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ORIGINAL RESEARCH

Principles of presupposition in development

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Abstract

This paper brings a developmental perspective to the discussion of a longstanding issue surrounding the proper characterization of presuppositions. On an influential view (Stalnaker in Synthese 22(1–2):272–289, 1970; Stalnaker, in Milton, Unger (eds) Semantics and philosophy, New York University Press, New York, 1974; Karttunen in Theor Linguist 1:181–194, 1974), formal presuppositions reflect admittance conditions: an utterance of a sentence which presupposes p is admitted by a conversational context c only if p is 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 an uttered sentence. While intuitive and general, the theory has been criticized (among other things) on methodological grounds (see e.g. Gazdar in Pragmatics: implicature, presupposition and logical form, Academic Press, New York, 1979): the availability of accommodation makes it difficult to empirically examine the notion of presupposition as admittance conditions because a central tenet—pragmatic infelicity results whenever c does not entail p—may be masked due to the pragmatic sophistication of language users. In this paper, we argue that child language presents an opportunity to avoid this intrinsic difficulty. In a series of behavioral experiments, we show that young children generate a default expectation that the presuppositions

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of an asserted sentence have common ground status prior to utterance. Furthermore and more tellingly, we also find that even when accommodation is the preferred option for adults, children fail to accommodate presuppositions in an adult-like manner. This pattern of behavior, we argue, is expected under the admittance theory: in a population where the interference from accommodation is reduced, the impact of failing to satisfy the formal admittance conditions becomes directly observable.

Keywords Presupposition · Language acquisition · Accommodation · Experimental pragmatics

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 can 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. Importantly, in both cases the presuppositions of an uttered sentences must be accepted so that the evaluation of the asserted content of

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

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. Given the assumption that the formal requirement can be satisfied via accommodation, how can the very existence of this requirement be corroborated or refuted? This methodological difficulty has led to skepticism about the usefulness of the entire approach. 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). Many alternative approaches have been developed that altogether reject the notion that presuppositions impose formal admittance conditions (Atlas, 1977; Gazdar, 1979; Soames, 1989; Atlas, 2005; Abbott, 2006; Simons, 2007; Simons et al., 2010, 2016; Beaver et al., 2017).

Our goal in this paper is to argue that the study of language development can help in this respect. Specifically, over three experiments, we present evidence that there is a stage in language development where presupposition accommodation is unavailable, or at least difficult to deploy, and in which the predictions of the admittance theory are indeed corroborated. Across three experiments, adults and children were asked 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 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. A control condition revealed, furthermore, that adults and children distinguish presuppositions from asserted content, which they expect to be novel information to the addressee and hence addressed to the ignorant addressee.

In Experiment 3, which examined accommodation, the context was set up in a way such that the knowledgeable addressee was overly knowledgeable: their information state had previously been updated to contain not just the presupposed proposition, but also the asserted proposition. Thus, the choice of the knowledgeable addressee for the presuppositional sentence would violate the communicative principle that assertions be informative. 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, receives a natural explanation on the admittance theory. 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 Sect. 2 with an overview of the admittance theory of presuppositions. In Sect. 3, we articulate specific develop-

mental predictions it makes for child language. We turn to our experiments in Sect. 4. Experiments 1 and 2, discussed in Sects. 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 Sect. 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. Section 7 discusses the developmental and theoretical implications of our findings.

2 Admittance theory

Here we articulate a version of the admittance theory that 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]

(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.

(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

When exchanging information, speakers aim to increase the body of mutually accepted propositions. 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

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

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 setup as a control, 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 some of the worlds 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 needs 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 ($p \cap c = c$)

The formal 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 their 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. In other words, presuppositions must be entailed by the context that feeds update. While this might appear to be an overly strong view on the logical relation between presupposed content and the context set[3], Stalnaker takes this bridge assumption to be a natural one, following 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

[3] Gazdar (1979) for instance argues for a weaker requirement, wherein the presupposition need only be *consistent* with the context set.

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 its presuppositions for granted, i.e. when the presuppositions are presumed common belief.[4]

2.2 Two modes of meeting the formal requirement

The most direct 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 only utter a sentence in cases where its presupposition is already part of the common ground at time of utterance. In such cases, the formal admittance requirement is transparently satisfied (hence our term "basic mode"): the presupposed content has been (possibly only provisionally) accepted by the interlocutors over the course of conversation.

In ordinary conversation, however, speakers frequently use presuppositional sentences, seemingly successfully, even when they have no reason to believe that the interlocutor takes the presupposed presupposition to be true, 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.

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 the input context c, listeners might increment c to an update context c' that does entail p. As a consequence, at the

[4] 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.

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 in at least two ways. First, content that has been established by overt statements in the course of the conversation is plausibly more transparently part of the conversational record than content that is only inferred by a cooperative listener. Second, 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 Lewis (1979). 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 empirical arguments for the admittance theory

The availability of accommodation makes it difficult to see transparently the demands presuppositions impose on the common ground, raising concerns about whether the theory has any empirical bite (see von Fintel, 2008 and citations therein). We will argue that the empirical picture becomes clearer when we examine language development. 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 adult language. 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 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). At the same time, Chemla (2009) has argued that the objection can also be used when presuppositions are not at stake, thereby weakening the argument significantly:

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

More recently, there have been attempts to test core assumptions of the admittance theory using online processing evidence, though the argumentation is involved and depends on various auxiliary assumptions. Of particular relevance for our purposes are studies that report different processing signatures for basic versus accommodation modes of presupposition satisfaction. While we do not have space to discuss all of the pertinent work in this domain (see Schwarz, 2019 and references therein), let us mention a few that directly bears on the issues at hand. In a set of self-paced reading experiments, Tiemmann et al. (2011) found that reading times were faster for presuppositional sentences presented in contexts where the sentence presupposition had already been made part of the conversational record compared to when the same sentences were presented in so-called "neutral" contexts (see also Domaneschi and Di Paola, 2018). Clifton (2013) found that there was a processing cost when the presupposition of the definite or the indefinite was made unlikely by the content of a sentence (e.g., reading was slowed in *In the appliance store, Jason checked out the stove*, versus *a stove*), suggesting that speakers are sensitive to the presumed appropriateness of a definite versus indefinite article for the situation under discussion. Furthermore, Singh et al. (2016) found that accommodating a presupposition in a situation that made it implausible was more costly compared to the same content packaged as an assertion. The authors argue that the observed contrast between asserting versus presupposing implausible information is best explained on the admittance view: if presuppositions have to be common ground prior to update, it would be inappropriate for a speaker to use a sentence with a contextually implausible presupposition because—unlike with assertions—the hearer is expected to accept this presupposition without discussion. The online processing data thus represents another strand of evidence in favor of the admittance view, though its strength rests on assumptions that link the process of accommodation with increased processing loads.[5]

Another piece of evidence in favor of the admittance theory, one that is more closely aligned with the logic we deploy in our investigation, comes from the behavior of presuppositional sentences in question-answer dialogues as in (9) (I. Heim unpublished lecture notes 2015).

(9) 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.)

A asks an information seeking question and B as well as B' are two conceivable attempts to address the question, albeit indirectly. Interestingly, even though they encode the same information (which indicates a negative answer to A's question), only the reply provided by B is appropriate. The reply by B', by contrast, is inappropriate.

[5] The link is not always straightforward. For instance, in the same paper discussed above, Singh et al. (2016) found no processing cost for accommodating plausible presuppositions.

Why should that be case? Clearly presuppositions are relevant. After all, the only difference 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.

So what might be wrong with B'? The obvious answer within admittance theory is that the reply violates the appropriateness condition on presupposition — the presupposition it expresses is clearly not part of the common ground. For this answer to be taken seriously, however, we would have to explain why presupposition accommodation is not possible in this case. Heim argues in her unpublished lecture notes 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.[6]

Heim's paradigm shows that if accommodation is blocked for independent reasons, such that only the basic mode of presupposition satisfaction is available, the impact of failing to satisfy the admittance conditions becomes directly observable (e.g. in intuitions about pragmatic felicity). We adopt a similar strategy in our investigation. As mentioned, we will argue that early child language provides a situation where accommodation is less available globally. If so, for young children, pragmatic infelicity should arise whenever the presuppositions of an asserted sentence are not already common ground prior to utterance. This property of child grammar, we will claim, helps eliminate a major methodological confound, thereby allowing us to corroborate key tenets of the admittance theory.

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 ground at the point of utterance or they may be accommodated. 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 accommodation, but not the other way around.

[6] Variants of this constraint have been proposed in non-admittance theories as well, e.g. Potts (2005), Simons (2001); Simons et al. (2010) and Beaver et al. (2017).

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 accommodation 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 less involved than accommodation (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 Previous developmental evidence

On the admittance theory, then, it is natural to expect that insofar as there is staggered development, mastery of the basic mode of presupposition satisfaction precedes that of accommodation. This is a non-trivial prediction, especially when one considers the child's experience. In ordinary conversation, presuppositions may be old information or they may introduce new information, and there is no explicit signaling of which mode of satisfying the formal requirement is being invoked. In fact, if the learning task is to identify a model that best fits the available data, it is far from obvious why a learner should start off with the restrictive assumption that presuppositions are entailed by the context prior to utterance.

Still, existing evidence from the developmental literature is compatible with the predicted two-stage developmental trajectory. There is evidence for early sensitivity to presuppositional phenomena, but there is little to suggest competence with accommodation. Children use presuppositional expressions as early as one and a half years of age, and in seemingly adult-like ways (Hüttner et al., 2004; Höhle et al., 2009; Müller et al., 2011). Comprehension studies also demonstrate early understanding of various presupposition triggers. For instance, Berger and Pouscoulous (2013) show that toddlers distinguish the additive particles *auch* 'too' and *nochmal* 'again' based on the nature of preceding contextual information. Choi et al. (2018) found that 19-

month-olds had differential expectations of the use conditions governing definite and indefinite articles. In a third-party communicative situation, toddlers expected the addressee of a request of the form "Can you give me *the* ball?" to retrieve the ball that was mutually visible, but had no such expectations with "Can you give me *a* ball?"

In the above cases, mastery of accommodation is not a clear prerequisite. But there are two developmental studies—Syrett et al. (2010) and Dudley et al. (2015)—where the experimental task itself exploits presupposition accommodation, and therefore, more directly bear on the issue of when accommodation is mastered. In a study examining children's understanding of gradable adjectives, Syrett et al. (2010) presented children with pairs of objects, accompanied by a prompt to "Find the ADJ one" or reject the request if it could not be fulfilled, which could happen because the presuppositions of existence and/or uniqueness associated with the singular definite description were violated. Children as young as 3 rejected the request with absolute gradable adjectives if neither or both objects had the relevant property (e.g. "Find the spotted one" when both objects were spotted, albeit to different degrees). In the case of relative gradable adjectives like *long*, by contrast, they selected the object that possessed the relevant property to a greater degree. Syrett et al. (2010) argue that children's success in the latter condition shows their ability to accommodate the uniqueness presupposition of the singular definite via contextual shifting of the standard of comparison. However, while their results shows an appreciation of the presuppositions of the definite and a differentiation of relative and absolute gradable adjectives, success in the task does not require accommodation. Encountering two objects that differ along a single gradable dimension might be sufficient for children to draw a contrast between them along this dimension prior to utterance and represent them as e.g. as the short one and the long one.

Dudley et al. (2015) examine young children's sensitivity to the projective properties of presupposition, focusing on the factive verb *know*. In their study, 3-year-old children had to identify the location of a hidden toy based on attitude reports with *know* and *think*. They heard "clues" from a puppet, conveyed via the experimenter in the form of sentences as in (10), and had to choose the box they thought the toy was under.

(10) a. Lambchop knows that the toy is in the red box.
b. Lambchop doesn't know that the toy is in the red box.

The authors reason that if children (*i*) understand that *know* presupposes the truth of its complement and (*ii*) are able to accommodate that presupposition, they should select the red box at a high rate even in the context of matrix negation (10-b). If the presuppositional sentences (the clues) can be understood as addressing the question that the children are asked to resolve, then the experimental situation would be an instantiation of what Heim's constraint prohibits: participants are to arrive at the answer to the question via an accommodated presupposition. If Heim's constraint is correct, the setup might require contextual adjustments beyond just presupposition accommodation.[7] But even if not, the data are largely inconclusive on the issue of children's ability to accommodate. Three-year-olds chose the red box less than half

[7] For instance, accommodating a different question, or assuming a non-factive construal of *know* (e.g. Horn 2014)

of the time with (10-b), with the biggest group of children (13/28) consistently going for the non-red box.[8]

To summarize, the current state of developmental evidence shows that children use and understand various presuppositional expressions. At the same time, existing evidence falls short of providing evidence as to the availability of accommodation. The present study contributes to this literature by providing novel data on children's sensitivity to presuppositional phenomena and (in)ability to accommodate. Over three studies, we probe children's expectations about the information states of addressees of presuppositional sentences in different conversational situations. We ask, in the first instance, whether children prefer the presuppositions of an asserted sentence to be shared knowledge among the speaker and addressee (Experiments 1 and 2). Having established that they do, we ask whether they understand how accommodation works. In instances where the presuppositions of an uttered sentence did not have common ground status, do they expect the addressee to shift to a suitable update context? Findings from these three experiments, we will argue, reveal a two-step developmental trajectory that is most naturally compatible with the admittance theory.

3.3 The paradigm

All three of the experiments presented here 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 because they have been overtly informed of p earlier in the discourse, addressee B has not been so informed and therefore is naturally taken to be 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 (11), and participants were given a choice between two types of audiences, in (12):

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

(12) A: An audience who knows that the speaker rented a car (perhaps they had been told earlier that the speaker had rented a car)
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

[8] Note that even though children as a group fail with *know*, the authors argue that the distribution of performance might be bi-modal, with a subset (6/28) of children showing adult-like competence. However, they provide no statistical analyses, nor data on the relevant subset's behavior on controls, making this claim hard to interpret.

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 entail 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 accommodation: 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 (12), 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 by independently probing children's sensitivity to this condition) 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 (13), 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.

(13) 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* entail 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, is harder to use informatively — the additive particle *too*. On the traditional view (e.g., Karttunen and Peters, 1979), *too* associates with the focused phrase *Sam* in a sentence like (14) and triggers an "existential" presupposition that someone other than Sam plays videogames.

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

However, as famously observed by Kripke (1990), simply taking for granted that somebody other than Sam plays videogames — a proposition that is true and uncontroversial in most contexts — does not seem to suffice for uses of (14) 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 (14) 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. Indeed, previous work looking at children's sensitivity to the presuppositionality of *too* has found success in roughly the same age range as we test here (Jasbi, 2016).

4.1 Methods

4.1.1 Participants

Twenty-nine 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 and Wexler, 2007 for definite descriptions; Noveck, 2001; Katsos and Bishop, 2011 for scalar implicatures; Nadig and Sedivy, 2002 for referential communication). Pilot testing, furthermore, established 4;0 as the lower bound for the study, as younger children were unable to handle the demands of the task.

Additionally, thirty-four 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 Fig. 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.

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 under-

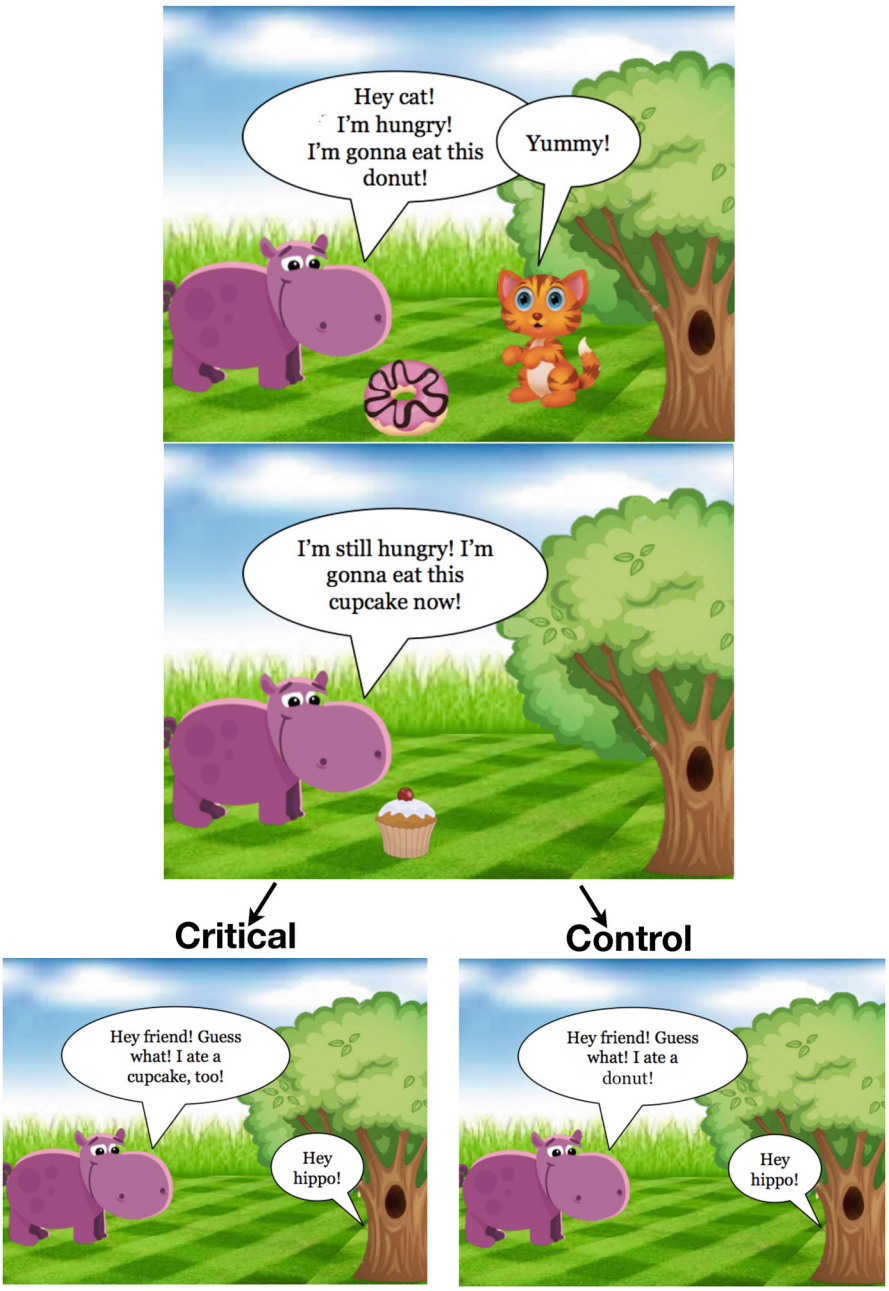

Fig. 1 Schema for child variant of Experiment 1. Actual items used vary across conditions

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

stood 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.

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. In the final scene, what they had read thus far disappeared and they read a coda sentence (e.g. "Later, Mike was on the phone with one of the girls and he said…[test sentence]"). Below,

they were presented with a binary choice between two characters, which they clicked on to make a selection. Figure 2 illustrates.

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

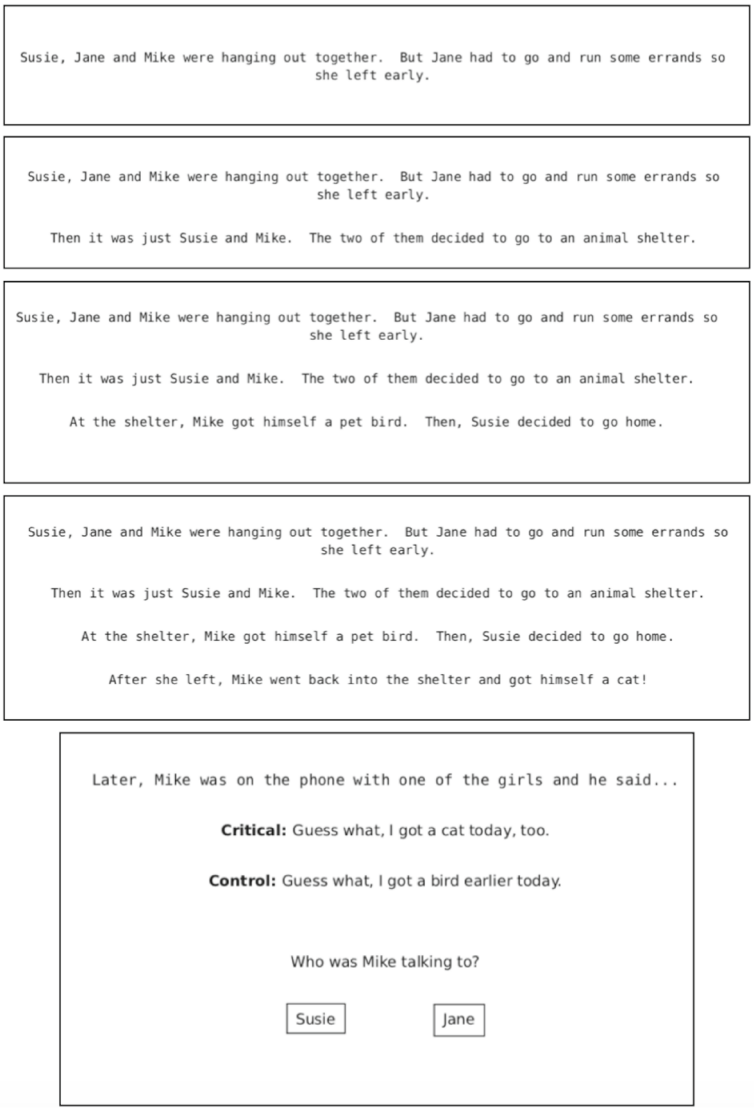

Fig. 2 Schema for adult variant of Experiment 1

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

4.2 Data coding and analysis

All responses in the child portion of the study were coded online and double checked offline from recorded audio. Data and analysis scripts for all experiments can be accessed via the Open Science Framework at https://osf.io/ms6r2/. We used the `lme4` package (Bates et al., 2014) to implement all generalized mixed effects models (GLMM). Models included the maximal random effect structure that was supported by the data (i.e. random effects of participant and item, up to convergence). We used the `ggplot2` package (Wickham, 2009) to produce all graphs. For all effects of interest, unless otherwise stated, we report p-values from Type II Wald χ^2 tests on each factor (i.e. its significance after the inclusion of all other factors, except for higher order interactions involving that factor), determined using the Anova function in the `car` package (Fox et al., 2013).

4.3 Results

Both adults and children tended to choose the knowledgeable addressee in the critical condition and reject the knowledgeable addressee in the control condition (Figs. 3, 4).

In our first set of analyses, we tested whether rates of choosing the knowledgeable addressee varied significantly as a function of condition by constructing a pair of generalized linear mixed effects models (GLMM), with condition as a fixed effect and by-subject random intercepts.[9] For the adult data, we used the formula: `ChoseKnower (0/1) ~ Condition (critical/control) + (1 | Participant)`. We found a significant effect of condition ($\chi^2_{(1)} = 161.06$, $p < .001$), with the critical condition eliciting greater rates of knowledgeable addressee choices compared to the control ($\beta = 5.06$, SE = 0.43, $z = 12.69$; $M_{critical} = 89.6\%$ vs. $M_{control} = 6.4\%$).

For the child data, we started by constructing a GLMM model with the formula: `ChoseKnower (0/1) ~ Condition (critical/control) * Age Group (4,5,6) + (1 | Participant)`. Age group was reverse Helmert coded, with one set of contrasts comparing 4yos and 5yos, and the other comparing the younger group (4 and 5yos) with the 6yos. Model comparisons revealed that while inclusion of condition significantly improved model fit ($\chi^2_{(1)} = 38.69$, $p < .001$), neither agegroup ($\chi^2_{(2)} = 5.3$, $p = .07$) nor the interaction term ($\chi^2_{(2)} = 1.3$, $p = .51$) significantly improved model fit. We therefore use the simpler model to draw inferences. Similarly to adults, child participants were more likely to chose the knowledgeable addressee in the critical condition compared to the control ($\beta = 3.91$, SE=0.53, $z = 7.49$; $M_{critical} = 74.1\%$; $M_{control} = 15.5\%$).

In a second set of analyses, we aimed to examine whether the choice of knowledgeable addressee in each condition was statistically different from chance. To do so, 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

[9] Models that included more complex random effects structures failed to converge.

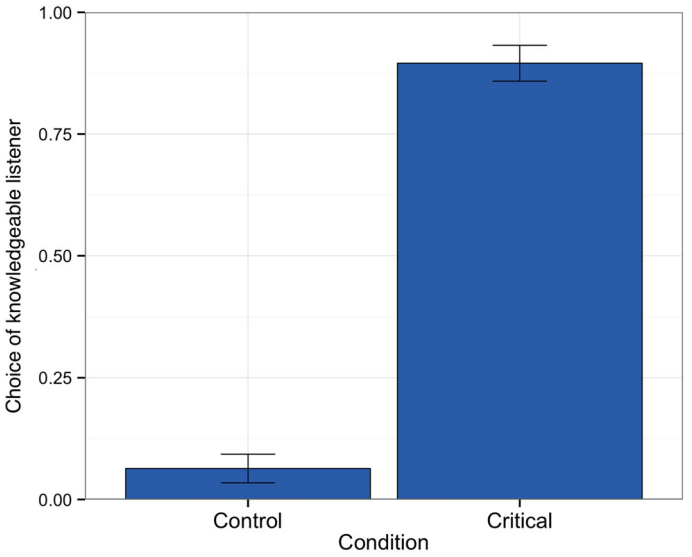

Fig. 3 Percent choice of knowledgeable addressee by adults in Experiment 1; error-bars represent 95% CIs

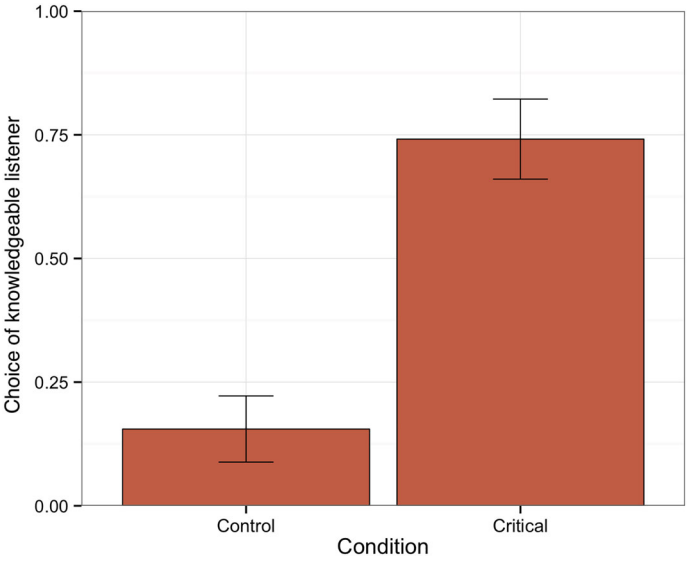

Fig. 4 Percent choice of knowledgeable addressee by children in Experiment 1; error-bars represent 95% CIs

Table 3 Results from intercept-only models, Experiment 1

Population	Condition	Estimate	SE	Percentage value [CIs]	*p* value
Adults	Control	− 3.3887	0.60	3% [1%, 9.9%]	< .001
	Critical	3.37	0.65	96.7% [88.1%, 99.0%]	< .001
Children	Control	− 7.15	2.44	0.07 [.06%, 8.7%]%	< .001
	Critical	1.54	1.27	93.5% [61.7%, 93.1%]	.003

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 confidence intervals, and *p* values obtained from likelihood-ratio tests comparing the intercept-only model with a zero-intercept one. For both populations, 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.

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 (15-a) (repeated from (4) earlier). The second was the common ground requirement on presupposition, a core tenet of the admittance theory, (15-b) (repeated from (5)).

(15) a. **Appropriateness Condition on Assertion (Control):** A declarative sentence S can be asserted against a context *c* iff S is not *redundant* in *c* ($[\![S]\!] \cap c \neq c$)

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

While these principles are meant to reflect the distinct and opposing natures of the two content type—asserted content being "new" and presupposed content "old" information—in practice, they do not perfectly mirror each other. Presuppositions may introduce new information to the context via accommodation. However, in this experiment, we set up a test environment that effectively rendered them so: 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.

In this environment, there were arguably independent reasons to expect a preference for a context that already entailed the presupposed content (e.g. constraints on anaphora resolution). But findings from this experiment are significant in that they help us set crucial baselines that form the basis for 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. characteristic 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 Sect. 2, repeated below:

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

On the admittance theory, the felicity of such uses falls out from the availability of accommodation. The appropriateness condition on presupposition 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.

But as discussed in Sect. 2, the availability of accommodation also makes it difficult to empirically test a central prediction of the admittance theory: that pragmatic infelicity results whenever the context does not entail the presuppositions of an asserted sentence. It is this intrinsic difficulty that we hope to avoid by examining child language. Experiment 2 therefore turns to a presupposition trigger that readily licenses informative uses in ordinary speech, and thus presents a stronger test case for the admittance theory: the definite article *the*. The definite article contributes presupposi-

tions of existence and uniqueness.[10] As we already saw with cases like (16), sentences containing the definite article can be used even when existence and uniqueness of the referent is new information to the listener.

Continuing our examination of the basic mode of presupposition, Experiment 2 asks: does the utterance of a sentence with *the* lead to an expectation that existence and uniqueness of the referent are entailed by the input context, even when accommodation is a readily available option? 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.[11]

5.1 Methods

5.1.1 Participants

Twenty-eight 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

[10] 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.

[11] 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 Sect. 5.3.

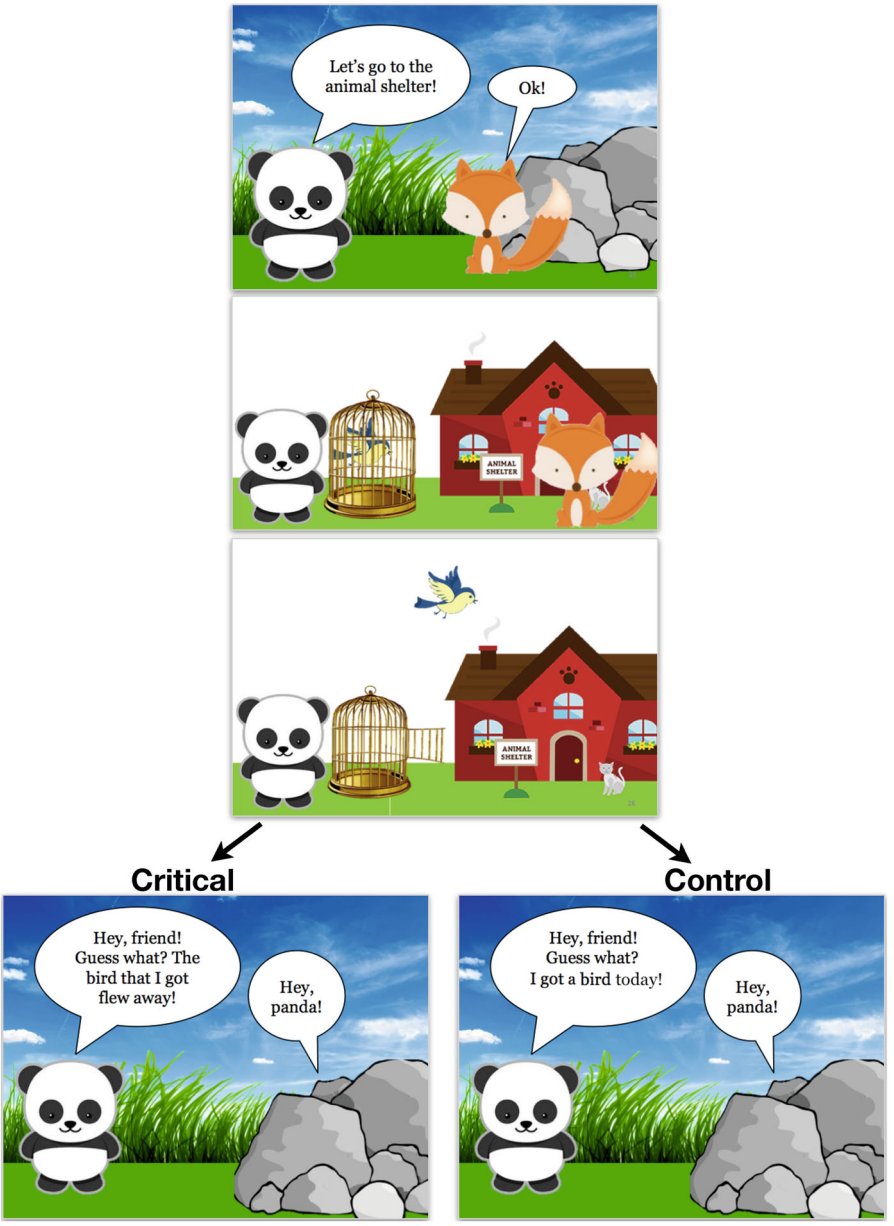

Fig. 5 Schema for child variant of Experiment 2

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

child's task is to figure out which of the two friends it is based on what Panda says to them. Figure 5 illustrates.

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.

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

Adults' and children's selection of the knowledgeable addressee is represented in Figs. 6 and 7. As in Experiment 1, we used generalized mixed-effects logistic regression modeling to test whether the selection-rates differed across condition. Analysis of the adult data revealed a significant effect of condition ($\chi^2_{(1)} = 139.22$, $p < .001$), indicating that they were more likely to choose the knowledgeable addressee in the critical condition ($\beta = 4.81$, SE = 0.40, $z = 11.8$; $M_{critical} = 88.8\%$, $M_{control} = 8.6\%$). The modeling strategy for the child data was identical to Experiment 1. We started with a model that included condition and agegroup (reverse Helmert coded) as fixed effects and random effect of participant. Again, model comparisons revealed a significant effect of condition ($\chi^2_{(1)} = 37.03$, $p < .001$), but no significant main effect ($\chi^2_{(2)} = 2.21$, $p = .33$) or interaction ($\chi^2_{(2)} = 5.17$, $p = .08$) of age. Like adults, children were more likely to choose the knowledgeable addressee in the critical condition relative to the control ($\beta = 3.82$, SE = 0.48, $z = 7.87$; $M_{critical} = 87.5\%$, $M_{control} = 16.1\%$).

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.

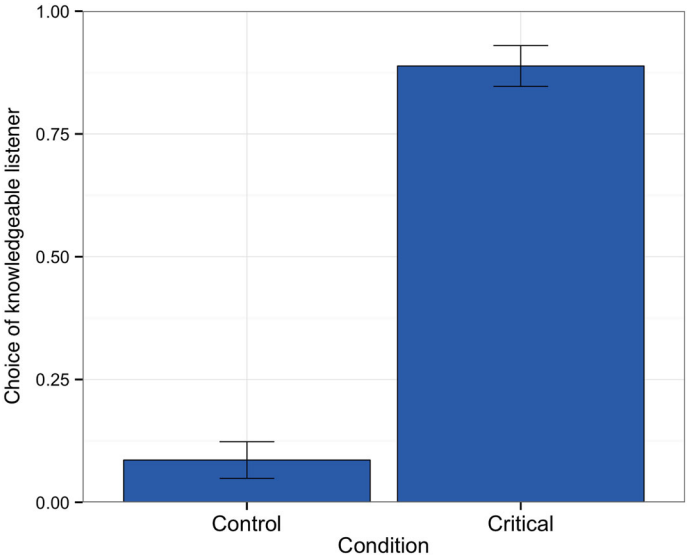

Fig. 6 Percent choice of knowledgeable addressee by adults in Experiment 2; error-bars represent 95% CIs

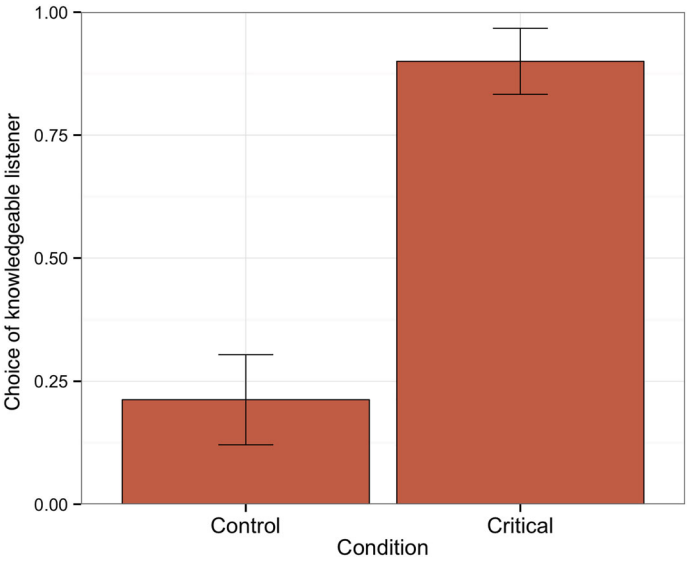

Fig. 7 Percent choice of knowledgeable addressee by children in Experiment 2; error-bars represent 95% CIs

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.

Table 6 Results from intercept-only models, Experiment 2

Population	Condition	Estimate	SE	Percentage value [CIs]	*p* value
Adults	Control	− 2.67	0.44	6.4% [2.8%, 14.1%]	< .001
	Critical	4.08	1.27	98.3% [82.9%, 99.8%]	< .001
Children	Control	− 1.92	.47	12.7 [5.4%, 27.1%]%	= .002
	Critical	2.4	0.55	91.7% [78.9%, 97.1%]	< .001

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. This hypothesis was borne out by our findings. Interestingly, adults also showed what looks to be a basic mode preference. This preference for the basic mode even among a population that makes ready use of accommodation in everyday conversation may seem at first blush surprising, but is expected given our task and the key tenets of the admittance theory. To see why, it is useful to walk through how participants in our task could have arrived 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 (17), with the presupposed component in (17-a) and the asserted component in (17-b).

(17) The bird that I got flew away.
  a. There is a unique bird that I got.
  b. A bird that I got flew away.

The speaker may be assumed to adhere to principles of cooperative communication, including the admittance conditions on presuppositional sentences such as (17). 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 admit-

tance conditions may be satisfied via accommodation. However, while the ignorant addressee is likely to accommodate the presupposition of the speaker's utterance, thus ensuring that the presupposition has common ground status prior to evaluation of the assertion, 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 contrast, the knowledgeable addressee has already (at least provisionally) accepted the presupposed proposition into the common ground and the risk of a conversational "snag" is not present in the same way. In this way, the temporal and conceptual distinctions between the two modes of meeting the formal requirement translates to a distinction between the two addressees in our task. The transparency of the basic mode renders it the less risky option and the knowledgeable addressee the more likely candidate.

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 (18) (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.

(18) 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 option of satisfying the admittance requirement via accommodation. As discussed, the accommodation mode is logically and procedurally more involved than the basic mode, which led us to the key hypothesis that it may be mastered later. If this prediction is borne out, we find in child language a situation where the consequences of the admittance conditions are more directly observable. A child who has understands the formal requirement presuppositions impose on the context, but have yet to figure out how accommodation works, will be working with more stringent criteria for appropriate use of presuppositional sentences, as in (19). For such children, pragmatic infelicity should arise whenever the presuppositions of an uttered sentence is not already established shared belief among the interlocutors.

(19) **Appropriateness Condition on Presupposition, Child variant:** A declarative sentence S with presupposition p can be asserted against a context c iff p is *redundant* in *c at the time of utterance*

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 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 $S_{\underline{pq}}$, 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 accommodation mode. Alternatively, it could be because they do not acquire a notion of presuppositions as 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 is what we expect on the admittance theory, if indeed there is a developmental stage in which children know the formal requirement on presupposition and the basic mode of satisfying it, but are not yet adept at accommodation.

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 native English speaking adult controls, recruited via Amazon Mechanical Turk, were tested. Four 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 Fig. 8. Later on, one of the two friends visits Panda, but is hidden behind some object

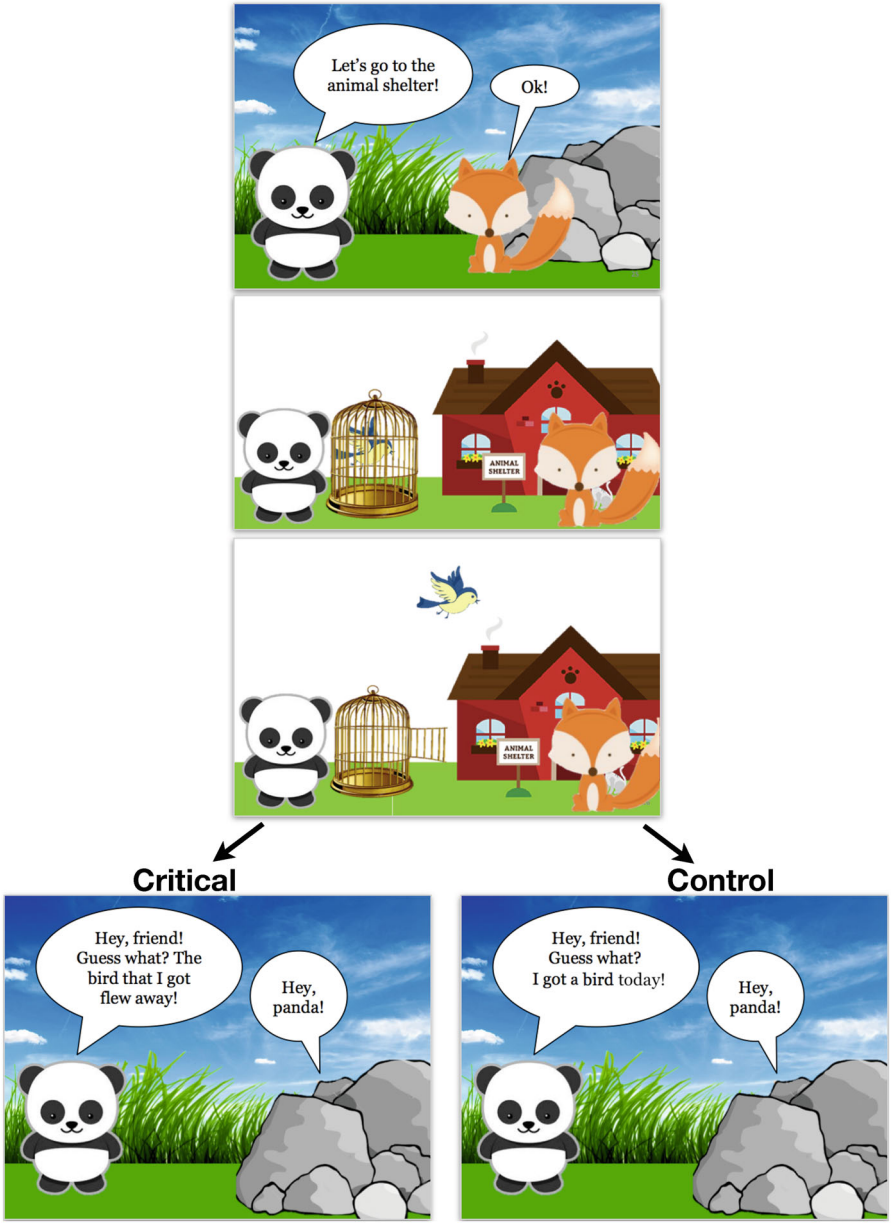

Fig. 8 Schema for child variant of Experiment 3

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

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.

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.

6.2 Results

As shown in Fig. 9, adult participants tended to choose the more ignorant addressee in both critical and control conditions. A GLMM fit to these data (model syntax: `ChoseKnower ~ Condition + (Condition|Subject)`) revealed only a marginal effect of condition ($\chi^2_{(1)} = 2.79$, $p = .096$), indicating that participants' choice of addressee was not substantially different across the two conditions ($\beta = 1.16$, SE = 0.69, $z = 1.67$; $M_{critical} = 19.2\%$, $M_{control} = 4.7\%$).

As before, we examined whether participants' choices were significantly different from chance. Intercept-only mixed effects logistic regressions revealed that in both critical and control conditions, participants' selection of the knowledgeable listener was *below* chance, as indicated in Table 8.

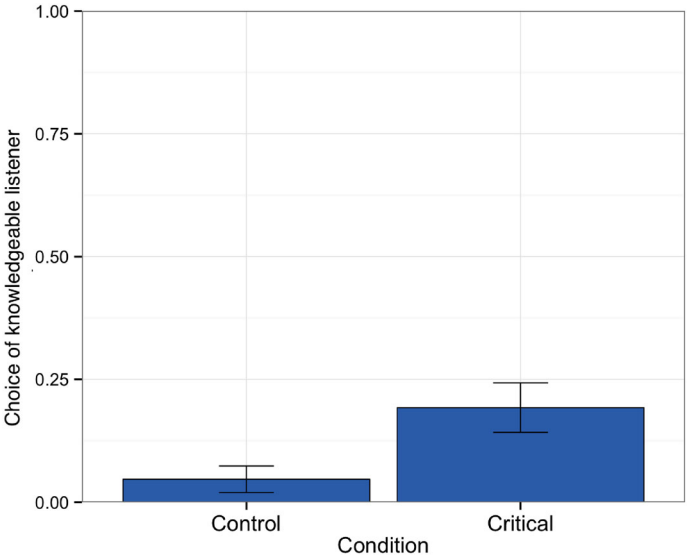

Fig. 9 Percent choice of knowledgeable addressee by adults in Experiment 3; error-bars represent 95% CIs

Table 8 Results from intercept-only models for adults, Experiment 3

Condition	Estimate	SE	Percentage value [CIs]	*p* value
Control	− 3.20	0.56	3.9% [1.4%, 10.9%]	< .001
Critical	− 2.17	0.50	10.3% [4.1%, 23.3%]	< .001

Children's response patterns are represented in Fig. 10. We fit a GLMM on these data with condition and age group (reverse Helmert coded) as fixed effects, with random slopes for participant and random effect for item, using the formula: `ChoseKnower ~ Condition * Agegroup + (Condition|Subject) + (1|Item)`. We found that inclusion of the interaction term significantly improved model fit ($\chi^2_{(2)}$ = 6.08, p = .048). This effect was driven by the fact that the rates of choosing the knowledgeable addressee in the critical condition was significantly different for the younger age groups (4 and 5yos) compared to the 6yos (β = -1.28, SE = 0.63, z = -2.013, p = .044; $M_{younger}$ = 57.7% vs. M_{older} = 2.5%). Additionally, there was a marginal effect difference between 4 and 5yos in their selections in the critical condition (β = -1.08, SE = 0.60, z = -1.79, p = .07; M_{4yo} = 70.5% vs. M_{5yo} = 45%). See also Fig. 11.

We pursued these differences further in follow-up *post hoc* comparisons using the *lsmeans* package (Lenth, 2016), with Tukey adjustments for multiple comparisons. The results from this analysis is summarized in Table 9. We found that 4-year-olds behaved differently across conditions, selecting the knowledgeable listener significantly more in the critical condition relative to control. However, there were no differences in the 5- or 6-year-old groups. 4-year-olds differed from 6-year-olds in their behavior on the

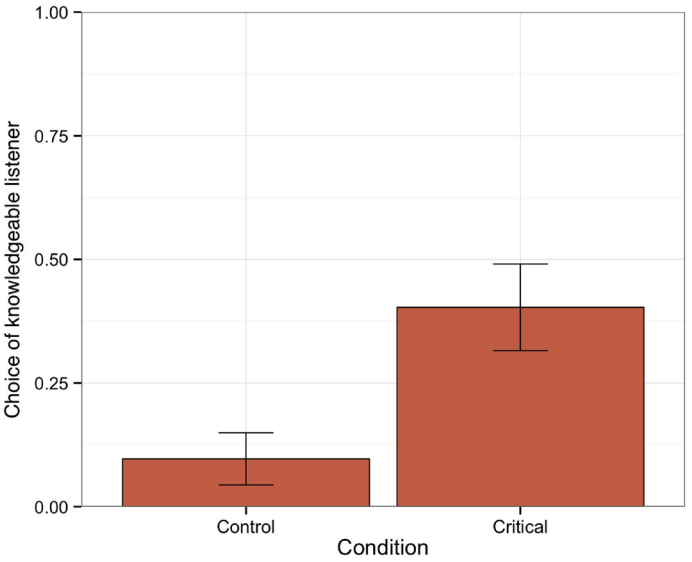

Fig. 10 Percent choice of knowledgeable addressee by children in Experiment 3

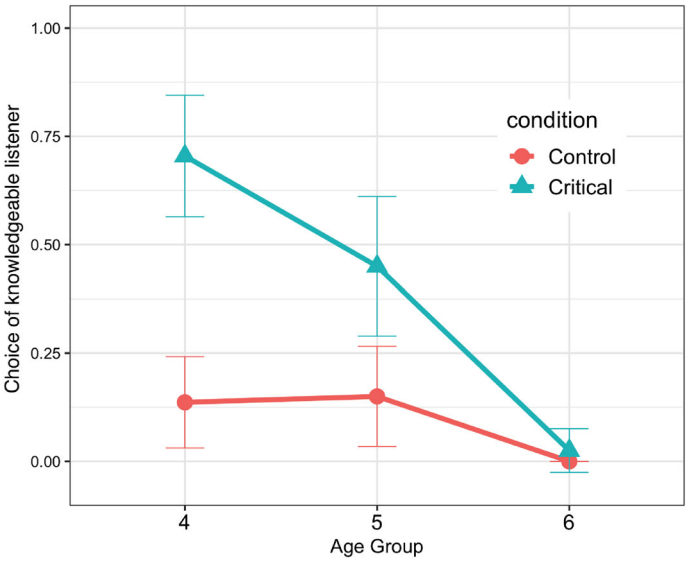

Fig. 11 Choice of knowledgeable addressee by age group

critical trials, though not for controls. 5-year-olds' behavior in the critical condition was marginally different from that of 6-year-olds, but no difference was found across the two age groups in the control condition. In sum, there seems to be a developmental shift, in the adult-like direction, in the critical condition, but the control condition is adult-like throughout.

Table 9 Pairwise comparisons from post hoc analysis

Contrast	Estimate	SE	z	p
4-year-olds, Control versus Critical	− 3.752	0.99	− 3.76	0.023*
5-year-olds, Control versus Critical	− 1.59	0.86	− 1.85	0.43
6-year-olds, Control versus Critical	1.16	1.80	0.65	0.99
4-year-olds versus 5-year-olds, Control	− 0.18	0.73	− 0.24	0.99
4-year-olds versus 6-year-olds, Control	1.87	1.17	1.60	0.60
5-year-olds versus 6-year-olds, Control	2.05	1.18	1.74	0.51
4-year-olds versus 5-year-olds, Critical	1.97	1.20	1.65	0.57
4-year-olds versus 6-year-olds, Critical	6.78	1.93	3.51	0.006*
5-year-olds versus 6-year-olds, Critical	4.80	1.69	2.83	0.052†

6.3 Discussion

Experiment 3 focused on children's mastery of accommodation. 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 do the same.

Note that this is the first point of divergence from adult behavior we have seen thus far, and it is difficult to account for it on the basis of surface-level considerations. It cannot have been the case that the task itself was too demanding for the younger children who were non-adult like in the critical condition, as the same children performed like adults on controls. Likewise, it cannot have been the case that the linguistic material—which after all, differed across critical and control trials—was beyond the reach of the younger children. Children in the same age range showed adult-like performance with identical material in Experiment 2. Children's asymmetric failure here, therefore, is a substantive one and one that an adequate theory of presupposition needs to account for.

Faced with the choice between the two addressees, children (on aggregate) choose at a 50–50 rate. This is different from adults, who understand that the ignorant listener can accommodate the speaker's presupposition (contrasting, presumably with the knowledgeable listener, who can't 'un-know' the asserted content). Thus, despite sharing a preference for the basic mode with children (as evidenced by our Experiment 2 results, as well as prior psycholinguistic work), adults have a clear winning strategy. We might ask, then, why children don't have a winning strategy. From the perspective of the admittance theory there is a natural answer: acccommodation may not yet be (fully) available. If it isn't, then they should find either addressee-choice resulting in a deviant conversational situation: choice of the knowledgeable addressee would violate the appropriateness condition on assertion; choice of the ignorant addressee would

violate the appropriateness condition on presupposition. If the violation of one is less severe than violating the other, whichever presents the lesser evil for the child should be chosen more often. The 4-year-olds' preference for the knowledgeable addressee could be tentative evidence that violating the redundancy condition on assertion is less severe for this age group. If a violation of the admittance condition on presupposition was less severe, we should find an advantage for the ignorant listener. We only see this reliably at 6, but this possibility is not distinguishable from the claim that this population has mastered accommodation, i.e. there may not be a violation of the admittance condition at all. As soon as accommodation is assumed to be equally available (or more available) than dealing with a presupposition in the basic mode, we expect the adult-like preference for the ignorant listener.

7 General discussion

This paper examined children's understanding of the relation between presuppositional sentences and the conversational context, as a means of gaining insight into the proper characterization of the phenomenon. 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 assertions. An asserted sentence that presupposes p is admissible in a context c only if c entails p. The ramifications of this requirement are not always transparent in ordinary conversation. This is because there are two modes of meeting the requirement that presuppositions impose on the common ground — the common ground may already entail the presupposition or it may be adjusted, 'quietly and without fuss,' to meet the presuppositional requirements of the uttered sentence.

On the admittance theory, accommodation is a natural aspect of the dynamics of discourse. Still, many have seen it as undermining the whole enterprise (Gazdar, 1979 et seq.), as its central tenet—that a presuppositional sentence should be inadmissible in a context that doesn't entail p—is difficult to verify empirically. We suggested that looking to development can help in this respect. In particular, if there is a stage in development in which accommodation is less robustly available, child language 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, over one that would require the listener to accommodate them. They showed this preference robustly for a trigger whose presuppositions are more difficult to accommodate (*too*) as well as for a trigger for which accommodation is easy and for which evidence to that effect is abundant (*the*). We then demonstrated in Experiment 3 that children diverge from adults with respect to their willingness to rely on accommodation. In circumstances where adults showed a preference for an addressee who accommodates the sentence presupposition, younger children adopted a different stance. Their failures in the specific kind of situations we

created for Experiment 3 suggests a lack of full understanding of how a cooperative listener might deal with an "informative" presupposition. And since these kinds of situations arguably create the strongest possible incentive for deploying accommodation, it is plausible to conjecture that they have not mastered 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 admittance requirements from presuppositions that already have common ground status. This distinction 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 them satisfied in a more transparent way compared to adults. During this stage in child language development, therefore, we see in action the strong demands presuppositions impose on the context of use.

Our experiments were designed to test specific predictions derived from the admittance theory, but there are accounts of presuppositions that do not take them to impose admittance conditions on the common ground. It is an open question whether our results can be explained on such accounts. For instance, on a prominent alternative approach, presuppositions are entailments that are *backgrounded* or *non-at-issue* (Atlas, 1977, 2005; Abbott, 2006; Simons, 2007; Simons et al., 2010, 2016; Beaver et al., 2017). On these accounts, presuppositions are not pre-requirements on the common ground. Rather, when a sentence is uttered, the context gets updated by both the at-issue and non-at-issue entailments, neither of which needs to have common ground status prior to update. Proposals vary with respect to how the notions of backgroundedness/non-at-issueness are made precise. On one approach (Simons et al., 2010, 2016; Beaver et al., 2017), non-at-issueness is defined in relation to the Question Under Discussion (QUD). Whatever content doesn't address the QUD is treated as backgrounded information. The QUD, in turn, may be recovered from the information structure of the uttered declarative. Is it possible to explain our results within this type of approach? We think it might be possible, but not without some auxiliary assumptions. Suppose the participants use the information-structure of sentences like *The bird that I got FLEW AWAY* to infer a QUD like *What did the bird that you got do?*. This might lead them to conclude that the speaker intends for the information that there is a unique bird to be backgrounded. This alone wouldn't explain even the less interesting datapoints, e.g. our participants' preference for the knowledgeable addressee in our Experiment 2, however. What is missing is a link between what information gets backgrounded as a result of a speaker's answer to a QUD, and the prior beliefs of the listener who may have raised that QUD. In other words, we need a principled account of why participants expect that a listener who knows about the bird is the one to raise a QUD about what happened to that bird. If this can be worked out in a way that doesn't appeal to a notion of presupposition in the admittance theoretic sense, our findings could be compatible with such a theory.

Beyond its theoretical implications, our study also helps 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. If our interpretation of the results is correct, a broad conclusion that follows is that children at a fairly young age know what presuppositions are and treat them as pre-requirements

on the common ground. But how do they come to reach such a cognitive stage? Stalnaker's Bridge Principle, which makes presuppositional sentences assertable only when the context entails their presuppositions, is surface-false. Given the availability of accommodation, the assertion-presupposition distinction is often collapsed, which means that the learner would have to extract the right formal principle from a set of data that doesn't look like it adheres to it. On the other hand, the bridge assumption is a natural one if the learner is trying to arrive at the cleanest cut between two kinds of semantic content; anything weaker would result in partial overlap. This, of course, would mean that the learner starts out with the expectation that there are in fact two types of content. The distinction between presupposition and assertion is not something they need to learn from experience.

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Declarations

Conflict of interest The authors declare that they have no conflicts of interest.

Human and animal rights The studies involving human participants were reviewed and approved by MIT COUHES. Written informed consent to participate in this study was provide by adult participants or, in the case of child participants, the legal guardian.

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