

Children's Knowledge of Principle C in Discourse

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1. Introduction

In the generative framework, it is assumed that children are born with 'Universal Grammar', a set of innate principles and parameters that guides children's language development. The principles of Universal Grammar (UG) constrain children's hypothesis space, preventing them from making certain kinds of errors, such as allowing meanings that are not admitted in the adult grammar. The UG framework can be contrasted with alternative ones that propose that children are born with little, if any, innate knowledge of grammar. In this case, children use item-based learning, later combined with general learning mechanisms that are used in other cognitive domains (such as analogy) to learn the grammar. Since these mechanisms do not eliminate errors, children may initially overgenerate, and allow illicit meanings. One way to test between the theory of Universal Grammar and alternative learning theories is to test whether children have knowledge of the purported UG principles in place early in the course of language acquisition. This paper reports an experiment that investigates children's knowledge of Principle C, one of the UG constraints that is proposed to prevent children assigning certain logically possible coreference relations between noun phrases.

The experiment we report complements previous experiments by investigating how children interpret coreference relations in question/answer discourse. The logic of the experiment relies on a theory of how sentence fragments are interpreted recently proposed by Merchant (2005). If Merchant's theory is correct, Principle C applies in fragment answers of discourse also. The empirical evidence may shed some light on Merchant's theory. If children can be shown to perform equally well on declarative sentences governed by Principle C, and those argued to be governed by Principle C in discourse, then we could provide evidence that is, at the very least, compatible with Merchant's theory of fragments.

2. Theoretical Background

In the theory of Universal Grammar, principles of binding theory demarcate possible relationships between noun phrases. These principles, or constraints, restrict the range of permitted sentence forms and sentence meanings. Since the principles are postulated to be innate, the range of permissible sentence forms and meanings should be restricted in a child's grammar in the same way as in the adult's. If the binding principles were not part of the child's grammar, however, the expectation would be that children would overgenerate. That is, children would allow sentence forms and sentence meanings that are not sanctioned in the adult grammar. Such overgeneration is problematic because it has been observed that children do not receive (or respond to) the negative evidence that would be required to purge the unwanted sentence forms and meanings (cf. Brown and Hanlon 1970, Morgan and Travis 1989). Without the helping hand of corrective feedback, it is not clear how children would succeed in converging on the adult grammar.

The principle of binding theory at issue in this paper is Principle C. For our purposes, Principle C can be stated as us: "An R-expression must be free everywhere" (Chomsky 1981; 1986, Lasnik 1976) (where the term 'R-expression' stands for Referring-expression, which includes names and definite NPs, such as 'Chuckie' and 'the boy'). The relevant case for the present paper is that a pronoun may not c-command a co-indexed R-expression that is within the same sentence boundaries, as shown in (3).

(3) *He₁ sent the letter to Chuckie₂

Adult speakers of English do not accept the meaning in which 'he' and 'Chuckie' are coreferential, presumably because the pronoun 'he' c-commands and is coindexed with 'Chuckie'; the interpretation is therefore in violation of Principle C. Native speakers do, of course, allow the pronoun 'he' to refer to some other male individual not mentioned in the sentence.

Although it is not stated explicitly, the binding principles are assumed to apply sentence internally. In some discourse contexts, however, it is pertinent to ask whether or not the binding principles are relevant. Consider the short question/answer discourses shown in (4) and (5).

(4) Speaker A: Where did he₁ send the letter?

Speaker B: To Chuckie's₂ house

(5) Speaker A: Where did he₁ send the letter?

Speaker B: *To Chuckie's₁ house

It is clear to native speakers that in (4) the pronoun 'he' is taken to refer to some male other than 'Chuckie' as illustrated by the indices; the indices in (5) show that 'he' and 'Chuckie' cannot corefer. The judgments, then, are the same as for (3). A number of possibilities present themselves. The judgments may be the same because the underlying mechanism prohibiting coreference is the same. As we will see, Merchant (2005) argues that Principle C is responsible for both judgments. Alternatively, the fact that the judgments are the same may be coincidental. The judgments for sentences and fragment answers may be the product of different mechanisms – Principle C for declaratives and pragmatics for discourse. Another possibility is that adult speakers prefer disjoint reference for both cases due to learned pragmatic principles. We discuss these possibilities below.

The first possibility is to invoke Principle C to handle the facts in discourse sequences as well as in declarative sentences. If Principle C is to be extended to discourse, however, it will be necessary to define its purview. It is immediately clear that Principle C can not constrain the interpretation of pronoun-name sequences that are separated by many speaker turns in the discourse. Principle C may not apply to all kinds of discourse either, as the example in (6) between Speaker A and Speaker B demonstrates:

(6) Speaker A: He sent the letter to the house on the hill.

Speaker B: Oh, yes. I saw Chuckie going to the Post Office yesterday.

It is unclear whether or not 'he' and 'Chuckie' can corefer in (6). While the native speaker's first instinct may be to assume disjoint reference between 'he' and 'Chuckie', it seems that adults, at any rate, are able to accommodate to allow a coreferential reading. So the question is: What makes this example different from the question/answer discourse seen in (4) and (5)? In the discourse shown in (6), each speaker utters a complete sentence. There is no part of the sentence that has to be 'filled in' by the next speaker. There is a gap to be filled in when a speaker answers a question with a piece, or fragment of a sentence, however. We turn

our attention to these cases, and will not discuss examples like (6) further (but see Merchant 2005 for discussion).

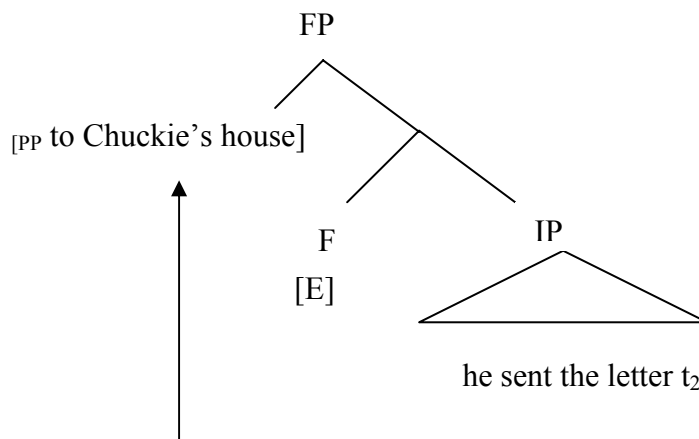
The proposal that fragment answers are tied to the preceding discourse was explored in the early literature by Hankamer (1979), and Morgan (1973, 1989), and more recently by Merchant (2005). The idea is that part of the structure of the question is reconstructed in the next speaker's representation, and later deleted, with just a fragment being pronounced. This is illustrated in (7) and (8), where the struck out text in Answer 1 is reconstructed, but is not audible. Answer 2 in (9) shows that a full sentence answer to the same question is also possible.

- (7) Question: Where did he₁ send the letter?
- (8) Answer 1: ~~He₁ sent the letter~~ To Chuckie's₂ house
- (9) Answer 2: He₁ sent the letter to Chuckie's₂ house

The innovation of these early approaches was that the same mechanism, Principle C, could be invoked to handle the coreference relations in both question/answer discourse sequences like (7)/(8) and in declarative sentences like (9). Both answers convey the same propositional content – that of a full sentence.

A problematic feature of the early analyses was noted by Merchant (2005). The deleted or elided portion was not a constituent, violating the requirement that all linguistic operations are structure-dependent (Chomsky 1968;1971). To solve this problem and to present an analysis more Minimalist in spirit, Merchant proposed that there is movement of the fragment to a clause-peripheral position, mostly likely a focus projection, as illustrated in (10).

(10)



Movement of the fragment to a Focus position means that the structure remaining is an IP constituent. The F(ocus) head is generated with an E-feature that instructs the post PF phonological-interpretative component not to pronounce its complement IP.

To summarize, when a speaker responds “To Chuckie’s house,” there is more structure underlying the representation than just a PP. As the tree diagram in (10) shows, a full sentence is generated. Before movement of the PP to Focus position, the pronoun and the name are in a c-command configuration that is relevant for Principle C, so the illicit coreference relations can be ruled out. This explains how Principle C can be invoked while the pronoun no longer appears to be part of the answer.

Other analyses of the judgments of coreference in declaratives like (3) and discourse sequences like (4)/(5) postulate no relation between the two utterance types. Alternatives to the approach advanced by Hankamer, Morgan, Merchant and others have proposed that fragment answers to questions are generated as DPs or PPs, with no underlying full sentential structure (e.g. Ginzburg and Sag (2000), Barton (1990) and Stainton (1998)). The disadvantage of these “what you see is what you get” approaches is that they allow DPs or PPs to be interpreted as propositions in the semantic component, thereby requiring a revision of the way in which syntactic structures are mapped onto semantic structures (Merchant 2005). The problems would be further compounded in fragment answers like in (8) where coreference relations are relevant.

Proponents of this view, called the ‘direct interpretation approach’ by Merchant, would presumably call on principles of pragmatics to prevent speakers and hearers from interpreting the discourse too permissively. In fact, some theoreticians such as Levinson (2000) would call on pragmatic principles to handle coreference in declaratives and in discourse. Basically, coreference between pronouns and names in configurations governed by Principle C in the theory of Universal Grammar is dispreferred because there is a preferential mode of expression available. Levinson’s theory of generalized conversational implicatures elaborates on two interacting Gricean principles to rule out coreference in a sentence like (9). First, there is the Principle of Information (which Levinson states is a rendition of one of Grice’s maxims of Quantity) that exhorts speakers to say as little as necessary while still achieving communicative goals, and hearers to take the most specific interpretation possible. This cashes out in the anaphora arena as a preference for local coreference (p.117). This pragmatic preference for local coreference is problematic for sentences like ‘He sent the letter to Chuckie’s house’, however, because adult speakers do not allow local coreference. Grice’s

maxim of Manner, elaborated by Levinson as the M-principle, is invoked to have speakers refrain from intending coreference (or hearers from thinking coreference is intended). The M-Principle has speakers “indicate an abnormal, non-stereotypical situation by using marked expressions that contrast with those you would use to describe the corresponding normal, stereotypical situation”. The hearer takes something said in an abnormal way to indicate an abnormal situation. When applied to anaphora, the hearer of ‘He sent the letter to Chuckie’s house’ takes ‘Chuckie’ to be a marked expression, and takes the speaker to intend disjoint reference.

While it is easy to attribute this knowledge to adults, it is difficult to see how children successfully master these principles and their implementation early in the course of language acquisition. For Levinson they are learned: “True, it is not clear exactly how the learner comes to formulate such principles [.....] others like Grice and those who follow him more closely (like the present author) imagining that they arise from some complex interaction between native rationality and the demands of the communication setting [...]. Be that as it may, such inferential principles (or something like them) indubitably exist and are clearly utilized (to growing extents) by the language learner, as are many other, not specifically linguistic, inferential procedures” (Levinson 2000, pp. 361-362).

We can now turn to language acquisition and consider how these two proposals might align with models of children’s language development.

3. Acquiring Fragments

3.1. The Nativist View

The nativist position is based on the poverty of the stimulus argument. Children are not informed of the ungrammaticality of certain sentence forms, or of certain meanings, yet, all adults come to have this knowledge (e.g Chomsky 1981). Given that they cannot have learned this knowledge from the input, it can be inferred that the knowledge must be biologically endowed. If we take the argument and apply it to the facts of interest in this paper, we can observe that children are not informed of the prohibited meanings for the sentences in (11) and (12). Parents do not tell their children that the string of words in (11) cannot mean that Chuckie sent the letter to his (own) house. All that children hear is positive evidence, that is, the same string of words with the meaning in which some other male individual sent the letter to Chuckie’s house. The same point can be made for the

question/answer sequence. The fact that every adult is in command of which meanings are not permitted has led to the claim that Principle C is part of the child's innate endowment.

(11) He sent the letter to Chuckie's house

(12) Q: Where did he send the letter?

A: To Chuckie's house

As an abstract principle of grammar, Principle C is not stated in a way that can be gleaned by observation; it rests on the c-command configuration of the derivation at some pre-Spell-Out level of representation. This means that it rules out prohibited coreference relations in sentences that look considerably different on the surface. Consider the sentence types in (13) and (14).

(13) *Who did he₁ say t₁ sent the letter? Chuckie.

(14) *Bill sent Chuckie a letter and he₁ <sent Chuckie₁ a letter> did too

The crossover question in (13) differs from the declarative in (11) in an obvious way – the pronoun does not precede a name that is pronounced. Technically, the wh-trace is the R-expression that is c-commanded by the pronoun. Since Principle C is relevant in this configuration, the pronoun cannot be taken to be a bound variable, and the sentence cannot have the meaning “Who said he sent the letter?” In the sentence with VP ellipsis in (14) again, the pronoun does not precede a name as it does in (11); here the name is ‘silent’ inside the ellipsis. The main point is that, on the nativist view, whatever the surface configuration of pronoun and name, children should treat all sentence types governed by Principle C as tied together. In other words, children should respect Principle C in all cases from the earliest testable stages.

3.2. The Usage-Based View

In recent years views of language development that rely on learning have regained some popularity in the literature. This empiricist view stands in direct opposition to Chomsky's nativist view. On usage-based accounts, such as the constructivist view espoused Goldberg (2003), Lieven, Behrens, Speares and Tomasello (2003), Tomasello (2003) among others, children do not have a biologically endowed grammar, except for, perhaps, the concept of NP

(Tomasello 2003). Instead, the task of learning the grammar is aided by an innate social predisposition to attend to the context. The child is seen as conservative, with preemption and entrenchment holding down overgeneralization (cf. Tomasello 2000).

On the constructivist approach, children begin learning the grammar by attempting to imitate instances of language use from the input. They first memorize particular verbs used in particular frames. Only later do they try those verbs in other syntactic frames, or abstract across verbs to come up with a template (Tomasello 2003). Children acquire the grammar ‘construction by construction’, with the order of development determined by the frequency of the particular construction in the input (e.g., Goldberg 2003, Tomasello 2003). The linguistic experience of the child is the driving force behind the grammar. For this reason, these researchers focus on the properties of child-directed speech in their research. It is worth considering, then, the frequency of both full sentences and fragments in children’s input, so that we can see which might emerge earlier in a child’s production.

A study by Cameron-Faulkner, Lieven and Tomasello (2003) analyzed child-directed speech of 12 mothers to 2-year-old children from the Manchester corpus in CHILDES to see what kinds of constructions are frequent. In total, 16,903 child-directed utterances were analyzed, and the frequency of different construction types in the input was determined.

(15) Fragments	20%
Questions	32%
Imperatives	9%
Copulas	15%
Subject-Predicate	18% (SVO= 10%; SV=3%; Other=5%)
Complex (2-verbs)	6%

As seen in (15), fragments formed 20% of the input, while full sentences (not including questions) accounted for 48% of the input. Notice that the 20% is the frequency for all fragment constructions, although it is reported many of these are answers to questions. The number of fragments that appear as answers to questions containing pronouns will be considerably smaller in number. If these figures are indicative, we might expect to see young children productively using full sentences before giving fragment answers to questions.

Because usage-based accounts rely on learning the syntax and syntactic computation does not come ‘for free’, theories of this kind are unlikely to be compatible with Merchant’s (2005) theory of fragments. It is highly unlikely that young children would have learned on the basis of the input to sort out different types of fragments, choosing to obligatorily

reconstruct the syntactic structure from a previous utterance just in the case of question/answer pairs. Furthermore, since usage-based accounts do not attribute innate grammatical principles such as Principle C to children, Principle C will not be invoked to rule out coreference relations in fragment answers to questions either. None of the usage-based accounts make explicit proposals about how these cases are learned, but presumably, something like Levinson's pragmatic principles together with domain-general learning principles would be invoked.

Let us return to the example. As we have observed, innate constraints such as Principle C serve to make potentially ambiguous sentences unambiguous. This is why the pronoun in (11) and (12), repeated below, can only refer to an individual other than 'Chuckie'. Put another way, without Principle C, (11) has the potential to mean that Chuckie sent the letter to his (own) house, and the speaker in (12) could be using a pronoun with the intention of referring to 'Chuckie'.

(11) He sent the letter to Chuckie's house

(12) Q: Where did he send the letter?

A: To Chuckie's house

On usage-based accounts, the child is closely tied to the linguistic input. At the early stages of language development, then, it could be argued that children only use pronoun/name sequences they have heard in the input (if this construction is frequent enough for them to be 'working on it'). Attention to the positive input would mean they too would only allow the pronoun to refer to someone other than 'Chuckie'. But at some point, usually around age 3, usage-based accounts allow the child to make generalizations using domain-general learning mechanisms. At this point, children could observe that pronouns that come before names can corefer. Consider the examples in (16) and (17), where 'his' can be construed as 'Chuckie'.

(16) His_{1/2} Mom had the the letter sent to Chuckie's house

(17) Speaker A: Where did his_{1/2} Mom have the package letter sent?

Speaker B: To Chuckie's₁ house

If children make this observation, and by analogy, apply it to the cases in (11) and (12), they will overgenerate, and allow ambiguity. Alternatively, if children are in the process of

learning pragmatic principles such as those outlined by Levinson, they will also overgenerate for some considerable time.

There is another point of importance to make about usage-based views. Since constructions are learned one by one, on the basis of the surrounding input, syntactic constructions will not be ‘grouped’ together, tied by an underlying principle, such as Principle C. On this account, there is no reason to expect children to treat coreference relations in declarative sentences, in crossover questions, in VP ellipsis constructions, and in question/answer discourse sequences and so forth in the same way. Therefore, we would expect to see, for example, young children who have mastered coreference relations in full sentences, but not in fragments (or vice versa), since these are different constructions. Furthermore, we might expect the order in which these constructions are mastered to be correlated with the frequency with which these constructions appear in the input. In this case, children may come to an understanding of possible coreference relations in declarative sentences before discourse sequences. Furthermore, since discourse sequences of this kind appear to be infrequent, the coreference facts may be acquired late in the course of acquisition. A learning theory would also expect younger children to make more errors than more linguistically-experienced older children,

The next section outlines previous research on cases governed by Principle C in the generative framework.

4. Previous Literature on Acquisition of Principle C

In the early days of generative acquisition research, researchers investigated whether or not the binding principles formed part of children’s Universal Grammar. An early proposal on the acquisition of Principle C by Solan (1983) proposed that the knowledge emerges gradually. Based on experiments by Lust (1981), Tavakolian (1978) and his own experiments with 5- to 8-year-old English speaking children, Solan proposed that Principle C starts out as purely a principle of precedence; only later does c-command kick in as relevant to its formulation. Solan’s formulation views the child as initially conservative, admitting cases where pronouns may precede names at some later point in acquisition. The proposal is not a problem for learnability, because children can acquire the cases where a preceding pronoun can corefer with a name on the basis of positive input. However, as Lasnik and Crain (1985) point out, nothing in the theory predicts that children will acquire the grammar slowly.

Many of the early 80s experiments with children were based on act-out or ‘Do-what-I-say’ methodology which was not well-suited to investigation of constraints such as Principle C. Act-out experiments can highlight children’s preference for a particular meaning, but they cannot show whether or not children are willing to entertain a less-preferred, perhaps prohibited meaning. To overcome this problem, Crain and McKee (1985) designed the Truth Value Judgment Task (see section 5.2 for details).

Using this technique, Crain and McKee (1985) showed that children do not live by linear precedence. Once the TVJ task forced children to entertain backwards anaphora interpretations, they were found to respond like adults, admitting (19), while ruling out (18).

(18) *He₁ said that Chuckie₁ opened the box.

(19) Because he₁ likes presents, Chuckie₁ opened the box.

In the Crain and McKee experiment, preschool 3- to 5-year-old children accepted sentences like (19) 73% of the time, while rejecting Principle C violations such as (18) 88% of the time. Children accepted the extra-sentential reading of pronouns 81% of the time. As they conclude, the experimental results show that the c-command relation, not precedence is critical to ruling out the correct set of data.

In a later study on binding, Thornton and Wexler (1999) studied Principle C in VP ellipsis sentences like (20).

(20) The Kiwi Bird cleaned Flash Gordon and he*₁ <cleaned FG₁> too

The coreference relations in the elided clause were judged as ungrammatical a lesser percentage of the time – 54%. Post-hoc, Thornton and Wexler suggest that even adults may allow a ‘surprise’ meaning, whereby unexpectedly, Flash Gordon ends up cleaning himself. At any rate, these VP ellipsis structures are the exception to other findings. For example, in another experiment, children rejected crossover violations in sentences like (18). The experiment tested 3- and 4-year-old who rejected one-clause crossover questions that violate Principle C like (21) 95% of the time (Crain 1991, Thornton 1990, Crain and Thornton 1998).

(21) I know who he hit. Chuckie.

(22) *I know who he₁ hit t₁. Chuckie₁

Notice that the utterance in (21) that is presented by the puppet is a question/answer pair; the puppet both produces and answers an indirect question. There is an important difference between (21) and (4), however. In (21), the computation for Principle C can be carried out on the basis of just the indirect question, since the pronoun c-commands the wh-trace, the R-expression, as shown in (22). In the discourse cases we test, the wh-phrase is not ‘who’, so the wh-trace cannot be coindexed with the pronoun in the question. For this reason, Principle C is computed on the basis of the underlying representation of the fragment answer.

5. The Experiment

The main objective of our experiment was to investigate how children interpret coreference relations that hold across question/answer exchanges in a discourse. A second goal was to try to identify whether or not the mechanism for constraining coreference relations in question/answer sequences in discourse is the same mechanism that constrains coreference relations in declarative sentences. We reasoned that, all things being equal, if Principle C is responsible for the lack of ambiguity in pronoun resolution in both cases, then children should reject the illicit meaning roughly the same percentage of the time – ideally, at a rate of 90% or more³. On the other hand, if Principle C is constraining coreference relations in declaratives, but pragmatic principles are exerting their weight on discourse, or even if children were using pragmatic principles to interpret the coreference relations in both cases, there would be no reason to expect children to tie the two sentence types together. Learning is not error-free. To test these predictions, we tested the same children on both cases.

5.1. Subjects

Twenty children from the preschool at the University of Maryland (the Center for Young Children) participated in each of the two sessions of the experiment. The children were tested individually, in a research room at the preschool. The children who participated ranged in age from 3;3 to 5;5, with a mean age of 4;6 for the children in Session 1 and 4;10 for the children in Session 2. Seventeen of the 20 participated in both sessions. Three children from the first session were not available to participate in the second part and so 3 additional children were recruited for session 2. All child subjects were fluent English speakers, but English was not necessarily their first language. The children all had written parental permission to participate, were willing participants, and were able to play the game.

Children's ability to play the game was evaluated in a pretest training session, in which they were asked to judge the truth or falsity of a puppet's description of sentences in context. Children had to be able to reject a false statement, and were also asked to identify the toy characters being used in the accompanying acted-out story. Story contexts used in the pretest were unrelated to the test items.⁴

The adult participants were undergraduates from the University of Maryland who were recruited from flyers or announcements in introductory linguistics classes. The adult participants differed for each of the two sessions; 14 adults were subjects in session 1, and 18 adults participated in session 2. The adults included both native and non-native speakers of English. One adult from the 18 in the second session was excluded, because this person was not able to reject any sentence, and wrote question marks by all the items on the score sheet. The stories were not acted-out individually for the adults, but videotaped. The adults watched the video snippets, and wrote their 'Yes' or 'No' answers on a score sheet.

5.2. Methodology

The experiment was conducted using the Truth Value Judgment Task (Crain and McKee 1985; Crain and Thornton 1998). This task requires two experimenters – one to act out stories with toy figures and props and the other to play the role of the puppet. The puppet watches the story unfold along with the child, and at the end of the story, tries to say what happened. This is the presentation of the test sentence. The child's task is to tell the puppet if she or he was right or wrong, that is, whether the statement was true or false. If the child deems the puppet to be correct, the child rewards the puppet with a treat. If the puppet is judged to be incorrect, the puppet is given a less desirable treat, and encouraged to pay better attention next time. It is important to note that the puppet responds enthusiastically even to a less desirable treat, so that the child does not feel compelled to answer one way or another in order to please the puppet.

A basic assumption of the task is that children judge sentences to be true whenever they can. The methodology is employed to test children's knowledge of a linguistic constraint in the following way. The story is designed to incorporate both the meaning of the sentence that is permitted in the adult grammar and the meaning that would be permitted, should the constraint not be innate. The illicit meaning that is associated with violating the constraint is designed to be true in the story, and therefore, if children permit this interpretation, they

should say ‘yes’. The meaning that is associated with the adult grammar is false, and therefore children responding as adults should say ‘no’.

Several safeguards are put in place to ensure that the experiment is biased towards the null hypothesis. First, the illicit meaning that violates the constraint is associated with the ‘Yes’ response. Given that it is considered easier to say ‘yes’ than ‘no’, this favors the null hypothesis over the experimental hypothesis. In addition, the part of the story that is associated with a violation of the constraint is placed at the end of the story. It is generally assumed that the last mentioned part of a story is more salient and therefore more likely to be retained in memory and accessible to the child. If so, the illicit meaning is given an advantage, and the null hypothesis is again favored. The status of the child’s grammar as adult-like or non-adult-like is inferred from their judgment of the puppet’s statement as true or false, and backed up with production data from the child in cases of a ‘no’ response. If the child tells the puppet he is wrong, the child is asked to explain ‘what really happened.’ In this way, it can be ascertained whether the child is rejecting the sentence for the right reason.

The stories used in the experiment followed the ‘recipe’ for the TVJ task outlined in Crain and Thornton (1998). In particular, stories presented in this format for judgment as true or false need to satisfy plausible dissent. The idea is that it is only plausible to reject a sentence if the corresponding assertion has been under consideration. For this reason, it has to be possible that the action presented in the assertion might have been true, even though it turns out to be false. Consider the declarative sentence presented earlier.

- (23) Puppet: I know what happened in that story. It was a story about Tommy and Chuckie. And, he sent the letter to Chuckie’s house.

In the story that would be used to test the above presentation by the puppet, events take place such that ‘he’, ‘Tommy’ almost ends up sending the letter to Chuckie’s house. For some reason, however, this doesn’t eventuate, and a reason is given for this. Tommy forgets the stamp, or the letter gets dirty, for example. Events transpire so that Chuckie takes over (perhaps he finds a stamp or a clean envelope) and he sends the letter to his (own) house. Now, when the puppet presents the above lead-in and test sentence, the child can reasonably answer either true or false. If the child can interpret the test sentence as meaning that Chuckie sent the letter to his own house, then he or she should judge the puppet to be correct. If the child has only the adult interpretation, then he or she can give reject the sentence, and give a

good reason for it being false. Tommy didn't send the letter to Chuckie's house because he forgot the stamp, or the envelope was dirty or whatever.

The TVJ methodology was adjusted slightly for the present experiment. Two different puppets were used to present the question/answer sequence. The first puppet presented the question as an assertion, embedded under 'I know'. The second puppet presented the fragment NP or PP. When chiming in with the fragment answer, the second puppet always preceded the fragment with a filler like 'Me too', 'I know too' and so on, to signal clearly to the child that the discourse was taking place between two speakers. This is illustrated in (24).

- (24) Speaker A: I know where he sent the letter.
Speaker B: I know too. To Chuckie's house.

5.3. Materials

The experiment was divided into two sessions, each consisting of 8 stories. Each session contained four experimental 'target' stories testing Principle C and four controls. Two of the control sentences checked that children allow forwards anaphora, and the other two control sentences tested whether or not children allow backwards anaphora in cases when it is permitted by the grammar.

The experimental sessions were presented as an ongoing story about the adventures of the Rugrats kids, Tommy, Chuckie and Lil. Although the actual sentences presented to the child for judgment only contained the characters Tommy and Chuckie, Lil was always part of the action in the story, to add interest. Because the stories built on earlier adventures, the stories were not interchangeable, but had to be presented in a particular order. The target stories, if interpreted in an adult-like way would invoke 'No' answers and the control stories were all designed to invoke 'Yes' answers. Each session contained 4 'Yes' answers and 4 'No' answers that were semi-randomized, so that there were never more than 2 'Yes' or 'No' responses in a row. The items were presented in the same order to each child. Two simple 'warm up' items preceded the 8 experimental trials. The individual items for each session are presented in Appendix 1.

The story line for each item was designed to satisfy the requirements of the Truth Value Judgment task. The target question/answer or declarative sentence was preceded by a linguistic antecedent that named the character in the target sentence last. For example, in the

following discourse taking ‘he’ to be ‘Chuckie’ would violate Principle C, so ‘Chuckie’ was mentioned last in the linguistic antecedent to bias the experiment toward the null hypothesis. The target sentences can be summarized with the following template, where the ‘+’ symbol represents a speaker turn in session 1, the discourse session.

(25) He opened + Chuckie’s box.

The forwards anaphora controls ensured that children could take a pronoun to refer to a name. These stimuli were of the following form:

(26) Chuckie opened + his box.

In the backwards anaphora controls, the pronoun preceded the name, and was embedded in a noun phrase. This control was designed to ensure that children do not use linear precedence to reject examples like (25). If so, then they would also reject controls like (27).

(27) His mother opened + Chuckie’s box.

To our knowledge, children have not been tested on this particular form of backwards anaphora before. It is also not entirely natural for some adults, since forwards anaphora is often preferred, but recall that the sentences were presented with a linguistic antecedent. Assuming that children say ‘Yes’ when the grammar allows it, we hypothesized we would get a good number of acceptances of the coreference reading.

6. Experimental Results

The main finding is that children gave strong rejections of coreference between the pronoun and name in the question/answer discourse sequences like (24), rejecting coreference 88.8% of the time. Children’s rejection of coreference in the 4 target sentences can be contrasted with their acceptance of coreference in the two kinds of control sentences. In the control sentences, a ‘Yes’ response from children meant an acceptance of coreference between the name and pronoun. Overall, children accepted the control items 87.5% of the time, with 75% acceptances for the forwards anaphora controls, and 100% acceptances for the backwards anaphora controls. Recall that the controls are ambiguous, so it is correct to

either accept or reject the puppet’s statement. Every child except for one accepted at least 75% of the controls, showing that they do allow coreference where it is permitted by binding theory.

In the experimental session testing declarative sentences, again, we found that children gave robust rejections of coreference when the pronoun and name were in a configuration governed by Principle C. Coreference was rejected 85.7% of the time, in striking contrast to the control sentences. Overall, the controls were accepted at a rate of 83.8%; the forwards anaphora controls were accepted 87.5% of the time, while the backwards anaphora controls were accepted 80% of the time.

The results from the two experimental sessions taken together allow us to address the second goal of the experiment, which was to compare children’s responses to the discourse targets in session 1 and the declarative sentences in session 2. The experimental findings from the two sessions are almost identical; the discourse target sentences were rejected 88.8% of the time, and the declaratives were rejected 85.7% of the time.

	Discourse Session 1 % Correct (N=20)		Declarative Session 2 % Correct (N=20)	
Target Items	71/80	88.8%	66/77	85.7%
Target Items- excluding #1	55/60	91.7%	57/60	95%
Forwards Anaphora	30/40	75%	35/40	87.5%
Backwards Anaphora	40/40	100%	32/40	80%
Controls (Collapsed over Forward and Backward)	70/80	87.5%	67/80	83.8%

Table 1: Children’s Experimental Results for Sessions 1 and 2

Turning to individual items, one of target sentences from each session had a lower rate of rejection than the rest. Post-hoc, in each case this appears to be because it was the first trial in the experiment. In the discourse session (session 1), the ‘no’ response rate for the first question was 80% as compared to the 91.7% rate for the remaining experimental sentences. In the session with declarative sentences (session 2), the ‘no’ response rate for the first question was 70.6% as compared to the 95% rate for the remaining experimental sentences⁵. If the first target sentence from each session is removed, and the results

recalculated for the remaining 3 target sentences, children are seen to make even fewer errors, bringing their rate of correct rejections to over 90%, as can be seen in Table 1.

Turning to the experimental results for the adult controls, the adults rejected the target items 93% of the time in the discourse session. The adult subjects accepted the forwards anaphora controls 71% of the time, and the backwards anaphora controls 100% of the time. In the second session with declarative sentences, adults rejected coreference in full sentences 91% of the time, accepted forwards anaphora 100% of the time, and backwards anaphora 29% of the time. It is assumed that adults did not accept the backwards anaphora sentences like ‘His mother took Chuckie’s hat’ to a high degree because they have acquired, with experience, a preference for forwards anaphora.

6.2. Discussion

Our experiment has demonstrated that children, like adults, show a strong prohibition on coreference between a pronoun in a question and a name in the following answer, as seen in examples like (28).

- (28) Puppet 1: I know what he₁ opened.
Puppet 2: Me too. *Tommy₁’s package.

If we follow Merchant’s (2005) analysis of fragment answers to questions, then these cases illustrate children’s adherence to Principle C in a new context. Children are attending to the binding relations across speakers in discourse. This new context adds to a number of previous experiments showing children’s mastery of Principle C (see Crain and McKee 1985, Crain and Thornton 1998, Kiguchi and Thornton 2004, Lust, Eisele and Mazuka 1992, McDaniel and Maxfield 1992, Thornton and Wexler 1999 among others).

Let us turn to theories of language development, and evaluate the predictions made by nativist and usage-based approaches. The nativist view of language acquisition predicts that if a principle of Universal Grammar is constraining children’s hypotheses, then it has broad coverage over relevant ‘constructions’ that may look quite different in surface form. Specifically, we predicted that if Principle C is constraining children’s hypotheses about pronominal coreference in both declarative sentences and in question/answer discourse, then children should treat the two cases in the same way. The prediction was that children should reject coreference in the two ‘constructions’ at about the same rate.

Examination of the experimental findings lends support to the nativist view. Children rejected coreference in question/answer discourse 89% of the time, and in declaratives 86.3% of the time, a difference that is not statistically significant ($\chi^2 = 0.228$ n.s). Children's performance in the two experimental sessions is compared in Figure 1 below.

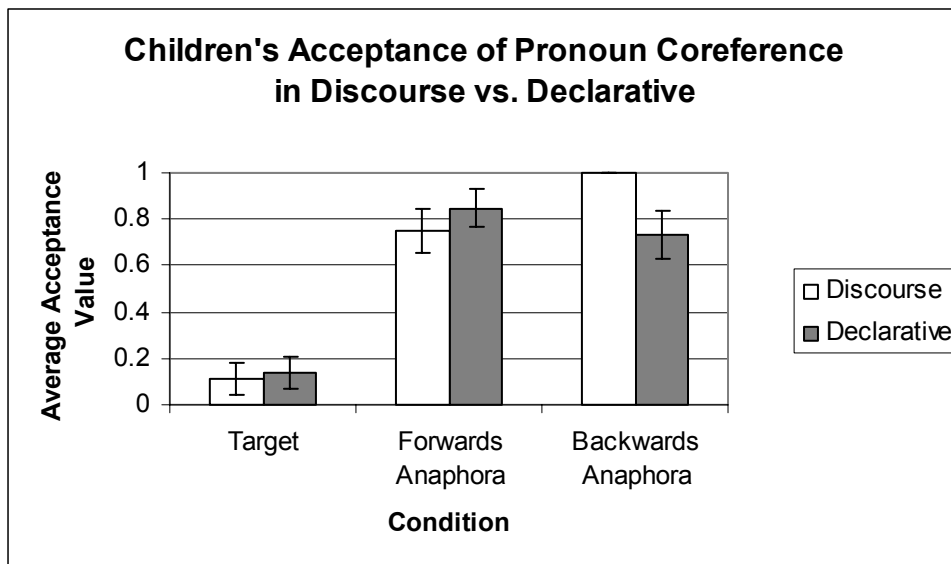


Figure 1: Children's Responses to the Discourse and Declarative Sessions.

A comparison of children's and adults' performance on the experiment reveals very similar responses on the experimental targets, as shown in Figure 2.

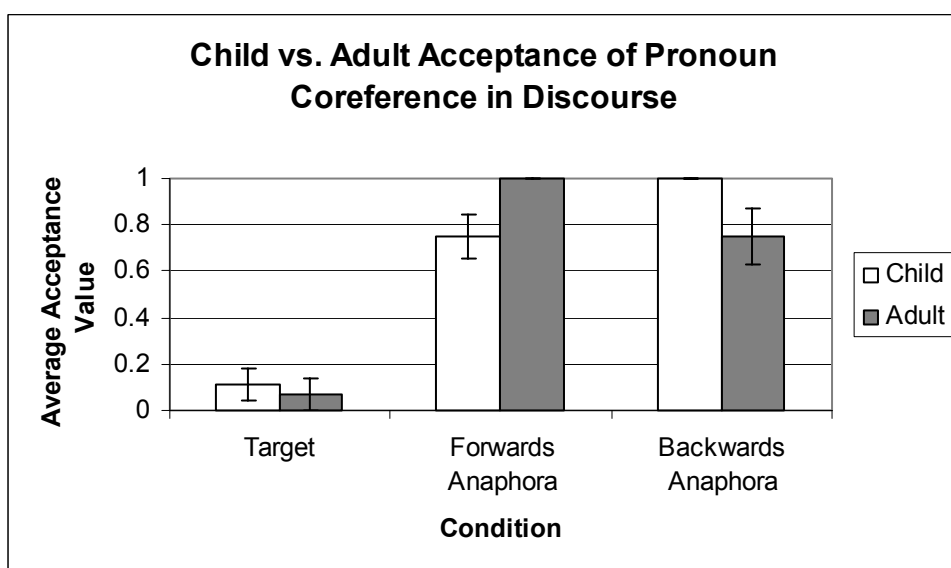


Figure 2: Children's and Adults' Responses to the Discourse Session

The fact that children's performance is similar to adults' suggests two things. First, children already have the knowledge that is giving rise to the same responses. Since pragmatic knowledge is learned, and is often mastered late, the results invite the inference that the knowledge in question in both declaratives and in discourse is Principle C. This being the case, the empirical data lend support to the theory of fragments advanced by Merchant (2005).

Although usage-based accounts do not make specific predictions about the structures tested in the experiment reported here, we have laid out some general predictions. On the constructivist account, for example, children learn grammatical constructions one by one, with order of acquisition strictly correlated with frequency in the input (cf. Goldberg 2003). Thus, declaratives will be learned at a different point in time from question/answer sequences, presumably earlier (cf. Cameron-Faulkner, Lieven, and Tomasello 2003). It follows that properties of these constructions, such as coreference relations, will be confronted at different times also. Older children, being more experienced language users, should be more accurate than younger children.

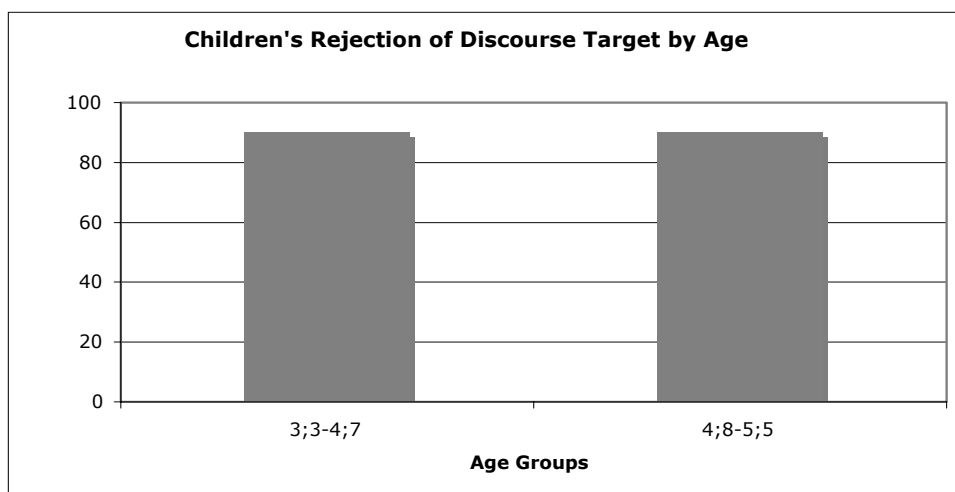


Figure 3: Younger and Older Children's Responses to the Discourse Targets

The 20 children were divided into two groups of 10, a younger group of children between 3;10 and 4;7, and an older group of children between 4;8 and 5;7. There was no difference in the performance of the two groups. Both the younger and older groups rejected the target at the same rate of 90% and the youngest child, age 3;3, performed perfectly. These results are unexpected on learning accounts, which expect younger children to perform poorly.

In conclusion, the results add to a growing number of studies showing that children's hypotheses about coreference relations are highly constrained early in the course of language acquisition, in line with Chomsky's proposal that children are biologically endowed with abstract knowledge of the grammar.

Notes

¹ Additional independent evidence to support the existence of this kind of ellipsis operation (i.e. sluicing) comes from case-matching connectivity effects, and preposition stranding across a wide variety of languages (see Merchant 2005 for details).

³ In experiments testing children's knowledge of constraints, a 90% rejection rate of the violating sentence form or meaning is usually taken to confirm knowledge of the constraint. The 10% error margin allows for performance errors due to warm-up effects, fatigue, inattention etc. Some explanation of the results is called for if the error rate exceeds about 10% (see Crain and Thornton 1998 for more on this assumption).

⁴ A sample pretest item is given below. Children were asked to judge the baby dinosaur puppet's statement as true or false. In this case, the child should reject the puppet's statement. If the child did not reject the sentence, the puppet acted confused and asked for clarification.

Chuckie: Hey, guys! Let's go play with some toys!

Lil: Yeah, great idea. I like skateboards. Maybe I'll play with the skateboard. But I got hurt last time, so I think I'll play with the ball to be safe.

Tommy: I'm not afraid of skateboards, I'll play with it.

Chuckie: Yes! I'm glad the jump rope is still left, it's my favorite!

(Scene ends with reminders in front of each character to show what they took)

Baby dinosaur: I know what happened! Lil took the skateboard.

⁵ Three data points were removed from children's responses to target item 1, since the 'Yes' responses were not due to an experimental design problem with the story. The target sentence was 'He went to Chuckie's base'. Since the story was about playing tag, to satisfy plausible dissent, Tommy started to go to Chuckie's base, but then had to turn around, since the base was full. However, the fact that he started to go to the base made the reading in which 'Tommy went to Chuckie's base' true, at least for some children. In this situation, all three children made clear that they interpreted the sentence correctly but they produced 'Yes' responses due to the nature of the story. Therefore, the data of these three children were excluded for this one experimental item.

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Appendix 1

Experimental Stimuli from Sessions 1 and 2

Session 1.

Target Sentences

1. I know what he opened. + Tommy's package.
2. I know which bear he played with. + Tommy's brown bear.
3. I know whose flower he picked. + Chuckie's blue flower.
4. I know where he went. + To Chuckie's house.

Forwards Anaphora Controls

5. I know whose shoes Tommy decorate with jewels. + His shoes.
6. I know whose cup Chuckie threw. + His cup.

Backwards Anaphora Controls

7. I know what his bear stuck to. + Chuckie's shirt.
8. I know whose present his mother bought. + Chuckie's present.

Session 2.

Target Sentences

1. He went to Chuckie's plant.
2. He slept in Tommy's bed.
3. He colored with Tommy's pencil.
4. He sat in Chuckie's blue chair.

Forwards Anaphora Controls

5. Chuckie drank his lemonade.
6. Tommy got his favorite color.

Backwards Anaphora Controls

7. His large plant stuck to Tommy's arm.
8. His favorite toy hurt Chuckie's foot.

Appendix 2

1. Story from discourse session designed to test Principle C.

(Spaceship flies over and drops three packages with the Rugrats' pictures on them)

Tommy: Oh, wow! These are for us! What should we do?

Chuckie: We should open them! I can open them up, because I have a new pair of scissors that can cut the ribbon off the package.

Tommy: Okay, that sounds like a good idea. Which one do you want to open?

Lil: I don't want mine opened. I want to bring the package home and show my mom, so she'll believe that a package really came down from a spaceship!

Tommy: Okay, you can do that, but I really want Chuckie to open mine. I'm so excited to see what's inside.

Chuckie: Okay, I'll open yours. (Chuckie picks up Tommy's package) Eew, your package has a slime ball on it. I don't want to get my brand new scissors dirty with alien slime. I'm sorry, I can't open your package. I can open my package though. (Chuckie opens his package). Wow! Ice cream! Yummy!

Tommy: I don't care about your scissors getting dirty, I'm going to open my package myself. With the slime, I can just slip the ribbon off. (Tommy opens his package). Wow! An alien! He's going to be my new best friend. See you later, guys! I'm going to play with my new friend.

Snail: I watched very closely, and I'm sure I know what he opened. Do you know baby dinosaur?

Baby dinosaur: Yeah! Tommy's package.

2. Story from discourse session designed to check backwards anaphora.

Chuckie: I have an idea! Let's play catch 'em with our bears.

Lil: Good idea!

Tommy: I don't know how to play catch 'em. Could you tell me?

Chuckie: Sure, it's easy. We all take our bears, and try to stick them on someone's shirt. The person who doesn't have a bear on their shirt wins!

Tommy: That sounds like fun.

Lil: Let's go.

Tommy: Hmm, who should I go after? This is my first time, so maybe I should stick this bear to Chuckie's shirt because he is closest to me. Let me try to catch him.

Chuckie: You can't catch me!

Tommy: I will stick this bear to your shirt!

Chuckie: (Chuckie trips, drops his bear) Oh no! I dropped my bear. There's no time to pick him up, I have to run before Tommy gets me!

Tommy: (tries to stick bear to Chuckie's shirt, but drops it) Oh, I just missed you. I wish I could have stuck my own bear on your shirt. Now I have no bear to use. Wait! I can use Chuckie's bear that he dropped. (picks up Chuckie's bear) I'm going to get you! (sticks bear to Chuckie's shirt) I stuck your bear on your shirt!

Chuckie: Oh, you got me. I'm out.

Lil: I'm so tired of running. I give up.

Tommy: Yay! I win!

Snail: I know what his bear stuck to. Were you paying attention, baby dinosaur?

Baby dinosaur: Ummm....Chuckie's shirt!