Morphological Uniformity
and the Setting of the Null Subject Parameter

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1. Introduction

It is well-known that thematic (referential) lexical subjects are optional in early child language and that lexical expletive subjects are entirely lacking. The null subject phenomenon appears to be a universal property of child language. Examples from English are provided in (1); the sentences in (1a) have null thematic subjects, those in (1b) null expletive subjects.(Cf. Bloom, Lightbown & Hood, 1975)

(1) a. Want more apple
       See under there
       No play matches
       Show Mommy that

    b. Outside cold
       Is toys in there

In Hyams (1983, 1986) it is proposed that null subjects in early language can be explained much in the manner of adult null subject languages such as Italian and Spanish. Specifically, it is argued that the Null Subject Parameter, a parameter of U(niversal G(rammar)

which accounts for the difference between languages like Italian and English with respect to the possibility for unexpressed subjects, comes fixed at an initial setting, one which permits phonologically null subjects. The central claim of that analysis was that all children start out speaking an Italian-like language. The child acquiring a non-null subject language, such as English, eventually changes the initial parameter setting based on certain information in the input data.

However, a number of empirical problems have surfaced which cast doubt on the particular analysis proposed in Hyams (1983,1986). For discussion of these inadequacies, we refer you to Hyams (1987). Thus in this paper we would like to propose a reanalysis of the null subject phenomenon in child language, one which we believe overcomes these problems and which also sheds light on a number of other properties of child language which were not explained under the original analysis. The new analysis is based on an approach to null subject phenomena developed in Jaeggli & Safir (1987), inspired by the analysis of morphological development proposed in Hyams (1986b).

An explicit claim of the approach to language development that we are adopting is that child grammars are not fundamentally different from adult grammars and that such differences as exist can be understood as variation within the limits defined by principles of UG. The parameterized approach allows for a principled description of what are often apparently unrelated properties of child language. It also provides an explanation for the child's transition from one developmental stage to the next, where this is the result of the resetting of certain parameters. Given these assumptions, it becomes imperative to provide an analysis of the adult system in light of which the child data can be interpreted. We turn to this task next.

2. Null Subject Languages, Morphological Uniformity, and "Rich Agreement"

A standard assumption made by every theory of null subjects, including those which fall within traditional grammatical frameworks, is that the inflectional system of null subject languages (like Spanish or Italian) is in some sense "rich" enough to allow for the phenonema in question, while this is not the case in other non-null subject languages (like English). While intuitively quite appealing, this idea raises more questions than it answers. What is the notion of "inflectional richness"

relevant to an accurate charaterization of null subject
phenomena? How is this richness to be compared cross-
linguistically, especially when one considers systems as
diverse as the ones found in Spanish, German, Irish,
Japanese, and Chinese, for example. Another question that
arises within such theories is why some languages allow
only expletive, i.e. non-referential, null subjects (like
German, some dialects of Dutch, Icelandic, etc.).

Most GB accounts have either implicitly or
explicitly approached the problem by positing what can be
called a 'licensing condition' on the appearance of null
subjects, and an 'identification' process responsible for
recovering the referential value of the empty subject, cf.
Jaeggli(1980,1982), Chomsky (1981), Rizzi (1982, 1986),
and Safir (1985). Although we maintain the distinction
between licensing and identification in our theory, we
present a novel treatment of these two processes.

Let us begin by reviewing the typology of agreement
systems which license null subjects. This list is not
exhaustive, obviously, but we believe it is representative
of the major classes to be included in any more
comprehensive and exhaustive survey.

On the one hand, there are systems like those found
in Spanish and Italian, where a tensed verb is inflected
for number, person, tense and mood.

(2) habl-o   'I speak'   1s
    habl-as   'you (sg.) speak'   2s
    habl-a   'he speaks'   3s
    habl-amos   'we speak'   1pl
    habl-ais   'you (pl.) speak'   2pl
    habl-an   'they speak'   3pl

Here the inflectional paradigm distinguishes all six
persons uniquely.[1]

Consider next the German paradigm. The verb is
inflected for person, number, tense, and mood; and often
two (or more) forms are identical:

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[1] This is not always the case in Spanish. In certain
cases, two endings are identical, yielding ambiguity. Even
in such cases, however, Spanish allows subjects to remain
null.

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(3) (ich)  arbeit-e       'I work'      1s
    (du)   arbeit-est     'you work'    2s
    (er)   arbeit-et      'he works'    3s
    (wir)  arbeit-en      'we work'     1pl
    (ihr)  arbeit-et      'you work'    2pl
    (sie)  arbeit-en      'they work'   3pl
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German, however, does not allow thematic null subjects, though it does permit expletive subjects to be null.[2] Compare the following examples (from Safir (1985) and Koster (1986)):

(4) a. ...dass ec in den Garten ein Kind gekommen ist.
       'that in the garden a child come has'

    b. ...dass ec dem Kind geholfen wurde
       'that the DAT child helped was'

    c. Gestern wurde ec ein Mann getötet.
       'yesterday was a man killed'

(5) a. *...dass ec gegessen hat.
          'that eaten has'
    b. * Gestern hat ec gegessen.
         'yesterday has eaten'

It seems highly unlikely that the lack of thematic null subjects is due to the fact that not all forms in the inflectional paradigm of German are distinct, as they are in Spanish. Indeed, if the relationship were this direct, we would expect that a language like Irish would pattern with German, never allowing thematic null subjects. But this is not true. Consider one of the verbal paradigms of Irish, cf. McCloskey and Hale (1984, 489):

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(6) chuirf-inn     'I would put'           1s
    chuirf-ea      'you (sg.) would put'   2s
    chuirf-eadh    'he/she would put'      3s
    chuirf-imis    'we would put'          1pl
    chuirf-eadh    'you (pl.) would put'   2pl
    chuirf-eadh    'they would put'        3pl
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In this paradigm, only three forms are synthetic, showing overt morphological person number agreement. McCloskey and Hale note that this paradigm is unusually rich in that it has an "unusually large number of synthetic forms" (p.

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[2] Dutch presents a slightly more complex situation. Cf. Safir (1985, section 6.4.3) and Koster (1986, section 5.3) for relevant, and partially conflicting, discussion.

42). Much more typical is the case illustrated in (7), where most of the verb forms are 'analytic' (op. cit., 492):

(7) cuir-im   'I put'   1s
    cuir-eann   'you (sg.)/he/she/we   2s,3s,1pl,2pl,3pl
                    you (pl.)/they put'

Here only one form is distinct, and yet Irish does allow thematic subjects to remain phonologically null when the verb is synthetic (in fact, it <u>requires</u> them to be phonologically null). These facts cast doubt on any simple definition of inflectional "richness" which may be involved in the null subject parameter. As McCloskey & Hale (1984, 492) observe: "Irish is not a language which is in any general sense rich in its system of person-number marking morphology for verbs, though it has sometimes been claimed that this is the criterial difference between languages which show null subject phenomena and those which do not".

Finally, languages like Japanese or Chinese show no number-person agreement at all. Japanese verbal paradigms inflect for tense/mood/aspect and negation (as in (8)), but not for person or number; Chinese shows no inflection affixation at all (as in (9):

(8) yom-ru   'read-present'
    yom-ta   'read-past'
    yom-eba   'read-conditional'
    yom-oo   'read-imperative'
    yom-itai   'read-volitional'
    yom-are   'read-passive'
    yom-ase   'read-causative'

(9) xihuan   'like'

Given the diversity of inflectional systems which license null subjects, and the concomitant difficulty in stating a notion of 'rich agreement' which encompasses all of them (while, of course, excluding non-null subject languages), Jaeggli & Safir (1987) propose a different approach. On their analysis the licensing condition which accounts for the possibility of null subjects is <u>morphological uniformity</u>. They propose that the licensing condition for null subjects be stated as in (10), using the definition of morphological uniformity given in (11).

(10) Null subjects are permitted in all and only those languages which have morphologically uniform inflectional paradigms.

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(11) <u>Morphological Uniformity</u>

An inflectional paradigm P for a category K in a
language L is morphologically uniform iff L has
either only underived inflectional K-forms or only
derived inflectional K-forms.

In other words, a morphological paradigm is uniform if all
its forms are morphologically complex or none of them are.
If a paradigm is mixed, that is, if some of its forms are
morphologically divisible into stem+affix while other
forms are bare stems, then it is not uniform. Only
morphologically uniform paradigms license null subjects.
Morphological uniformity is a property of the INFL (or
AGR) node, which is ultimately reflected on the verbal
stems after whatever process affixes inflectional endings
to verb forms (e.g. affix hopping, rule R, or,
alternatively, verb raising into INFL).

All of the paradigms reviewed above are
morphologically uniform. Spanish, German, Irish, and
Japanese all show paradigms with forms which are analyzed
as a stem+affix. The Chinese paradigm contains only
underived forms. Notice that it is not crucial to this
analysis whether the affix in question is a person-number
marking affix. In Spanish and German, the affixes have
that function; in Irish only some of the affixes have that
function, i.e. the affixes found with synthetic forms;
while in Japanese, none of the affixes are person-number
affixes. Yet all of them count as morphologically uniform.

Compare now what obtains in English, Danish, or
French, languages which do not license null subjects.

(12) a. <u>English</u>

to talk	infinitive
talk	imperative [=STEM]
talk	present 1s,2s,1pl,2pl,3pl [=STEM]
talk-s	present 3s
talk-ed	past
talk-ing	gerund

b. <u>Danish</u>

leve	infinitive	'to live'
lever	present	
lev	imperative [=STEM]	

c. <u>French</u>

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parl-e     infinitive      'to speak'
parl       imperative 2s [=STEM
parl       present 1s,2s,3s,3pl [=STEM]
parl-õ     present 1pl
parl-e     present 2pl
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In all three paradigms, we see that some forms correspond exactly to the stem of the verb. Thus, these paradigms are not morphologically uniform. In the interest of brevity, we present only as many forms as are needed to show that the paradigm is not morphologically uniform. For French and Danish, for example, the cases given above suffice, though by no means do they even begin to exhaust the complete inflectional paradigm of the language.

3. <u>Identification</u>

While our discussion of licensing is meant to determine when a null subject is possible, nothing we have said so far distinguishes languages like German, which drop only expletives, from languages like Spanish or Italian, which drop thematic subjects as well as expletive ones. Furthermore, the licensing condition discussed so far does not provide a mechanism by which the referential value of a null pronoun can be recovered. To address these issues Jaeggli & Safir define a process of identification which applies to thematic subjects. The essential role of identification is based on the following statement, which may be derived from the θ-Criterion:

(13) A thematic null subject must be identified.

Presumably, if a predicate selects a subject to be thematic, i.e. fill a θ-role, then a null subject will be excluded whenever it is not identified, where identification is crucial to the determination of referential value and referential value is crucial for determining the argument status of an NP. Thus, an NSL with thematic null subjects will be a language in which null subjects are both licensed and identified. Expletive null subjects, on the other hand, only need to meet the licensing condition.

These assumptions make a strong prediction about languages with inherently complex morphology, like Hebrew for example. In Hebrew, thematic null subjects are possible only in paradigms for past and future tense. In the present tense, where person agreement is defective, null thematic subjects are disallowed as in (14) (cf. Borer (1986, 392)):

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(14) 'Ani/'ata/hu/*ec 'oxel et ha tapu'ax.
     'I/you/he/0 eat-sg the apple.'

The null subject option is disallowed here because
identification fails in the present tense. It cannot be
due to a failure of licensing, since Hebrew is
morphologically uniform throughout its verbal paradigm.
Bare skeletal roots are completely absent, indeed
impossible, from the verbal paradigm of Hebrew. Now, if
identification is irrelevant for expletive null subjects,
we predict that expletives should be possible with present
tense verbs, and this prediction is borne out:

(15) a. ec nir'a she-Itamar shuv me'axer.
        'It seems that Itamar is late again.'

     b. ec margiz 'oti she Itamar tamid me'axer.
        'It annoys me that Itamar is always late.'

This is important evidence, then, that licensing and
identification should be kept distinct, and that licensing
does not depend on the richness of agreement: two of the
central claims of the analysis of Jaeggli & Safir (1987).

        Identification may come about in a number of ways.
(Each method of identification mentioned below is inspired
and empirically motivated by recent work by several
scholars.) First, we assume that agreement affixes with
the relevant Φ-features are identifiers in languages like
Spanish, Italian, and with synthetic forms in Irish. These
agreement features arguably are located in INFL and they
govern the subject position. We may state the
identification condition in these cases as follows:

(16) <u>Identification by Agreement</u>

        AGR can identify an empty category as (thematic) pro
        iff the category containing AGR Case-governs the
        empty category.

Raposo (1987) shows that rich agreement alone is not
sufficient to achieve identification. In the Prepositional
Infinitival Construction in Portuguese, the infinitive is
fully inflected, but null subjects are not allowed:

(17) *Eu vi [pro a roubarem automoveis]
     I saw (them) to-steal+3pl cars

Raposo argues that in this construction the subject
position is not governed by AGR. Note, for instance that a
lexical subject does not receive nominative Case in this

construction. Identification fails, then, due to lack of government.

The requirement that AGR be contained in a category that Case governs the subject position allows us to account for the Germanic data mentioned above, under certain plausible assumptions concerning the location of TENSE and AGR in so-called V2 languages like German and Icelandic. (Icelandic is another language which has rich agreement but only allows expletive null subjects). In these two languages it is reasonable to argue that Tense is located in COMP (or C of CP in the X-bar system of Chomsky (1986)), while AGR is located in INFL (or I of IP) (cf. among others Den Besten (1977), Evers (1981), Koopman(1983), and references cited in those works). Under condition (16), then, the distribution of Tense and AGR in separate nodes does not allow for the identification of null subjects. We believe the role of Tense in identification configurations is crucial because it is the source of Case assignment (harking back to Rizzi's (1982) analysis of null subjects in Italian, and Chomsky's (1982) suggestion that "rich" Agreement is a licenser only if Case-marked). West Flemish, as described in Bennis & Haegeman (1984) confirms our approach to Germanic null subjects, in that in West Flemish null thematic subjects are possible iff the tensed complementizer is inflected for person and number:

(18) a. ... dase pro komt   'that she comes'
     b. *...da pro komt   'that he/she comes'

The reason that the inflected complementizer allows for thematic null subjects is then simply an instance of the case where both AGR and Tense are part of the same governing node, whereas the uninflected complementizer contains only Tense but no AGR.[3]

In languages which uniformly lack person-number agreement, such as Chinese and Japanese, we assume that null subjects are identified either by an overt c-commanding nominal -- this will be the case for embedded subjects -- or by a (possibly null) Topic. We return to the issue of identification by a Topic later. For the

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[3] This analysis has further consequences for the analysis of null (expletive) subjects of small clauses in French, a language which is otherwise NOT a null subject language. In the interest of brevity, we omit this discussion here. See Safir & Jaeggli (1987) for discussion.

purposes of this presentation, we may follow Huang's system of identification by an overt c-commanding nominal, basically through an extended interpretation of control theory (though we note that other alternatives are available, e.g. Borer (1987)). Note that since these modes of identification are not available to Irish analytic forms, we follow McCloskey (1986) who argues that in Irish "an analytic form of the verb has an AGR feature, but is unspecified for the value of that feature".

Although we have omitted many details, the analysis of null subjects outlined above provides a unified account of the null subject phenomenon across a wide range of adult languages. Moreover, it has rather direct implications for grammatical development in children, particularly as regards the use of null subjects and the acquisition of verbal inflection. We turn to these issues next.

4. The Acquisition of "Mixed" Languages

As noted at the beginning of this paper, the optionality of lexical subjects appears to be a universal property of child language, whether or not the adult target language is a null subject language. According to the analysis proposed here, the child who allows null subjects must be analyzing his language as morphologically uniform. With regard to the development of "mixed" (non-uniform) languages, like English (and French), two predictions follow. First, we expect that these children will omit inflection during their null subject stage. In short, they will treat their morphological systems as uniform.

As is well-known, young English speaking children omit inflectional morphology; this being one of the characteristics which lends their speech its "telegraphic" quality (Brown, 1973). Adult English is not uniform, however, and thus our second prediction is that once the English speaking child learns properties of the inflectional system and realizes that it is not uniform, s/he will abandon the null subject grammar. As noted by Guilfoyle (1984), this is in fact the case; the acquisition of the present and past tense morphemes coincides with the end of the null subject stage in English. Klima & Bellugi (1967) note that tense inflection appears during their Stage 3 – the stage which Hyams (1983) identifies as the end of the null subject stage.

5. Acquisition in V2 languages
Let us consider next the morphologically uniform

verb-second languages, taking German as a paradigm case. Recall that German has a uniform inflectional paradigm and hence null subjects are <u>licensed</u> in this language. However, the agreement features fail to satisfy the identification condition because of the position of Tense. Thus, adult German does not have thematic null subjects, though it does have null expletives.

In contrast to the adult language, however, early German is a null subject language. Clahsen (1986) observes that German children use lexical subjects only about 45% of the time during his stages II and III. Interestingly, during this same period German children fail to systematically respect the verb second requirement. The predominant word order at this point is SOV, although the correct adult order in simple clauses in SVO. Clahsen's Stage IV is marked by two important changes. First, the use of null subjects falls to 10%; at the same time, the use of verb second jumps to 90%. Both changes are dramatic by acquisition standards.

The co-occurrence of these two grammatical developments follows from the analysis of null subjects being proposed. In the early grammar of German, null subjects are both licensed and identified; at this point the tense features are in INFL with the agreement features and thus the identification requirement is satisfied. However, when the early grammar of German restructures such that Tense is situated in COMP, evidenced by the onset of the V2 rule, identification is blocked and null subjects are no longer licit.

6. The Acquisition of Inflection

We have discussed the use of null subjects and its real-time relation to other grammatical phenomena such as the V2 rule in German and the acquisition of tense morphology in English. There are, in addition, other more general properties of child language which are explicated by this analysis.

A number of people have observed that morphological development is a lot quicker and less errorful for children acquiring languages which are morphologically rich, such as Italian (Hyams, 1983) and Polish (Weist & Witkowska-Stadnik, 1985) than for children acquiring English, where acquisition of verbal inflection is very late (Brown, 1973). This result follows if, as we are proposing, the child's initial hypothesis (in advance of any linguistic experience) is that his language is morphologically uniform. Those languages which meet this expectation will be "easier" to acquire than those which

do not. Moreover, it has been noted, particularly by D. Slobin and colleagues, that children tend to make uniform those paradigms which are not. The ommission of inflection, as in English, is one example of how they do this. Another is the tendency which children have to avoid ∅ affixation in morphologically rich languages. This phenomeon can be explained, if we assume, that zero affixes do not count as affixes for the child. He would then tend to replace zero forms with overt ones in order to insure a uniform paradigm.

8. The Initial State

In the time we have left we would like to turn to discussion of the initial state. It is in this regard that the present null subject analysis differs most markedly from the analysis in Hyams (1983,1986).

Taking the MUP given in (10) to be the correct statement of the null subject parameter, we are proposing that [+uniform] is the initial setting -- hence null subjects are licensed in the child's grammar. The first question which arises is why should this be the case. A second issue concerns the status of identification at the initial state. Let us address these issues in turn.

With regard to the first point it should be noted that from the viewpoint of linguistic theory, or UG, there is no reason that "uniformity" should represent the initial parameter setting. (In fact, we assume in the general case that linguistic theory is neutral with respect to the question of initial parameter settings.) However, adopting a learnability-theoretic perspective, it becomes obvious that uniformity is a more restrictive hypothesis than non-uniformity. That is to say that if the child assumes that no forms are inflected or that all forms are, positive evidence will tell him otherwise. If, on the other hand, he assumes that his language is "mixed," when in fact it is not, no number of inflected or uninflected tokens will suffice to induce a reanalysis.

Let us turn now to the question of identification in the early grammar. As noted earlier, children acquiring richly inflected languages like Italian and Polish learn the inflectional system fairly early and thus it seems reasonable to assume that in these cases the null subject is identified by AGR, as is the case in the adult grammar of these languages. On the other hand, in the early grammar of languages like English, French (and ASL) something other than agreement features must be satisfying the identification requirement. We propose that in these

cases the null subject is identified by a null Topic, has been proposed for Chinese and other adult null subject languages which uniformly lack morphology.

This idea follows in the spirit of Huang's (1984) analysis of Chinese. Huang distinguishes "discourse-oriented" languages from "sentence-oriented" languages. The "discourse-oriented" languages, like Chinese, have a rule of "topic-chaining" by which the discourse topic is grammatically linked to a null sentence topic which in turn identifies a null argument (specifically, a variable in GB terms). Modifying Huang's analysis somewhat, we propose that in the early grammar the null subject is a pronominal (pro) which is identified by a null topic. Thus, the difference between the early grammar of Italian, on the one hand, and English and Chinese, on the other, is not the content of the empty subject position but rather the method of identification, as schematized in (19) (irrelevant structure is omitted). We discuss these structures further below. (D-TOPIC=discourse topic; Topic=sentence topic).

(19) a. $[_S \text{pro}_i \ [_{INFL} \text{AG}_i/\text{Tense}]_i \ ... \ ]$ Italian

    b. $\text{D-TOPIC}_i \ ... \ [\text{Topic}_i \ [_S \text{pro}_i \ ... \ ]$ Chinese

Thus, in contrast to the analysis in Hyams (1983) the current proposal is that some children start out "speaking Italian" while others start out "speaking Chinese"; English-speaking children fall into this latter category. They will ultimately abandon this grammar when they realize that English is not morphologically uniform and thus fails to satisfy the licensing condition.

8. Null Objects

This proposal raises a number of issues - one of which is that adult discourse-oriented languages typically allow null objects in addition to null subjects and this has obvious implications for the acquisition analysis we propose. So we would like to discuss this issue in some detail.

As noted earlier, on Huang's analysis a topic may bind a variable in either subject or object position, as illustrated in (20).

(20) a. $\text{D-TOPIC}_i \ ... \ [\text{Topic}_i \ [_S [\ e_i \ ] \ INFL \ VP \ ]]$
    b. $\text{D-TOPIC}_i \ ... \ [\text{Topic}_i \ [_S \ NP \ INFL \ [\ V \ [e_i]]]]$

Under this analysis, the null subject and null object phenomena are grammatically equivalent. Both gaps are

variables bound by a null topic (or Operator), the content of which is recovered through the discourse topic. All else being equal this analysis predicts that a discourse-oriented child language will have both null subjects <u>and</u> null objects.

We propose, in contrast, that in the adult language in addition to the Topic-variable structures, which we remain completely neutral about, a Topic may also <u>identify</u> a null pronominal in subject position, as illustrated in (19b). However, a topic cannot identify a null pronoun in object position. We assume, following Huang, that a null pronoun must be identified by the closest c-commanding NP. This will always be the subject NP, not the Topic. But then, condition B of the Binding Theory would be violated. Thus, (21) is an impossible structure in Chinese.

(21) *D-TOPIC$_i$ ... [Topic$_i$ [NP INFL [V pro$_i$]]

This analysis thus predicts that there could be a discourse-oriented grammar (in Huang's sense) in which null subjects are possible, but which disallows null objects. This would be true just in case the grammar had null pronominals, but not variables. We propose that this is in fact the case; in the early grammar the inventory of null elements includes little <u>pro</u>, but not variables. We will assume for the present that the latter are maturationally determined to emerge at some later point. The claim that <u>pro</u> emerges prior to variables in the early grammar was first proposed by Roeper, Rooth, Akiyama & Mallis (1984) who argue for this on the basis of entirely independent experimental evidence.

Returning to the acquisition data, our prediction of a null subject/null object asymmetry is certainly confirmed in the case of English, where children systematically omit subjects, but rarely objects. More interestingly, however, this asymmetry seems to exist for Japanese speaking children as well, despite the fact that Japanese, like Chinese, is a discourse-oriented language with null objects. In a study of the acquisition of Japanese, Mazuka, Lust, Wakayama & Snyder (1986) calculate the frequency of various null constituents in the 2-word utterances of several Japanese children. Their results show that null subjects occur in approximately %50 of the subject-predicate constructions, while null objects appeared in only %17 of the transitive verb constructions. Thus both English and Japanese speaking children exhibit a strong asymmetry in their use of null subjects and objects supporting the notion that these two structures can be grammatically distinct.

To sum up, we are proposing that the early grammar is a null subject grammar in which the null pronominal subject is licensed by morphological uniformity; this property is invariant across children. However, the early grammar can vary in the manner of identification; the null subject may be identified by agreement in some cases and by topic in others. We assume that this is largely (though perhaps not completely) determined by properties of the input language. In the case of topic-identification, a null subject grammar does not imply a null object grammar since the two phenomena can be grammatically distinct. The acquisition data support this claim since they show a subject/object asymmetry in the child's use of null arguments. Our analysis further predicts that children acquiring real discourse-oriented languages will produce null object structures at the point at which they develop variables, as evidenced, for example, by emergence of wh questions and so on. We do not at present know what the acquisition data show in this regard.

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