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Delay of Principle B in Spontaneous Speech

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Abstract

There is a debate over whether children exhibit a delay in the development of Principle B, one of three chief binding principles. The present study examines spontaneous speech data from nine children and identifies Principle B errors in third person pronouns. The study uses spectrographic analysis on a sample of utterances to determine the frequency of cliticized pronoun use. The results found that children do not make Principle B errors in spontaneous speech, and that they do not use shortened pronoun forms more often than fully pronounced pronouns.

Delay of Principle B in Spontaneous Speech

The Principle B debate has been ongoing for well over twenty years, and this experiment plays only a very small part in the understanding of child language acquisition. As the background cases have been thoroughly explained in most explorations of Principle B, instead I will briefly review what is directly relevant to the present study. Binding theory is, in essence, a set of rules governing whether two noun phrases (NPs) in a sentence may, must, or cannot refer to the same individual (i.e., person, place or thing). For two NPs X and Y, X "binds" Y if X "c-commands" Y and X bears the same "interpretive index" as Y. When X binds Y, Y necessarily denotes the same individual as X.

Principle A: An anaphor must be bound in its binding domain.

Principle B: A pronominal must be unbound/free in its binding domain.

Principle C: A referential expression must be free/unbound everywhere.

The "binding domain" is generally a single clause; Principle B has the effect that a pronominal (like *him* or *her*) in object position generally cannot be bound by the subject of its clause. Thus, "John_i likes him_i" is a violation of Principle B, while "John_i likes him_k" and "John_k likes himself_k" are both compatible with Principle B.

Through truth value judgment task experiments conducted in the 1990's, children judged forty to fifty percent of the time that the subject of a simple sentence can refer to the same individual as a pronominal direct object in the same clause. One of the most important of these experiments was that of Chien and Wexler in 1990, where children looked at pictures and responded to statements made about the picture.

Consider the following two sentences from Chien and Wexler (1990):

(1) "Mama bear is washing her / Is mama bear washing her?"

(2) "Every bear is washing her / Is every bear washing her?"

Chien and Wexler (1990) showed that some children allow a reflexive meaning for (1), seemingly in violation of Principle B. However, when the quantifier "every" is used in the subject NP, the children overwhelmingly disallow a bound (i.e. reflexive) reading of the pronominal, in accordance with Principle B. This is known as the Quantificational Asymmetry (QA), and indicates that the mechanisms operating in the quantificational sentences and the non-quantificational sentences are somehow different. Chien and Wexler, building on earlier work of Tanya Reinhart, proposed that there are two different ways for the NPs in a single clause to end up referring to the same individual.

One way is binding, but another is what Reinhart called "accidental coreference." For example, the indexing in "John_i likes him_i" is excluded by Principle B, but with the indexing "John_i likes him_k" one could in principle get the same meaning, if the index i and the index k happen to correspond to one and the same person. This type of accidental coreference is apparently excluded, given that adult English-speakers disallow a reflexive interpretation of "John likes him," but Principle B by itself is not sufficient to block it.

For sentences with a quantificational antecedent, such as "Every guy likes him", the picture changes. Accidental coreference is no longer possible (even in principle), because there is no single individual for "every guy" to refer to, and hence no single individual who could accidentally be picked out by two different indexes. The only way for a reflexive interpretation to arise is by putting the exact same index on "every guy" and "him," in violation of Principle B. (Here, coindexation would lead the sentence's interpretation to read as 'For every guy X, X likes X'.)

Rather than simply blame these errors on a lack of pure grammatical knowledge, Chien and Wexler maintain that while children do have the binding knowledge at this stage of development, they do not have the pragmatic knowledge to make the appropriate coreference judgment. Chien and Wexler proposed that the rules of pragmatics include Principle P, which states that a co-reference interpretation becomes unavailable without coindexation; the principle disallows one target to have multiple indexes.

As previously explained, it is impossible to violate Principle P when the antecedent is a quantifier. Moreover, accidental coreference would violate Principle P in “John likes him,” because it disallows two indexes to have the same target. By their results, children may inherently know Principle B, but their lack of knowledge of Principle P keeps them from properly interpreting sentences.

Thornton & Wexler’s results reached the same conclusion regarding children’s knowledge of binding. The researchers supposed that “The reason that children allow local coreference interpretations is that they create guises that are not supported by the context” (Thornton & Wexler, 1999), where ‘guises’ are distinct ways of viewing a single person. For adults, if there are two different guises available for the same individual, it is sometimes acceptable to have accidental coreference (e.g., in the sentence “Nobody likes John_k. Mary doesn’t like him_k, Sue doesn’t like him_k, even *John*_k doesn’t like him_k.”, where John is both the valid subject and object of a clause). The problem is not with the children’s knowledge of binding, but with the pragmatics of guises. In other words, the disconnect between the children’s binding knowledge and their pragmatic knowledge leads them to comprehend the sentence in a way that makes it true. For the sentence “Mama Bear washed her”, children simply treat Mama Bear as having one guise when she is the “washer,” and a different guise when she is being

washed (something incompatible with the pragmatics of adult speakers). By using a different index to refer to Mama Bear in each of her two guises, it becomes possible to avoid a Principle B violation.

In a similar vein, Grodzinsky and Reinhart (1993) suggested that children do have a delay in development of some aspects of language comprehension structures, but that it is also “directly traceable to the procedures required for computing coreference” (69). Consider, again, the following sentence:

(4) “Nobody likes John_k. Mary doesn’t like him_k, Sue doesn’t like him_k, even *John*_k doesn’t like him_k.”

For this sentence, adults will allow this instance of accidental coreference despite its violation of Principle P’s “one index per target” policy. Grodzinsky and Reinhart’s hypothesis suggests that maybe children are doing the same thing that adults do when they allow an exception in (4), but that they allow exceptions too frequently. Thus, while the binding and coreference abilities are innate, the children lack the computational capacity to properly utilize an overarching principle that governs the exceptions to Principle P. This overarching rule they called Rule I: Intrasentential Coreference, which states that “NP A cannot corefer with NP B if replacing NP A with C, C a variable A-bound by B, yields an indistinguishable interpretation” (79). When children do not know whether the speaker was permitted to use a referential pronoun instead of a bound pronoun when interpreting a sentence, they guess the answer, yielding the roughly 50% accuracy rate in comprehension tasks. Thus children often seem to violate Principle B in comprehension tasks, when they guess that the ‘accidental coreference’ indexing is compatible with Rule I (so that Principle B no longer applies), yet they generally obey Principle B when it comes to binding by quantifiers, because accidental coreference is always impossible

there. As children's brains mature and develop the needed computational resources, the tendency to guess disappears. Unlike Thornton and Wexler (1999), Grodzinsky and Reinhart did not use guises. They maintain that all the machinery needed for complex binding and coreference computation is available to children, but that they get confused in applying Rule I. This is because deciding whether you would have a different meaning if you allowed accidental coreference, as opposed to binding, means keeping track of multiple representations, which is so difficult that the kids give up and guess.

Contrary to Grodzinsky and Reinhart (1993), who maintain that children only disobey Principle B when it concerns referential antecedents as opposed to quantificational antecedents (the "quantificational asymmetry" or QA), Elbourne 2005 suggests that children do not obey Principle B in any situation (Elbourne 2005). In his research, he explains the three potential justifications for the performance asymmetry:

1. The Asymmetry Hypothesis, in which children's interpretation of Principle B reflects a real difference in the grammatical interpretation of bound and referential pronouns.
2. The Reference Hypothesis, which suggests that comprehension delays lead children to simply prefer referential readings over bound readings.
3. The Saliency Hypothesis, where the story used in the experiment leads children to relate binding to the most salient characters in the story.

Following these possibilities, Elbourne reviews several previous studies, and determines that QA seems to disappear in comprehension stories with more salient characters and narratives. He therefore asserts that, "the experiments that do not show the QA accurately reflect the state of the grammars of children learning English, while those that do show it do so because of experimental artifact" (358), asserting that the Asymmetry Hypothesis is reflects an actual QA in

the grammar. He also maintains that children have a genuine lack of understanding for Principle B, also known as a Delay of Principle B Effect (DPBE).

In response to Elbourne's challenge of the quantificational asymmetry, a group of researchers conducted the experiments described in "Equal Treatment for All Antecedents: How Children Succeed with Principle B" (Conroy, Takahashi, Lidz, & Phillips, 2009). Here, in addition to an extensive review of past studies, Conroy et al. conducted three experiments which carefully removed any "extragrammatical factors" that may be confounds in previous studies. Together, the three studies covered the issues of salience, contextual story details, the availability of an anaphoric pronoun reading, and the presence of DPBE and QA in stories with a "pronoun direct object NP and either a referential or a quantificational subject NP" (459). The combined results both support and fail to support the different proposals of Elbourne (2005).

Overwhelmingly, the results suggest that the QA disappears in the presence of carefully-constructed stories with highly salient characters, a result that vindicates Elbourne's Salience Hypothesis. However, there does not appear to be any significant violation of Principle B, a finding which challenges the very presence of the DPBE. In their final conclusion, Conroy et al. maintain that there is no QA and no apparent DPBE in a properly-conducted experiment, but they do concede that children for some reason seem highly susceptible to making Principle B errors in these types of experiments.

Interestingly, research by Bloom, Barrs, and Conway (1994) suggests that children do not exhibit any sort of DPBE in spontaneous speech. In their analysis of longitudinal data, they checked the children's use of first person pronouns (*me, myself*) and found that children have no trouble with the binding rules that govern speech. Their final conclusion is that children cannot possibly output utterances with correct use of Principles A and B unless they have inherent

knowledge of these principles. The question proposed by Conroy et al. (2009) becomes even more intriguing, then. Why is it that children are highly susceptible to making Principle B errors in comprehension tasks, yet competent in speech output? Conroy et al. conclude that comprehension experiments are simply not designed to adequately test the extent of children's grammar, but the question remains. Interestingly, the result of adult-like child speech from Conroy et al. also poses a problem for Principle P. Based on Chien and Wexler's (1990) conclusion that children's incorrect index assignment is due to their not yet having Principle P, one could imagine that if a child did not have Principle P, then a child would in theory freely assign indexes in spontaneous speech as well as in comprehension tasks. Given that the spontaneous data thus far seems to suggest that children speak with adult-like binding grammar, this is a small problem for Principle P.

Hendriks & Spenader (2005/2006) studied the comprehension/production gap in terms of an idea called 'bidirectional Optimality Theory (OT)'. In its barest form, bidirectional OT is essentially the two-way road behind accurate comprehension and production of sentences with binding. Based on their studies, an adult grammar consists of a bidirectional optimization. Children's accurate production but inaccurate comprehension suggest that children have only a unidirectional optimization, which means that children "must start to take into account not only their own alternative interpretations in comprehension but also the alternatives for production that were available to their conversational partner" (327). In the simplest terms, then, there appears to be an actual gap between production and complete comprehension that comes not from testing methods, but rather from the child's development of the binding principles (and their correct application).

In November of 2012, I attended the Child Language Development conference at Boston University. There, on behalf of himself and Wexler, Jeremy Hartman presented their (at this time) unpublished joint research on the Delay of Principle B Effect (J. Hartman, BUCLD lecture, November 2, 2012). There, he stated that in the testing condition of Conroy et al. (2009), the researchers used cliticized forms of the pronouns. Because clitic pronouns cannot be deictic, as per Avrutin & Wexler (1992), the children had no option but to choose the bound option and therefore could only give adult responses to questions requiring a referential response.

In order to resolve the discrepancy between the results of Conroy et al. (2009)'s data and their theory, Hartman & Wexler conducted an experiment with two different testing conditions. In one, the researchers used carefully-enunciated pronouns in relaying the story and asking questions, while in the other they used cliticized pronoun forms. The results suggested that the delay of Principle B effect was present in non-cliticized forms, and that the children's correct interpretations of Principle B were a result of cliticization present in the utterance.

What should logically follow from this result, as Hartman explicitly stated in the question period following his talk, is that one would expect children to succeed at Principle B in their spontaneous speech precisely because they are using cliticized forms of the pronouns. If children do not demonstrate Principle B errors in spontaneous speech, then their pronouns (at least in the sentences where Principle B is relevant) must be cliticized. On occasions when children use a non-clitic form of a pronominal pronoun, Principle B errors are expected to occur as often as they do in comprehension tasks.

This became my project. I endeavored to find the extent to which spontaneous child speech contains Principle B violations, and whether the children more often use clitic or non-clitic pronouns in their speech. In 2011, I conducted pilot research testing for Principle B errors

with first and third person pronouns, using longitudinal corpora from two children in the CHILDES database. Like Conroy et al. (2009), I found strong evidence that children make few first person errors, and some evidence that children make few third person errors. Because the pilot research of children's spontaneous speech seems to yield few errors, it does not make sense that binding errors would be exclusively restricted to non-cliticized forms as Hartman et al (2012) suggests. Based on the pilot data, my hypotheses were the following:

H1: Children correctly use the binding principles, including Principle B, in spontaneous speech.

H2: Children use non-clitic pronouns just as often, if not more often, than they do clitic pronouns.

H3: The frequency of Principle B errors will be approximately the same with clitic and non-clitic pronouns.

Method

Participants

As this quasi-experimental study used spontaneous speech data, the participants were children from the CHILDES database, whose parents previously consented to have the speech, video (in the cases of Lily, Naima, and William, from the Providence corpora), and transcripts hosted online. This study used three children from the Manchester corpora (Gail, Nicole, Ruth), three from the Providence corpora (Lily, William, Naima), two from the Brown corpora (Adam, Sarah), and one from the Sachs corpus (Naomi), totaling nine typically-developing children.

Their ages are as follows:

Naima: 0;11.28 – 3;10.10

Lily: 1;1.02 – 4;0.02

Naomi: 1;2.29 – 4;9.03

William: 1;4.10 – 3;4.15

Ruth: 1;11.15 – 2;11.21

Gail: 1;11.27 – 2;11.12

Nicole: 2;0.25 – 3;0.10

Adam: 2;3.04 – 5;2.12

Sarah: 2;3.05 – 5;1.06

Materials

The materials for this study included access to the CHILDES database and the files within it. The program CLAN was used to search for and compile specific information from the transcripts, and then the data was transcribed to a series of Microsoft Excel documents. For extracting sound from the video files saved from the Providence corpora, I used a program called Audacity, which ripped the sound files from the videos, converted them, and saved them as .wav sound files. For spectrographic analysis of the sound files, I used the program Praat. Save for Excel, all of these programs are available for legal free download from the Internet.

The utterances used for the spectrographic analysis part of the research were random in that I used every instance of a particular category. This totaled the complete number of utterances in which the subjects used a third-person pronoun preceded by a word ending in a plosive (for example: “I found him”, or “she hit him”). This particular type of utterance was chosen because it is the easiest to identify as clitic or non-clitic on a spectrogram.

Procedure

The first step was to find children eligible for the research. Using Snyder (2007) as a manual for the CHILDES corpora, as well as the descriptive manuals within each corpus, I selected the children based on age and normalcy of language development.

Using CLAN, I ran a series of commands to extract each child's use of the third person pronouns "him", "her", "himself", "herself", and a series of other pronouns that could be potentially relevant (including "itself", "hissel", and "themself"). I transcribed each utterance into a lab journal, marking the transcript and utterance numbers, as well as all or part of the utterance. In addition, I performed the same transcription on the children's parents' use of reflexive pronouns "himself" and "herself". Each utterance was then coded as described under "Analysis". The total number of coded utterances was 926.

For spectrographic analysis, it was impractical to obtain and analyze every use of relevant binding. Instead, I conducted both intuitive and spectrographic analysis on all of the utterances with the previously specified characteristics, totaling 140, to determine whether each pronoun was pronounced in its clitic or non-clitic form. Due to the nature of the sample, the results apply to the use of cliticization in third-person pronouns following a plosive sound.

Analysis

Once I had a full set of transcribed utterances for each child, I coded the data according to whether or not it obeyed the binding principles. In order to qualify for coding, the utterance had to include both a clear subject and a pronominal or reflexive direct object. The utterance was excluded if the latter pronoun was used as a possessive ("He combed *her* hair").

Additionally, fragments with an implied NP were coded if and only if I could derive the child's exact meaning from the transcript. For example, the utterance "find him!" was included if the child made clear that this utterance was a command to another person; validation came from

the parent's response, almost always an answer along the lines of, "Okay, I will find him." If the utterance stood alone as a fragment with no definite intention, or if the subject was merely parroting or responding to the parent, the utterance was not included. 76 utterances of this nature (Naima = 29, Adam = 14; Sarah = 9; William = 9; Lily = 5; Gail = 5; Naomi = 4, Ruth = 1; Nicole = 0) were included in the data.

I coded qualified utterances based on a 2x2 contingency table reflecting the appropriate pronoun in comparison to the pronoun used. The schema can be seen on Figure 1.

Here, an utterance such as "John_k saw him_i" would be marked as "D" for using the non-reflexive pronoun for a non-reflexive intention. "John_k saw him_k" would be marked as C, where the child intended reflexive meaning and used a non-reflexive pronoun. A sentence like "John_k saw himself_k" would be marked as A for appropriate use of the reflexive pronoun. Utterances like "John_k saw himself_i" would be marked as B for using a reflexive pronoun with non-reflexive intent.

For determining cliticization of pronouns, I used both auditory judgment and spectrographic analysis on every utterance.

In judging the pronouns based on sound, I listened to the entire phrase and determined whether the pronoun sounded cliticized. If the pronoun had a definite [h] sound, such as in "him" or "her", the pronoun was non-clitic. If the [h] was not audible, such as in the pronunciation of "I found 'im", the utterance was graded as clitic. Borderline cases were marked as ambiguous, and counted as clitic unless the spectrograph suggested otherwise.

For the spectrographic grading criteria, I looked for the visible presence of the [h] on the spectrogram between the end of the plosive and the start of the pronoun, as characterized by a band of light "static"-looking noise, as occurs with obstruents. Ambiguous cases (i.e., any case

without a visible and audible, isolated [h]) were marked as clitic. In the case where the intuitive and spectrographic analyses were not in alignment, I exercised conservatism by categorizing the pronoun by the visual spectrograph. Doubly ambiguous cases were marked as clitic. For examples of different spectrograms, see figure 2.

Results

To test the hypothesis that children use the binding principles with adult-like proficiency, I conducted separate two-tailed Fisher's Exact Tests on each of the subjects using the 2x2 contingency table (save for William, Ruth, and Nicole, none of whom used any reflexive third-person pronouns and therefore did not qualify for FET analysis), where T = the total number of graded utterances and E = the number of binding errors within the utterances. Lily (T = 152, E = 0), Naima (T = 141, E = 3), Adam (T = 239, E = 3), and Sarah (T = 200, E = 2) all yielded significant results, $p < .001$. Gail (T = 71, E = 0) and Naomi (T = 78, E = 0) were also significant, $p < .05$. Thus, for all six subjects whose utterances qualified for the test, the results show that the frequency with which the child chose the correct form is unlikely ($p < .05$) to have occurred by chance. See figures 3-8 for contingency tables. Note also that in addition to these statistical findings, for each child the number of possible Principle B errors was small in absolute terms, a combined total of 8 binding violations out of 926 utterances.

For the hypothesis stating that children do not use cliticized pronouns more than non-cliticized pronouns, the final data from the three Providence corpora showed that out of 140 spectrographically and intuitively graded utterances, 40 percent of those were clitic and the last 60 percent were non-clitic. On the individual level, Lily used clitic pronouns approximately 36 percent of the time and non-clitic pronouns 64 percent, given her 44 graded utterances. Out of William's 16 graded utterances, 14 of those were clitic, yielding an approximate 87 percent use

of clitics and a 13 percent use of non-clitics. Naima had 80 graded utterances, approximately 33 percent of which were clitic and 67 percent were non-clitic.

The final hypothesis stated that any binding errors produced were just as likely to be clitic as non-clitic. As there was only 1 codeable error out of 140 utterances, and that one error was pronounced as a cliticized form, the results suggest that the hypothesis is correct. Note that Naima made a total of three errors for all of her utterances, only one of which included the plosive sound that qualified it for the cliticization test.

I also ran two separate two-tailed Fisher Exact Tests on the subset of Lily and Naima's pronoun uses that were spectrographically identified as non-clitic. This was done using a pair of contingency tables, as was done for hypothesis 1, to assess proficiency in Principle B. For Lily the result was significant, $p < .05$. Naima results were also significant, $p < .001$. These results support the notion that even when using genuinely non-clitic pronouns, children use Principle B with adult-like proficiency. See figures 9 and 10 for their contingency tables.

Discussion

The results of this experiment show strong support for all three hypotheses presented in the study. In support of the hypothesis that children do not make binding errors in speech, the analysis conducted on the spontaneous speech data suggests that children do not make many errors with Principle B. Not only do children use the correct pronouns to relay their reflexive or non-reflexive intention, but do so with extreme proficiency; in almost a thousand relevant utterances, eight errors was found in total, where children intended a reflexive meaning and used a non-reflexive pronoun (such as "he_i needed to get him_i an umbrella" or "he_i hit him_i"). In none of the utterances did any of the children make an error where they intended non-reflexive

meaning and used a reflexive pronoun. These results make it rather clear that children have the knowledge of grammar needed at least to produce adult-like sentences.

The more novel aspect of this research addresses the use of clitic pronouns in child speech, with the results supporting the hypothesis that children use non-clitic pronouns just as often, if not more often, than clitic pronouns. Lily and Naima both used non-clitic pronouns a larger percent of the time than they used clitic, and while William did use clitic pronouns far more often than not, his low sample of 16 utterances is debatably too small to determine whether he selected by chance alone. Moreover, the analysis of Principle B use conducted on the spectrographically analyzed utterances included only one error, which occurred when the subject was using a clitic pronoun. This result supports the third and final hypothesis, that children's speech errors have little to do with pronoun selection (though, again, the low number of errors means this is merely an anecdotal finding).

Interestingly, the combination of these three affirmative hypotheses directly opposes the findings of Hartman et al. (2012) in their truth value judgment tasks. The research that Hartman orally presented in Boston suggests that children's correct interpretation of Principle B relies on the speaker's use of clitic pronouns. If comprehension failings are restricted to non-clitic pronouns, and the assumption is that the same applies for production, one would expect that the Principle B violations would be restricted to non-clitic forms, and also that when a non-clitic form is used, errors will occur frequently in spontaneous production (as they do in comprehension tasks). The present study, however, demonstrates that the pronoun's enunciation makes little difference in the use of Principle B. Children produce speech with a high level of accuracy, regardless of whether they speak more with clitic or non-clitic pronouns. Like those of Conroy et al. (2009), my results suggest that children have adult-like competence on Principle B,

thus implying that children's difficulty applying Principle B in well-designed comprehension tasks is compatible with some other reason, possibly a genuine production/comprehension asymmetry.

The question still remains, however, why several decades of research have led researchers to believe that children exhibit a Delay of Principle B Effect and Quantificational Asymmetry. As discussed in Conroy et al. (2009) and the meta-analysis conducted by Elbourne (2005), the QA disappears with careful experimental design, where the characters in the story are salient and their actions are specific within the story. But can all the research that finds children have an acquisition lag really be dismissed in terms of experimental confounds? Clearly, in spontaneous speech children do not solely encounter situations with salient people and clear ideas, yet their production remains pristine from Principle B errors. We must look again at the alternatives.

Elbourne (2005) had three hypotheses for children's susceptibility to Principle B errors. The Salience Hypothesis was supported by Conroy et al. (2009) with their use of highly salient characters; the characters in the stories all had distinguishable names and characteristics, which facilitates the child's task of referring to a specific character and lessens the likelihood for confusion in assigning indexes. The Asymmetry Hypothesis suggests that children's interpretation of Principle B reflects an actual difference in the way the children's grammar approaches referential and bound readings of pronouns, but Conroy et al. suggests that this is not the case.

This leaves the Reference Hypothesis, which points to a comprehension delay and, thus, a comprehension/production gap. This hypothesis would be supported by Grodzinsky & Reinhart (1993), in their claim that children do not yet have the computational brainpower to decide

whether the speaker is permitted to use a referential pronoun in place of whether to use a referential pronoun versus a bound pronoun, which becomes apparent in comprehension tasks. Moreover, in speech production children show little grammatical conservatism and few errors with deciding whether or not to have reflexive intent—if the mechanism for Principle B were underdeveloped, children would likely avoid expressing reflexive meanings, which they do not. This, again, points to a potential comprehension/production asymmetry. When a child is speaking, she knows what she wants to say, and can choose a corresponding indexing with little computational strain. However, when the child is listening to someone else speak, and then is deciding whether that person spoke truthfully, a great deal more computation is needed.

While my findings cannot necessarily disprove this theory, they go toward clarifying the reason for the different outcomes of comprehension tasks. On some tasks, the children perform with adult-like proficiency, and on others they regularly make Principle B errors. By pointing to cliticized speech as a means of dismissing the results of Conroy et al. (2009) as experimental flaws, Hartman et al. protects the idea of a comprehension deficit. There is certainly a reason why more salience-oriented stories lead children to better performance on these sorts of tasks. As evidenced by the results in the present study, children's difficulties with non-clitic pronouns seems restricted to comprehension. Additionally, one should note that Elbourne (2005) cites a study in which children were compared to adult controls for a comprehension task, and the adults accepted the Principle B violation 11% of the time at maximum, compared to children's roughly 40% error rate. The fact that adults accepted the violation at all is peculiar to me, the only potential explanation being some vagueness in the experiment itself that lead the adults to adults astray. I am therefore inclined to believe that the comprehension experiments yielding non-adult responses, rather than the children's grammar, are flawed.

Like all studies, the present research has its limitations. Perhaps the most important is that I designed the experiment to focus solely on the children's speech, rather than the combination of speech and action. While video footage was used to clarify in cases where Principle B use was unclear in the transcript and audio, most of the children did not have video information available. This lack of video also means that I am at this point unable to determine what other factors may have been at play in the child's use of pronouns; a child may respond to an adult's gesture, have some alternative reason besides pure grammatical intent for using the pronouns that they chose, or supplement their response with a deictic gesture.

I also ran into several complications while grading the spectrographic information. Specifically, the principle of coarticulation sometimes caused blending that made sounds difficult to distinguish from one another, or changed the plosive sound to something else. For example, the ending of non-vocalized [k] was difficult to distinguish from the onset of [h] on the spectrogram. Even if the [h] was present both in the audio and on the graph, there was often a release of breath accompanying the stop consonant that is debatably not an [h]. I tended to grade conservatively, even in these cases, though took into account that the vagueness of "I like him" pronounced in its full form is still different from the obviously cliticized "I like 'im", as was sometimes found.

In a broader sense, coarticulation sometimes affects the way that the word as a whole was enunciated. Even when the pronoun was not reduced, the plosive was often phonologically changed so that it did not actually sound like a plosive when it was pronounced (i.e., pronouncing the full [t] as in "write" without full pronunciation of the [t]). This does not affect the results of the experiment, but suggests that more than purely "plosive" sounds were analyzed in this sample. However, in the future researchers may want to look at speech sounds more

broadly, in order to definitely say whether cliticization impacts different speech sounds in a more profound way than it does for plosive sounds.

Future research with spontaneous speech data should focus on the comprehension aspect of language knowledge. To more soundly reject Hartman et al. (2012)'s hypothesis that children's successful application of Principle B relies on the use of clitic pronouns, there should be more analysis of the relationship between the speaker and listener in conversation. Collecting, performing spectrographic analysis on, and coding both parent and child utterance data would show whether children's understanding of parent intention depends on the parent's use of clitic versus non-clitic pronouns. Based on my own experience with the audio and transcripts, the children had little trouble with understanding their parents, regardless of whether the parent used clitic pronouns or not. However, as I have no numerical data to support this claim, the point should be held only as an unofficial observation, and perhaps a place to begin future research.

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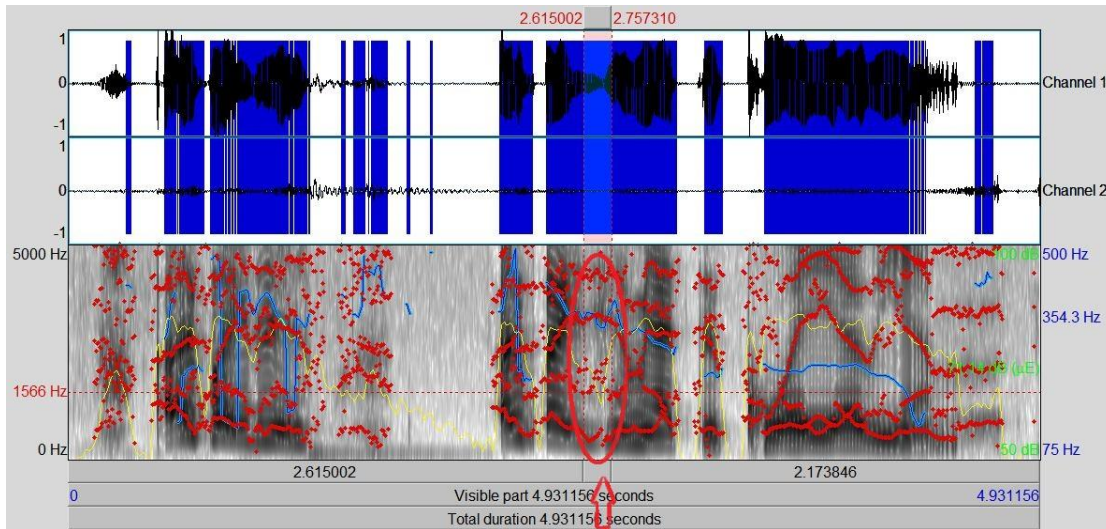
Special thanks to Dr. William Snyder, for his knowledge and guidance through this project.

Figure 1. Grading Criteria Contingency Table

		Pronoun Required	
		Reflexive	Non-R
Pronoun Used	Reflexive	A	B
	Non-R	C	D

Figure 2 (a & b). Examples of Spectrographic Analysis

- a. Sentence: “I bought him at the (a)quarium.” The [h] is marked by a brief indication of air exhalation following a plosive, without vocal fold vibration until the onset of the consonant.



- b. Utterance: “Let’s go find him.” The clitic is characterized by a lack of a “gap” following the plosive, in which there is no [h] indication and no delay between the end of the plosive and the onset of the following vowel.

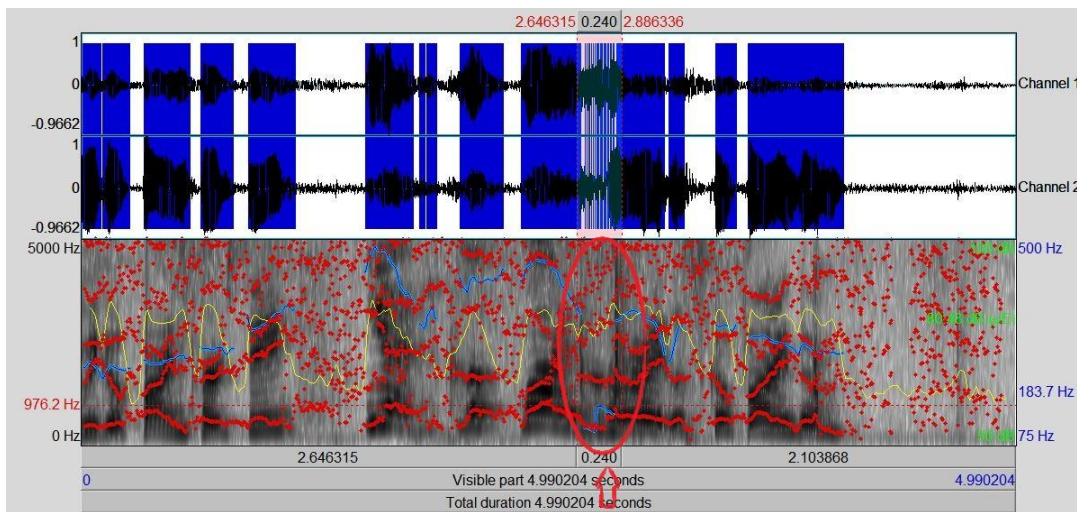


Figure 3. Lily – contingency table for binding errors in spontaneous speech.

Pronoun Required

	Column1	Column2	Column3
Pronoun Used		Reflexive	Non-R
Reflexive		2	0
Non-R		0	150

2-tailed FET $p < .001$

Figure 4. Naima – contingency table for binding errors in spontaneous speech.

Pronoun Required

	Column1	Column2	Column3
Pronoun Used		Reflexive	Non-R
Reflexive		11	0
Non-R		3	127

2-tailed FET $p < .001$

Figure 5. Naomi – contingency table for binding errors in spontaneous speech.

Pronoun Required

	Column1	Column2	Column3
Pronoun Used		Reflexive	Non-R
Reflexive		2	0
Non-R		0	76

2-tailed FET $p < .05$

Figure 6. Gail – contingency table for binding errors in spontaneous speech.

Pronoun Required

	Column1	Column2	Column3
Pronoun Used		Reflexive	Non-R
Reflexive		1	0
Non-R		0	70

2-tailed FET $p < .001$

Figure 7. Adam – contingency table for binding errors in spontaneous speech.

Pronoun Required

	Column1	Column2	Column3
Pronoun Used		Reflexive	Non-R
Reflexive		5	0
Non-R		3	231

2-tailed FET $p < .001$

Figure 8. Sarah – contingency table for binding errors in spontaneous speech.

Pronoun Required

	Column1	Column2	Column3
Pronoun Used		Reflexive	Non-R
Reflexive		6	0
Non-R		2	192

2-tailed FET $p < .001$

Figure 9. Lily – contingency table for binding errors for non-clitic pronouns.

Pronoun Required

	Column1	Column2	Column3
Pronoun Used		Reflexive	Non-R
Reflexive		2	0
Non-R		0	13

2-tailed FET $p < .05$

Figure 10. Naima – contingency table for binding errors for non-clitic pronouns.

Pronoun Required

	Column1	Column2	Column3
Pronoun Used		Reflexive	Non-R
Reflexive		11	0
Non-R		0	16

2-tailed FET $p < .001$