Principles of Presupposition in Development

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December 21, 2020

Abstract

This paper brings a developmental perspective on a longstanding issue in linguistics and the philosophy of language surrounding the proper characterization of presuppositions. On an influential view (Stalnaker 1970, 1974; Karttunen 1974), presuppositions reflect formal admittance conditions: an utterance of a sentence which presupposes p is admitted by a conversational context c only if p is already common ground in c. The theory distinguishes two modes of satisfying this formal requirement: (*i*) presuppositions may have common ground status prior to utterance, or (*ii*) they may achieve common ground status post-hoc, via accommodation, an adjustment of the common ground by cooperative listeners so as to meet the requirements of the uttered sentence. While intuitive and general, this two-pronged approach has been criticized on empirical methodological grounds and motivated alternative theories that reject the notion that presuppositions impose admittance conditions.

We present a novel set of evidence from child language in favor of the admittance view of presuppositions. In a series of behavioral experiments, we show that young children generate a default expectation that the presuppositions of an asserted sentence have common ground status prior to utterance, even in situations where accommodation is licensed. More tellingly, even when accommodation is the preferred option for adults, children adopt a different conversational stance. The observed two-step developmental trajectory, we argue, lends support to key tenets of the admittance theory, whose empirical validity may otherwise be masked due to the pragmatic sophistication of adult language users.

1 Introduction

Natural language affords speakers with means of distinguishing the main point of an uttered sentence, its *asserted content*, from content whose truth they take for granted, its *presuppositions*. Consider (1), with the asserted component in (1-a) and the presupposed component in (1-b). A sincere speaker of (1), while committed to the truth of both (1-a) and (1-b), seems to be assuming that (1-b) is old information that is already part of the background of conversation, accepted by the speech act participants as true.

(1)   Billy stopped playing video games.

      a.   Billy does not play video games now.
      b.   Billy played video games in the past.

Providing an explanation for the special informational status of presupposition is a core issue in the study of natural language meaning: how do the grammatical representations

of sentences as in (1), together with principles of information exchange, lead to the fact that (1-b) is taken for granted and (1-a) is not? This question has also been at the center of considerable theoretical debate.

On an influential view, following the Stalnaker-Karttunen tradition, the special status of presuppositions arises from the fact that they serve to establish the basis for making an assertion. They reflect "admittance conditions", conditions that must be met in a conversational context in order for an assertion to be felicitous against that context (Stalnaker 1970; Karttunen 1974; Stalnaker 1974 *et seq.*). On this approach, which we refer to throughout as the *admittance theory*[1], there are two modes by which presuppositions affect a conversation. In the most straightforward case, presuppositions of a sentence constitute content that is already part of the conversational record prior to the point of uttering the sentence, i.e. content that is part of the body of information that the discourse participants have mutually accepted into the conversational common ground; we refer to this throughout as the "basic mode" of meeting the admittance conditions. Presuppositions of an uttered sentence may also achieve common ground status *after* the point of utterance by virtue of *accommodation* – an adjustment of the common ground made by cooperative listeners to ensure that the conversation can proceed smoothly; we refer to this as the "repair mode". Importantly, in both modes the presuppositions of an uttered sentences must be accepted so that the evaluation of the asserted content of the sentence is possible. Thus, in both cases the presupposed content reflects a formal requirement which amounts to an admittance condition on utterances: an utterance of a sentence which presupposes p and proffers q is admitted by a common ground only if the common ground entails p.

The admittance theory rests on an idealization about the logical priority of presupposition that is not easy to detect in ordinary conversation. This has raised skepticism about its empirical adequacy and falsifiability and motivated alternative approaches that reject the notion that presuppositions impose formal admittance conditions (Atlas 1977; Gazdar 1979; Soames 1989; Atlas 2005; Abbott 2006; Simons 2007; Simons, Tonhauser, Beaver & Roberts 2010; Tonhauser 2015; Simons, Beaver, Roberts & Tonhauser 2016; Beaver, Roberts, Simons & Tonhauser 2017). Many of these alternatives take a reductive stance on presuppositions, wherein their information-structural effects are derived from various combinations of entailment and conversational implicature (Atlas 1977; Simons 2001; Atlas 2005; Abbott 2006; Simons 2007; Simons et al. 2010, 2016).

In this paper, we approach this theoretical issue from a developmental perspective and present a novel set of evidence in support of the admittance theory. Over three experiments, we show that there is a stage of language development where presupposition accommodation is unavailable, which in turn allows us to see more transparently the demands presuppositions impose on the common ground. We asked adults and children to choose between two possible addressees of a presuppositional sentence, as a proxy for their expectations about the common ground. In our Experiments 1 and 2, which examined the "basic mode" of presupposition satisfaction, the choice was between an addressee whose information state had previously been updated to contain the presupposed proposition (the knowledgeable

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1 In adopting this convention, we follow Heim (1983) et seq.

addressee) and one whose information state hadn't been so updated (the ignorant addressee). Here, adults and children reliably chose the knowledgeable addressee, indicating a preference for presuppositions to have common ground status prior to utterance. In Experiment 3, which examined the "repair mode", the context was set up in a way such that choice of the knowledgeable addressee would violate an independently attested communicative principle. In this set-up, children diverged from adults: whereas adults reliably chose the ignorant addressee, whose information state after accommodation would entail the presupposed content, children did not. This pattern of behavior, we argue, is most naturally compatible with the admittance theory, which distinguishes two modes of satisfying the condition that presuppositions be common ground prior to assertion. Within this framework, our findings can be understood as revealing a stage in development where children are sensitive to this formal requirement, but are constrained in ways that force presuppositions to literally be *pre*-suppositions at the point of utterance.

The rest of the paper is organized as follows. We begin in §2 with a brief overview of the admittance theory of presuppositions, before turning to its developmental predictions in §3. We turn to our experiments in §4. Experiments 1 and 2, discussed in Sections 4 and 5 respectively, probe children's expectations about the basic mode of presupposition, using two triggers (*too* and *the*) with importantly divergent properties. In Experiment 3, discussed in §6, we turn to accommodation. Using the same presupposition trigger as in Experiment 2 (*the*), but in a context that favors accommodation, we probe how, if at all, expectations about the context shift. §7 discusses the developmental and theoretical implications of our findings.

2 Admittance theory

We frame our experiments within an approach to presupposition as reflecting admittance conditions, conditions on the appropriateness of using a sentence to increment an information state. As will be explicated below, this view of presupposition falls out from a set of assumptions about (*i*) the semantics of presuppositional sentences, (*ii*) the principles governing cooperative discourse, and (*iii*) the link between semantics and pragmatics. The version of admittance theory we discuss here is couched within a possible worlds semantics, where a declarative sentence expresses a proposition which denotes a set of possible worlds, and a Stalnakerian picture of pragmatics, where presuppositions are "gate-keepers" for successful information update.

In a series of papers, Stalnaker (1970, 1974, 1978, 1999, 2002) offers a specific refinement of the general program developed by Grice (1967) of construing discourse as a sequence of rational actions by cooperative agents with a communal goal of information exchange. In this framework, sentences used in communication contribute to an existing conversational record among the discourse participants. Part of this record is the set of assumptions presumed to be common beliefs among the interlocutors, the conversational *common ground* (defined in (2)). The common ground describes a set of worlds, the *context set*, which are those worlds in which all of the propositions in the common ground are true, and which constitute the range of worlds that conversational participants take to be

candidates for being the actual world (3).

(2) **Common Ground:** A common ground is a set of propositions. A proposition p is in the common ground of context c iff it is commonly believed among participants in the conversation at c that every participant accepts p.[2]

(3) **Context Set:** The set of worlds compatible with every proposition in the common ground is the context set of c.

Since a distinction between these two conceptualizations of context will not make a difference to us, we will use both terms interchangeably and often replace either with the shorter "context".

2.1   Assertion and presupposition: the basics

When exchanging information, speakers aim to increase the body of mutually accepted beliefs about the world. The central vehicle for this is that of an assertion, which proffers content to be considered for adding to the common ground. The assertion of a (declarative) sentence S in context c is thus a proposal to *update* c so as to create a new context c', which encompasses the information conveyed by S. The update operation can be modeled as intersecting c with the proposition expressed by S (understood as a set of possible worlds), and can be thought of as a narrowing down of the set of candidate worlds that could be the actual world.

Issuing an assertion is subject to certain pragmatic conditions, which, while in principle independent of the admittance theory, are worth mentioning here. Of particular relevance for our purposes, as it plays a role in our experimental logic later on, is a *non-redundancy* constraint on assertions, proposed by Stalnaker (1978), (4). The assertion of a sentence S in a context c needs to result in a non-trivial update, in the sense that it should eliminate at least one possible world in c.

(4) **Appropriateness condition on assertion**: A declarative sentence S can be asserted against a context c iff S is not *redundant* in c ($[\![S]\!] \cap c \neq c$)

It is useful to contrast the non-redundancy requirement on assertions with the contextual requirements of presuppositions within the admittance theory. Unlike assertions, the truth of the presuppositions should *not* be an open issue in the context. Rather, they are taken to be content that need to be satisfied by virtue of being mutually accepted as true (Stalnaker 1974, 1978). In other words, presuppositions have to be redundant in c, (5).

(5) **Appropriateness condition on presupposition**: A declarative sentence S with presupposition p can be used to update a context c iff p is *redundant* in c ($p \cap c = c$)

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2 For an elaboration on why acceptance, rather than belief or knowledge, is the critical notion, see Stalnaker (2002).

The rationale for the use condition in (5) is an assumption about the partial semantics of presuppositional sentences — that they receive a classical truth value (1 or 0) only if its semantic presuppositions are true — coupled with the following principle that bridges the semantics and pragmatics:

(6)   **The Bridge Principle:** An asserted proposition can update a conversational context c only if every world in c is such that the proposition is either true or false in it. (Stalnaker 1999:88)

If presuppositional sentences receive a classical truth value only when their presuppositions are true, this amounts to a requirement that a presuppositional sentence is assertable in a context only when its presuppositions are true in all the possible worlds in that context. Stalnaker takes this bridge assumption to follow from cooperative considerations. Proposals to update a context with an asserted proposition are proposals to winnow down the context set by eliminating those worlds incompatible with that proposition. The update goes through so long as the listener is willing to accept the asserted proposition. Crucially, in order for the listener to decide whether or not to accept some piece of information as fact, thereby updating their information state, it is required on Stalnaker's Bridge principle that they be able to evaluate its truth *deterministically*. That is, there cannot be any uncertainty as to whether a given world should be included in the new context set after update. A cooperative speaker mindful of this should then use a presuppositional sentence only in circumstances where they have grounds to believe that the listener also takes the sentence presuppositions for granted, i.e. when the presupposition is presumed common belief.[3]

2.2   Refining the system: Accommodation

The most transparent way in which the Bridge Principle can affect actual conversation is to place constraints on the context immediately preceding the time of utterance: A speaker should not utter a sentence whose presupposition is not already part of the common ground at time of utterance. It has been long recognized, however, that this picture is not descriptively adequate. Speakers frequently use presuppositional sentences, seemingly successfully, even when they have no reason to believe that the presupposition is already mutually accepted, and sometimes even when they have reasons to believe otherwise (Stalnaker 1974; von Fintel 2008). Consider the sentence in (7). A speaker might utter this having just walked into a meeting full of people they barely know, presupposing that there is exactly one car that they have rented this morning without assuming that the audience knows this.

(7)   Sorry I am late! The car that I rented this morning broke down on my way here.

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3 What we describe here is a simplification that leaves out complex sentences and the problem of presupposition projection. On many admittance theories, computation of presupposition satisfaction takes place at the level of atomic sentences, rather than at the level of utterance. That is, the context under consideration is the "local" context, not the "global" context, which is the context of the utterance. Because we will not be considering complex sentences here, unless otherwise specified, when we say context, we mean the global context.

What cases like (7) highlight is the fact that the Bridge Principle, while mandating logical priority of presupposed content, is silent on temporal priority. For the appropriateness condition on presupposition to be satisfied, it suffices that the common ground meets the presuppositional requirements of an uttered sentence at the point of *update*. If an otherwise cooperative speaker utters a sentence whose presupposition is not already part of the common ground, listeners, so long as they are ready to accept the presupposed proposition, can adjust their contextual assumptions "on the fly" so as to allow for successful update (Stalnaker 1974, 2002; von Fintel 2008). This procedure is typically referred to as *presupposition accommodation*. Accommodation allows for divergences between the *input context*, i.e. the context at time of utterance, and the *update context*, i.e. context against which the assertion is ultimately evaluated. When a presupposed proposition p is not entailed by input context c, listeners might increment c to an update context c' that does entail p. As a consequence, at the point of evaluating the assertion, the context does indeed satisfy the appropriateness condition on presupposition use. Thus on this enriched picture, the admittance theory distinguishes two modes by which presuppositions of a sentence relate to the conversational context: (*i*) presuppositions may be content that already has common ground status prior to utterance, or (*ii*) they may be content that achieves common ground status post-utterance by virtue of accommodation.

The second mode is clearly more involved than the first. Content that has been established by overt statements in the course of the conversation is very plausibly more transparently accessible than content that isn't. If presuppositions are already common ground at the time of utterance, the input context and the update context will be identical; on the other hand, cases involving accommodation require an additional operation, one of incrementing the input context to one that provides a basis for successful update with the asserted proposition. It is in this sense that accommodation feels like a "repair" strategy. It is important to note, however, that it is an expected aspect of the picture where a proposition is common ground if it is mutually *accepted*. The notion of acceptance (as opposed to e.g. knowledge or belief) highlights the fact that speech act participants have agency over what is treated as common ground for the purpose of conversation. Within a Gricean articulation of discourse as goal-driven, intentional action, considerations of rationality thus come into play in determining whether a proposition should have common ground status. For cases like (7), it is easy to see that the rational move on the part of the listener would be to accommodate, assuming that the content is recognized as uncontroversial and not the main point being conveyed.

2.3 Existing evidence in favor of the admittance theory

The admittance theory takes a strong view on the logical relation between presupposed content and the context — that presuppositions be entailed by the context that feeds update. However, given the assumption that this formal requirement can be satisfied by accommodation, it is difficult to tell (at least at first sight) whether the tenets of the theory have any empirical bite, and in particular whether the Bridge Principle in (6) can at all be corroborated or refuted. This difficulty has led to skepticism about the usefulness of the entire approach

(see von Fintel 2008 and references therein). Gazdar (1979), an early critic, for instance raises the concern that the theory "involves treating the bulk of the data (i.e. ordinary conversation) as something special... circumvent[s] any possibility of counterexamples, and concomitantly...render[s] the inclusion of any notion like 'appropriacy' in the definition wholly vacuous" (p.107). Our goal in this paper is to argue that the study of language development can help in this respect. Specifically, we will present evidence that there is a stage of language development in which accommodation is not available and in which the strong predictions of the admittance theory are indeed corroborated.

But before we get there, we would like to say a few words about the kind of evidence that has been presented in favor of the theory on the basis of ordinary language use, i.e. by adults. This evidence has been, by necessity, rather indirect. One type of evidence was based on the claim that there is a form of objection to an assertion that is reserved to cases in which the presupposition does not have common ground status prior to utterance, i.e. it is not satisfied in the basic mode: "Hey wait a minute, I didn't know that p" in response to an utterance with formal presupposition p. The idea, more specifically, is that although cases of this sort can be dealt with by accommodation, a speaker might also feel that they are not ready to modify the common ground in the way expected by the speaker and object in the specific way mentioned above. The objection, and its specific form, has been taken to argue in favor of the view of presuppositions as imposing admittance requirements (von Fintel 2008, building on Shanon 1976).[4]

We will focus on another piece of evidence, mainly because it is based on the logic we deploy in our investigation of language development. Consider the two possible exchanges in (8) and focus on the contrast between the two replies to the question, by B and B'. The reply provided by B is appropriate, and as such it conveys the negative answer to the question (that A cannot adopt the Labrador). The reply by B', by contrast, is inappropriate. Why should that be case? Clearly presuppositions are relevant. After all, the only different between the two replies pertains to the division of labor between assertion and presupposition: if we collapse assertion and presupposition, the two replies end up being semantically identical.

(8)   A is visiting a dog shelter and is particularly interested in adopting a Labrador.

   a.   A: Can I adopt the Labrador?
   b.   B: Someone from NY just adopted the Lab. (No presupposition)
   c.   B': #It is someone from NY who just adopted the Lab. (Presupposes that someone adopted the Labrador.)

So what might be wrong with B'? The obvious answer within admittance theory is that the reply violates the appropriateness conditions on presupposition — the presupposition it expresses is clearly not part of the common ground. For this answer to be taken seriously,

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4 But see Chemla (2009) for arguments that the objection can also be used when presuppositions are not at stake, thereby weakening the argument significantly:

(i)   a.   Mary did all of the homework.
       b.   Hey wait a minute, I didn't (even) know that she did some of the homework.

however, we would have to explain why presupposition accommodation is not possible in this case. Heim in unpublished class notes (2015) argues for a constraint on accommodation that provides the missing explanation. Specifically, she proposes that questions cannot be answered by an accommodated presupposition and B' violates this constraint. The presupposition of the reply by B' (the existential presupposition of a cleft) is that someone adopted the Labrador and this conveys all of the information that A's question was concerned with.

So, if Heim's constraint is correct, we have here a situation in which only the basic mode of presupposition satisfaction is available and we see more transparently the impact of failing to satisfy the admittance conditions. As mentioned, we will propose that early child language provides another such situation. We will suggest that there is a stage of language development where presupposition accommodation is unavailable (due to later mastery of the repair mode). And like Heim, we will claim that this constraint on the child grammar eliminates the noise that comes from presupposition accommodation thereby allowing us to corroborate key tenets of the admittance theory.[5]

3 Evidence from child language

3.1 Deriving developmental predictions

The admittance theory distinguishes two modes of satisfying the formal requirements on presupposition use: the presuppositions of an asserted sentence may already be common

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5 See footnote 10 for the possibility that Heim's constraint is even more directly involved in the explanation of our experimental data.

    A second argument in favor of the admittance theory is presented in unpublished class notes by Percus (1998). The argument is based on the existence of specific markers (e.g. *moreover*) which indicate that upcoming information is new relative to the common ground. Percus shows that, in the presence of these markers, an assertion is unacceptable if the only new information it provides is in the presuppositional dimension:

(i)   a.   Mary is under surveillance. Moreover, she's aware that she is.
         b.   Mary believes that she's under surveillance. #Moreover, she is aware that she is.

(ii)   a.   John was sick last week. Moreover, he continues to be sick.
             ...Moreover, he is still sick.
             ...Moreover, he is sick again.
         b.   John is sick today. Moreover he was sick yesterday.
             ...#Moreover, he continues to be sick.
             ...#Moreover, he is still sick.
             ...#Moreover, he is sick again.   (example from Heim 2015)

Admittance theory provides a very simple explanation for the unacceptability of the (b) sequences in (i) and (ii). Specifically, for the formal admittance requirement to be satisfied, the sentence presupposition needs to be accommodated before the evaluation of the assertive component. The sequences are unacceptable because post-accommodation, the asserted component provides no new information relative to the accommodated common ground, thus violating the requirements imposed by moreover. Note that if the non-redundancy constraint on assertion in (4) above is correct, the demand for new information holds even in the absence of *moreover*. Our sense is that the sequences are not entirely bad in the absence of a marker of new information, but that they nevertheless feel as redundant repetitions.

ground at the point of utterance (the basic mode), or they may be accommodated (the repair mode). Both modes are reflections of the same principle regarding when a speaker has grounds to use a presuppositional sentence — when they have reason to believe that its presuppositions have been accepted or are acceptable among all parties in the conversation (5). At the same time, the two modes involve meaningfully different processes. In the first case, the input context is itself one in which the formal requirements are met. In the second case, the input context must be amended in an appropriate manner. From a purely formal perspective, this two-mode theory allows us to derive a straightforward directional prediction on how the system could be instantiated only partially: the basic mode can be in place without the repair mode, but not the other way around.

The two modes are also asymmetric in their deployment in conversational situations, specifically with respect to temporal order. On the basic mode, presuppositions are literally *pre*-suppositions of the utterance. The formal requirement of "logical priority" of presuppositions translates into "temporal priority". So long as the listener has in memory the presupposed proposition and recognizes that it satisfies the relevant formal requirement, this temporal priority guarantees presupposition satisfaction. In the repair mode, on the other hand, the presupposed content becomes common ground *after* the point of utterance. And unlike in the basic mode, presupposition satisfaction is contingent. The listener must recognize that the relevant formal requirement is not yet satisfied and abductive inferencing on speaker intent in order to update to a suitable context.

These computational and extra-grammatical differences between the two modes render child language an especially suitable arena for testing the core tenets of the admittance theory. Specifically, this population offers an opportunity to look for evidence for a particular form of partial instantiation of the system. In (typically-developing) children, we might find a population that is like adults, but with less experience, less dexterity with sophisticated conversational maneuvers and potentially less computational resources. If indeed the basic mode is computationally less involved than the repair mode (one-step vs. two-step process, less vs. more mind-reading and abductive inferencing), we should find this asymmetry reflected in the acquisition trajectory. For instance, children may expect presuppositions to not just be logically prior, but temporally prior to assertion. If so, child grammar would represent a more constrained — and in turn less noisy — variant of adult grammar, where the formal demands of presupposition must be met in more transparent ways.

3.2 Testing the predictions

We test these predictions over three experiments that investigate children's understanding of the use conditions governing presupposition. To do so, we probe their expectations about the information states of addressees of presuppositional sentences in different conversational situations.

All three experiments use a novel paradigm, the Listener Identification Task, in which participants are asked to make a binary choice between two potential addressees of a speech act. The two differ with respect to their assumptions of some proposition p: whereas addressee A assumes p to be true, addressee B is agnostic about the truth of p. Participants

have to rely on properties of an asserted sentence and the divergent information states of the two candidate addressees to make a decision about who is in fact being spoken to.

As a concrete illustration of how the task works, imagine the speaker uttered the sentence in (9), and participants were given a choice between two types of audiences, in (10):

(9)   Sorry I am late! <u>The car that I rented this morning</u> broke down on my way here.

(10)   A: An audience who knows that the speaker rented a car (perhaps they had made the rental arrangements for the speaker)
        B: An audience who is ignorant vis-à-vis the speaker's plans of commute

To make a decision in this task, participants have to reason from the perspective of the speaker. They are told that the speaker knows who they are addressing. Thus, the question is: would the speaker have made the specific choice of utterance had they been addressing the more knowledgeable audience of type A? Would they have made the specific choice of utterance had they been addressing the more ignorant audience of type B? Put this way, participants' expectations regarding the intended addressee can serve as a proxy for their conception of the conversational common ground between the speaker and the intended addressee: if both the speaker and the addressee assume the truth of p, p is common ground between them at the point of utterance, and otherwise not.

Experiments 1 and 2, which focus on the basic mode of presupposition satisfaction, directly tests whether, given an utterance of a sentence that presupposes p, children prefer an *input context* that entails p over one that does not. More specifically, do children in our task choose the addressee who already takes the truth of p for granted at the point of utterance over one who is ignorant with respect to p at time of utterance?

Experiment 3 examines children's expectations regarding the repair mode of presupposition satisfaction: given an utterance of a sentence that presupposes p and an input context that does not entail p, do children expect the addressee to shift to an *update context* that does entail p? To test this, we construct scenarios in which the more knowledgeable potential addressee should be ruled out from consideration for independent reasons. We construct minimally different scenarios where the more knowledgeable addressee also happens to take for granted the truth of the asserted content of the speaker's utterance. In the case of the example in (10), perhaps they had been in the rental car with the speaker during the break-down. In such cases, the appropriateness condition on assertion — that the asserted proposition be non-redundant against the conversational context — militates against the choice of the more knowledgeable individual as the addressee. If the formal requirement on presupposition use can be met via accommodation, the more ignorant individual remains a suitable option. In fact, this addressee is predicted to be the only option for a participant who is sensitive to the non-redundancy condition on assertive speech acts. A participant who nevertheless chooses the more knowledgeable addressee, then, either (*i*) lacks sensitivity to the appropriateness condition on assertion (as explicated below, we control for this possibility) or (*ii*) ranks satisfaction of the appropriateness condition on presupposition *via the basic mode* above meeting the non-redundancy condition on assertion.

Across all three experiments, children's behavior with presuppositional sentences is

assessed relative to two kinds of baselines. First, results from adult participants tested using parallel materials establish the target response patterns against which children's responses are compared. Second, we compare participants' treatment of presuppositions to a control condition examining their treatment of asserted content, making crucial use of the non-redundancy condition on assertion. To take a concrete example, participants would be presented with a sentence like (11), and a choice, once again, between one of two types of audiences: (A) one who knows that the speaker rented a car, versus (B) one who knows nothing of the matter.

(11)   I rented a car this morning.

In this control condition, we ask: given an utterance of a sentence with the asserted content *p*, do children prefer an *input context* that *does not* entails *p* over one that does? Put this way, the non-redundancy condition is recognizable as the mirror of the basic mode of presupposition satisfaction. Asserted propositions are not yet entailed by the input context, whereas on the basic mode, presuppositions constitute content that is already entailed by the input context. Consequently, we expect the choice of addressee in this control condition to be the opposite of what is chosen in the critical condition in Experiments 1 and 2. In Experiment 3, the non-redundancy requirement is further exploited in the presupposition condition. Hence, we expect participants to choose, in both the presupposition and control conditions, the addressee whose common ground with the speaker does not already entail the asserted proposition at the time of utterance.

4   Experiment 1

We begin in Experiment 1 by examining participants' command of the basic mode of presupposition satisfaction. We ask whether the utterance of a presuppositional sentence can lead to an expectation that the presupposed proposition is entailed by the input context of utterance.

As our starting point, we use a presupposition trigger which, for independent reasons, are harder to use informatively — the additive particle *too*. On the traditional view (e.g., Karttunen & Peters 1979), *too* associates with the focused phrase *Sam* in a sentence like (12) and triggers an "existential" presupposition that someone other than Sam plays videogames.

(12)   SAM$_F$ plays videogames, too.

However, as famously observed by Kripke (1990), simply taking for granted that somebody other Sam plays videogames — a proposition that is true and uncontroversial in most contexts — does not seem to suffice for uses of (12) to be appropriate. The sentence seems to require an input context where an antecedent proposition of the form "*x* plays videogames" (where *x* is distinct from Sam) has been made salient. For Kripke and others (e.g. Heim 1992; van der Sandt 1992), this is because *too* introduces an anaphor that must find its antecedent in the preceding discourse. Others (e.g. Ruys 2015) have attributed the infelicity of out-of-the-blue uses of sentences like (12) to independent constraints on absence of

focus, specifically the requirement that unfocused material must be contextually *Given* (see Schwarzschild 1999).

While it is not so crucial to us what lies behind the resistance of too-sentences to out-of-the-blue uses, this property makes the trigger a good first case study of the basic mode of presupposition satisfaction. Sentences with *too* tend to be used in circumstances where its presupposition is supported in the preceding discourse, making the basic mode of presupposition satisfaction the prevalent mode with the trigger. This allows us to make plausible assumptions about target adult behavior. Specifically, we expect adults to have a strong preference for an addressee with whom the presupposed content was previously under discussion and mutually accepted.

4.1 Methods

4.1.1 Participants

Thirty 4, 5, and 6-year-old (ranging from 4;0 to 6;9; Mean Age=5;1) English-dominant children participated in Experiment 1. Four additional children were tested, but excluded for reasons of inattention or failure on two or more (out of 4) filler items. Children were recruited from preschools and museums in the Boston Area. The age range for child participants was based on both pilot testing and previous developmental work in related areas. Previous work in pragmatic development has identified the preschool and early primary school ages as ones where important developmental shifts take place (see among others, Karmiloff-Smith 1979; Modyanova & Wexler 2007 for definite descriptions; Noveck 2001; Katsos & Bishop 2011 for scalar implicatures; Nadig & Sedivy 2002 for referential communication). Pilot testing, furthermore, established 4;0 as the lower bound for the study, as younger children younger were unable to handle the demands of the task.

Additionally, thirty-seven adult controls also participated. Three additional adults were tested but excluded for low performance (<60%) on fillers. Adults were recruited via Amazon Mechanical Turk. English was the dominant language of all participants.
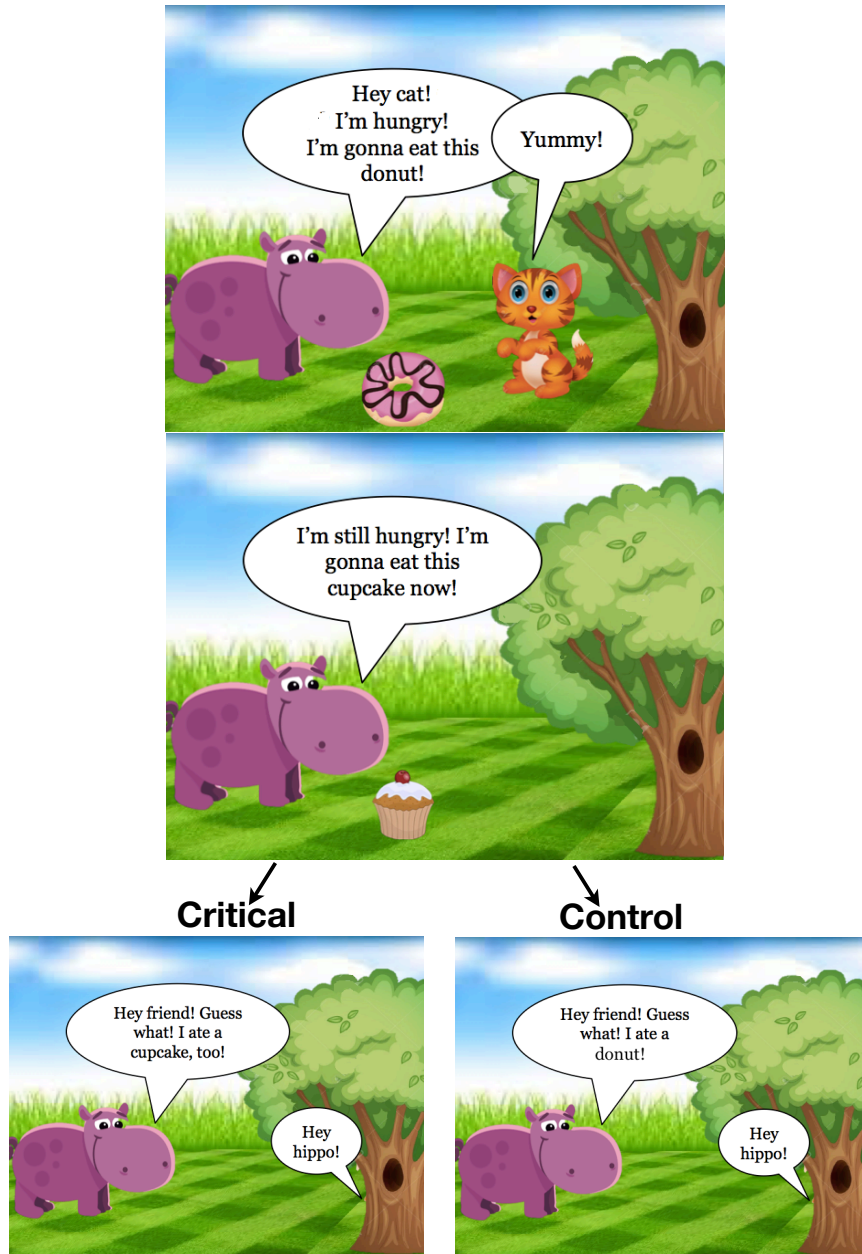
4.1.2 Materials and design

Children partook in a "game" where they help an experimenter figure out the identity of an occluded character in a scene. They were presented with a series of stories, via PowerPoint, about an animal character, a Hippo, and his two friends, Cat and Fox. They were told that Hippo lived in the woods, where the friends visit him. The friends sometimes like to hide behind bushes and trees, making it difficult for the experimenter to tell who is visiting him. However, Hippo himself can always see the friends and it is possible to figure out who is there based on what Hippo says to them.

In all of the stories, Hippo was shown to eat a number of familiar food items. Hippo ate at least one of the food items in front of a friend. After that friend leaves, Hippo eats something else. Later on Hippo reports to the occluded visitor either that he ate food item #2, *too* (critical condition) or that he ate food item #1 (control condition). See Figure 1. The

child is then asked whether the visitor at that time was Cat or Fox. Neutral feedback (e.g. "Thank you!) was provided irrespective of accuracy of response.

Figure 1: Schema for Child Variant of Experiment 1

All children saw both critical and control items. The order of presentation of items was

as follows. The experiment began with a set of 2 training items designed to familiarize them with the idea that what Hippo says serves as the sole clue to the visitor's identity. Then, children saw 4 critical items, 4 control items and 4 fillers in pseudo-randomized order. In the critical condition, the speaker uses a presuppositional sentence, involving the trigger *too*, whose presupposition is known to only one of the two friends, the one who was there before. In the control condition, a non-presuppositional sentence is asserted, whose truth-value is an open issue for only one of the two friends, the one who hadn't visited previously.

Filler items relied on knowledge of constraints on the use of the second person indexical pronoun and proper names. Their purpose was to ensure that children understood the goals of the game and took into consideration the relevant linguistic cues in making their judgments. Children who did not meet our criteria for success (3/4 correct) on these fillers were excluded. Examples of all three types of items are given in Table 1.

Table 1: Experiment 1 example items, child variant

Condition	Scenario	Expected Choice
Critical	In this story, Hippo and Cat were playing together, when Hippo got very hungry. He said to Cat, "Cat, let's take a break from our games because I am hungry and I'm going to eat an apple." And he ate an apple. But then, Cat heard his mom calling him so he went home. After Cat left, Hippo realized he was still hungry, so he ate an orange. Then, one of his friends came to see him. But, we can't tell who's there — they're hidden behind that big rock! I don't know if it is Cat or Fox behind the rock, but Hippo said to them, "Guess what, I ate an orange, too, today!" Does that give us a clue about who is with Hippo?	Cat
Control	In this story, Hippo and Cat were playing together, when Hippo got very hungry. He said to Cat, "Cat, let's take a break from our games because I am hungry and I'm going to eat a watermelon." And he ate a watermelon. Then, Cat was feeling sleepy so he went home to take a nap. After Cat left, Hippo realized he was still hungry, so he ate a pineapple. Then, one of his friends came to see him. But, we can't tell who's there — they're hidden behind the blueberry bush! I don't know if it is Cat or Fox behind the blueberry bush, but Hippo said to them, "Guess what, I ate a watermelon today!" Does that give us a clue about who is with Hippo?	Fox
Filler	In this story, Cat visited Hippo and told him, "Look! I brought you this ice cream!" But then, Cat had to go home and do some chores, so he left. After Cat left, Hippo said to himself, "I am very hungry, I'm going to eat this ice cream right away." And he ate it up. Later on, one of his friends came to see him. But, we can't tell who's there — they're hidden behind that tree! I don't know if it's Cat or Fox, but Hippo said to them, "Guess what, I ate the ice cream that you gave me!" Does that give us a clue about who is with Hippo?	Cat

Adults were given age-appropriate scenarios presented in written form on a computer screen using the IbexFarm experiment presentation tool (Drummond 2013). Participants read, line by line, brief descriptions of situations involving three characters. The situations end with one character reporting something to another over the phone, and adults, in a parallel fashion to the child participants, are tasked with identifying the addressee based on what was said. Context presentation was self-paced; participants pressed the Space Bar to continue reading the next line. The final scene presented them with a binary choice between

two characters, which they clicked on to make a selection. Figure 2 illustrates.

Figure 2: Schema for Adult Variant of Experiment 1

Susie, Jane and Mike were hanging out together. But Jane had to go and run some errands so she left early.

Susie, Jane and Mike were hanging out together. But Jane had to go and run some errands so she left early.

Then it was just Susie and Mike. The two of them decided to go to an animal shelter.

Susie, Jane and Mike were hanging out together. But Jane had to go and run some errands so she left early.

Then it was just Susie and Mike. The two of them decided to go to an animal shelter.

At the shelter, Mike got himself a pet bird. Then, Susie decided to go home.

Susie, Jane and Mike were hanging out together. But Jane had to go and run some errands so she left early.

Then it was just Susie and Mike. The two of them decided to go to an animal shelter.

At the shelter, Mike got himself a pet bird. Then, Susie decided to go home.

After she left, Mike went back into the shelter and got himself a cat!

Later, Mike was on the phone with one of the girls and he said...

Critical: Guess what, I got a cat today, too.

Control: Guess what, I got a bird earlier today.

Who was Mike talking to?

Susie   Jane

In each scenario, an event takes place that only a proper subset of the characters bears witness to. For example, characters A and B may go together to a pet shelter to get a pet for character A, while character C stays home. Later, A comes back to get a second pet, unbeknownst to both B and C. After the event transpires, one of the characters tells another

character about it over the phone. Thus, A is described as reporting to someone — either B or C, we don't know which — about what happened at the pet shelter. Participants are tasked with guessing the addressee based on what the speaker said.

As with the child variant, all participants saw critical items involving presuppositional sentences, and non-presuppositional control items. There were 8 items per experimental condition. In addition, all participants saw 16 filler items. Filler items involved similar stories, but the questions were about other aspects of the story and did not require participants to reason about the common ground between the characters. Order of presentation was randomized. Table 2 provides examples of all three types of items.

Table 2: Experiment 1 example items, adult variant

Condition	Scenario	Question	Expected Choice
Critical	**Susie**, **Jane** and **Mike** were hanging out together. But **Jane** had to go and run some errands so she left. Then it was just **Susie** and **Mike**. The two of them decided to go to an animal shelter. At the shelter, **Mike** got himself a pet bird. Then, **Susie** decided to go home. **Mike** decided to go back to the shelter and get himself a cat! Later, **Mike** was on the phone with one of the girls and he said, "Guess what, I got a cat, too!"	Who was Mike talking to when he said, "Guess what, I got a cat, too!"?	Susie
Control	**Katie**, **John** and **Molly** were hanging out. But then, **Katie** decided to go to the library to study. Then, it was just **Molly** and **John** and the two of them decided to go to the beach instead. At the beach, they found a seashell and **John** decided to keep it. Then, **Molly** had to leave too. **John** stayed at the beach awhile, and he found a fossil. Later **John** was on the phone with one of the girls and he said, "Hey, guess what, I found a seashell today!"	Who was John talking to when he said, "Guess what, I found a seashell today!"?	Katie
Filler	**Amanda**, **Erik** and **Katie** were at the beach together. **Katie** had to go home early, so then it was just **Amanda** and **Erik**. Then **Erik** told **Amanda**, "You know, I love parasailing. But I don't like surfing much." **Amanda** responded that she didn't like either. Later on at home, **Erik** was on the phone with **Katie** and she told him "Guess what, I really love surfing".	Which one liked parasailing?	Erik

17

4.2 Data coding and analysis

All responses in the child portion of the study were coded on-line and double checked offline from recorded audio. Data for all experiments can be accessed via the Open Science Framework at https://osf.io/ms6r2/?view_only=c64771bf4020473b8abe3c9a17a3251f. We used the `lme4` package (Bates, Machler, Bolker, & Walker, 2015) in R (Team, 2015) to implement all generalized mixed effects models. All models included random by-participant slopes for condition and random intercepts for item. All reported *p*-values are two-tailed. We used the `ggplot2` package (Wickham, 2009) to produce all graphs.

4.3 Results

Both adults and children consistently chose the knowledgeable addressee in the critical condition and rejected the knowledgeable addressee in the control condition (Figures 3 and 4). Adults' as well as children's responses across the two conditions were found to be reliably different from each other in a logistic regression predicting rate of knowledgeable addressee choice as a function of condition (Model-syntax for both groups = `ChoseKnower` $\sim$ `Condition + (Condition | Subject) + (1 | Item)`; Adults: β=6.78, SE=0.93, z=7.22, p <.001; Children: β=7.54, SE=2.96, z=2.55, p=.01).

Figure 3: Percent choice of knowledgeable addressee by adults in Experiment 1; error-bars represent 95% CIs
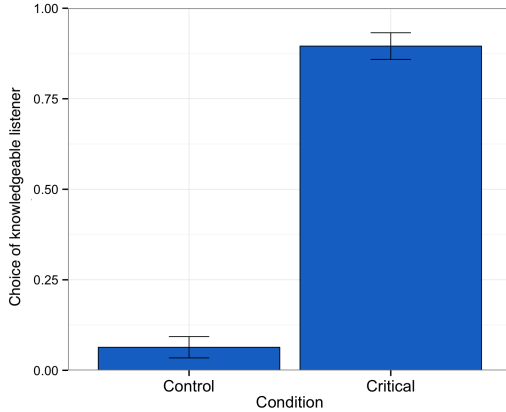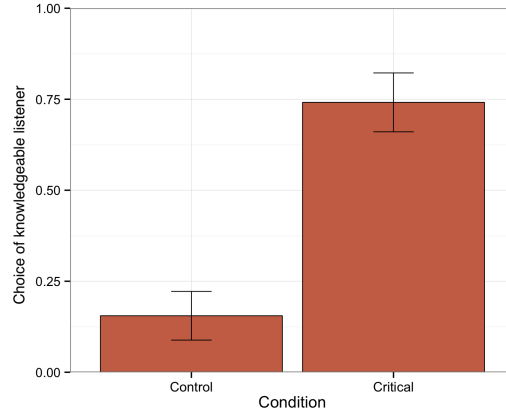
Figure 4: Percent choice of knowledgeable addressee by children in Experiment 1; error-bars represent 95% CIs

To examine whether the choice of knowledgeable addressee in each condition was statistically different from chance, we fit a series of random-effects only logistic mixed-effect regressions. These models, run separately for each condition, included the intercept as a fixed effect and random intercepts for participant and item. We ask whether the estimated intercept, after by-subject and by-item random variation was accounted for, was different from chance by comparing the model with a zero intercept variant. Logistic regression without any predictors and with a zero intercept predicts 50% chance, and in this instance, that the choice of the knowledgeable addressee was equally likely to occur as the alternative. Given this, an estimated intercept that is significantly different from a zero-intercept model can be taken to indicate that the probability of choosing the knowledgeable addressee is more informative than chance.

Table 3 reports the model estimates (log odds), standard errors, converted probabilities, and *p*-values. For adults and children, the rate of choosing the knowledgeable addressee was well *below* chance level on the control condition, and well *above* chance level on the critical condition. In other words, choice of addressee across conditions is systematic, in the predicted directions, for both populations.

Table 3: Results from intercept-only models, Experiment 1

Population	Condition	Estimate	SE	Percentage Value	p
Adults	Control	-3.3887	0.60	3%	$<.001$
	Critical	3.37	0.65	96.7%	$<.001$
Children	Control	-7.15	2.44	0.07%	$<.001$
	Critical	-1.54	1.27	93.5%	$<.001$

19

4.4 Discussion

Experiment 1 was a first assessment of participants' sensitivity to two principles of language use. The first was a basic informativity constraint on assertion (13-a). The second was the common ground requirement on presupposition, a core tenet of the admittance theory:

(13)   a.   **Appropriateness Condition on Assertion (Control):** asserted propositions must be *non-redundant* in the input context (i.e. prior to utterance)
         b.   **Appropriateness Condition on Presupposition (Critical):** presupposed propositions must be *redundant* in the update context (i.e. prior to assertion)

As stated, these two principles are not mirrors of each other (e.g. presuppositions may be non-redundant in the input context), but we set up a test environment that effectively rendered them so. This is because adult intuitions about our probe, *too*, is that its presuppositions should be supported by the preceding discourse. Our expectations, then, was that participants in this experiment show opposing selectional behavior across the two conditions, preferring the knowledgeable addressee for the critical trials and the ignorant addressee for the control trials.

Results from adults conform to these expectations. Given an utterance of a presuppositional sentence with *too*, they had a strong expectation that the additive presupposition associated with the particle was already known to the addressee prior to utterance. That is, they expected that the presupposed proposition be redundant in the input context. Moreover, they expected that the addressee did not already know the asserted content of an uttered sentence prior to utterance. That is, they expected the asserted proposition be non-redundant in the input context.

The observed preference for an input context that entails the presupposition is consistent with the admittance theory, and not straightforwardly so from a perspective that rejects a view of presuppositions as admittance conditions. However, the anaphoricity of our critical sentences — whether directly due to *too* or due to their focus structure — might offer a way out. Participants' preference of the more knowledgeable addressee could simply be due to constraints on anaphora resolution and thus orthogonal to issues surrounding presupposition. Thus, these results cannot by themselves be taken as a knock-down argument against such an alternative view.

Nevertheless, these results are significant in that they help us set crucial baselines that form the basis of the rest of the experiments. Importantly, we find that children showed the same patterns of behavior as adults. Children's adult-like performance on both critical and control trials can be taken, first of all, as a methodological proof-of-concept: children are able to track what was common ground among the three characters in this experimental setting and tailor their addressee choices on the basis of this information. Furthermore, preschoolers seem to understand what the input context must look like in order for an assertive speech act to be felicitous, and what the input context must look like in order for a sentence with *too* to be felicitous. Thus, by the preschool age, children draw a distinction, at least in some cases, between content that must contribute new information to the common ground and content

that need not.

5 Experiment 2

Unlike *too*, many expressions that pass diagnostics of presuppositionality — e.g. character-istic projection behavior — can be readily used even when the presupposed content is not entailed by the input context, i.e. when the presupposition is "informative". Recall (7) from §2, repeated below:

(14)   Sorry I am late! <u>The car that I rented this morning</u> broke down on my way here.

On the admittance theory, the felicity of such uses falls out from the availability of accom-modation. The appropriateness condition on presupposition (13-b) may be satisfied *after* the point of utterance, so long as the listener is willing to shift to an update context that entails the presupposed proposition. This two-step process is what we have been calling the repair mode of presupposition satisfaction.

The admittance theory has often come under attack for having to appeal to accommo-dation to deal with informative presuppositions. An alternative perspective on the same empirical terrain involves rejecting the idea that the presuppositions of (14) needed to have been common ground in the first place. Over the last few decades, there have been a number of theories that adopt such a stance (e.g. Atlas 1977, 2005; Kempson 1975; Wilson 1975; Grice 1981; Abbott 2006; Simons 2007; more recent, QUD-based instantiations in Simons et al. 2010, 2016). On these theories, presuppositions are primarily the result of inference: depending on the conversational situation, presupposed content may be treated as noncontro-versial, background information that would comport with the expectation that the speaker is being fully conversationally appropriate. While a full presentation of the various alternatives is beyond the scope of this paper, a core unifying theme among them is worth noting. All involve a weakening of the formal requirements on presupposition use in a manner that would eliminate the distinction between informative and redundant presuppositions.

Given this theoretical landscape, an evaluation of the tenets of admittance theory should include presupposition triggers that readily license informative uses. Experiment 2 turns to one such trigger, the definite article *the*. The definite article contributes presuppositions of existence and uniqueness.[6] As we already saw with cases like (14), sentences containing the definite article can be used even when existence and uniqueness of the referent is new information to the listener.

We continue our examination of the basic mode of presupposition. We ask: does the

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6 This is arguably an over-simplification. There are at least two families of approaches to analyzing definite descriptions: ones based on a notion of uniqueness, on the one hand, and ones based on the notion of anaphoricity on the other. On an anaphoric treatment of *the*, it is not clear that the trigger should impose different requirements on the context from *too*. Our assumption here, following Schwarz (2009), is that both notions are necessary and set the basis for the underlying distinction of *weak* and *strong* definite articles found across languages. We find it plausible, furthermore, that the weak-strong distinction exists in English even though this distinction is not surface-apparent in the language. In these experiments, we intended to target what would correspond to a non-anaphoric definite.

utterance of a sentence with *the* lead to an expectation that existence and uniqueness of the referent are entailed by the input context, even though informative uses are licensed for such sentences? As we suggested earlier, we might find a preference for more transparent satisfaction of the formal requirements of presuppositions in children. The basic mode is computationally simpler than the repair mode. The temporal priority of presuppositions on this basic mode guarantees satisfaction of the appropriateness condition on presupposition, whereas on the the repair mode, satisfaction of the requirement is contingent on the listener shifting to an appropriate update context. All else equal, then, children in our task may expect that a sentence with *the* would be addressed to a listener who takes its presuppositions for granted prior to utterance.[7]
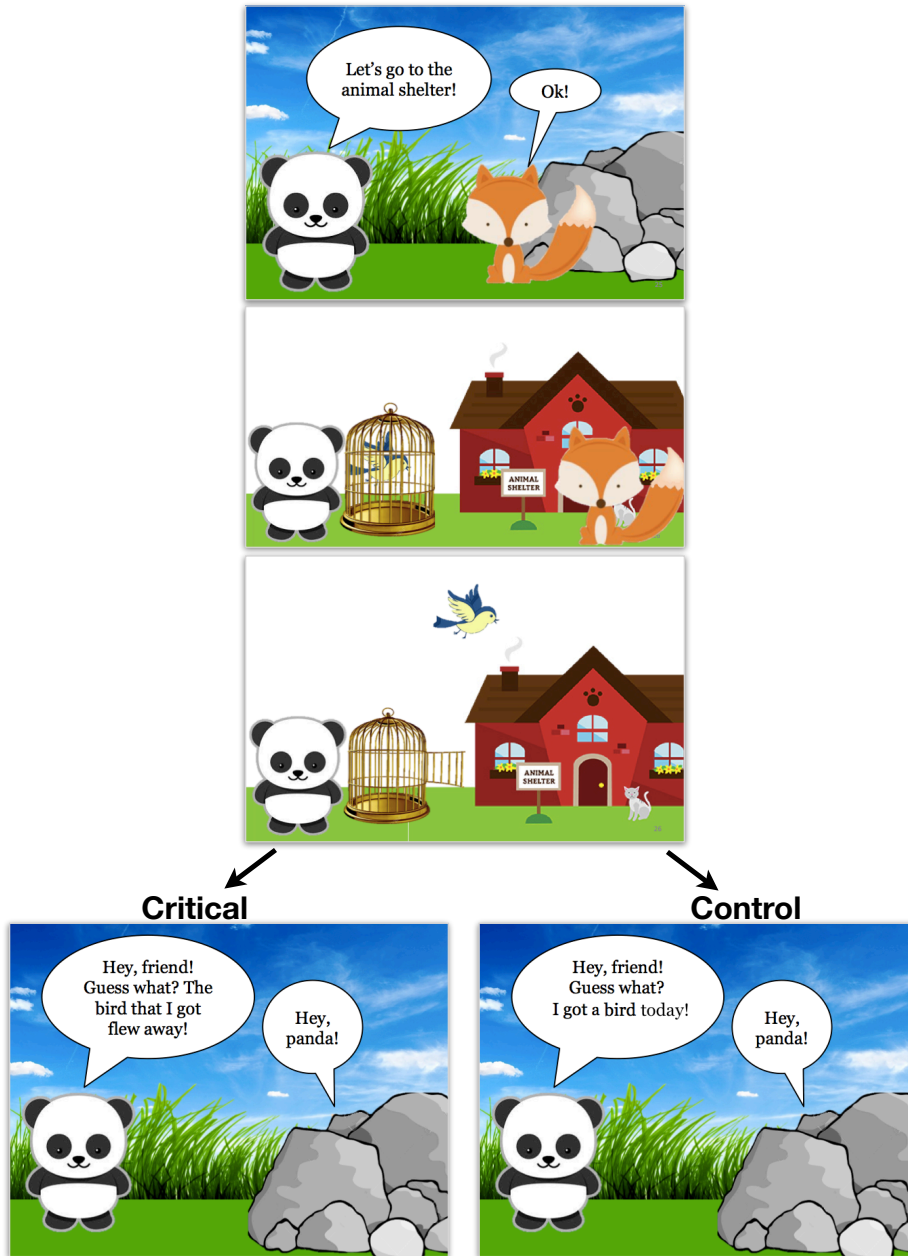
5.1 Methods

5.1.1 Participants

Thirty 4, 5, and 6-year-olds (ranging from 4;0 to 6;9; Mean Age=5;1) and twenty-eight adult controls participated in Experiment 2. Six additional children were excluded for reasons of inattention or failure on two or more filler items. Two additional adult participants were tested, but excluded for low performance (<60%) on fillers. Children were recruited from preschools and museums in the Boston Area. Adults were recruited via Amazon Mechanical Turk. English was the dominant language of all participants.

5.1.2 Materials and Procedure

Both child and adult variants of Experiment 2 were very similar to those in Experiment 1. Children were presented with a set of stories about an animal character, a Panda, and his two friends, Cat and Fox. In each story, Panda has an "adventure" with one of the two friends, over the course of which he comes into possession of something. After the friend leaves, however, something happens to that entity. Later on, one of the two friends visits Panda, but is hidden behind some object in the scene, and the child's task is to figure out which of the two friends it is based on what Panda says to them. Figure 5 illustrates.

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7 It should be noted that the child population introduces independent challenges for interpreting our results. We do not know, for example, how the existence of informative uses might impact learning. We return to this issue in §5.3.

Figure 5: Schema for Child Variant of Experiment 2

As before, children saw 4 critical items, 4 control items and 4 fillers in pseudo-randomized order. Sample scenarios from critical and control conditions are given in Table 4; the filler items were the same as in Experiment 1.

Table 4: Conditions, Experiment 2, Children

Condition	Scenario	Expected Choice
Critical	In this story, Panda and Cat were playing together, and Panda said to Cat, "Cat, let's go to the animal shelter." The two of them went to the animal shelter, and Panda found a bird he really liked, so he decided to adopt it. Afterwards, Cat had to go home so he left. Right after Cat left, the bird flew right out of his cage — oh no! And Panda was very sad. Later on he was at home, and one of his friends came to see him. But, we can't tell who's there — they're hidden behind that big rock! I don't know if it is Cat or Fox behind the rock, but Panda said to them, "Guess what, the bird that I got flew away!" Does that give us a clue about who is with Panda?	Cat
Control	In this story, Panda and Cat were playing together, and Hippo said to Cat, "Cat, I wanna go to the beach today." So they went to the beach. At the beach, the two of them found a very pretty seashell and Panda decided that he would keep it. After a while, Cat was feeling tired so he went home early. Panda stayed at the beach. But it was really windy, and the seashell got buried in the sand and Panda couldn't find it anymore — oh no! Later on, he was at home and one of his friends came to see him. But, we can't tell who's there — they're hidden behind the blueberry bush! I don't know if it is Cat or Fox behind the blueberry bush, but Panda said to them, "Guess what, I found a seashell earlier today!" Does that give us a clue about who is with Panda?	Fox

The procedure for adults was identical to Experiment 1 and the scenarios differed only minimally to better support the new target sentences. Sample scenarios for each condition is given in Table 5. As before, participants saw 8 items per condition and 16 filler items, which were identical to those used in Experiment 1.

Table 5: Conditions, Experiment 2, Adults

Condition	Scenario	Question	Expected Choice
Critical	**Susie**, **Jane** and **Mike** were hanging out together. But **Jane** had to go and run some errands so she left. Then it was just **Susie** and **Mike**. The two of them decided to go to an animal shelter. At the shelter, **Mike** got himself a pet bird. Then, **Susie** decided to go home. After she left, the bird flew right out of its cage! Later, **Mike** was on the phone with one of the girls and he said, "Guess what, the bird that I got flew away!"	Who was Mike talking to when he said, "Guess what, the bird that I got flew away!"?	Susie
Control	**Katie**, **John** and **Molly** were hanging out. But then **Katie** decided to go to the library to study. Then, it was just **Molly** and **John** and the two of them decided to go to the beach instead. At the beach, they found a seashell and **John** decided to keep it. Then, **Molly** had to leave too. **John** stayed at the beach awhile, but the seashell got buried in the sand somewhere and he couldn't find it again. Later **John** was on the phone with one of the girls and he said, "Hey, guess what, I found a seashell today!"	Who was John talking to when he said, "Guess what, I found a seashell today!"?	Katie

5.2 Results

As in Experiment 1, both adults and children in Experiment 2 consistently chose the more knowledgeable addressee in the critical condition; likewise, they chose the more ignorant addressee in the control condition (Figures 6 and 7). For both adults and children, rates of choosing the knowledgeable addressee were significantly different across the two conditions (Model-syntax for both groups = `ChoseKnower ~ Condition + (Condition | Subject) + (1 | Item)`; Adults: β=6.42, SE=1.09, z=5.85, p <.001; Children: β=4.28, SE=0.72, z=5.91, p<=.001).

Figure 6: Percent choice of knowledgeable addressee by adults in Experiment 2; error-bars represent 95% CIs
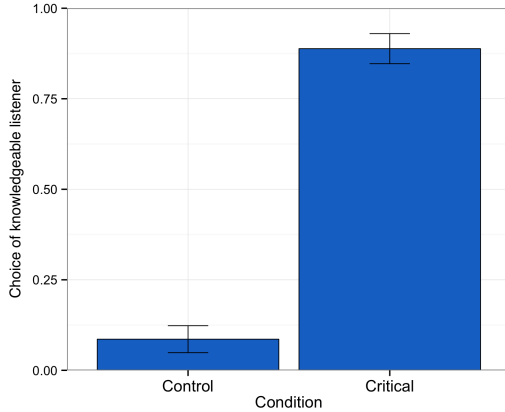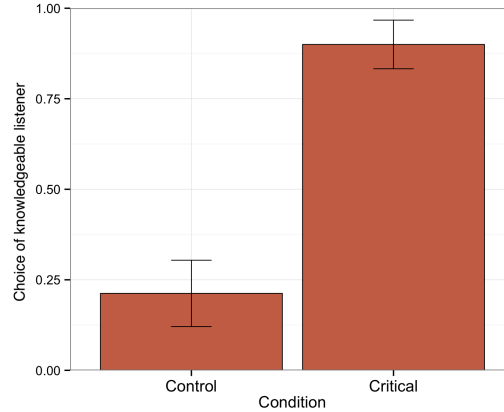
Figure 7: Percent choice of knowledgeable addressee by children in Experiment 2; error-bars represent 95% CIs

As in Experiment 1, we fit intercept-only mixed effects logistic regressions to explore whether the observed rates were different from chance. Results (estimates, standard errors, converted probabilities and *p*-values) are provided in Table 6.

Table 6: Results from intercept-only models, Experiment 1

Population	Condition	Estimate	SE	Percentage Value	p
Adults	Control	-2.67	0.44	6.4%	<.001
	Critical	4.08	1.27	98.3%	<.001
Children	Control	-1.92	0.47	12%	<.001
	Critical	2.4	0.55	91.7%	<.001

For both populations, choice of addressee was not random, indicating a systematic preference for the more knowledgeable addressee in the critical condition and a systematic preference for the more ignorant addressee in the control condition. Overall, results from both populations replicate the pattern of findings from Experiment 1.

5.3 Discussion

In Experiment 2, we turned to a presupposition trigger that can be used to introduce new information. The aim was to assess how, if at all, the possibility of informative uses affected participants' expectations about the intended addressee of presuppositional sentences. Our results show that given a choice between two addresses, one who takes the sentence presupposition to be common ground (the knowledgeable addressee) and one who doesn't and

would therefore have to accommodate (the ignorant addressee), both adults and children strongly prefer the former.

We had hypothesized that children may prefer the knowledgeable addressee due to the relative simplicity and transparency of the basic mode of presupposition satisfaction. But a somewhat surprising finding is that adults, who make ready use of accommodation in ordinary conversation, also showed what looks to be a basic mode preference.

To see how this pattern of results from adults can still be accounted for on the admittance theory, it is useful to walk through how participants in our task might arrive at a decision about the intended addressee. Participants reason from the perspective of the speaker, who has made a certain choice in form regarding their utterance. Specifically, in the critical condition of this experiment, the speaker chose the form in (15), with the presupposed component in (15-a) and the asserted component in (15-b).

(15)   The bird that I got flew away.

      a.   There is a unique bird that I got.

      b.   A bird that I got flew away.

Suppose the speaker were addressing the more knowledgeable addressee. The choice of utterance is of a suitable form. The formal requirement on presupposition use would be satisfied on the basic mode: the input context between the speaker and the knowledgeable addressee entails existence and uniqueness of the bird. The presuppositional form is arguably better than the partially redundant and more cumbersome "I got exactly one bird today and it flew away", where the two pieces of information are packaged as asserted content.

Suppose, on the other hand, the speaker were addressing the more ignorant addressee. Again, the choice of form would be appropriate, given that the admittance conditions may be satisfied on the repair mode, via accommodation. Why, then, don't our participants choose the ignorant addressee at higher rates?

Here is a line of reasoning a participant might take to systematically arrive at a choice of the knowledgeable addressee. While the ignorant addressee is likely to accommodate the presupposition of the speaker's utterance, the speaker cannot know this for certain. There is thus a small, but non-zero risk that the requirement of logical priority of presupposition could go unsatisfied. A speaker sensitive to this may then opt for a form that expresses the same content as part of the main point and thereby avoids the risk that their assertion is not admitted. In this way, the two-way distinction in how presuppositions relate to the context can be translated to an asymmetry between the two kinds of addressees in our task, with the more ignorant addressee being a less likely candidate given the choice of a presuppositional form compared to one who already knows the presupposed content. By forcing a choice between the two candidate addressees, then, our experimental set-up provides an environment where see more transparently the effects of the formal requirement, even in adults.

Notice that an explanation along parallel lines is not available once you abandon a notion of presuppositions as reflecting formal admittance conditions. Whatever the reason behind participants' strong preference for the knowledgeable addressee, it must be explained away

as stemming from extra-grammatical sources.[8]

Turning back to the child data, it is worth noting the significance of these findings from a purely developmental standpoint. The child's input for a trigger like *the* is bound to be different from that of a trigger like *too*. The child's input for *too* shows consistency with respect to the circumstances under which *too* can be used. As shown in Dudley (2017), caregivers tend to use *too* in situations where its presupposition is supported in the immediately preceding context. On the other hand, the definite article is varyingly used in situations where the input context entails its presuppositions and where it does not. An example of the latter is given in (16) (Brown corpus; Brown 1973; MacWhinney 2000). In this situation, the child asks about her father and the mother responds with a sentence that presupposes the existence and uniqueness of a man from Morgan Memorial. There are, however, no previous mentions of any such individual in the transcript.

(16)   Context: *Child (Eve) has asked about her father's whereabouts*
         Mother: He'll be right here.
         Mother: He's just helping the man from Morgan Memorial.

Despite the differences in availability of informative uses across the two triggers, and despite their divergent profiles in child-directed speech, sentences with *the*, like those with *too* in Experiment 1, elicited in children (and adults) a strong preference for the addressee to whom the presupposed content was old information. What this suggests, then, is that variability in rates of informative uses in children's experience does not seem to play a critical role in the acquisition trajectory, raising the possibility that the use conditions governing presupposition are acquired wholesale, not item-by-item or class-by-class.

6 Experiment 3

Experiments 1 and 2 examined the basic mode of presupposition satisfaction. We found that irrespective of the availability of accommodation, the basic mode was privileged by participants in our task: they preferred situations where presuppositions of an uttered sentence was already common ground prior to utterance. This preference, we suggested, might reflect the fact that the basic mode constitutes the most transparent and straightforward means of satisfying the formal admittance requirements presuppositions impose. In Experiment 3, we turn to the repair mode of satisfying the admittance requirement. As discussed, the repair mode is logically and procedurally more involved than the basic mode, which led us, in §3.1, to hypothesize that it may be mastered later.

In the present experiment, we once again use the Listener Identification Task and ask participants to choose between two addressees of a presuppositional sentence, one whose information state entails the presupposed content and one whose information state doesn't. But

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8 For instance, an admittance-theory skeptic might take the observed asymmetry to be an artifact of our task. Forced to choose between two equally good candidate addressees, perhaps participants in the experiment resorted to extra-linguistic criteria, like going with the addressee who had already been involved in some parts of the relevant event.

this time, choice of the knowledgeable addressee violates an independently attested communicative principle. More concretely, in Experiment 3 critical trials, the more knowledgeable addressee is not only aware of the presupposed content of the speaker's utterance, but also the asserted content. As a result, the choice of the more knowledgeable addressee — i.e. the choice that would indicate a preference for the basic mode of presupposition satisfaction — would be in violation of the appropriateness condition on assertion, which requires an input context that does not already entail the truth of the asserted proposition. On the other hand, the more ignorant addressee does not know any of the information expressed by the uttered sentence (parallel to Experiment 2). Consequently, the ignorant addressee should now be the favored choice, at least for participants sensitive to the fact that the formal requirement on presuppositions can be satisfied by accommodation.

Our adult participants, then, might reason along the following lines to arrive at their choice: The speaker has uttered a sentence S_{pq}, presupposing p and asserting q. A speaker sensitive to the appropriateness condition on assertion would not have chosen this form of utterance had they been speaking to the more knowledgeable addressee, who already takes for granted that q. In contrast, the choice of form is suitable if the speaker were talking to the more ignorant addressee, so long as the speaker believes the listener is prepared to increment to an update context that entails the sentence presupposition p, thereby meeting the appropriateness condition on presupposition use. The speaker has no obvious reason to believe otherwise, therefore, they must be speaking to the ignorant addressee.

Our key question is whether children can reason in an analogous manner. We have already seen that children, like adults, prefer conversational situations where the presuppositions of an asserted sentence is common ground at the point of utterance and the asserted content is *not* common ground at the point of utterance. What will they do when the two preferences conflict? One possibility, of course, is that they behave just like adults, choosing the ignorant addressee and allowing for the possibility that presuppositions may be accommodated. This result by itself would not constitute novel evidence in support of the admittance theory. Their adult-like behavior may be because, in a manner consistent with the admittance theory, children at this stage have not only mastered the basic mode of presupposition satisfaction, but also the repair mode. Alternatively, the adult-like behavior could be because knowing the pragmatics of presupposition entails knowing that they can be used informatively, potentially consistent with alternative approaches on which presuppositions do not impose admittance conditions in the first place.

Another possibility is that children show non-adult behavior, choosing the knowledgeable addressee more often than adults. We already know from the earlier experiments that children are sensitive to the appropriateness condition on assertion. Moreover, in Experiment 2, children show an adult-like bias for presuppositions to be entailed by the input context when the discourse is not otherwise problematic. So if children show non-adultlikeness in this experiment with the same set of target sentences, it must be because children, unlike adults, are unwilling to accept those sentences as utterable against an input context that does not already entail the sentence presuppositions. Such a pattern of finding would only be consistent with the admittance theory, which allows for the possibility of a stage where

29

children know the formal requirement on presupposition and the basic mode of satisfying it, but are not yet adept at the repair mode.
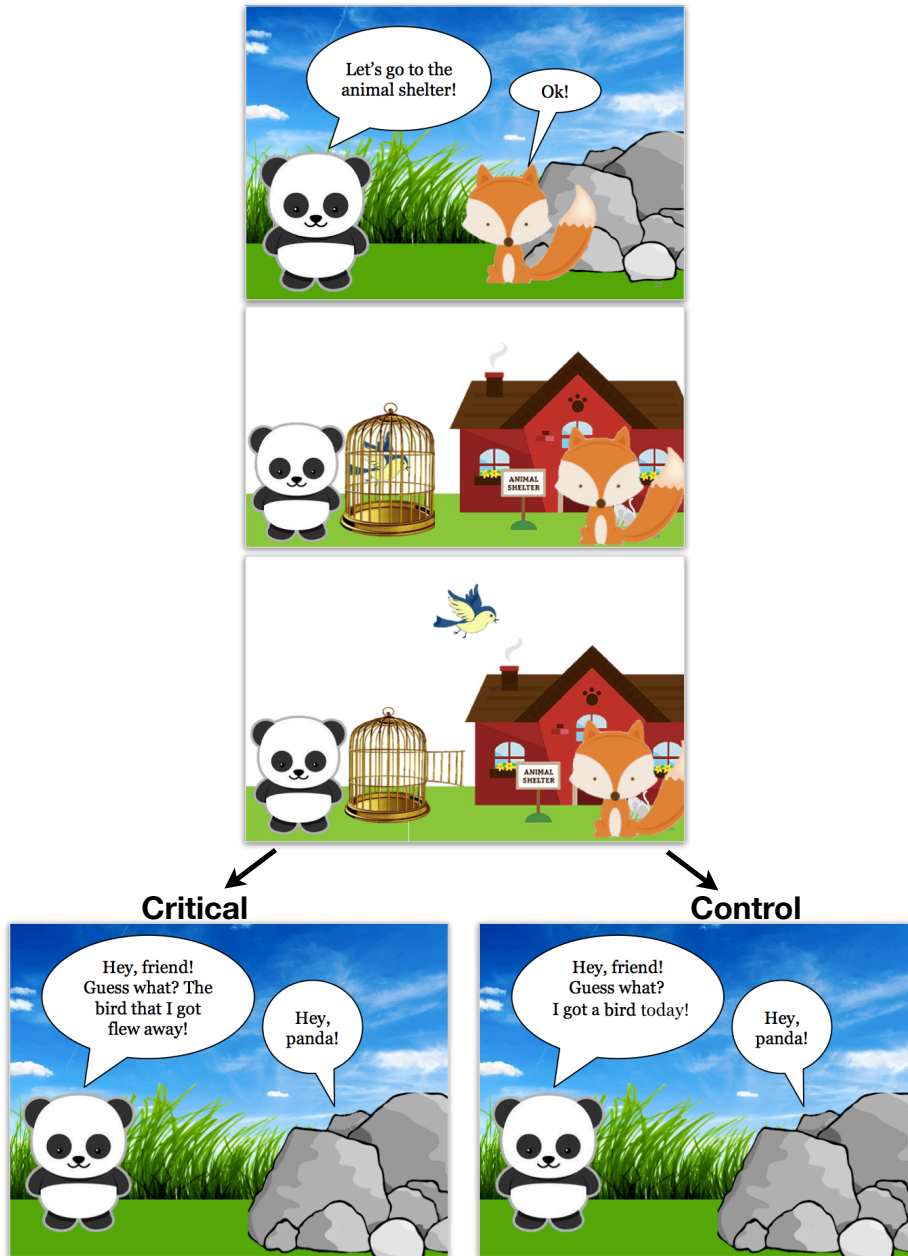
6.1 Methods

6.1.1 Participants

Thirty-seven English-primary 4, 5, and 6-year-olds (ranging from 4;0 to 6;9; Mean Age=5;4) were recruited from preschools and museums in the Boston area. Results from thirty-one are reported here, after the exclusion of 6 participants who did not meet our criteria of success on fillers (3/4 correct). Additionally, thirty-five native English speaking adult controls, recruited via Amazon Mechanical Turk, were tested. Six additional adults were tested but excluded for low accuracy ($<60\%$) on fillers.

6.1.2 Materials and procedure

As our probe, we once again employ the definite article. Both children and adults were given the appropriate variant of the Listener Identification Task, with minimally different critical items from Experiment 2. Children heard a series of stories about Panda, and his two friends, Cat and Fox. In the critical items, Panda has an "adventure" with one of the two friends, over the course of which he comes into possession of something. The portion that differs crucially from Experiment 2 is that *while the friend is present*, something happens to the object or entity that Panda had just procured; see Figure 8. Later on, one of the two friends visits Panda, but is hidden behind some object in the scene, and the child's task is to figure out which of the two friends it is based on what Panda says to them.

Figure 8: Schema for Child Variant of Experiment 3

As before, adults saw all experimental materials in written form presented on a computer screen using the IbexFarm experiment presentation tool (Drummond 2013). The critical items in Experiment 3 involved minimal modifications of the adult variant in Experiment 2.

Sample critical items from children and adults are given in Table 7. For both populations, the control items and fillers were identical to that of Experiment 2.
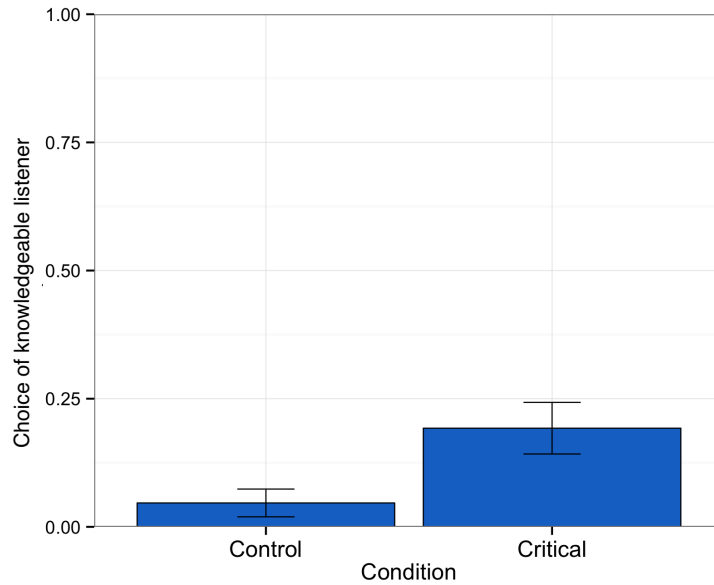
Table 7: Critical Condition, Experiment 3, Children and Adults

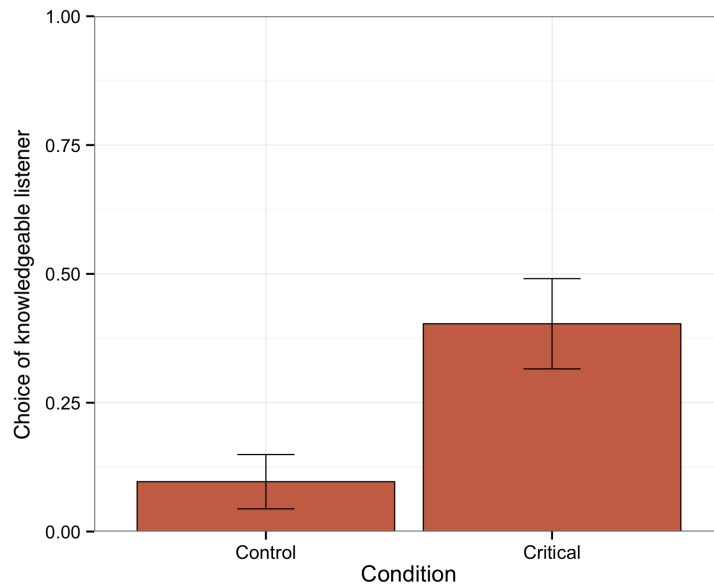| Population	Scenario	Expected Choice
Child	In this story, Panda and Cat were playing together, and Panda said to Cat, "Cat, let's go to the animal shelter." The two of them went to the animal shelter, and Panda found a bird he really liked, so he decided to adopt it. As the two of them were watching, the bird flew right out of his cage — oh no! And Panda was very sad. Then, Cat had to go home so he left. Later on Panda was at home, and one of his friends came to see him. But, we can't tell who's there — they're hidden behind that big rock! I don't know if it is Cat or Fox behind the rock, but Panda said to them, "Guess what, the bird that I got flew away!" Does that give us a clue about who is with Panda?	Fox
Adult	**Susie**, **Jane** and **Mike** were hanging out together. But **Jane** had to go and run some errands so she left. Then it was just **Susie** and **Mike**. The two of them decided to go to an animal shelter. At the shelter, **Mike** got himself a pet bird. Right afterwards, the bird flew right out of its cage! Then she had to go home, too. Later, **Mike** was on the phone with one of the girls and he said, "Guess what, the bird that I got flew away!". Who was Mike talking to when he said, "Guess what, the bird that I got flew away!"?	Jane

6.2   Results

As shown in Figure 9, adult participants overwhelmingly chose the more ignorant addressee in both critical and control conditions, with no significant difference across the two conditions in this choice (model: `ChoseKnower ~ Condition + (Condition|Subject) + (1|Item)`; $\beta = 0.98$, SE $= 0.75$, $z = 1.30$, $p = 0.19$).

Figure 9: Percent choice of knowledgeable addressee by adults in Experiment 3; error-bars represent 95% CIs
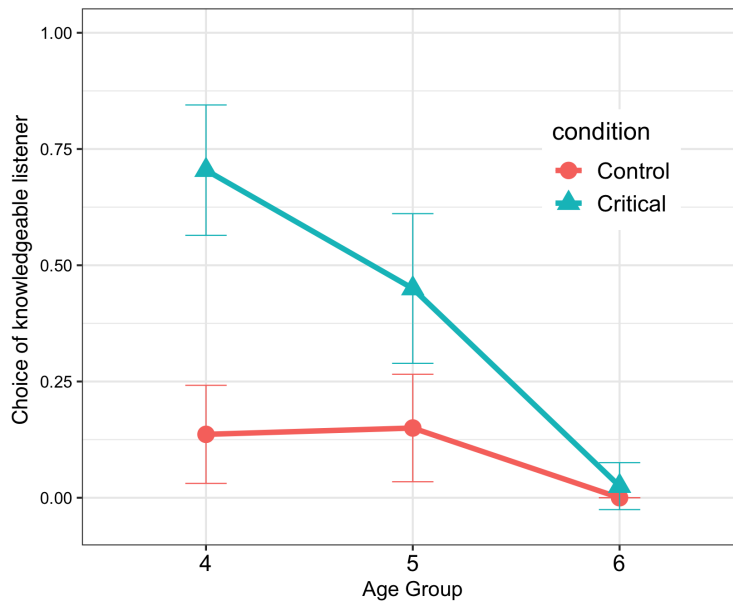

Children's response patterns are represented in Figure 10. The rates at which children choose the knowledgeable addressee in the critical condition were significantly greater than the rates of choosing the knowledgeable addressee in the control condition (model: ChoseKnower ~ Condition + (Condition|Subject) + (1|Item); β = 1.79, SE = 0.88, z = 2.016, p = 0.04). However, though children chose the knowledgeable listener more often than adults, the patterns are also quite different from those in Experiments 1 and 2, where the preference for the knowledgeable addressee was near-categorical.

Figure 10: Choice of knowledgeable addressee, Experiment 2

A closer look at the data split by age reveals that the child data do not simply represent a noisier version of the adult patterns. In the critical condition, 4- and 5-year-olds' performance clearly diverged from that of adults — they chose the knowledgeable addressee more than half of the time. In contrast, 6-year-olds are adult-like. See Figure 11. Children at all ages, on the other hand, performed at adult-like rates in the control condition.

Figure 11: Choice of knowledgeable addressee by Age Group

We fit a secondary mixed-effects logistic regression model to explore the potential effect of age on performance. We grouped children into three age bins, 4-year-olds (n=11), 5-year-olds (n=10) and 6-year-olds (n-10) and included condition and age-group as interacting fixed factors in our model. We then used the *lsmeans* package (Lenth 2016) to conduct *post-hoc* comparisons of the relevant interaction with Tukey adjustments for multiple comparisons. The results from this analysis is summarized in Table 8. We found a significant effect of condition in the 4-year-old group, but not in the 5- or -6-year-old groups. There was a significant effect of age group within the critical condition: the 4-year-old group differed both from 5-year-olds and 6-year-olds, and the 5-year-olds from the 6-year-olds. In contrast, there was no significant changes across age groups within the control condition. This implies that there is genuine improvement with age only in the critical condition.[9]

To summarize, children's behavior in this experiment, especially at the younger age groups, reveals important deviances from that of adults. Whereas adults were shown to reliably choose the ignorant listener in the critical conditions, children at ages 4 and 5 did not show such a bias. Moreover, we find a clear developmental progression, with children becoming increasingly adult-like between ages 4 and 6. This points to a developmental trajectory on which children start out unable to deal with informative presuppositions in an adult-like manner.

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9 Note that we did not find any significant age effects in Experiments 1 and 2.

Table 8: Pairwise comparisons from post-hoc analysis

Contrast	z	p
4-yr-olds, Control vs. Critical	-3.65	0.004*
5-yr-olds, Control vs. Critical	-1.79	0.47
6-yr-olds, Control vs. Critical	-0.064	0.99
4-yr-olds vs. 5-yr-olds, Control	-0.25	0.99
4-yr-olds vs. 6-yr-olds, Control	0.76	0.99
5-yr-olds vs. 6-yr-olds, Control	0.077	1.00
4-yr-olds vs. 5-yr-olds, Critical	1.64	0.57
4-yr-olds vs. 6-yr-olds, Critical	3.51	0.006*
5-yr-olds vs. 6-yr-olds, Critical	2.84	0.05*

6.3 Discussion

Experiment 3 turned to the repair mode of presupposition satisfaction. We devised a variant of the Listener Identification Task that privileged a treatment of an uttered sentence as introducing new information via presupposition. The potential addressee for whom the presupposed content was old information was also someone for whom the asserted content was old information. Adults in this case showed a strong preference for the addressee for whom the presupposed content, as well as the asserted content, constituted novel information. Children, especially at the younger ages, did not behave like adults, but their listener preferences become increasingly adult-like over the course of the tested age range. Note that this is the first point of divergence from adult behavior we have seen thus far, and thus a divergence that an adequate theory of presupposition should account for.

We suggest that this asymmetry receives a straightforward explanation on the admittance theory. From an admittance-theoretic view, children who are non-adult in this task can be understood as being sensitive to the formal demands presuppositions impose, while also being less flexible than adults in how those demands may be satisfied. If children have yet to fully master how accommodation works, or how the repair mode works more broadly, they might see both choices of addressee in our task as resulting in a deviant conversational situation: some pragmatic rule is violated in either case. When forced to choose one, as is required by this task, they choose randomly. If anything, there is a numerical tendency in the younger age groups to ensure satisfaction of the appropriateness condition on presupposition, but crucially, in the mode they command better: the basic mode.[10]

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10 An alternative explanation of our results is that children have mastered the repair mode of presupposition satisfaction, but take the choice of the ignorant listener to be a violation of the constraint on question-answering proposed in Heim (2015). Suppose they construe each addressee as raising a broad question of the form, "What happened since we last talked?". If the the more ignorant character were to raise such a question, they would be presuming a context in which it is not a settled matter whether the speaker has e.g. procured a bird. The speaker's utterance of a sentence like "The bird that I got flew away", on the other hand, presumes a context where the issue of bird-getting *is* settled. Thus, for children — though apparently not for adults — the choice of the ignorant addressee violates a constraint on question-asking, whereas the choice of the knowledgeable addressee violates a constraint on assertions. Such an explanation would attribute more competence to the child,

In contrast, it is far from obvious how our findings can be explained on alternative approaches to presuppositions on which they do not need to be common ground prior to assertion. It is unclear why children should ever choose the more knowledgeable addressee over the ignorant one, especially given their performance on the control condition, which shows that they are sensitive to use conditions governing assertions. We take these findings, then, to be evidence in favor of admittance view.

7 General Discussion

This paper examined children's understanding of how presuppositional sentences can be used in conversation as a means of gaining insight into the proper characterization of presuppositions. In particular, we sought to test the empirical predictions of a prominent theory of presupposition — the admittance theory — on which the distinctive way presuppositions affect the conversation has to do with the fact that they reflect preconditions on making a felicitous assertion. This theory, while intuitive and general, has often come under attack, as its core claim about the logical priority of presupposition is not always easy to verify using ordinary linguistic data. Our main objective was to bring child language data to bear on this theoretical issue. Here, we briefly summarize our findings and discuss their theoretical and developmental implications.

We took as our starting point the distinction made on the admittance theory between two modes of satisfying the formal requirements on using a presuppositional sentence S: (*i*) the "basic mode", where presuppositions of S already have common ground status at the point of utterance or (*ii*) the "repair mode", where the presuppositions of S achieve common ground status post-utterance via accommodation. Much of the skepticism about the admittance theory revolves around the repair mode, which allows for the admittance requirements of presuppositional sentences to be satisfied *after* the point of utterance and thus makes it a challenge to corroborate the strong predictions of the theory. We suggested that looking to development can help in this respect. In particular, if there is a stage in development in which the repair mode is unavailable, child grammar might present a situation where the empirical force of the admittance view is more transparent.

Over three experiments, we presented evidence for such a developmental stage. First, we showed in Experiments 1 and 2 that children are adult-like when it comes to the basic mode of presupposition satisfaction. Children in our task, like adults, preferred conversational situations where the listener's information state already entailed the presuppositions of an uttered sentence, as opposed to one that would require the listener to accommodate them. They showed this preference robustly both for triggers whose presuppositions are more (*too*) and less (*the*) hard to accommodate. We then demonstrated in Experiment 3 that children diverge from adults with respect to the repair mode. In circumstances where adults showed a preference for an addressee who would need to accommodate the sentence presupposition,

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and does not require positing a developmental asymmetry between the two modes of presupposition satisfaction. Crucially, however, it also requires a treatment of presuppositions as imposing admittance conditions on the context and that children know this. We should be able to tease apart these possibilities with a set of experiments that explicitly manipulate the question under discussion.

children ages 4 and 5 adopted a difference stance. Their failures in the specific kind of situations we created for Experiment 3 indicates a lack of full command of how informative presuppositions are dealt with under the admittance theory. Since such situations arguably create the strongest possible incentive for deploying the repair mode, it is plausible to conjecture that they have not mastered such this mode at all.

This two-step developmental picture fits well with the admittance theory, on which informative presuppositions call for a different mode of meeting the formal requirement on presupposition use from redundant presuppositions. This distinction, first of all, allows for asymmetries in when the two kinds of uses are mastered by children. More significantly, children's selective failures reveal a developmental stage where children are sensitive to the formal requirements on presupposition use, but need then satisfied in a more transparent way compared to adults. Child language during this stage presents an empirical terrain in which we can see in action the strong demands presuppositions impose on the context of use within the admittance theory.

On the other hand, it is not obvious how these findings can be explained if presuppositions do not reflect admittance conditions in the first place. If presuppositions do not need to be common ground prior to assertion, we lose the key (theoretically relevant) distinction between redundant and informative presuppositions. And theories of presupposition that cannot distinguish between the two also have no principled way of explaining the fact that the two come apart in development.

Our findings thus contribute a novel set of evidence to bear on an important theoretical issue. Along the way, they also help chart the developmental trajectory of certain key principles governing information exchange and in doing so, fill a gap in our understanding of how the system of presupposition develops. We close with a few remarks on the developmental implications of our results.

Children's success in Experiments 1 and 2 demonstrates awareness of the semantics of presuppositions and the special ways in which they constrain information exchange. At a more basic level, our results reveal children's competence with core tenets of information-gathering discourse. Children's behavior in our experiments show that they can (*i*) construct models of others' information states, including their sets of beliefs (*ii*) track the conversational record and the common ground as discourse evolves, and (*iii*) reason about how the context constrains the use of various linguistic forms. These conclusions have broad implications for models of pragmatic development. Much of the early work in language development underestimated children's pragmatic abilities: children were argued to be egocentric (Piaget 1959; Maratsos 1976; Karmiloff-Smith 1979), oblivious to their conversation partners' goals and intentions (Pechmann & Deutsch 1982; Perner & Leekam 1986; Sonnenschein & Whitehurst 1984; Epley, Morewedge & Keysar 2004; Davies & Katsos 2010), insensitive to general concerns about informativity (Noveck 2001; Pouscoulous, Noveck, Politzer & Bastide 2007), etc. Recent years, however, have seen a paradigm shift. Studies using novel methods have revealed that children are capable of fairly complex reasoning about the social world from infancy (Baillargeon, Scott & Bian 2016; Tomasello, Carpender, Call, Behne & Moll 2005; Saxe 2013). Moreover, very young children can formulate accurate expectations

about others' actions and intentions and utilize these skills in sophisticated ways in communication (e.g. Saylor & Ganea 2007; Moll & Tomasello 2007; see Matthews 2014 for a review). Even though children's pragmatic abilities continue to develop throughout early childhood and beyond, rich social-cognitive skills seem to underlie human interactions from the very beginning. The present findings add to this growing body of evidence.

At the same time, we were also able to identify an aspect of language use where adults and children look strikingly different: the ability to handle informative presuppositions. On the admittance theory, the problem can be characterized as a problem with the repair mode of presupposition satisfaction. Consider again what this mode entails. A speaker uttering a presuppositional sentence whose presupposition is not entailed by the input context must reason about whether or not the listener is likely to shift to a suitable update context that entails it. The listener who chooses to accommodate the speaker's utterance must reason about which candidate update context, among the many that might satisfy the formal requirement the speaker is likely to have in mind.[11] In these ways, the repair mode is more challenging, requiring more "fluidity" in social reasoning, more nimbleness, more practice. Insisting on common ground status, as in the basic mode, is simpler. At this stage, we have little to add about what specific skill-sets are required or how those skills develop. We leave this as a topic for further theory development and refinement, as well as more empirical work.

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11 Any update context that entails $p \subseteq q$ would satisfy the formal requirements of a sentence presupposing q.

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