

Children's Grammar of Null Subjects: Evidence from Comprehension

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The null subject (NS) stage is one of the best-described hallmarks of first language development. We present a series of experiments assessing children's interpretation of NS sentences, as a way of testing the two main competing analyses of the phenomenon: grammatical accounts, under which young children's grammars license NSs in declarative sentences; and performance accounts, which hold that children have an adult grammar, but omit subjects in production for extrasyntactic reasons. Overall, we find evidence of an NS stage in comprehension, just as in production. This suggests that child and adult grammars differ, in line with grammatical accounts.

Keywords: first language acquisition, comprehension, null subject, child grammar, imperatives

1 Introduction

1.1 *The Null Subject Stage*

Subject omission is a salient feature of early language production. It begins at roughly age 2, when children begin producing multiword utterances, and it lasts, on average, until age 3½ (Guasti 2002). While first noted in English-speaking children (1a) (L. Bloom 1970), this phenomenon can also be observed in a variety of other non-null subject languages, including, but not limited to, Danish (Hamann and Plunkett 1998), Dutch (De Haan and Tuijnman 1988, Weverink 1989, Haegeman 1995), French (Pierce 1989, Rasetti 2003), and German (Hamann 1992, Behrens 1993, Krämer 1993) (1b–e).

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- (1) a. *Falled in the briefcase.* (English: Eve 1;10, Brown 1973)¹
 b. *Ikke tøre traktor.* (Danish: Jens 2;0, Hamann and Plunkett 1998)
 not drive tractor
 c. *Eerst kleine boekje lezen.* (Dutch: Hein 2;6, Haegeman 1995)
 first little book read
 d. *Va sous la tabouret.* (French: Philippe 2;2, Suppes, Smith, and
 goes under the stool Leveillé 1973)
 e. *Hubsauber putzn.* (German: Andreas 2;1, Krämer 1993)
 helicopter clean

What is notable about the examples in (1) is that in these languages, subject omission is not a grammatical option in the adult language, except in special syntactic or discourse environments. In English, for example, finite null subject sentences are only grammatical as imperatives (2); in informal conversational contexts with either expletive constructions (3) or questions involving auxiliary drop (4); and in a discourse register known as diary drop (5), in which the author of a letter or a diary entry drops the subject, which is typically, though not exclusively, first or second person (Haegeman 1990).

- (2) *Eat your dinner!*
 (3) *Looks like it's going to rain today.*
 (4) *Want another beer?*
 (5) *Talked to Mom yesterday. Don't know why she won't learn to text.*

In adult Dutch and German, topics may be dropped, but this requires a finite verb in second position (6). Children acquiring these languages, however, also regularly drop subjects in non-verb-second contexts—that is, in sentences with an infinitival verb in final position (7) (e.g., Weverink 1989, Haegeman 1990, Krämer 1993).

- (6) *(Ich) habe es gestern gekauft.*
 (I) have it yesterday bought
 'I bought it yesterday.'
 (7) *Taartjes bakken.* (Dutch: Tobias 1;10, Weverink 1989)
 cake.DIM.PL bake.INF
 'Bake pastries.'

Another striking feature of the null subject (NS) stage is that subject omission is optional (Hyams 1986). During the same period in which children drop subjects in some sentences, they

¹ Many of the child language examples reported here are taken from other sources. In each case, we have provided the glosses/translations as given by the original author(s).

also produce them in many others. The frequency of subject omission varies across individual children, across languages, and within the same child across time.² The individual variation is complicated by the fact that different researchers use slightly different sampling and coding criteria for identifying NS sentences. For English, reported percentages of NS sentences in children's spontaneous speech range from 10% (Eve, ages 1;6 to 2;3, as reported in Phillips 1995, Sano and Hyams 1994) to 57% (Adam, ages 2;3 to 2;7, as reported in P. Bloom 1990, Hyams and Wexler 1993). Putting frequency aside for the moment (we will return to this in section 3.2), what seems abundantly clear is that young children acquiring English and other non-NS languages freely omit subjects in contexts where this is ungrammatical for adults.³

1.2 Grammatical and Performance Accounts of the Null Subject Stage

The NS stage (and also the widely discussed root infinitive stage) are of extreme interest because they stand in marked contrast to many other areas of development, in which children appear to have adult knowledge of their language from the earliest ages.⁴ Attempts to explain this non-target-like behavior illustrate the long-running debate about the effects of competence and performance in language acquisition. Some accounts consider children's erroneous productions to reflect a difference between the child and adult grammars (e.g., Hyams 1986, 1992, Hyams and Wexler 1993, Rizzi 1994, 2000, Yang 2002, 2004). These accounts claim that the early grammar derives NS sentences in declarative contexts, in the form of either Italian-like null pronominals (Hyams 1986), Chinese-like null topics (Jaeggli and Hyams 1988, Yang 2002, 2004), or 'root NSs,' a null element restricted to root contexts (Rizzi 2000, 2005).

In contrast to grammatical accounts, performance accounts hold that subject omission is due to extrasyntactic factors, such as limitations on memory, planning, and production capacity (L. Bloom 1970, P. Bloom 1990, Valian 1991) or an early preference for a trochaic metrical structure that NS sentences satisfy (Gerken 1991). On this view, children's syntactic representations include

² Various studies have reported on the frequency of NSs in different children at different ages and speaking different languages. An in-depth discussion is not directly relevant to the comprehension study reported on in this article. For more detailed statistical information on NSs in production, see P. Bloom 1990, Hyams and Wexler 1993, Hoekstra and Hyams 1995, Hamann and Plunkett 1998, Rasetti 2000, and Yang 2002, among many others.

³ As a reviewer notes, a further question is whether children drop subjects in pronominal contexts (where an adult speaker would use a pronoun) or whether children are dropping full lexical NP subjects. This issue is discussed at length by Hyams and Wexler (1993), who show that over time, as NSs decrease, pronoun subjects increase, with the proportion of lexical NP subjects remaining roughly constant. The trade-off between pronouns and dropped subjects strongly suggests that the same discourse givenness requirements that hold in adult English for pronouns apply to child English for dropped subjects and hence that children are sensitive to the pragmatic factors governing NS use. This sensitivity is supported by recent findings that look at the discourse contexts of children's NSs and pronouns (e.g., Hughes and Allen 2006). Hyams (2011) reviews various results concerning the discourse conditions on early NSs.

⁴ See Wexler 1994 and Hoekstra and Hyams 1995 for discussion of children's early target-like parameter settings and knowledge of morphosyntax. Wexler refers to the phenomenon as very early parameter setting (VEPS) and Hoekstra and Hyams as early morphosyntactic convergence (EMC).

an overt subject, just as adults' representations do, but the subject is dropped in production because of these other influences.

Viewed against spontaneous speech data, production accounts face a number of empirical difficulties. Here, we will briefly outline some of the arguments against processing and metrical accounts (see Hyams 2011 for a more in-depth discussion of the issues involved).

First, processing accounts take as their premise that the more resources the child uses to produce the subject, the fewer are available to support the presence of other complex material in the sentence. One early observation due to L. Bloom (1970) is that subjects are dropped more often when the child's utterance contains negation. In addition, P. Bloom (1990) finds an inverse correlation between the length of children's VPs and the heaviness of the subject:⁵ VPs are shortest in sentences with lexical subjects, longer in sentences with pronouns, and longest when the subject is omitted. This VP length effect has been noted for English-speaking children in both spontaneous speech (L. Bloom 1970, P. Bloom 1990, Valian 1990) and elicited imitation (Valian, Hoeffner, and Aubry 1996).⁶

Using the same methodology, however, Hyams and Wexler (1993) also found a relationship between VP length and subject heaviness in adult speakers of Italian, an NS language. As Italian-speaking adults presumably are not constrained by the same processing limitations as children, the parallel findings suggest that the VP length effect has little to do with production constraints, but rather is associated with some—possibly pragmatic—property of NS languages. While this is not evidence against a processing account per se, it calls into question one of the key pieces of evidence for such an explanation.

A further observation is that subject drop in early English occurs at a far higher frequency than object drop (Brown 1973, L. Bloom, Miller, and Hood 1975, P. Bloom 1990, MacWhinney and Snow 1985, Valian 1990). To explain this, P. Bloom (1990) proposes that the processing load is greatest at the beginning of the sentence, causing children to preferentially drop that material. In English, however, subjects also drop in post-*wh* contexts (Roeper and Rohrbacher 1994, Bromberg and Wexler 1995). This is unexpected on a processing account because in this case it is the first-position *wh*-phrase that should drop, rather than the subject.

⁵ P. Bloom (1990) specifically assumes that full lexical subjects impose a greater processing load than pronouns, and that a dropped subject imposes the lightest load. Thus, the probability of omission is a function of the heaviness of the subject. Experimental evidence speaks against this assumption: both Gerken (1991) and Valian, Hoeffner, and Aubry (1996) have found that in elicited imitation, young English-speaking children are more likely to omit pronouns than full NPs. In addition, it is at odds with findings from adult language, showing that comprehending pronouns, which must be linked to an antecedent, is more computationally demanding than processing lexical items. See Hyams 2011 for further discussion.

⁶ Hamann and Plunkett (1998) have also noted this effect in the spontaneous speech of Danish-speaking children. Interestingly, they also find that overall MLU (mean length of utterance) is shorter in subjectless sentences than in sentences with subjects, meaning that processing resources, as measured by utterance length, do not determine subject omission.

Finally, the grammatical contingencies that exist between missing subjects and other parts of the sentence also argue strongly against a pure processing account. For example, in languages such as German, Dutch, Swedish, and Flemish, subjects drop disproportionately often with root infinitives⁷ and other nonfinite forms, as compared to finite verbs. The same asymmetry is noted in English in *wh*-questions, which have a much higher rate of subject omission with nonfinite (bare) verbs than finite verbs (Roeper and Rohrbacher 1994, Bromberg and Wexler 1995). At best, this relationship remains unexplained by a processing account. At worst, it runs directly counter to what is predicted if sentence complexity is the conditioning factor for dropped subjects. A finite VP should recruit more processing resources than an infinitive and thus cause a higher rate of subject omission, contrary to fact.

A similarly unpredicted characteristic of early English is that subjects are regularly dropped with lexical verbs, but not modals (Valian 1990). Additionally, subjects are rarely dropped with inflected forms of the copula *be* in either early English (Sano and Hyams 1994) or early Danish (Hamann and Plunkett 1998). Again, these tendencies fail to support processing models, which predict more subject drop with the additional complexity of a modal or auxiliary.⁸

Like the processing limitations model, a metrical analysis (Gerken 1991) fails to explain these syntactic contingencies—for example, why subjects are more likely to be omitted in root infinitives than in finite clauses in many languages. Also, as noted by Hamann and Plunkett (1998), the metrical account does not generalize easily to other languages. In German, for example, non-clause-initial subjects are omitted to a much higher degree than in-situ objects, although the metrical structure is the same (Hamann 1996); and in French, object clitics are dropped from both iambic and trochaic feet (Hamann, Rizzi, and Frauenfelder 1996, Jakubowicz et al. 1996).

⁷ As first noted by Guilfoyle (1984), at the same time that children omit subjects, they also optionally produce main clause declaratives with infinitival verb forms (i), alongside the target finite forms.

(i) *Eve sit floor.* (English: *Eve 1;7*, Brown 1973)

Root infinitives have since been documented in the same set of languages in which children's speech displays non-target-like NSs, including Danish (Hamann and Plunkett 1998), Dutch (Weverink 1989, Haegeman 1995), and French (Pierce 1989, 1992, Rasetti 2003). This link is bidirectional; children acquiring true NS languages such as Italian, Spanish, and Portuguese rarely produce root infinitives (Sano and Hyams 1994, Wexler 1994).

⁸ A reviewer suggests that processing models also fail to account for the crosslinguistic differences in NS use (Boster (1994) makes the same point). The logic of the argument is that Italian-speaking children (Valian 1991), and also Chinese-speaking children (Wang et al. 1992), drop subjects at rates that are comparable to adult speakers of those languages, an NS language and a topic drop language, respectively. If (English-speaking) children are dropping subjects because of processing limitations, why would these limitations not also affect Italian- and Chinese-speaking children, who might therefore be expected to drop at higher rates than adult speakers?

Although we are sympathetic to this line of reasoning, we don't find it persuasive for the following reason: Assuming for the sake of argument that children do drop subjects for processing reasons, it is evident from the data that the processor does not require 100% omission, as children do use subjects to varying degrees (differing as a function of language, child, age, etc.). It is therefore entirely possible, a priori, that the normal pragmatically determined rates of subject omission in NS and topic drop languages are sufficiently high that no additional dropping is required by the young child's processor. This idea also seems implicit in Rizzi's (2005) proposal that (English-speaking) children begin with a positive setting of the (root) NS parameter because this is a computationally less costly option, while Italian-speaking children satisfy the computational requirements of the processor by virtue of having a pro-drop grammar.

Finally, as Valian, Hoeffner, and Aubry (1996) observe, the metrical account also fails to explain their imitation findings showing that expletive subjects are omitted more often than referential subjects, and that pronominal subjects are dropped more often in contexts in which a prior referent has been established for the pronoun (see footnote 3). In both of these cases, metrical factors are held constant.

Setting aside the production data, what is most relevant to the present study is that performance and grammatical accounts make different predictions regarding how children will *comprehend* NS sentences. Grammatical accounts predict that English-speaking children can interpret NS sentences as grammatical declaratives, as would adult speakers of an NS language. Performance accounts, however, which hold that omission is caused by production bottlenecks rather than different grammars, predict that children should interpret NS utterances in an adult manner. Thus, for English-speaking children, only an imperative or diary reading for NS sentences should be possible, not a declarative reading. Our experiments, to be discussed in section 3, are designed to test these competing predictions.

Among proponents of grammatical accounts, there has been serious debate about the precise grammatical characterization of the child's NS grammar, and also about the mechanism responsible for the change to the correct, adult grammar—whether it involves statistical regularities or other aspects of input, maturation of some biological characteristic, or a combination of the two. This issue is beyond the scope of the present study, whose goal is to determine whether children's comprehension of NS sentences is more consistent with a grammatical or a performance account. The experiments described in the following sections were not designed to evaluate competing grammatical accounts. To the extent that our results show that children allow NS sentences with declarative readings, they would support a competence-based approach and, as far as we can determine, would be consistent with any analysis in which children grammatically represent NSs.

As our experiments also test children's interpretation of imperative sentences, in the following section we provide some background on the production of imperatives in child and child-directed language.

2 Imperative Sentences in Spontaneous Production and in the Linguistic Input:

A CHILDES Study

As noted above, the grammatical contexts for subject omission in adult English are limited. Imperatives are one case, and young children seem to correctly interpret and produce imperative sentences, including NS imperatives, from the earliest ages. Thus, children's nonadult declarative NS sentences are *in addition to* their NS imperatives.

Various authors have observed that imperatives are used quite regularly by English-speaking children as young as 2. For example, Menyuk (1972) reports that all the youngest children in her study (aged 2;10 to 3;1) used imperatives. Similarly, Klima and Bellugi-Klima (1971) report that the three children they studied used imperatives by their Period 2 (ages range from 20 to 36 months). Ervin-Tripp (1977) found that young children use different kinds of directives at different ages (imperatives, requests, need statements, hints, etc.). Imperatives are included among direc-

tives used by children before age 2. She also notes that imperatives are still the dominant form of directive at age 3.⁹

Interestingly, by age 2 children seem able to modify the form of their directive depending on interlocutor. Thus, Lawson (1967) observes that the 2-year-old he studied used almost exclusively imperatives with her peers, but used desire statements or questions with adults.

With respect to the child's input, various studies note that imperatives are a frequent occurrence in motherese (see Snow and Ferguson 1977). In terms of frequency, Bellugi (1967), for example, observes that about 15% of negative structures in mothers' speech to children are imperatives. More generally, Gleitman, Newport, and Gleitman (1984) found that imperatives constitute about 16% of the input up to 2 years; and in an earlier study, Newport, Gleitman, and Gleitman (1977) put the figure at around 18%, with maternal use of imperatives decreasing as MLU (mean length of utterance) increases.

In terms of imperative comprehension, little controlled experimental data has been collected. However, several early studies, most famously Shipley, Smith, and Gleitman 1969, found that children in the telegraphic stage respond most often to well-formed, adult imperatives.

Despite general agreement that imperatives are used by children early on and also occur frequently in their input, there is little in the way of quantitative studies of imperative use in English acquisition. Because our study crucially relies on the child's being able to understand imperatives, we wanted to first examine the range of imperative types in spontaneous production and in the input to the child during the NS stage. We conducted a study of the speech of Alex, in the Providence corpus of the CHILDES database, analyzing 24 of his sessions from a one-year period between 2½ and 3½ years old. (This approximates the age range of the children in our experiments.) Throughout this entire period, Alex is in the NS stage, dropping the subject in 22%–40% of declarative contexts.¹⁰ We looked at the kinds of imperatives both he and his mother produced, as well as their frequency.

We counted imperatives of the following four types: imperatives beginning with *please* (8a), vocative imperatives (8b), imperatives beginning with temporal adverbs (8c), and simple imperatives in which the subject is dropped (8d).

- (8) a. Please let Mommy get by you, sweetie.
- b. Alex, move.
- c. Now put your toys away.
- d. Put it right there.

⁹ Similar observations are made for Italian by Bates (1976). More recently, Salustri and Hyams (2006) looked at imperatives in the language of children acquiring Italian and German and in the adult input to these children, finding a high rate of imperatives both produced by children and present in the adult input for even the youngest children they studied.

¹⁰ Criteria for identifying a child as being in the NS stage are described in section 3. In all transcripts, Alex meets our requirements.

Table 1
Percentage use by imperative type, CHILDES study

Imperative type	Adult #	Adult %	Child #	Child %
<i>Please</i>	113	4.6	25	3.0
Vocative	153	6.2	220	26.7
Temporal adverb	374	15.1	12	1.5
Simple (null subject)	1,837	74.2	566	68.8
Total	2,477	100.1	823	100.0

Transcripts were analyzed by two independent coders, with a third coder acting as a tie-breaker. For all transcripts, the intercoder reliability rate was higher than 93%. Percentage use of each imperative type is shown in table 1.

Both in the input to Alex and in his own speech, simple imperatives are more than twice as frequent as all other imperative forms combined. The example in (9) is a case in point. Alex has just refused to pick up his toys and then points to his mother.

(9) Clean up my mess!

Alex's results are thus consistent with earlier (nonquantitative) reports cited above. Children in the NS stage are not only hearing NS imperative sentences, but also producing them, alongside their nonadult NS declarative sentences. With this in mind, let us now turn to our comprehension experiments.

3 Experiment 1: Children's Comprehension of Null Subject Sentences

In order to evaluate children's comprehension of NS sentences, we conducted a modified version of a truth-value judgment (TVJ) experiment (Crain and McKee 1985, Crain and Fodor 1993). In a TVJ task, the child views a story and then listens to a comment made by an observing puppet. The child is then asked to decide if the puppet—or in our case, a stuffed animal named Mr. Bear—has made a comment that matches the scenario, or one that does not.¹¹ When our task was explained to the children, they were asked to be Mr. Bear's teacher for the day, telling him if his statements were right or wrong, and why.¹²

¹¹ An anonymous reviewer points out that this task differs very slightly from most TVJ tasks in that strictly speaking, we are not asking the child to assess the truth value of the utterance; rather, we are asking whether it is appropriate for the puppet to utter it, given the scenario. As our task still requires the child to have an adult-like grammatical representation of each test item to assess its appropriateness, this seems an acceptable and useful extension of the typical TVJ methodology.

¹² The TVJ task has been used successfully with children as young as 2. For example, using this task, Crain and McKee (1985) provided clear evidence that 2- to 5-year-old children obey Principle C of the binding theory (Chomsky 1981) in accepting backward anaphora. Barner, Chow, and Yang (2008) adopted the TVJ task to test quantifier and numeral comprehension in 2-year-olds. For more discussion, see Gordon 1996.

Table 2

Experiment 1 participant details

Group	Age range	Mean age	<i>N</i>
2;6–2;11	2.54–2.96	2.79	10
3;0–3;5	3.06–3.33	3.18	10
3;6–3;11	3.56–3.97	3.78	10
Total	2.54–3.97	3.25	30

3.1 Methods

3.1.1 Participants Thirty children (13 boys, 17 girls) were tested in daycare centers around Los Angeles, with 10 children in each six-month interval between 2½ and 4 years (2.54–3.97 years, mean age 3.25). To reach this goal total of 30 children, 6 additional children were tested; their data were eliminated because they did not pass one or both of the control conditions discussed in the following section.

The three age groups were chosen to capture the entire span of the NS stage. On the basis of previous production data gathered from children, we expect virtually all of the children in the youngest age group to be in the NS stage, and virtually all of the children in the oldest age group to have exited that stage. The middle age, 3–3½ years, is the period in which children exit the NS stage, and variation should be found: we expect some children to be still in the NS stage, and others to have passed out of it. Participant details are shown in table 2.

3.1.2 Experimental Design and Materials We used a within-subjects design to test children on three sentence types, shown in table 3 with the relevant adult judgments: finite habitual declarative clauses (10), imperative commands using *please* (11), or NS sentences (12).¹³

(10) They always play with blocks.

(11) Please play with blocks.

(12) Play with blocks.

Table 3

Example items with adult judgments, Experiment 1

Example items	Big kids picture	Little kids picture
They always play with blocks	Correct	Silly
Please play with blocks	Silly	Correct
Play with blocks	Silly	Correct

¹³ Playing with blocks was one of four scenarios. The other scenarios involved eating a cookie, drawing a picture, and putting on socks.

Each condition was tested eight times, with 4 true and 4 false items, for a total of 24 test items. The test items were pseudorandomly ordered such that children were not tested on the same condition more than twice in a row.

The uninflected form of the verb was used in the imperative and NS conditions, because grammatical *please*-imperatives in English require the use of the bare verb, as do NS imperatives. Presenting children with grammatical test sentences is necessary in a TVJ task, because it is unclear whether a child's acceptance or rejection of an ungrammatical sentence reflects linguistic competence or a desire to succeed on the task. In order to make the declarative condition as comparable as possible to the other two, the plural subject *they* was used, making it possible to use the same form of the verb.

The declarative and imperative conditions served as controls in two important ways. First, high performance on these conditions indicated that the child understood the scenario and was paying attention to the experiment (not an insignificant concern, given the age groups involved). Second, high performance established that the child comprehended declarative and imperative clauses in an adult manner. Establishing this comprehension is a necessary prerequisite for interpreting the results of the third, NS condition. Thus, children scoring fewer than seven out of eight items correct on either the declarative or the imperative condition were not included in any subsequent analyses. Only 6 total children had to be eliminated because of this restriction, 4 of whom were in the youngest age group (2½–3 years). This suggests that on the whole, the task was simple enough to be understood by even the youngest children tested (see footnote 12).

The NS items are the items of interest: for these sentences, the predictions of performance and grammatical accounts differ, the former predicting adult (imperative) comprehension, and the latter predicting nonadult (declarative or mixed) comprehension.

To keep the children engaged and attentive, we used four different scenarios. Each scenario consisted of a story and an accompanying pair of pictures. The first of the pair was always a picture of two "big kids" named Mary and Billy, and the second was always a picture of two "little kids" named Emma and Ben.

In the pictures, the big kids were always shown engaged in a particular activity, such as drawing a picture or playing with blocks, while the little kids were shown in close proximity to the relevant items (e.g., paper and crayons or blocks) but *not* interacting with them. Participants were told that Mr. Bear was the children's babysitter. They were also told that Mary and Billy were old enough that they could engage in these activities without Mr. Bear giving them permission,¹⁴ but that Emma and Ben had to wait until Mr. Bear told them to engage in the activity in question. This relationship between age and control over actions is very salient to children, even at the youngest ages, and our participants had no difficulty understanding and accepting this premise. Table 3 shows the adult judgments for the three conditions in (10)–(12).

Before the experiment began, participants were told that Mr. Bear's comments would either describe the actions of one pair of children or command them to do something. In effect, Mr.

¹⁴ In English, the simple present tense has a habitual meaning. For this reason, *always* was included in *declarative* items, and the story about the older children indicated that they engaged in the relevant activity every day.

Bear would either “tell *us*” (the participant and the experimenter) or “tell *them*” (the two characters in the picture).¹⁵ The experimenter then explained to the child that it would “be silly” for Mr. Bear to tell the older children to do an activity they were already doing. It would, however, “make sense” for him to say what they were already doing. Conversely, it would be silly for Mr. Bear to describe the younger children performing an action they were not doing, but it would make sense for him to tell them to do the activity, because they were waiting for him to tell them what to do. The previous sentences are near verbatim versions of the words used in the experimental session, and most children understood and concurred with this explanation on the first telling. For those who did not, it was repeated until they did, or the testing session was discontinued.

3.1.3 Intonation One concern regarding the presentation of the items is intonation. If the NS sentences were consistently uttered with either declarative or imperative intonation, children’s judgments might be influenced in that direction. To assess the intonational cues in the test stimuli, we conducted an informal survey of 10 English-speaking adults, all undergraduates at the University of California, Los Angeles. These adults listened to recordings of modified experimental stimuli, in which the beginning portion of the declarative and imperative sentences (*They always* and *Please*, respectively) had been removed, leaving behind a sentence fragment identical to the NS sentence (e.g., *play with blocks*). The adults were told that stimuli had been altered by removing the beginning portions, and they were instructed to identify whether each fragment had originally been a declarative sentence or an imperative sentence. For each experimental item, all 10 adults identified the declarative and imperative items correctly. In addition, they all identified the NS items as being commands. Thus, if intonation plays a role in children’s answers, it should be in the direction of promoting the adult imperative interpretation.

3.1.4 Procedure Participants were first introduced to Mr. Bear and his role as the babysitter of the children in the pictures. Then the difference between the older and younger children was explained, using the pictures as illustration.

Prior to each test item, subjects were shown both pictures and reminded of the story in order to reinforce the distinction between the big kids and the little kids. Then, before Mr. Bear commented, the child was asked two background questions: “Do Mary and Billy have to wait for permission to do X?” and “Do Emma and Ben have to wait for permission to do X?” These questions established that the child understood the details of the scenario. If the child did not answer correctly, the scenario was repeated until he or she did. At that point, one of the pictures was removed, and Mr. Bear (the experimenter) commented on the remaining picture. Each item was repeated, guaranteeing that the child heard it twice before responding.

Children were instructed to tell Mr. Bear if he was right or wrong after each item without prompting from the experimenter. They were only prompted when a significant amount of time

¹⁵ One concern that has been raised regarding the experimental design is that the child must believe that Mr. Bear can command characters in a drawing. If children did hold this belief, it would affect not only their responses to the NS sentences but also their responses to the imperative sentences. By requiring that children perform at an above-chance level on the imperative condition, we circumvented this potential problem.

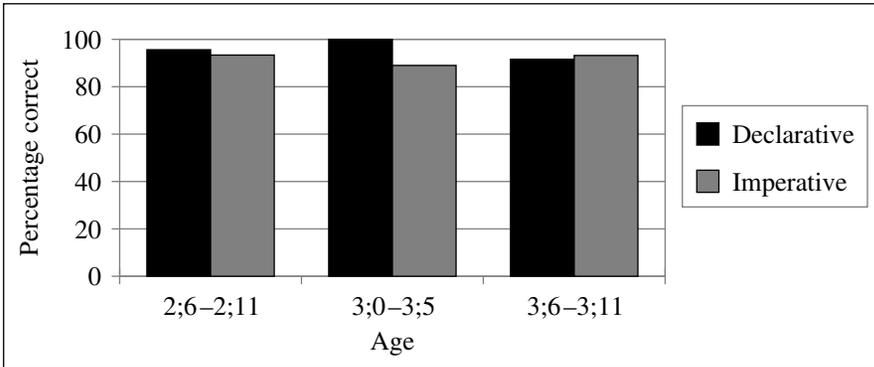


Figure 1

Performance on declarative and imperative conditions, Experiment 1

had passed without their giving a response. The children's response justifications were written down by the experimenter before moving to the next test item. Not all children were able or willing to provide response justifications for every item, although the majority (26 of 30) provided justifications for at least some of the items.

3.1.5 Results In accordance with our requirement, only children who correctly answered at least seven out of eight items on declarative and imperative conditions were included in our final analysis (figure 1). These 30 children had no difficulty with our task and had a correct, adult interpretation of both declarative and imperative sentences. Their interpretation of the NS items is therefore independent of these factors.

Figure 2 shows the children's performance on the NS condition by age group, comparing the percentage of trials for which children assigned an imperative (adult) with the percentage for which they assigned a declarative (nonadult) interpretation. As figure 2 suggests, the three age

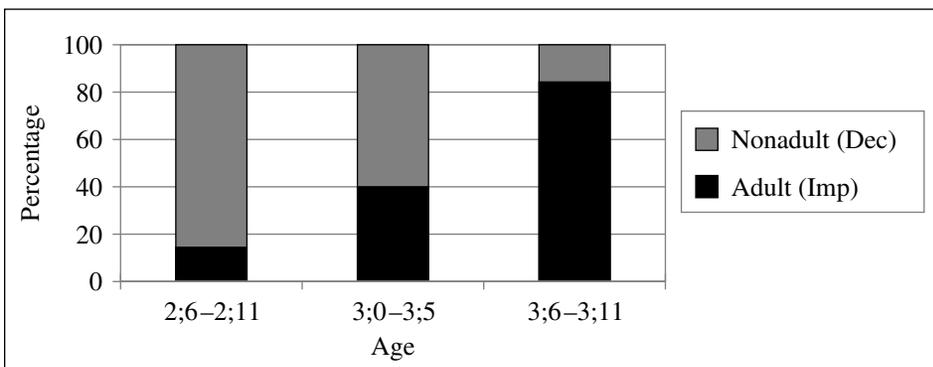


Figure 2

Interpretation assigned to null subject items, Experiment 1

groups differ greatly in their performance on the NS condition. According to a logistic regression with accuracy as a binomial dependent variable (with success defined as an adult-like imperative interpretation), age group as the fixed effect, and subject as a random effect, there is a significant difference between the youngest and middle age groups ($p = .0097$), and between the middle and oldest age groups ($p < .001$). In both cases, an increase in age was associated with a significant increase in adult-like performance.¹⁶

Examining each age group separately, we see that the youngest children consistently prefer a declarative interpretation, assigning one 86% of the time. This means that this age group considers ‘‘Play with blocks’’ to be an acceptable description for a picture of two children playing with blocks, thereby demonstrating a grammatical NS stage in comprehension, as has been observed for production in children in this age range. In section 3.2, we will discuss NSs in the spontaneous production data of the children who participated in our study.

Conversely, the middle age group assigns a declarative interpretation to NS items only 60% of the time. This represents a marked increase in adult-like behavior from the youngest age group; in fact, the middle age group’s performance does not significantly differ from chance ($t(9) = -0.32$, $p = .33$).¹⁷ The group result is deceptive, however, in that it is not due to a marginal change for each child. Table 4 shows the individual subject performance. We see that the middle group itself consists of two distinct groups: 2 of 10 children tested consistently demonstrated adult comprehension of NS sentences, while 8 of the 10 continued to prefer a nonadult, declarative interpretation. This behavior mirrors the spontaneous speech of 3- to 3½-year-olds, in which variation is found, some children having moved out of the NS stage and others remaining in it.

In contrast to the two younger age groups, the oldest children behave like adults, correctly assigning an imperative interpretation to NS sentences. As shown in table 4, 7 of 10 children in the oldest age group assign a consistent imperative interpretation, as compared with only 3 of 20 children in the younger two age groups combined. The transition to adult comprehension at roughly age 3½ mirrors the loss of the NS option in production that also occurs at this age.

Children who assigned an imperative interpretation for zero items or one item out of eight were considered to show ‘‘consistently declarative’’ performance. Conversely, children assigning an imperative interpretation for seven or eight items out of eight total were considered to show

Table 4

Individual performance on the null subject condition in Experiment 1

Child’s interpretation	2;6–2;11 ($n = 10$)	3;0–3;5 ($n = 10$)	3;6–3;11 ($n = 10$)
Consistently imperative (7–8 imp.)	10% (1)	20% (2)	70% (7)
Both interpretations allowed (2–6 imp.)	0% (0)	0% (0)	10% (1)
Consistently declarative (0–1 imp.)	90% (9)	80% (8)	20% (2)

¹⁶ Model run in R using the *lmer* function of the *lme4* package. The *p*-values were obtained using the *pvals.fnc* function with 10,000 simulations (Baayen, Davidson, and Bates 2008). A larger model, identical to the previous one excepting the inclusion of item as an additional random effect, was compared with the previous one using R’s *ANOVA* function. This change did not significantly alter the model fit, showing that there is no item effect.

¹⁷ Unless indicated otherwise, all reported *t*-tests are unpaired, and all *p*-values are two-tailed.

Table 5

Expected judgments on null subject items given an adult (imperative) or nonadult (declarative) interpretation

Picture	Imperative (adult) interpretation	Declarative (nonadult) interpretation
Big kids	Silly	OK
Little kids	OK	Silly

“consistently imperative” performance. These two response patterns are significantly different from chance performance at the $p < .05$ level.¹⁸ Therefore, the majority of children (17/20) in the two younger age groups were consistently assigning a grammatical analysis that led them to an incorrect, nonadult answer—in this case, a declarative interpretation. Our study design is such that if children assign a declarative interpretation to NS items, they will be incorrect regardless of whether Mr. Bear is referring to the picture of the big kids or the picture of the little kids. This is shown in table 5, which lists predicted responses for NS sentences, given an imperative or declarative interpretation.

The response justifications provided after each item also suggest that the younger children are interpreting NS sentences as declarative. The reasons provided by the children who performed poorly on the NS sentences resembled those given for the declarative control condition. On declarative items, they would explain that Mr. Bear was right or wrong because he had been describing what the children were *doing*, and not what they were *supposed to do*. In (13a) and (13b), we provide examples of these justifications for a big kid scenario and a little kid scenario, respectively. Note that in each case, the child is incorrectly interpreting the NS sentence as a declarative.

- (13) Child answers *true* (“OK”) when the adult answer would be *false* (“silly”).
- a. He know these kids play every day. —M., 2;7
Child answers *false* when the adult answer would be *true*.
- b. He said they play with blocks, but they aren’t. —K., 2;9

This behavior lasts until roughly age 3½ in our data, at which point the children’s responses become adult-like.

3.2 Spontaneous Production

In addition to predicting that children will have a nontarget interpretation of NS sentences, grammatical theories predict a relationship between comprehension and production. If children produce NS sentences as a result of a nonadult grammar, we should see a strong correspondence between an individual child’s production of NS sentences and his or her nonadult assignment of a declarative reading to such sentences.

To test this prediction, a 10-minute audio recording was made of each child who participated in the TVJ task. The child was presented with a variety of toys and encouraged to tell stories

¹⁸ This is based on a binomial distribution for the eight items in the NS condition.

about them to an experimenter. The experimenter participated as little as possible in these sessions, speaking only to encourage the child to continue or begin a new story.

The recording sessions were transcribed, and for each session, obligatory subject contexts (OSCs) were identified. OSCs were defined as clauses in which a native English-speaking adult would require an overt subject. Cases in which subjectless sentences are grammatical for English-speaking adults, such as imperative clauses, were not counted. Every child's 10-minute recording session had at least 21 OSCs, and many recording sessions had over 30.

Two native English-speaking researchers scored all OSCs for the presence or absence of a subject. Then, for each child, the number of OSCs lacking a subject was divided by the total number of OSCs to get the percentage of NS sentences for each child. Following Brown (1973), we allowed for 10% noise in the data so that 10% or fewer NSs in a child's data might simply be due to error and such a child was assumed to have a target-like non-NS grammar. A child producing NSs at a rate greater than 10%, on the other hand, was considered to be in the NS stage.

Our choice of 10% as the cutoff for an NS grammar in production deserves some discussion. Valian (1991) was the first to observe that children acquiring English produce NSs at proportions considerably smaller than children acquiring Italian (and other true NS languages). Valian's cross-sectional data from 21 English-speaking children showed a mean NS rate of 30% for children younger than 2;6 and a rate of 5%–11% for children older than 2;6. Sano and Hyams (1994) calculated the mean NS rate for Adam and Eve at 16%, and Wang et al. (1992) put the mean rate at 15% for the 3- to 4-year-old English-speaking children they tested. Given the range of variation observed in other studies of spontaneous speech and the age of the children in our study (2;6 to 4), the conservative 10% measure seemed the most reasonable.

For the 30 children included in our comprehension task, the percentage of NS utterances ranged from 0% to 56.3%. A scatterplot of these percentages, by age, is given in figure 3.

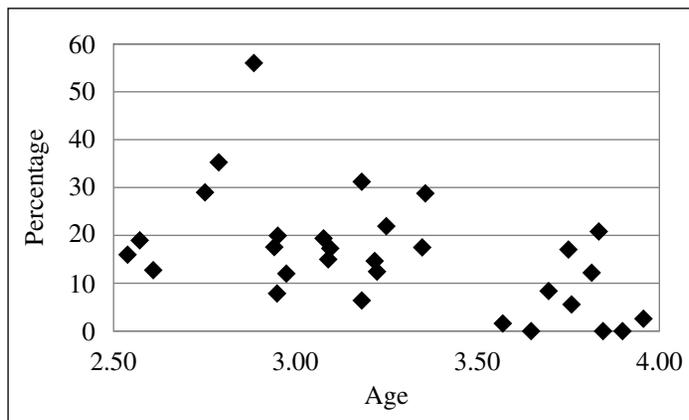


Figure 3
Percentage of null subject sentences produced by age

An individual subject analysis compared children's performance on the NS condition of the TVJ task with the proportion of NS sentences each one produced in the recording session. For 29 of the 30 children, we found a correspondence between nonadult comprehension (below chance or chance performance) on the TVJ task and more than 10% NS sentences produced in the recording. This means that children who were classified as being in the NS stage by the production measure were also classified as being in the NS stage by the comprehension measure.¹⁹

As a more fine-grained assessment of the relationship between NS comprehension, NS production, and age, we constructed an uncrossed logistic mixed-effects model in R.²⁰ As before, the binomial dependent variable was whether or not a comprehension response was adult-like. The fixed effects were each child's exact age at testing and his or her score on the production task (percentage of NS utterances produced). Random coefficients were included for subject and item. Controlling for age, the model finds that NS production is a highly significant predictor of NS comprehension ($p = .005$); therefore, a decrease in NS production leads to a decrease in declarative interpretations of NS sentences. We take this link to indicate that our comprehension task is targeting the NS stage previously noted in production.

When NS production is controlled for, the model also finds age to be a significant predictor for NS comprehension ($p < .0001$)—indeed, an even stronger predictor than NS production. This is expected, and does not undermine the relationship found between NS production and NS comprehension. As children grow older, they are less likely to assign a declarative interpretation to NS sentences. This matches our own descriptive findings, as well as corresponding to the decline of NS production as children grow older (see Hyams and Wexler 1993, Hamann and Plunkett 1998).

3.3 Discussion

In designing this experiment, we set out to address the issue of children's grammatical competence. English-speaking children have long been noted to produce declarative sentences that lack subjects, but production data cannot tell us what interpretation children would assign to these utterances. Would they interpret them as adults do, as imperatives, or allow a declarative interpretation?

The results of the TVJ comprehension task support the conclusion that children and adults possess different grammars, with the immature child's grammar allowing subject omission in declarative contexts. Despite virtually perfect performance on the declarative and imperative control conditions of our experiment, children persist in assigning a declarative interpretation to

¹⁹ The single child who did not show a correspondence between comprehension and performance produced over 10% NS sentences despite adult-like performance on the TVJ task. It is worth noting that he produced only 22 OSCs in his recording, the second lowest of any child tested. In addition, had he produced two fewer sentences without subjects, his percentage would have dropped below 10%.

²⁰ The same model was run with a crossed fixed-effects structure, to investigate possible interaction effects between age and NS production. No significant interaction was found. However, the crossed model was found to be significantly worse than the uncrossed one, providing no improvement to explanatory value, but significantly increasing complexity (BIC = 238.6 for the crossed model as compared with BIC = 233.6 for the uncrossed model). For this reason, we discarded the crossed model in favor of the simpler uncrossed model.

NS sentences until approximately 3½ years old. Furthermore, we find a near perfect correspondence between this nonadult comprehension and the children's production of NS utterances, suggesting a single underlying cause for both behaviors.

Our results raise one puzzling question. Recall that the youngest children in our study systematically interpreted the NS items (e.g., *Play with blocks*) as declarative and rejected an imperative meaning for these same items (table 3). We know, however, that in their normal day-to-day interactions children this age both produce and understand NS imperatives (section 2) in addition to NS declaratives. If there is a mood ambiguity associated with these sentences, as the production data suggest, how can we explain children's strong preference for the declarative interpretation in our experiment?

One possible explanation for this behavior is that when faced with an ambiguity, younger children will choose to resolve it in favor of the less marked, or more economical, structure. Assuming that imperatives require additional structure and feature checking relative to declaratives (Koopman 2007), the younger children might resolve the ambiguity in favor of the simpler declarative structure.

An alternative explanation is that some characteristic of our experimental design influenced the children's choice. In particular, recall that items in the imperative condition all contained the word *please*, which is arguably a very salient indicator of imperative mood for children in this age group.²¹ It is possible that the children took *please* as a signal of imperative mood in the imperative controls and concluded that only items containing *please* were commands. If so, they may have resolved the ambiguity associated with the NS items in favor of a declarative reading or been biased toward such a reading precisely because these items did not contain *please*.²² To check for this possibility, we designed a second experiment in which we eliminated the possibility of using a *please* strategy.

4 Experiment 2: Comprehension of Null Subject Sentences Revisited

As we will detail below, in Experiment 2 we included additional imperative items that did not contain *please* and therefore would not allow children to use a *please* strategy to resolve the mood ambiguity. Our expectation was that children in the NS stage would then allow both an imperative and a declarative reading for NS items, in accordance with the two options made available by their grammars, and parallel to what we find in spontaneous speech. In other words, we expected that with removal of the potentially biasing *please*, the ambiguity seen in production would resurface in comprehension.

²¹ We thank the anonymous BUCLD 32 reviewer for pointing out this possibility.

²² In Experiment 2, we directly test the feasibility of the *please* strategy. However, given the results of Experiment 1, we are skeptical that a *please* strategy could be the *only* cause of children's nonadult interpretation of NS sentences. If children are basing their interpretations on a strategy of this sort, we would expect to find variation in the age at which children exit the NS stage, rather than a sudden leap at approximately 3½ years. Also, the input to children (and their own output) contains an overwhelming number of imperatives that do not contain *please* (see Alex's productions, section 2), suggesting that they are aware that imperative mood does not require the presence of the word.

Table 6

Experiment 2 participant details

Group	Age range	Mean age	<i>N</i>
2;6–2;11	2.54–2.96	2.73	10
3;0–3;5	3.12–3.48	3.30	10
3;6–3;11	3.64–3.98	3.82	10
Total	2.54–3.98	3.28	30

4.1 Methods

4.1.1 Participants As in Experiment 1, we tested 30 children (14 boys, 16 girls) in daycare centers around Los Angeles, with 10 children in each six-month interval between 2½ and 4 years old. Participant details are shown in table 6.

4.1.2 Experimental Design and Materials The characters, stories, and methods for this task were the same as those in Experiment 1. The test items differed, however, in that Mr. Bear's comments could now take one of five forms (table 7). Three of these conditions were identical to those in Experiment 1: the habitual declarative sentence (14), the *please*-imperative (16), and the NS sentence (18). Two additional conditions were added: the progressive declarative sentence (15) and the vocative imperative (17). The addition of these conditions eliminates the possibility of using a simple heuristic to identify a sentence as either imperative or declarative, as we will explain below.

- (14) They always play with blocks.
- (15) Now they are playing with blocks.
- (16) Please play with blocks.
- (17) Hey kids, play with blocks.
- (18) Play with blocks.

As in Experiment 1, there were 24 total items, evenly divided between correct true and false answers. Unlike in Experiment 1, however, these 24 items were not divided evenly among the

Table 7

Example items with adult judgments, Experiment 2

Example items	Big kids picture	Little kids picture
They always play with blocks	Correct	Silly
Now they are playing with blocks	Correct	Silly
Please play with blocks	Silly	Correct
Hey kids, play with blocks	Silly	Correct
Play with blocks	Silly	Correct

five conditions. The NS condition consisted of 8 items, and the 8 declarative and 8 imperative items were divided into two conditions, with 4 items each. Both subtypes of the declarative and imperative conditions served as controls, and children had to perform well on both types for their data to be included in further analyses. Thus, high performance on these conditions shows not only that the child understands the scenario, but also that the child is not using some sort of heuristic to determine which items are declarative (e.g., *always*) or imperative (e.g., *please*).²³ As before, children scoring fewer than seven out of eight items correct on either the declarative or the imperative condition were not included in any subsequent analyses. This meant that a child could answer incorrectly on only one item on *either* of the two declarative or two imperative conditions in order to be included in further analyses.

A higher number of children had to be eliminated from Experiment 2 than from Experiment 1, potentially because of the increased difficulty of the five conditions. Thirteen of 43 total participants, or approximately 30%, were eliminated. Of these 13 children, 10 did not meet the inclusion criteria on the basis of their performance on the imperative and declarative control conditions, and 3 were unable to complete the task for attentional reasons.

Because of the near perfect correspondence found between our TVJ task and the recordings in Experiment 1, we feel confident that the comprehension task is successfully identifying the NS stage; therefore, we did not make recordings of the children who participated in Experiment 2.

4.1.3 Results In accordance with our stipulation, the 30 children included in our final analysis performed well on declarative and imperative trials of both subtypes (figure 4). This high accuracy

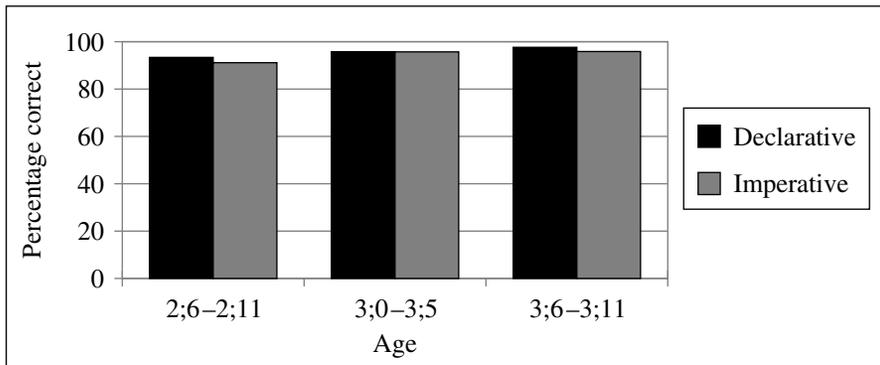


Figure 4
Performance on declarative and imperative conditions, Experiment 2

²³ It remains logically possible that children could be using a more complicated strategy to identify commands, such as “Anything without *please* or *hey kids* is a declarative.” The greater the number of variables that are added, the less likely this becomes; however, we find it unnecessary to include even more subconditions to generate real randomness.

indicates that these children had no difficulty with the task and had a correct, adult interpretation of both declarative and imperative sentences, despite the addition of multiple types of declarative and imperative trials. For these children, *please* cannot be the only indicator of imperative mood; the adult syntactic structure must also be accessible. Therefore, performance on the NS items must be independent of these factors.

A side-by-side comparison of children's performance on the NS condition in Experiments 1 and 2 is shown in figure 5. For all three age groups, overall performance is higher in Experiment 2. Performance by the youngest age group is at 40% imperative (adult) interpretation, a marked increase from the 14% found in Experiment 1. A similar improvement is seen for the middle age group as well; these children answered approximately 64% of the items in an adult manner, compared with 40% in Experiment 1.

Despite the increase in performance, significant differences remain between the age groups, just as in Experiment 1. A logistic regression model identical to the one used for Experiment 1 finds a significant difference between the youngest and middle age groups ($p = .013$), and between the middle and oldest age groups ($p < .0001$). Just as in Experiment 1, an increase in age was associated with a significant increase in adult NS comprehension.²⁴

A second and far more crucial similarity remains between Experiments 1 and 2: there are two distinct groups of children. One group shows adult performance on the NS condition; the other does not. In both experiments, the oldest age group falls into the first category, and the

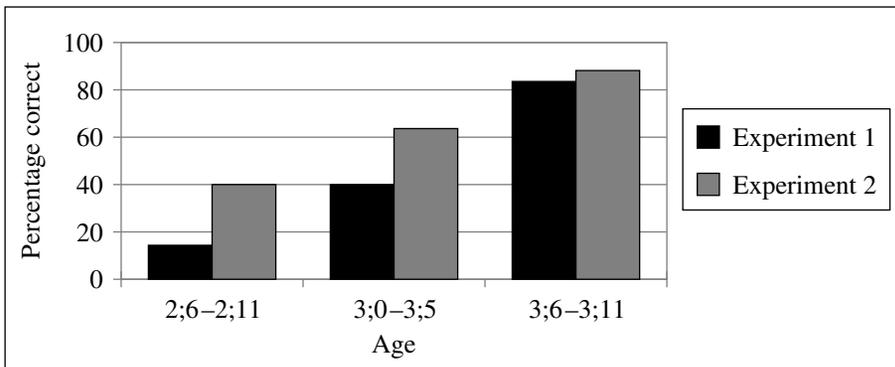


Figure 5
Performance on null subject condition, Experiments 1 and 2

²⁴ See section 3.1.5 and footnote 16 for the details of the model and for details on the follow-up item effect analysis. As in Experiment 1, we found no effect of item.

Table 8

Individual performance on the null subject condition in Experiment 2

	2;6-2;11 (<i>n</i> = 10)	3;0-3;5 (<i>n</i> = 10)	3;6-3;11 (<i>n</i> = 10)
Consistently imperative (7-8 imp.)	0% (0)	40% (4)	80% (8)
Both interpretations allowed (2-6 imp.)	80% (8)	60% (6)	20% (2)
Consistently declarative (0-1 imp.)	20% (2)	0% (0)	0% (0)

majority of children from the youngest two age groups combined fall into the second (16/20 in Experiment 2); see table 8.

How is it that the overall pattern of results is the same for Experiment 2 as for Experiment 1, while the group performance is markedly higher? The answer lies in the behavior of those children who show nonadult performance. Contrary to the results of Experiment 1, none of the children tested in Experiment 2 consistently prefer a declarative interpretation for NS sentences, with the exception of a single child in the youngest age group. Instead, as predicted, when the potential for a *please* strategy is eliminated, children allow both an imperative and a declarative interpretation for NS sentences, demonstrating the presence of a semantic ambiguity (table 8).

These results are consistent with the children's having a nonadult grammar that licenses NS sentences as declaratives or imperatives. The findings of Experiment 1 can be explained if the children exploited a strategy that allowed them to disambiguate the otherwise ambiguous NS items. As predicted, when this strategy is removed in Experiment 2, children allow both interpretations (leading to approximately 50% adult-like answers).

Logically, two patterns of behavior could have led to mixed performance on the NS condition. If children rely solely on their grammar, which licenses an NS utterance as either an imperative or a declarative, we might expect them to answer *true* to all NS items, regardless of scenario. In other words, they would assign an imperative meaning to the NS sentence in the little kid scenario and a declarative meaning in the big kid scenario, answering *true* or *false* appropriately for each item. This is not what occurred. Considering only the 16 children who allowed both interpretations for the NS items, approximately 50% of the false items (those referring to the big kids) were answered correctly. For the true items (those referring to the little kids), approximately 50% were answered correctly. Rather than answering *true* 100% of the time, children appeared to be resolving the ambiguity in one direction or the other, and only then considering whether or not this mood would match the scenario that had just been presented.

Children's justification responses for the NS condition support this conjecture. When children answered correctly, they supplied justifications that matched an adult, imperative interpretation (19a-b). Conversely, their incorrect answers were supported by declarative justifications (20a-b).

- (19) Child correctly answers *true* to "Put on socks."
 a. He needs to tell the younger kids to put on socks. —S., 3;3
 Child correctly answers *false* to "Play with blocks."
 b. They are already playing with blocks, it's silly. —A., 3;4

- (20) Child incorrectly answers *true* to “Eat a cookie.”
 a. They’re doing it! —J., 3;1
 Child incorrectly answers *false* to “Eat a cookie.”
 b. Because they aren’t eating a cookie. —E., 3;10

We will set aside the question of what might cause this behavior until section 5.2, where we will discuss the issue in greater detail.

5 General Discussion

5.1 A Grammatical Basis for the Null Subject Stage

This study addressed the issue of competence versus performance: do children have a fundamentally different grammar from adults that allows them to produce and interpret NS sentences as grammatical declarative sentences, or are there production limitations that cause children to produce NS sentences, even though their grammar rejects them?

Given the findings presented here, the best answer lies in an account in which the child and adult grammars differ in some fundamental way. A purely performance-based account cannot explain why children allow NS sentences to have a nonadult declarative interpretation.

The change in children’s interpretations in Experiment 1 and 2 does not weaken this finding. There is no qualitative difference between the two sets of results; in both cases, the children allowed a nonadult declarative interpretation for NS sentences, as supported both by their responses and by their response justifications. Crucially, we find the same developmental curve in both experiments: children somewhat abruptly cease to allow the nonadult interpretation at approximately 3½ years. This shift mirrors the one that has been seen in production, and indeed, Experiment 1 reveals a near perfect within-subject correspondence between production and comprehension. With only one exception, the children who dropped subjects in declarative contexts in our production task were the same ones who allowed these same sentences to have a declarative interpretation in the comprehension task. This connection is not expected on a performance account, but is explicitly predicted by grammatical accounts, as both behaviors would arise from the same root cause: the child’s different grammar.

5.2 The Real Role of Performance Factors in the Null Subject Stage

Returning to the question of children’s “mixed” performance in Experiment 2, how did the children arrive at either an imperative or a declarative interpretation of the NS sentences, given that their grammar licenses both? The results of Experiment 2 lead us to believe that this is where processing factors may come into play.

In his groundbreaking work on lexical priming, Swinney (1979) shows that when faced with a lexical ambiguity, adults are initially primed for both possible meanings, regardless of context. It is only after several hundred milliseconds that the contextually inappropriate meaning is suppressed. In contrast, when children are faced with a lexical ambiguity, priming only occurs for the meaning of the word that occurs more frequently in their input. For the less frequent word

meaning, no such priming is found (Swinney and Prather 1989). It appears that children ignore context entirely, relying instead on frequency to resolve the ambiguity.²⁵

This difference between children and adults is not restricted to lexical ambiguity resolution. In cases of sentence-level ambiguities, adults are able to incorporate multiple sources of evidence (lexical and referential information, intonation, etc.) to arrive at a meaning, while children appear to fixate on one dominant cue, when one is available. Consequently, unlike adults, who are able to revise incorrect parses to reflect additional contextual and other information, children appear to be bound by their original parse (Trueswell et al. 1999).

Let us now consider the situation that the children in our experiment face. We have argued that for young English-speaking children, NS sentences present an ambiguity. When attempting to assign a meaning to an NS utterance, the children have to decide between a declarative and an imperative representation for the sentence, evaluate the representation relative to the context of the experimental situation, and revise their representation when necessary.

This revision process is precisely the kind that children have been shown to have difficulty with. In Experiment 2, young children treat the NS items as if they are declaratives in approximately 50% of the trials, and provide follow-up justifications that are consistent with this interpretation. In the other 50% of the trials, they interpret the NS sentences as imperatives, again with appropriate follow-up justifications. Thus, while children in the NS stage are clearly able to assign both declarative and imperative readings to NS sentences, they seem unable to integrate the contextual (or other) information necessary to assign, or update to, the correct meaning. Thus, the children choose one of the two meanings permitted by their grammar—the basis for this initial assignment is unclear to us—but then they are stuck with it.²⁶ This pattern is strikingly similar to the inconsistent performance found in previous studies of scopal resolution under antecedent-contained deletion (Syrett and Lidz 2005), and it may be amenable to a similar explanation.

In Experiment 1, however, the younger children did not behave inconsistently. It appears that in this instance, the presence of *please* afforded them a way to assign a consistent interpretation and resolve the declarative/imperative ambiguity. *These* results are reminiscent of children's behavior with respect to PP-attachment ambiguity, in which preferential use of lexical and syntactically based cues leads children to a consistent—and sometimes incorrect—answer (Trueswell et al. 1999, Snedeker and Trueswell 2004) (see footnote 26).

Overall, children's behavior on our two experiments seems in line with their behavior on other instances of sentence-level ambiguity. The key difference is that the ambiguity inherent in

²⁵ Swinney, Nicol, and Zurif (1989) find the same pattern of results for agrammatic aphasics, another group that has been argued to have limited processing resources.

²⁶ In their study of children's resolution of PP-attachment ambiguities, Trueswell et al. (1999) find that children do not exploit referential information from the scene they are presented with. Rather, they rely exclusively on the lexical properties of the verb. In our study, we also find that children ignore the TVJ task story in resolving the mood ambiguity, consistent with Trueswell et al.'s results. However, lexical information does not provide an obvious explanation for our children's preferences. In section 3.1.3, we also noted that the children's responses cannot be explained by prosodic factors.

the NS stage is one that exists only for children up to the age of 3½ years, unlike attachment or scopal ambiguities, which are also ambiguous for adults. Thus, when children exit the NS stage, their grammar changes, and the processor is no longer faced with the problem of ambiguity resolution.

It seems, then, that the pattern of data we report in Experiment 2 is due to a combination of three factors, listed in (21).

- (21) a. A nonadult grammar that allows subject omission in declarative sentences
- b. A nonadult processing system that cannot simultaneously keep track of the multiple sources of information needed to resolve the ambiguity
- c. Lack of any salient cue that will allow the child to consistently assign an interpretation

If any of these conditions are altered, we expect to find a different pattern of behavior. If (21a) ceases to be true, for instance, then neither (21b) nor (21c) is relevant, as the child has moved out of the NS stage and will behave as an adult. If (21b) ceases to be true, because the processor has matured, then we expect the child to always accept either a declarative or imperative interpretation for NS sentences. Essentially, in an experimental setting such as ours, the child would consistently answer yes. We do not find this pattern of behavior in any of the children we tested; we therefore conclude that children's grammars exit the NS stage before their processor matures. As children continue until as old as 5 to show nonadult behavior in sentence-level ambiguity resolution such as PP-attachment, this conclusion seems warranted. With regard to (21c), Experiment 1 provides an illustration of the kind of salient cue that children might use. *Please*, which conveniently occurs early in the sentence, is taken as an indicator of imperative mood, allowing children a way of dealing with the processing difficulties inherent in ambiguities, and allowing them to assign a consistent (although incorrect) interpretation to NS sentences.

6 Conclusions

First and foremost, the data presented here suggest that the NS stage is caused by a grammatical difference between child and adult English speakers. Just as English-speaking children produce NS sentences in both declarative and imperative contexts, so they allow them to have a declarative interpretation in addition to the adult imperative interpretation. As with production, nonadult comprehension disappears around the age of 3½. Of the two classes of theories examined, grammatical and performance, only grammatical theories can account for these findings, as they predict parallel production and comprehension results.

While performance factors are not the underlying cause of the NS stage, they appear to play an important role in the resolution of the mood ambiguity associated with NS utterances. Children's processing resources do not allow them to integrate all sources of information needed to resolve the ambiguity, and this leads to the very specific pattern of responses seen in Experiment 2. Experiment 1, however, demonstrates that when a salient cue is available, such as *please*, children are able to use it. This gives rise to a consistent (in this case, nonadult) interpretation, rather than the variability that is found when such heuristics are controlled for.

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