment described below (rising declarative on left, polar interrogative on right), produced by a female speaker of North American English, annotated with words and ToBI transcriptions.

The nuclear contour in each of these utterances—that is, the contour from the final (nuclear) pitch accent in the utterance, located in the word *school*, to the end of the utterance—is typically transcribed in ToBI as having a low pitch accent (L^*), followed by a high phrase accent (H^-) and a high boundary tone ($H\%$), or $L^* H-H\%$ (Pierrehumbert, 1980; Beckman and Pierrehumbert, 1986; Pierrehumbert and Hirschberg, 1990; Bartels, 1999; Gunlogson, 2003). Each of these

examples also feature a pre-nuclear low pitch accent L* on the subject followed by a high phrase accent H- on the verb.

Rising declaratives can be divided into two kinds, *inquisitive* and *assertive* (Jeong 2018, building on Gunlogson 2003, 2008, Farkas and Roelofsen 2017, among others). The rising declarative in (1) exemplifies inquisitive rising declaratives, which are characterized by the following three pragmatic features: (i) the speaker makes no new commitments, (ii) the speaker expects the addressee to answer, and (iii) the speaker anticipates that the addressee will commit to the proposition p denoted by the declarative clause. Inquisitive rising declaratives are distinguished from polar interrogatives by (iii), which the latter do not have to meet.

Inquisitive rising declaratives can be further subdivided by whether they are *incredulous* or *confirmative*. The context of (1) is underspecified with respect to this distinction, allowing (1a) to achieve either interpretation. Compare (1a) to the following example, which is only appropriate as a confirmative rising declarative:

- (4) S and A made plans two days ago to get drinks tonight. They haven't spoken about it since. S says to A:
We're still on for tonight? (Rudin, 2018: 37)

The rising declarative in (4) can't be incredulous because S is double-checking a proposition p that she already held to be true. Nevertheless, both (4) and the incredulous reading of (1a) share the features (i)-(iii) above that characterize inquisitive rising declaratives: in neither case does the speaker make a *new* commitment in uttering the rising declarative, and in both cases, the speaker expects the addressee to treat their utterance as a question about p to be answered, and the speaker has reason to expect the addressee to commit to p . Below, we will see that the rising declaratives in our experiment are a kind of confirmative rising declarative.

Note that while (iii) might be thought of as a speaker expectation of addressee bias for p , nothing in the above implies that the speaker is biased for p . This is as it should be, since incredulous and confirmative rising declaratives cut in different directions on this issue (cf. Rudin, 2018). Incredulous rising declaratives convey that the speaker does not or did not previously expect p to be true, while confirmative rising declaratives convey the opposite, bias for p . This suggests that whether or not an inquisitive rising declarative conveys speaker bias for p needs to be derived context by context. In section 5, we will explain why our experimental context gives rise to the inference that the speaker is biased for p .

Assertive rising declaratives are characterized by the following four pragmatic features: (a) the speaker commits to p , (b) the speaker does not necessarily expect the addressee to be committed to p , (c) nor to answer the rising declarative as if it were a question about p , and (d) the utterance of the rising declarative raises a second, metalinguistic issue. Assertive rising declaratives are distinguished from falling declaratives by (d), which the latter do not have to meet. Here is an example.³

³Examples of assertive rising declaratives from the recent literature are also felicitous with the rise-fall-rise contour (Ward and Hirschberg, 1985; Büring, 2003; Constant, 2012; Wagner, 2012), perhaps even preferred with it. E.g. Rudin's (2018: 31) example (30), or Jeong's (2018: 307) example (1d), based on Farkas and Roelofsen 2017: 239, based in turn on Ward and Hirschberg 1985: 765. The example we use here avoids any ambiguity in the intended intonation.

- (5) A: What are you eating?
 S: This is a persimmon?

(5) exemplifies the four features (a)-(d) above that characterize assertive rising declaratives. S commits to *p*, S doesn't expect A to be committed to *p*, nor to treat S's utterance as a question about *p*, and S seems to raise another issue, in this case, "Have you ever heard of a persimmon before?", or as Hirschberg and Ward (1995) put it, "Can you relate that propositional content of my declarative to the contents of your own (unshared) beliefs?".

Given our interest in testing preschoolers' understanding that questions can be asked using clauses other than interrogatives, our goal is to test our participants' comprehension of inquisitive, not assertive, rising declaratives (though the latter are clearly an interesting avenue for future work). Jeong (2018) demonstrates through a series of experiments that when the final rise rises steeply to a higher final boundary tone, the rising declarative is more likely to be interpreted as inquisitive than assertive.⁴ So we made sure that all of our rising declarative stimuli feature steep rises, equivalent to the rises found in our polar interrogative stimuli, discussed further in section 3 below.

In prior work, some researchers have sought unified accounts of inquisitive and assertive rising declaratives (Malamud and Stephenson, 2015; Westera, 2017), some have focused only on inquisitive rising declaratives (Gunlogson, 2003, 2008; Farkas and Roelofsen, 2017; Krifka, 2017; Rudin, 2018), and others have offered distinct accounts of each kind (Jeong, 2018). Most of these accounts have been developed within some version of Farkas and Bruce's (2010) table model of discourse, with the exception of Westera (2017), who bases his account on Gricean maxims, and Krifka (2017), who develops the novel dynamic framework, commitment space semantics.

We will briefly describe the Truckenbrodt 2006/Rudin 2018 theory of inquisitive rising declaratives, to help structure the discussion of the experimental results in section 5 below. Truckenbrodt (2006: 272) proposes that falling intonation commits the speaker to the propositional content of the declarative clause, while rising intonation expresses the absence of this speaker commitment. Rudin (2018) builds on this idea, modeling it within the table framework in Farkas and Bruce 2010 and Farkas and Roelofsen 2017, in which utterances are treated as functions from the contexts to contexts. For Rudin, intonation manipulates how an utterance updates the context: falling intonation adds the propositional content of the utterance to the speaker's set of discourse commitments, while rising intonation does not. Other than this, utterances with either intonation update the table with their semantic content, and a set of future common grounds is projected which contains possible updates of the input common ground

⁴In some of the literature above and also including e.g. Pierrehumbert 1980; Pierrehumbert and Hirschberg 1990; Hirschberg and Ward 1995; Bartels 1999; Truckenbrodt 2012, when this intonational distinction is discussed, it is transcribed in ToBI as follows: the steeper rise is L* H-H%, while the lower rise is H* H-H%. A review of the phonological literature suggests that many take the distinction between the two transcriptions literally in that the two nuclear tunes are supposed to differ only in that the former has a lower pitch accent than the latter. While it is possible that there are two nuclear tunes in English that differ in precisely this way, and while this would make the rise of L* H-H% steeper than that of H* H-H%, it is not clear that this is the relevant distinction between the two rising declarative contours here. Jeong's stimuli manipulated the height of the final boundary tone while holding the height of the pitch accent constant. We agree with Jeong in assuming that, to the extent that there is a key intonational distinction here, it is a distinction in the height of the final boundary tone, not the preceding pitch accent.

with each proposition on the table.

To see how this works, consider the following example of a rising declarative.

- (6) Update with *It's raining?*

c_0	c_1		
DC_A	Table	DC_B	\rightarrow
		DC_A	Table $\{p\}$

$CG_0, PS_0 = \{CG_0\}$ $CG_1 = CG_0, PS_1 = \{CG_1 + p\}$ (Rudin, 2018: 55)

In the context c_0 before the utterance of the rising declarative in (6), the table and discourse commitment sets (DCs) for the two interlocutors A and B are empty, and the projected set (PS) is just the current common ground (CG). At context c_1 , after the utterance, the denotation of the rising declarative is added to the table⁵, the CG remains the same, and because the intonation is rising, so does the speaker's discourse commitments, DC_A . But the PS changes to include all possible updates to the CG that could result by resolving the issue on the table. Since there is only one proposition in the issue on the table, p , the only new possible CG in the PS is $CG + p$.

Recall the three pragmatic features of inquisitive rising declaratives above: (i) the speaker makes no new commitments, (ii) the speaker expects the addressee to answer, and (iii) the speaker anticipates that the addressee will commit to the proposition p denoted by the declarative clause. (i) is explained straightforwardly on this account. (ii) is explained on the assumption that there is general conversational pressure to shrink the CS by resolving issues on the Table. Issues are resolved by adding a proposition p in the issue to the CG , which requires an interlocutor to commit to p . Since the speaker does not commit to p when uttering a rising declarative, pressure is placed on the addressee to weigh in on whether p is true, explaining (ii). Rudin derives (iii) from Gricean competition with the polar interrogative *Is it raining?*. Essentially, the choice to use a declarative clause that denotes $\{p\}$ instead of a polar interrogative that denotes $\{p, \neg p\}$ conveys that $\neg p$ is likely to be inconsistent with an interlocutor's beliefs. Since the speaker didn't commit to p with a falling declarative, it can't be her beliefs at issue, so it must be the addressee's. If $\neg p$ is likely to be inconsistent with the addressee's beliefs, she is expected to commit to p , explaining (iii).

2.3. A critical test case

Rising declaratives provide a critical test case for children's understanding of the English clause type-speech act mapping and its exceptions by pitting declarative syntax against rising intonation.

On the one hand, rising declaratives feature declarative clausal syntax, the form that is canonically used to assert. If a child has already acquired the mapping between declaratives and assertions, then one possibility is that they might incorrectly interpret rising declaratives as assertions, identically to falling declaratives.

⁵Rudin uses a Hamblin semantics for clauses, so a declarative clause ϕ denotes a singleton set of its propositional content ($\llbracket \phi \rrbracket = \{p\}$), while a polar interrogative $? \phi$ denotes the set of its answers ($\llbracket ?\phi \rrbracket = \{p, \neg p\}$).

On the other hand, it is a near crosslinguistic universal that polar interrogatives rise utterance finally (Gussenhoven, 2004; König and Siemund, 2007), making it a good candidate for a universal that learners may be equipped with. Moreover, we know that newborns display sensitivity to the prosody of their language, suggesting that aspects of prosody are acquired early, even before birth (e.g. Nazzi et al., 1998; Mampe et al., 2009). If children blindly identify the relevant rising intonation with polar questionhood, they will interpret rising declaratives as questions, identically to polar interrogatives.

However, neither one of these interpretations would be adult-like. What we're looking for is that children know that rising declaratives violate the mapping between declarative syntax and assertion, and that they know that rising declaratives are a kind of question that is similar to but distinct from polar interrogatives.

2.4. Rising declaratives in speech to children

In order for children to be able to do this, they need to be exposed to rising declaratives in the input. In recent and ongoing work, Zaitsu et al. (2020) have analyzed 15,000 adult utterances to children between 1 and 3 years of age for both clause type and speech act. Relevant to us are their results for polar questions (include rising declaratives): First, the vast majority of these questions in the input have utterance-final rising intonation. Second, only 49% feature the subject-auxiliary inversion that is the syntactic hallmark of interrogative clauses in English. Third, at least 12% of these questions are genuine rising declaratives, with another 15% that could be rising declaratives, though they could also be left-edge ellipsis polar interrogatives. Gunlogson (2008: 6) warns about the potential for confusion in such cases due to the fact that many tensed and untensed forms of English verbs are indistinguishable. To see the issue, compare the unambiguous example of left-edge ellipsis in (7) with a sentence that could either be a rising declarative or a left-edge ellipsis interrogative in (8).

- (7) You kissing that penguin? (Zaitsu et al., 2020)
(8) You put Bob in the pilot? (Zaitsu et al., 2020)

(7) is a polar interrogative with the auxiliary *are* elided from the beginning of the sentence. It cannot be a declarative, as the lack of an auxiliary between the subject and the verb would make it ungrammatical. For examples of rising declaratives that cannot be left-edge ellipsis polar interrogatives, see (1a), (4), and (5) above. (8), on the other hand, could be a polar interrogative with the auxiliary *did* elided from the beginning of the sentence, or it could be a rising declarative with tense on the verb *put*. 15% of the input data fell into this ambiguous territory. For some of these cases, the input context may help disambiguate between polar interrogative and rising declarative while others are less clear. However, from the perspective of a learner who is not already aware of the pragmatic restrictions on rising declaratives, this portion of the data will be indistinguishable from the 12% genuine rising declaratives, as in both cases a clause that appears to be declarative is used to ask a question. So according to this study, 27% of polar questions in the input are asked using, what are from the naïve learner's perspective, declarative clauses.⁶

⁶The remaining 24% of polar questions in the input were split between 15% unambiguous left-edge ellipsis polar interrogatives like (7), and 9% tag interrogatives like: "We're not really going to the zoo, are we?".

The main takeaway is that children are exposed to plenty of evidence that declarative clauses can be used to ask questions. Another takeaway is that, given the stronger correlation between rising intonation and polar questions in the input, it would be reasonable to think that rising intonation is a stronger signal of polar questionhood than subject-auxiliary inversion. This latter fact suggests that it is at least possible that young children may struggle to arrive at an adult-like understanding of rising declaratives, instead identifying the relevant rising contour with standard polar questionhood and nothing more.

To test children’s understanding of rising declaratives, falling declaratives, and polar interrogatives, we designed a game in which it is natural for a puppet to both ask questions and make assertions. The game context is designed so that each speech act should lead to a different response from the participant. So observing the child’s responses to the puppet’s utterances enables us to infer how they interpret different clause types in context.

3. Methods

3.1. Participants

So far, we have collected data for 19 children, age 3;6 to 4;6 (mean 3;11), and 16 adults (undergraduate students at the University of Maryland). The target n for each group is 32, with half of the children younger than 4;0. The reason for this is to be able to look for effects of age between younger and older children. An additional 11 children failed training. Of those, 8 were on the younger end of the range, with a mean age of 3;7. This suggests that the task may be difficult for some younger children.

3.2. Materials

A 2×3 foot poster of a cartoon village with six workplaces in it was used as the game board. 29 cartoon animals were printed and laminated. Both the village and animals had velcro attached to them so the animals could be stuck in front of their workplaces. A three-ring binder was used to construct a book in which each page displays where one of the animals works in the village. See fig. 2 for examples of these materials.

Audio stimuli were recorded of a female native speaker of American English using child-directed speech. These stimuli were recorded and edited for length using the Praat phonetics software (Boersma and Weenink, 2020). The stimuli were presented as recordings to ensure that the prosody was consistent across trials and participants. There were 8 rising declaratives and 8 polar interrogatives total. We checked these stimuli to ensure that indistinguishable contours were used across these two conditions. The mean final boundary tone for the rising declaratives was 506 Hz (standard deviation = 19). The mean final boundary tone for the polar interrogatives was 499 Hz ($sd = 14$). To see whether there was any significant difference between the two groups of boundary tones, we ran a two-sample t-test, which failed to find any difference ($p > 0.38$).

We made video recordings of a puppet to present via a laptop as the speaker of the audio stimuli. The video and audio were combined via Adobe Premiere Pro video editing software.

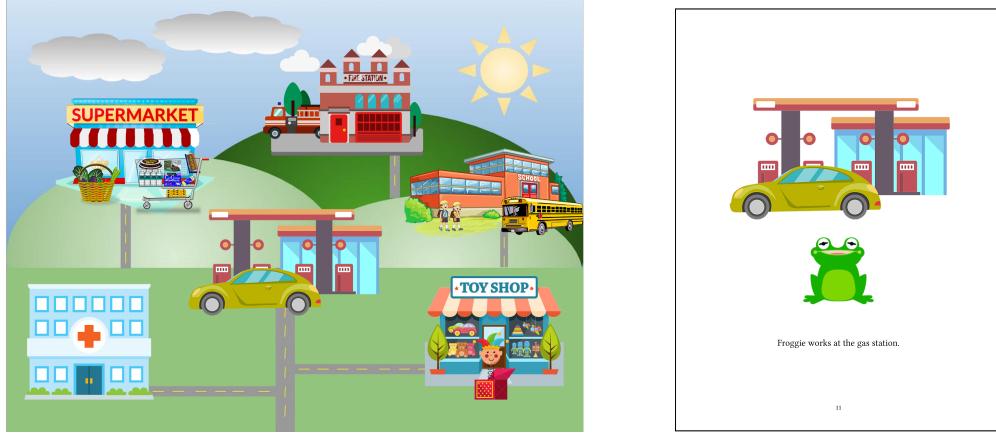


Figure 2: The village game board and a page from the book.

3.3. Procedure

Children sat to the left of an experimenter in front of a low table. The village game board was on top of the table in front of the child. To the right in front of the experimenter was a closed laptop, the book, and farther to the experimenter's right were the 29 animals. A schematic drawing of the layout of the experimental materials can be seen in fig. 3.

First the child was introduced to the village and shown the animals, and the experimenter told them that they had to help all of the animals get to work. Then the experimenter said that they were going to call Boo Boo (the puppet) who would help them get the animals to all of the right places. At this point, the experimenter opened the laptop, which displayed the video recordings as power point slides, and initiated a conversation with Boo Boo. Boo Boo made clear that she had to help the animals get to work, and that she remembered where some of them work, but for others she forgot, and asked for the child's help.

In each trial, the child was handed an animal, and then heard the puppet say something about where that animal works. The task was divided into two phases. In the training phase, the child heard four imperatives as in (9), three wh-interrogatives as in (10), and three polar interrogatives as in (11), for ten training trials total.

- | | | |
|------|------------------------------|---------------------|
| (9) | Put Cat in the school. | Imperative |
| (10) | Where does Cat work? | Wh-interrogative |
| (11) | Does Cat work at the school? | Polar interrogative |

In each trial, the puppet made a thinking sound “mmm” before uttering the sentence. For imperatives, the child was instructed to directly place the animal in the corresponding location. For interrogatives, the child was instructed to check a book that contains information about where each animal works.

The placement of the book was crucial, as whether or not the participant chose to check it was the dependent variable. On the one hand, the experimenter had to control any searches through the book so that the child wouldn't flip through it and find out where animals in upcoming trials work. Moreover, we were concerned that if the child had easy access to the book, they might

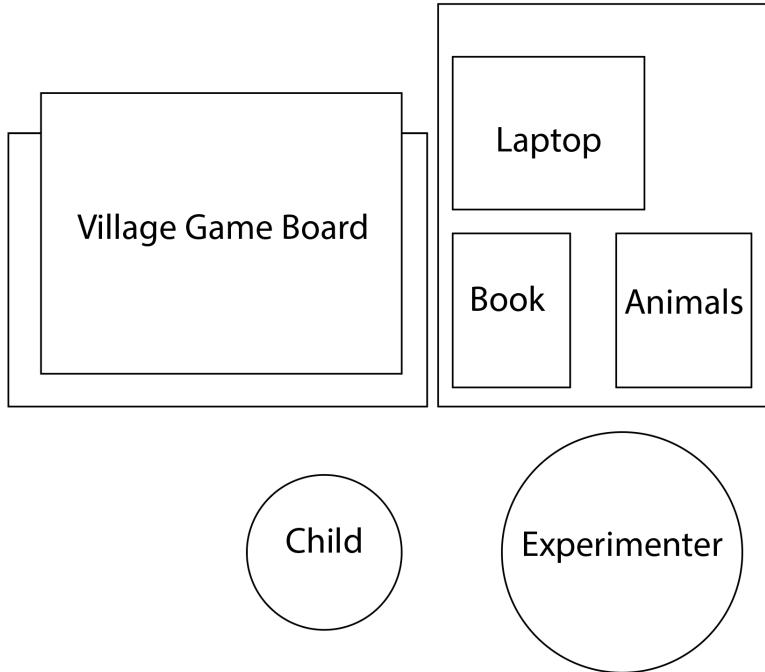


Figure 3: A schematic drawing of the layout of the experimental materials.

become overly interested in it and want to check it in every trial. On the other hand, we needed the child to feel that they had access to the book when it was needed, so that they would feel free to ask to check it in trials in which they needed too. We found that placing it in front of the experimenter, but close enough to the child for them to reach it, struck the right balance. We also demonstrated to the child in the first training trials that it was the experimenter's job to handle the book when it needed to be checked.

The location that Boo Boo mentioned in the polar interrogative was correct exactly half of the time. This was to reinforce that sometimes Boo Boo remembered where the animal works and sometimes she forgot. The location Boo Boo mentioned in the imperative condition and the falling declarative condition (below) was correct 100% of the time. After two trials in which the child was instructed to check the book, the experimenter stopped prompting. If the child did not respond to an interrogative, the experimenter asked, "What should we do?" Most children checked the book spontaneously and correctly by the end of the training phase. Children who did not check the book on the last training interrogative or who checked the book on the last training imperative were not included in the final sample (11 participants).

The test phase was identical to the training phase from the perspective of the child, but differed in the kinds of sentences presented. The test phase had four conditions: imperatives and polar interrogatives like in (9) and (11), as well as falling declaratives like in (12), and rising declaratives like in (13). Falling declaratives were produced with standard falling intonation, the nuclear contour transcribed as H* L-L%. There were also three wh-interrogative trials distributed throughout the test phase, as a reminder to the child that they could use the book.

- | | | |
|------|--------------------------|---------------------|
| (12) | Cat works at the school. | Falling declarative |
| (13) | Cat works at the school? | Rising declarative |

There were four trials of each condition, making for 16 test trials total. The test trials were presented in four blocks to maximize distance between conditions. Two separate lists were constructed to vary order of presentation. The dependent variable was whether or not the participant checked the book before placing the animal.

Table 2: Conditions and expected responses

<i>Clause type</i>	<i>Intended speech act</i>	<i>Example</i>	<i>Expected response</i>
Imperative	Request	Put cow in the school!	Place animal
Falling declarative	Assertion	Cow works at the school.	Place animal
Polar interrogative	Question	Does Cow work at the school?	Check book
Rising declarative	Question	Cow works at the school?	???

This task allows us to see what speech act children assign to a given utterance by observing whether they check the book. If they perceive the utterance as a request, then they place the animal in the mentioned location. If they perceive it as an assertion, then they understand the speaker to be providing information; if they are able to take the step from a direct speech act to an indirect one, then they will further interpret the assertion as an indirect request to place the animal in the mentioned location; if indirect speech acts are not available, we expect children not to react to an assertion. If they perceive the utterance as a question, then they understand that the speaker lacks information and should check the book to find it.

As discussed above, the critical condition is the rising declarative. If children focus on the declarative syntax, they should treat rising declaratives identically to falling declaratives. If they focus on the rising intonation, they should treat rising declaratives identically to polar interrogatives. However, another possibility, one that is more likely if they have an adult-like interpretation for rising declaratives, is that they treat them differently from each of the other conditions. The reason for this is that rising declaratives have their own unique discourse restrictions. In particular, the rising declaratives in our experimental context were of the confirmative sort, introduced in section 2.2. Boo Boo is recalling from memory where each of the 29 animals works. Meanwhile, the child has access to the book of information about where the animals work (perhaps Boo Boo’s memories stem from a prior consultation of this book as well, though we leave this implicit in the experiment). Thus, a likely interpretation of Boo Boo’s rising declaratives is that she is double-checking her memory with the child, who has access to an independent source of relevant information, much like S double-checks her memory of her plans to get drinks with A in (4). While confirmative rising declaratives request confirmation, given that Boo Boo frequently remembers accurately where the animals work, and given that confirmative rising declaratives tend to convey that the speaker is biased toward the proposition p denoted by the declarative, we expect participants who understand rising declaratives to go along with Boo Boo’s bias at least some of the time by assuming that her memory is correct and choosing to directly place animals in the mentioned location. We return to this interpretation of Boo Boo’s rising declaratives and their impact on the results in the discussion in section 5.

4. Results

The plots in Figure 4 display the proportion of trials in which participants checked the book in each condition, split by adults and children, with percentages of book-checking for all observations in each condition listed in the plots. Adults rarely check the book in the imperative

condition (3% of observations), never check the book in the falling declarative condition, and always check it in the polar interrogative condition. As for the rising declarative condition, they check the book 78% of the time.

The child results display a similar pattern. They rarely check the book in the imperative (12%) and falling declarative (13%) conditions, they check it frequently in the polar interrogative condition (91%), and they check it 63% of the time in the rising declarative condition.

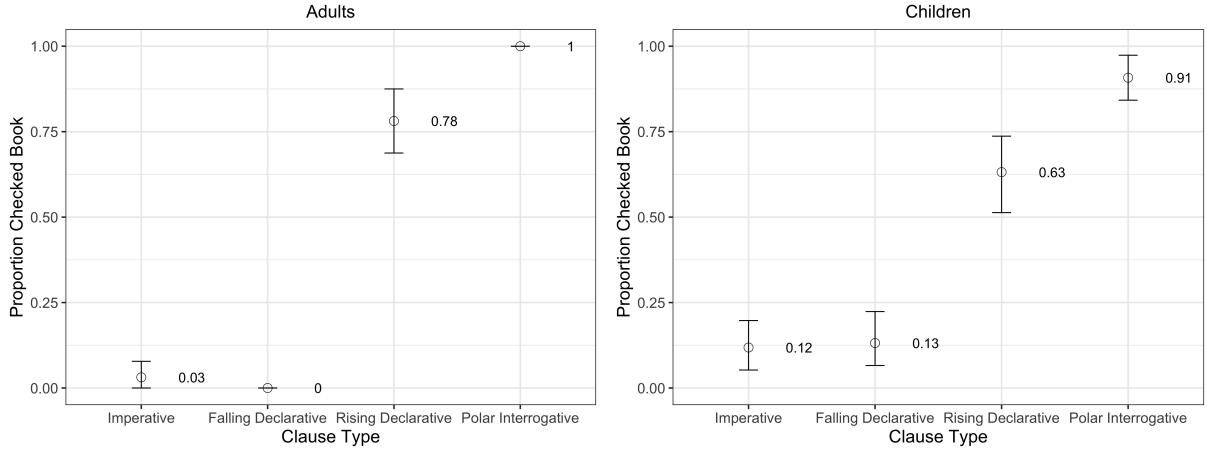


Figure 4: Proportion of book-checking by adults and children in each condition with 95% confidence intervals.

Digging into the data a little further, we can see in the histograms in fig. 5 that some adults and children check the book for every rising declarative, while some never check the book in the rising declarative condition. The adult behavior in this condition is roughly bimodal, while children display a little more variability.

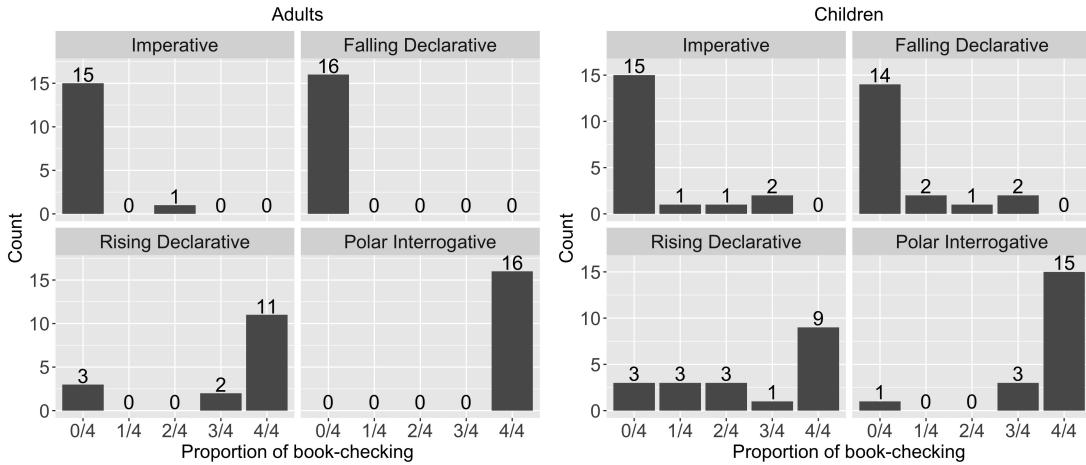


Figure 5: There were four trials in each condition, so participants could check the book between zero and four times in each condition. These histograms sort participants by how many times they checked the book in each condition, and show the counts of participants in each bin.

Due to the absence of variance in the falling declarative and polar interrogative conditions in the adult data, a logistic regression would be an inappropriate statistical test here. As a means

of comparing the adult rising declarative data to the polar interrogative data, we calculated the 95% confidence interval for the rising declarative condition to see if it excludes 1 and it does: the 95% CI for the adult rising declarative condition is 0.67 and 0.86.

We also calculated the 95% CI for the child rising declarative data, and found that it also excludes the result for their response to the polar interrogative condition: the 95% CI for the child rising declarative condition is 0.52 and 0.73. Furthermore, we ran a mixed effects logistic regression on the child data, with random intercepts for item and participant, and random slopes for participant. We used simple contrast coding with rising declarative as the reference level. This allows us to compare the rate of book-checking in the rising declarative condition against the rate of book-checking for each other clause type. The model (see Table 3) reveals a significant effect of rising declaratives vs. imperatives and falling declaratives on the rate of book-checking. The effect of rising declaratives vs. polar interrogatives is approaching significance ($p < .09$).

	Children
(Intercept)	$\beta = -1.13$ ($p > .40$)
Imp vs. RD	$\beta = -7.61$ ($p < .05$)
FD vs. RD	$\beta = -6.48$ ($p < .05$)
PQ vs. RD	$\beta = 3.37$ ($p < .09$)

Table 3: Mixed effects logistic regression with random intercepts for item and participant, and random slopes for participant, and with simple contrast coding with rising declarative as reference level, modeling the effect of clause type on book-checking (the table lists model estimates and p values).

5. Discussion

The results demonstrate clearly that children age 3;6 to 4;6 do not treat falling declaratives identically to polar interrogatives. This shows that preschoolers are well aware of the canonical mappings between these two clause types and their associated speech acts. At the same time, they do not treat rising declaratives identically to falling declaratives either. In particular, rising declaratives elicit a much higher rate of book-checking, suggesting that they are treated as questions most of the time. This further shows that preschoolers are aware that not all declarative clauses convey assertions, and that they can convey questions. That is, they are aware of exceptions to the canonical declarative-assertion mapping that depends systematically on intonation.

The adult results show that adults do not treat rising declaratives identically to polar interrogatives. As discussed above, we suspect that the reduced rate of book-checking in the rising declarative condition relative to the polar interrogative condition is due to the fact that rising declaratives are questions that are biased toward the positive answer. On the one hand, a biased question is still a question, and so should frequently lead participants to choose to check the book to confirm the answer. This is predicted by Rudin's (2018) theory, which derives the expectation that the addressee will answer from pressure to shrink the context set. On the other hand, if Boo Boo poses the question in a way that suggests that she is biased for p , then that, combined with the fact that Boo Boo frequently has the correct information in other trials,

should lead some participants to go along with Boo Boo's bias and place the animal in the mentioned location without checking the book in some trials.

This explanation of our results depends on our participants inferring that Boo Boo's rising declarative expressed a bias for p in our experimental context. Given that rising declaratives can, but do not always, convey that the speaker is biased for p as discussed in section 2.2, we would like to be able to explain why they would have drawn the speaker bias inference here. We believe that they did draw this inference, and that we can explain it. To see how, consider another requirement of rising declaratives, discussed in section 2.2: (inquisitive) rising declaratives require the speaker to anticipate that the addressee will commit to the proposition p denoted by the declarative clause. This was also predicted by Rudin's account, which says that Boo Boo's choice of the rising declarative over the polar interrogative conveys that $\neg p$ should be inconsistent with the addressee's beliefs, leading to the expectation that the addressee will commit to p . Now, why would Boo Boo have this expectation about the participant in our experimental context? It's not as if the participant asserted or otherwise implied p . The answer is that in the context of our experiment, Boo Boo's expectation that the participant will commit to p depends on Boo Boo herself being biased for p . Suppose Boo Boo weren't biased for p , that is, she had no idea whether or not p was true. Then the fact that the participant has access to the book would not by itself lead Boo Boo to expect the participant to commit to p . After all, the book could reveal that p is false. So, from the participant's perspective, if Boo Boo behaves as if she expects the addressee to commit to p by asking a rising declarative, Boo Boo must have some partial evidence herself that the book will reveal that p is true. That is, Boo Boo must have a shaky memory that the proposition p denoted by the declarative clause is true. Thus it is reasonable for the participant to conclude from the fact that Boo Boo used the rising declarative instead of the polar interrogative that she is biased toward p . And it is this bias, we think, that explains the asymmetry in participants' responses to the rising declarative and polar interrogative conditions.

The child results are remarkably similar to the adult results in this respect: children check the book less frequently for rising declaratives than for polar interrogatives. This suggests that by age 3;6 to 4;6, many children are aware of subtle differences between these two means of asking questions, and that they do not just blindly treat rising polar question intonation as a signal to questionhood. Rather, they seem to understand that rising declaratives are a unique means of asking a question, distinct from polar interrogatives, with their own pragmatic requirements and implications.

There remain other possible explanations of the rising declarative results. One is that participants may have arrived at an assertive rising declarative interpretation in some trials. In such cases, we would expect participants to directly place the animal without checking the book, as sometimes happened. One mystery on this explanation of our results is what metalinguistic issue Boo Boo could be raising in the context. The only one that comes to mind is, roughly, the unpronounced parenthetical in (14):

- (14) Boo Boo: Cow works at the school? (How do you not know this?)

Given the experimental context, this seems rude and therefore an unlikely interpretation for participants to have. Moreover, recall that Jeong (2018) shows that steeper rises make assertive interpretations less likely. Our intuition is that in order to achieve an assertive interpretation

like in (14), the rising declaratives in our experiment would have to have been uttered with a lower final rise than the steep, high-rising intonation we actually used. So our stimuli likely blocked such assertive readings.

Another possible explanation for the asymmetry between responses to rising declaratives and polar interrogatives in our results is that it corresponds to the relative frequencies with which these clause types are used for questions. We know that rising declaratives are used less frequently than polar interrogatives in the input to children (Zaitse et al., 2020). This asymmetry could be having a low-level effect, causing children to treat the more frequent form of polar interrogatives as questions more frequently. Another distinct, but related possible explanation is that rising declaratives provided a weaker signal to questionhood than polar interrogatives because the former only has one signal of questionhood (rising intonation) while polar interrogatives have rising intonation plus subject-auxiliary inversion. Thus children might check the book less in the rising declarative condition because it is harder to notice the signal to questionhood. However, on the assumption that adults would not be subject to either of these low level effects, neither of these alternative explanations seem likely given that we found the same qualitative pattern in the adult data.

6. Conclusion

These results show that by age 3;6 to 4;6, many children are aware of the relation between the main clause types and their associated speech acts, and they are sensitive to the impact of intonational contour on interpretation of the illocutionary force of utterances. But while they are aware of each of these, they do not seem to just rely on clause type or intonation. Rather, their interpretation of rising declaratives is similar to that of adults, treating them as a special kind of question distinct from standard polar interrogatives.

We see a few avenues for future work related to this project. The first is to further explore the subtleties of children's understanding of rising declaratives. As discussed above, recent work on formal pragmatics shows that not all rising declaratives are interpreted in the same way, in particular rising declaratives can be incredulous, confirmative, and assertive. Future work could test child and adult comprehension of these subtle distinctions.

Second, while these results demonstrate that preschoolers are aware of canonical links between clause types and speech acts, as well as the unique exception of rising declaratives, we still do not have a lower bound on when children first acquire these links or their exceptions. We suspect that this may happen much earlier than preschool age, likely in the second year of life, as the ability to distinguish declaratives from other clause types may help explain aspects of basic syntax acquisition like argument structure, word meanings, basic word order, syntactic categories, pro-drop, etc. (Pinker, 1984, 1989; Gleitman, 1990; Gleitman et al., 2005; Perkins, 2019). We are planning a preferential-looking study designed to test infant comprehension of this mapping. We will begin by comparing falling declaratives to polar interrogatives, and will expand from there to consider wh-interrogatives and rising declaratives as well. One question we are focused on as we embark on this project is about the order of acquisition: Do children figure out the canonical mappings between clause types and speech acts first, and only later that there are exceptions to these mappings? Or do they start by identifying the intended speech acts of utterances regardless of the form they take, and later realize that there is a canonical form that typically goes with each act? We leave these questions to future work.

Finally, the acquisition of rising declaratives poses a familiar puzzle. As demonstrated implicitly in various examples above, polar interrogatives are felicitous in every context that (inquisitive) rising declaratives are felicitous in, as well as other contexts that would render rising declaratives infelicitous. Thus the extension of the correct analysis of the semantics and pragmatics of rising declaratives—that is, the set of felicitous uses of rising declaratives predicted by the analysis—is a proper subset of the extension of the correct analysis of the semantics and pragmatics of polar interrogatives (cf. Gunlogson 2003, who makes this claim explicitly). This poses a subset problem for the learner (Berwick, 1985; Pinker, 1989; Gleitman, 1990; Yang, 2017). If the child arrives at a superset analysis of the correct analysis—for example, if the child mistakenly analyzes rising declaratives as a standard means of forming a polar question, equivalent to inverted polar interrogatives—what evidence could they observe that would lead them to reanalyze rising declaratives as a more restricted phenomenon? The challenge is that there will never be any direct negative evidence that rising declaratives are unacceptable in certain contexts that inverted polar interrogatives are acceptable in. Rendering the challenge even thornier is the fact that this missing negative evidence is directly contradicted by false positive evidence in the input. Recall Zaitsu et al.’s (2020) study of the English input data reported in section 2.4, which reveals that a substantial portion of polar questions are ambiguous between rising declaratives and left-edge ellipsis polar interrogatives. A key portion of that data is bound to consist of genuine polar interrogatives used in contexts in which rising declaratives would be infelicitous, but that are nevertheless formally *indistinguishable* from rising declaratives due to left-edge ellipsis. *Prima facie*, this portion of the input data could mislead the child into believing that rising declaratives do not have any special pragmatic restrictions, but are instead a normal means of forming standard polar questions in English, just like polar interrogatives with subject-auxiliary inversion. Given all of this, why don’t English acquiring children erroneously conclude that their language has more than one means of forming a standard polar question? After all, some languages do exhibit this pattern, for example French, in which polar questions can be formed colloquially via the question particle *est-ce que* or via rising intonation on what otherwise looks just like a declarative clause (Reinhardt, 2019).

(15) Two colloquial forms of standard polar questions in French:

- | | | | | |
|----|-------------------|-------------|----|---------------|
| a. | Est-ce que | c'est bon ? | b. | C'est bon ? |
| | QUESTION PARTICLE | it.is good | | it.is good |
| | "Is it good?" | | | "Is it good?" |

How do English learners sort out the special pragmatic restrictions on the use of rising declaratives? One possibility is that they make use of another aspect of the input mentioned in section 2.4, namely, in addition to the data that is ambiguous between rising declaratives and left-edge ellipsis polar interrogatives, the input includes unambiguous rising declaratives and unambiguous left-edge ellipsis polar interrogatives. The child may need to use the existence of these two parts of the input data to learn that the ambiguous input data is indeed ambiguous, so as not to conclude that rising declaratives convey standard polar questions. How exactly does the learner do this? What does the answer to this question predict about the developmental course? These questions are left to future work.

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