DISCOURSE AND GRAMMATICAL CUES IN THE ACQUISITION OF SPANISH PRONOUNS

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ABSTRACT

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From an acquisition standpoint, personal pronouns are particularly interesting to study because they are a perfect encapsulation of the problem faced by the language learner: how to coordinate information from multiple levels of representation while still in the process of acquiring those representations. Pronoun interpretation is influenced by constraints at every level of representation, from phonology to discourse, and acquisition at one level can constrain the path of acquisition at other levels.

This dissertation focuses on the interaction between the levels of morphosyntax and discourse during development, specifically, how the acquisition of person and number features relates to the acquisition of discourse relations: the semantic relations between events and states in a discourse. Person and number cues provide bottom-up information about who the referent of a pronoun can and cannot be, while discourse relations provide top-down information about which referents are likely to be the targets of pronominal reference. The question for acquisition is very simple: Do children proceed bottom up or top down? Focusing on preschoolers acquiring Mexican Spanish, a language with abundant person and number cues, we divide the problem into three parts:

Q1. Which person and number cues are children sensitive to, and when?
Q2. Which discourse cues are children sensitive to, and when?
Q3. How do children integrate these cues together at different ages?

Person and number cues: In picture-selection and act-out tests, children show early comprehension of 1st and 2nd person morphology but inconsistent behavior in the 3rd person. Children are aware that 3rd person pronouns select a referent or antecedent from the preceding physical or linguistic discourse, but they fail to consistently choose referents compatible with their person and number morphology.

Discourse cues: Adults use a combination of discourse relations and pronominal form (null vs. overt subjects) to interpret grammatically ambiguous subject pronouns. Children under 4 ½ show sensitivity to discourse relations, while children over 4 ½ show sensitivity to the null/overt contrast.

Integration: Four picture-selection experiments examine children's sensitivity to different discourse relations, first in isolation and then in combination with person and number cues. When cues to the *Parallel* discourse relation appear in isolation, children show weak sensitivity at best. However, when parallelism and number cues are combined, parallelism has a facilitating effect on the comprehension of number by children ages 4 ½ and up. Moreover, this facilitating effect coincides with a jump in children's *overall* sensitivity to number morphology. When cues to the temporal discourse relation *Occasion* appear in isolation, we again find little evidence of sensitivity. However, when temporal and person cues are combined, temporal cues have a facilitating effect on the comprehension of 3rd person features by children ages 4 ½ and up. Moreover, this facilitating effect coincides with a jump in children's *overall* sensitivity to 3rd person morphology. In other words, we see a correlation between sensitivity to discourse relations (*Parallel, Occasion*) and adult-like use of person and number morphology.

Do children proceed bottom-up or top-down? Children's difficulty with at least some person and number cues, plus their early sensitivity to at least some discourse cues, rules out a strictly bottom-up hypothesis. However, their early adult-like use of 1st and 2nd person morphology also rules out a strict top-down hypothesis. Instead, we come down in favor of a weak version of the top-down hypothesis. Specifically, we claim that while children have early representations of the full set of person and number features, this knowledge is more difficult to deploy when interpreting semantically and morphologically underspecified pronouns (3rd person singular and 3rd person plural), and that discourse sensitivity facilitates the interpretation of such pronouns.

This thesis is dedicated to
Nina and Rob—
the poet and the mathematician,
who one day got together and decided to make
a linguist.

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As with a child, it takes a village to make a dissertation. There may be one name on the copyright page, but there are dozens of people whose cumulative effort you will find in between the lines of this thesis. I would like to take a moment to thank some of them.

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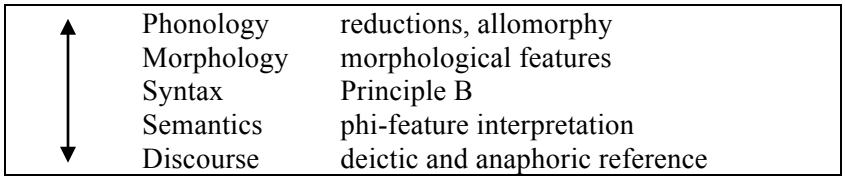
1. The problem of integration

From an acquisition standpoint, personal pronouns are particularly interesting to study because they are a perfect encapsulation of the problem faced by the language learner: how to integrate information from multiple levels of representation while still in the process of acquiring those representations. Pronouns are a particularly clear example of this puzzle because their interpretation is influenced by constraints at every level of representation, from phonology to discourse, and the acquisition process is not complete until the child has learned all of these constraints and can coordinate them in both production and comprehension.

The figure below offers a schematic overview of some of what confronts the child acquiring personal pronouns. Every level presents a challenge of its own, as the child learns to identify and incorporate a new set of constraints into her model of pronoun representation. At the level of phonology, for example, the child must identify and reverse reductive processes in order to recover underlying phonological forms. At the morphological level, she must learn how these phonological forms map to bundles of morphosyntactic features like case, animacy, gender, and so on. At the syntactic level, she must learn to incorporate structural constraints, such as Principle B, into her interpretation. At LF, she must learn to map interpretable features to their semantic denotations. And at the discourse level, she must learn to use contextual cues like recency of mention and real-world knowledge to link pronouns to their referents, whether directly (deictic reference) or through a previously mentioned linguistic antecedent (anaphoric reference).

Figure 1: Examples of constraints on pronoun interpretation



Studying children's changing use and comprehension of pronouns offers a window into how the language acquisition device proceeds through each of these levels, and how progress at one level can lead the way to progress at another level. At lower levels of representation, the acquisition task is simply to establish the inventory of pronominal forms in the target language: segmenting strings like *she* and *her* from the speech stream, reversing phonological reductions like *'er* from *her*, and so on. Fairly complete acquisition at these levels is arguably necessary for learning at other levels to proceed. At higher levels, however, greater cross-level interaction is possible. Here, the acquisition task is to map these forms to their meaning, which involves not only mapping each phonological form to its semantic features but also learning to link each individual pronoun token to its intended referent. Decisions made at these levels can be mutually informative. For example, establishing a mapping between the phonological form /hɪ/ and the semantics of the feature [+feminine] narrows down the set of potential antecedents that can be chosen from the discourse, thus constraining the child's hypotheses about how to identify intended antecedents. On the other hand, associating the form /hɪ/ to discourse-salient antecedents constrains the child's hypotheses about the possible semantic features encoded by the form /hɪ/. Systematically tracking children's sensitivity to cues at each of these levels can illuminate how and when decisions made at one level inform decisions made at other levels.

This dissertation will focus on the interaction between the levels of morphosyntax and discourse, specifically on the interaction between person and number features on the one hand, and discourse relations on the other. Morphosyntactic person and number features constrain the participant status and cardinality of a pronoun's ultimate referent, as illustrated in (1). And discourse relations help to adjudicate between multiple compatible referents by making some referents more likely targets than others, as illustrated in (2) and (3). In (2), the causal relation between the two sentences makes *Bill* the more likely antecedent of *he*, whereas the temporal sequence in (3) makes *John* the more likely antecedent.

(1) John scared Sally. {He/She} yelled. *he* = John, *she* = Sally
(2) John scared Bill. So he yelled. *he* = Bill
(3) John scared Bill. Then, he yelled. *he* = John

The acquisition question this thesis addresses is very simple: Do children proceed bottom up or top down?

2. Bottom up or top down?

Roughly speaking, there are two possibilities for how children go about acquiring constraints on pronoun interpretation: bottom-up or top-down. At first, the bottom-up hypothesis seems to be the most reasonable. Person and number cues are categorical, while discourse cues are probabilistic, hence the former are more statistically reliable. Person and number cues operate at the level of individual pronouns, while discourse cues operate between two or more clauses, hence the former seem like they would be easier to extract. It seems like a logical course of action to acquire morphosyntactic cues first. However, there are at least three reasons why a more top-down approach is reasonable, maybe even smarter.

First, just because person and number cues are extractable from pronouns does not mean that they are easier to process. Timing is also important. Pronouns typically retrieve antecedents from the preceding discourse, meaning that person and number cues are normally encountered *after* the intended antecedent has already been uttered. If children follow a strictly bottom-up learning path, then they will be forced to go through a stage in which the search for an appropriate antecedent begins only once a pronoun is encountered. Given children's limited processing resources, this may simply be too late. A smarter learning strategy would be to begin setting up expectations about future pronoun reference *before* a pronoun is even encountered. Of course, discourse cues themselves can occur at or after the pronoun as well; this argument is merely to say that children would do best to hedge their bets, learning to immediately use whatever cues they encounter—be they discourse cues or person and number cues.[1]

[1] Thanks to John Grinstead for pointing this out to me.

Second, just because a cue is categorical doesn't mean it is useful. Consider the example of Principle B, famously studied in children by Chien & Wexler (1990), using sentences like (4). Principle B is a categorical constraint on the interpretation of pronouns, which states that a (non-reflexive) pronoun cannot be bound by a c-commanding DP within the same domain. Hence, in (4), *her* cannot corefer with the c-commanding DP *Mama Bear*. But even if Principle B may be helpful for ruling *out* certain interpretations, it alone is not sufficient for ruling *in* the intended interpretation. More information is needed to locate the intended referent, either from the preceding discourse, as in (5), or from the extralinguistic context. If the child is aware of and able to use available discourse information, then Principle B need not even be invoked. That is, Principle B is not only not sufficient for adult-like pronoun interpretation in (5), it is also not strictly necessary, either. Other pieces of information can be crucial.

(4) *Mama Bear$_i$ is washing her$_i$.
(5) Goldilocks$_{Topic}$ is at home. Mama Bear is washing her$_{Topic}$.

The situation is similar for the case of person and number features. If their primary contribution is to narrow down the set of grammatically possible pronoun referents, then in many contexts they too are neither necessary nor sufficient for pronoun interpretation. Whenever the discourse contains more than one potential antecedent with the same grammatical features, as in (6) below, information from phi-features is automatically insufficient to narrow down this set of potential referents to one. On the other hand, if children are aware of and can deploy discourse cues like topicality, they may not even need to invoke phi-feature compatibility to identify the intended antecedent in sufficiently rich discourses.

(6) Goldilocks$_{3SgFem}$ is at home with Dora$_{3SgFem}$. Sponge Bob is washing her$_{3SgFem}$.

Finally, just because a cue is categorical, and just because children are sensitive to it, does not mean that they will use it in a categorical way. Consider again Principle B. Children have been shown to allow violations of Principle B until well past 4 (Chien & Wexler 1990), a result so common that it has been dubbed the "Principle B effect" or the "Pronoun interpretation problem." Interestingly, however, this problem has been found to decrease significantly when certain discourse cues are provided (Conroy et al.

2009, Spenader et al. 2009). For example, Spenader et al. (2009) replicated Chien & Wexler's Truth-Value Judgment task, manipulating the discourse context. They compared children's responses to prompts like (4) preceded by three different preambles: (i) Chien & Wexler's "classic" preamble, in which two characters are introduced but neither one is established as the topic (*Here you see Mama Bear and Goldilocks'. Mama Bear is washing her.*), (ii) a discourse-coherent preamble, in which the target character is introduced as the topic (*Here you see Goldilocks. Mama Bear is washing her.*), and (iii) an "embedded" condition in which the target character is introduced, not as a topic, but as the subject of a matrix clause in which the target sentence is embedded (*Goldilocks says Mama Bear is washing her*). In the discourse-coherent condition, the pronoun interpretation problem dissolved entirely: children were no worse at linking *her* with *Goldilocks* than they were at linking *herself* with *Mama Bear* in the same context. In both of the other conditions, the problem persisted, with children allowing *her* to be coreferential with the ungrammatical antecedent *Mama Bear*. Studies like this highlight the need to embed experimental prompts in coherent discourse so as to avoid masking children's grammatical sensitivity. More importantly, however, they show that grammatical sensitivity can be masked: children are not above violating categorical constraints that are in conflict with probabilistic ones.

In fact, there is evidence that despite having knowledge of phi-features, children can still fail to use this information in comprehension until well into the preschool years. This evidence comes from literature on the comprehension of person and number agreement. For example, in picture-selection tasks testing the comprehension of agreement, English-acquiring children as old as 5 fail to use 3rd singular /-s/ to infer the cardinality of a masked subject (Johnson et al. 2005, see example prompt in (7) below), while Spanish-acquiring children fail to use 3rd plural /-n/ and 3rd singular null morphology to infer the cardinality of a null subject until age 5 (Pérez-Leroux 2005, see example prompt in (8) below).

(7) Prompts testing comprehension of agreement in English (Johnson et al. 2005)
   a. The cats_sleep on the bed.
   b. The cat_sleep**s** on the bed.

(8) Prompts testing comprehension of agreement in Spanish (Pérez-Leroux et al. 2005)
a. *Duerme-**ø/n** en la cama*.
pro sleep-3S/3P in the bed

At the same time, children much younger than this correctly *produce* verbal agreement (Grinstead 1993, Clahsen et al. 2002) and can detect subject-verb agreement violations (Soderstrom et al. 2007, Brandt-Kobele & Höhle 2014). This production/comprehension asymmetry has been replicated in picture-selection tasks in many languages (English: Keeney & Wolfe 1972, Childers et al 2001, Johnson et al. 2005; Spanish: Childers et al 2001, Pérez-Leroux 2005; Xhosa: Gxilishe et al 2009; Farsi: Rastegar et al 2012, Dutch: Verhagen & Blom 2014).

In sum, even though grammatical person and number cues may be more statistically reliable than discourse cues, they are not necessarily more useful to the child. They are often encountered later in processing; even when they are encountered there is no guarantee that they will provide sufficient information to arrive at an interpretation; and even if they are sufficient there is no guarantee that children will use them. This means that we must consider the possibility that children begin acquiring discourse cues at least as early as morphosyntactic cues. We consider this possibility by taking a systematic look at (i) what children know about person and number features of pronouns, (ii) what children know about discourse, and (iii) how children integrate the two types of information when both are present.

3. Linguistic assumptions

Before addressing these three questions, it is important to clarify which pronouns we will be examining and what linguistic assumptions we have about them. Pronouns encompass a closed class of DP and PP elements whose meaning varies depending on the inter- or intra-sentential context. They can be personal, locative, or temporal, and within each of these categories we find indefinites (ex. *someone, somewhere*), demonstratives (ex. *this, that, there*), indexicals (ex. *I, you, here, now*), and reflexives (ex. *myself, herself*), among other sub-categories. (See Buring 2011for a descriptive classification.)
Here, we will be concerned with Spanish-language definite, non-demonstrative, non-reflexive pronouns. In subject position, these include the null subject and the overt subjects *yo, tú, él, ella, nosotros, ustedes,*

ellos, ellas (‘I,’ ‘you (sg.),’ ‘he,’ ‘she,’ ‘we,’ ‘you (pl.),’ ‘they (masc.),’ ‘they (fem.)’) In direct object position these include clitics *me, te, lo, la, nos, los, las* (‘me,’ ‘you (sg.),’ ‘him,’ ‘her,’ ‘us,’ ‘them (masc.),’ ‘them (fem.)’).

3.1. Syntactic assumptions

Syntactically, all of these pronouns behave like DPs, although their internal structure may differ (see Cardinaletti & Starke 1999, Dechaine & Wiltschko 2002 for specific proposals on the fine-grained structure of pronouns). For instance, clitics are commonly assumed to be structurally deficient in some way that forces them to move from their original argument position into a position dependent on some other element. For the clitics studied here, this position is adjacent to a verb, either immediately preceding a finite verb (9) or immediately following a non-finite verb (10).

(9) Los maestros la llamaron.
a. the teachers CL.fem called-3Pl
b. “The teachers called her.”

(10) Los maestros están llamándola.
Q1. the teachers are-3Pl calling-CL.fem
Q2. “The teachers are calling her.”

(11) Los maestros la_i llamaron {pro_i/a $la\ niña_i$}
Q1. the teachers CL.fem called-3Pl {*pro*/A the girl}
Q2. “The teachers called her/the girl.”

(12) $Ellos_i$ $llamaron_i$ a la niña.
Q1. they called-3Pl A the girl
Q2. “They called the girl.”

An alternative to this assumption is that clitics are not actually arguments, but agreement markers, agreeing with a null object pronoun in argument position. Evidence in favor of this comes from the phenomenon of clitic doubling, in which the clitic is accompanied by an overt DP (11). However, I assume that clitic doubling is a special case, analyzable along the lines of nominal incorporation in other languages (ex. Farkas and de Swart 2003). I adopt the traditional perspective that clitics are moved arguments, though nothing hinges on this assumption.

Just as clitics have been analyzed as agreement, so too have agreement markers been analyzed as pronominal (Alexiadou & Anagnostopoulou 1998). On this view, so-called null-subject sentences have no

null subject: the agreement marker itself fulfills this function when the verb moves into the IP. This forces one to deal with overt-subject sentences (12) in a manner similar to either clitic doubling structures or clitic left dislocation (see Alexiadou & Anagnostopoulou 1998 for a defense of the latter position). Nevertheless, this position has never been widely accepted, and I therefore retain the more traditional assumption that the null subject and the overt subject are both overtly present in the syntax, initially merged into SpecIP but potentially traveling to higher locations within the extended CP projection. In Chapter 3 we will review in more detail a handful of different proposals about the precise location of null versus overt subjects and the differing predictions that these proposals make regarding the semantics of the null/overt subject contrast.

3.2. Semantic assumptions

The pronouns studied here have two semantic properties that are important to mention. First, like other personal pronouns, they carry phi-features, including person, number, and gender. Second, like most pronouns they are referentially dependent, relying for their interpretation on either a binder, as in (13), a linguistic antecedent, as in (14), or a salient contextual referent, as in (15). 1st and 2nd person pronouns are usually deictic, but they can also be bound (16).

(13) Every girl$_i$ thinks she$_i$ is smart.
(14) Sara$_i$ aced the test. I think she$_i$ is smart.
(15) [pointing] She$_i$ is one smart cookie.
(16) [Teacher to students]
Each of you$_{addr}$ should bring a question to our$_{spkr+addr}$ one-on-one meeting.

Much of the debate over the correct representation of pronouns has centered around non-referential uses, such as (13), in which the pronoun never ultimately refers to an individual, but instead behaves like a bound variable. For instance, the Binding Theory is concerned with correctly defining the domain within which binding is evaluated, how binding conditions differ for reflexive and non-reflexive pronouns, and whether such domains should be defined in syntactic or semantic terms (see Elbourne (2008) for an overview of the evolution of this debate and studies on children's awareness of binding

conditions). We will not be concerned with this debate here but will limit our attention to children's comprehension of anaphoric, referential uses of pronouns, such as (14).

Another debate revolves around whether pronouns are best represented formally as variables or as covert definite descriptions. Again, arguments for this approach have relied on non-referential uses of pronouns, including so-called donkey or E-type pronouns (17) and paycheck pronouns (18), where the pronoun is dependent on a DP (*a donkey*, *any woman*) that itself behaves as a variable (there is no one specific donkey or woman, but a hypothetical series of them). Since we will only be concerned with anaphoric, referential uses of pronouns, we will adopt the semantic variable approach for convenience.

(17) Every man who owns a donkey beats it.
(18) Mary, who deposited her check, was smarter than any woman who kept it in her purse.

The semantic variable approach to pronouns is summarized in Buring (2011) section 2.1. Essentially, what it claims is that variables do not directly denote anything themselves, but that they can be mapped to any number of DP meanings with the help of an assignment function sensitive to context. On this approach, the process of interpreting a pronoun is essentially the process of finding the right assignment function for the context. In formal terms, the denotation below says that pronouns are interpreted with respect to an assignment function *g*, which is modeled as a sequence of DP meanings (ex. *Goldilocks, Mama Bear,* etc.). The assignment function sets up a mapping between a given instance of a pronoun, *i*, and a particular DP meaning (ex. *g*(*i*) = *Goldilocks*, *g*(*j*) = *Mama Bear*, etc.). Different assignment functions (*g, g', g'',* etc.) will result in different mappings and hence, different pronoun interpretations (ex. *g*(*i*) = *Goldilocks*, but *g'*(*i*) = *Mama Bear*). To provide another example, say we have a pronoun *her* with index 3. If the third member of *g* is *Maria* and the third member of *g'* is *Sara*, then $[\![her_3]\!]^g = g(3) =$ *Maria*, and $[\![her_3]\!]^{g'} = g'(3) =$ *Sara*.

(19) for assignment function *g*, the interpretation of a pronoun with respect to *g* is
$[\![[_{\text{pron}}\text{X}]_i]\!]^g = g(i)$ (the *i*-th member of *g*)

The variable approach to pronouns captures the contrast between bound and referential uses. In bound contexts, the DP binder itself manipulates the assignment function *g*, so the sentence can be interpreted without reference to the wider context. For example, the proposition in (13), *Every girl thinks she is smart*, is a claim not about any particular girl, but about the relationship between being a girl and thinking one is smart. It does not matter which particular girl *g* maps *i* to. The claim made by the sentence is that, regardless of which assignment function is chosen, so long as *girl*(*x*) is true, then *x thinks x is smart* is also true. Of course, one needs to look to the context to know whether this claim is true or false, but the point is that one need not look outside the sentence to know what the claim itself is.

As mentioned before, will only look at children's comprehension of referential uses of pronouns, where the choice of assignment function crucially does matter. Much of the action of this dissertation will center on how children learn to choose the *right* assignment function, i.e., the one that maps *i* to the salient DP meaning intended by the speaker. In anaphoric contexts, *g* maps *i* to a salient DP meaning, which in turn picks out a referent. In deictic contexts, *g* assigns *i* directly to the most salient referent in context.

Aside from context, comprehenders also use the phi-features carried by a pronoun to help them identify *g*. Standard accounts model phi-features as presuppositions. That is, the feature presupposes something about the referent to which *g* points, as illustrated in (20). Phi-features are modeled as presuppositions rather than part of the asserted content because using the wrong feature results not in falsehood, but infelicity. This is easiest to see with gender features; for example, pointing at a girl and uttering (21) can be corrected, but not directly contradicted.

(20) $[\![she_i]\!]^g = g(i)$ if $g(i)$ is a female individual, undefined otherwise

(21) A: He is short.
#B: That's not true, he is a she!
B: That's true, but actually he is a she.

The last important assumption to point out is that some phi-features are more marked than others, and that this kind of semantic markedness does not always line up with morphological markedness. Sauerland

(2003) presents a number of diagnostic tests to argue that person, number, and gender features each have one or more marked values and one unmarked value. For person, the marked values are 1st and 2nd person, which presuppose that the referent includes the speaker or hearer, while the unmarked value is 3rd person, which presupposes nothing. Evidence for this can be found from the dominance of 1st and 2nd person over 3rd in coordination (22), as well as from the emergence of 3rd person in cases where person status is unknown (23) or changes over the different values of a bound variable (24). Similar evidence is presented for the markedness of feminine vis-à-vis masculine features.

(22) Dominance test for markedness
a. Tú y él sois locos.
You and he are-2.pl crazy-masc.pl
b. Ella y yo somos locos.
She and I are-1.pl crazy-masc.pl

(23) The winner will be a lucky guy. He could be me.
(24) Every one of us has to call his/their/*our/*your mother.

Somewhat more controversially, Sauerland (2003) and Sauerland et al. (2005) argue that for number systems with a singular/plural distinction, it is actually the plural that is unmarked. The dominance test is irrelevant, since coordinated items are necessarily non-singular, but other tests work. For instance, when number is unknown (25) or when it varies across values of a bound variable (26) plural forms surface, rather than singulars.

(25) Does your office have windows/*window?
(26) Every boy should invite his sisters to the party.
[Felicitous even when some boys have only one sister]

If some phi-feature values are semantically meaningless, how then are they interpreted? Following Heim (1991), Sauerland et al. (2005) propose that the meaning is generated in much the same way as a scalar implicature. The marked and unmarked values form a scale, and comprehenders generally assume that speakers will use the stronger item wherever possible (this assumption is dubbed "Maximize Presupposition"). The use of a semantically underspecified feature therefore triggers the inference that the stronger item is not permissible in context, presumably because its presupposition would be violated. In

this manner, the use of a 3rd person implies "not speaker, not hearer," the use of a masculine implies "not feminine," and the use of a plural implies "not singular."

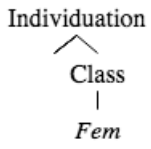
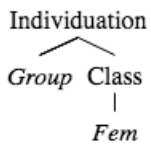
As with scalar implicatures, the calculation of these Implicated Presuppositions imposes an extra step on the comprehender, and experimental work has attempted to show that this step poses a special difficulty for children (Sauerland et al. 2005, Legendre et al. 2011). We will return to this question when testing children's comprehension of number in Chapter 2 and their integration of number and discourse relations in Chapter 4. In brief, we fail to find the predicted singular/plural asymmetry; however in Chapter 6 we point out that this may be due to the confounding factor of a different type of underspecification, morphological underspecification, to which we turn now.

3.3. Morphological assumptions

I assume Distributed Morphology (Halle & Marantz 1993), a model of the grammar in which the dividing line between the lexicon and the syntax is erased. Instead, both words and sentences are built by the syntax, which constructs them piece by piece from formal features. The resulting bundles of features are then matched to their pronunciations at the interface with phonology (PF) and to their interpretations at the interface with the semantics (LF). Crucial to the process of spell-out is the idea that different pronunciations, called Vocabulary Items, all compete for the chance to spell out a given bundle of formal features, and it may be the case that no single Vocabulary Item is a perfect match for the bundle of features in question. In this case the competition is decided on the Subset Principle: the Vocabulary Item that spells out the biggest subset of features—without adding any extraneous features—wins. The notion that the winning Vocabulary Items may be underspecified for some features makes it possible to account for the fact of syncretism, where the same form surfaces in environments with different formal features. There is an ongoing debate over whether pronouns are built from bundles of binary features (ex. [+Plu] vs. [-Plu]) or privative features (ex. [Plu] vs. [ø]). I won't be able to resolve this debate, but what is important here is the fact that *both* systems allow some Vocabulary Items to be underspecified. In a two-way number system, for example, a privative treatment would force one VI to have a number feature and

the other to lack that feature. One implementation of this, following Harley & Ritter's (2002) Feature Geometry analysis, is illustrated in (27) for the Spanish 3rd person feminine singular and plural clitics. On the other hand, a binary system would require one VI to have a positive number feature but would allow the other to have either a negative value *or no value at all*, as illustrated in (28). Both options are formally sufficient. I assume that in two-way number systems like Spanish, plurals are morphologically marked for number, while singulars are unmarked. This fairly standard assumption is based on the cross-linguistic observation that plurals are rarely if ever null, and that the existence of plural forms entails the existence of singular forms, but not vice-versa.

(27) Privative treatment of a singular-plural number system:

Vocabulary Item	features	semantics
la		feminine singular
las		feminine plural

(28) Binary treatment of a singular-plural number system

Vocabulary Item	features	semantics
la	[+Fem]	feminine singular
las	[+Fem, +Plu]	feminine plural

The existence of morphological underspecification is important because, it makes the comprehension of underspecified Vocabulary Items a very different process from production. In production, the speaker compares the intended meaning (ex. feminine singular) to the available forms (ex. *la, las*) and chooses the winner according to the Subset Principle; this allows the underspecified form to surface when all other competitors fail. Reversing this process to achieve comprehension, however, is somewhat more complicated. First, the comprehender must map the Vocabulary Item (ex. *la*) to its features (ex. [Fem]).

This produces an incomplete interpretation, so the comprehender can compare the VI to all the potential competitors that *could* have been inserted in the same node but *weren't*, presumably because they carry clashing features (ex. *las* carries a plural feature). This comparison then allows the comprehender to infer what the value of this feature is for the underspecified form (ex. *la* is non-plural, i.e., singular).

In sum, I assume that underspecification can be either morphological or semantic in nature, that both types of underspecification place a greater demand on the comprehender than on the producer, and that these two types of underspecification line up in the case of person features but not in the case of number. Hence, 3rd person singular and 3rd person plural pronouns should be more difficult to interpret than they are to produce.

4. Structure of the thesis

This thesis focuses on children between 3 and 6 years of age acquiring Mexican Spanish, a language with abundant person and number cues. The experimental tasks we use will help us to answer three basic questions about their competence, each addressed in a different section of the thesis:

Q1. Chapter 2: Which person and number cues are children sensitive to, and when?
Q2. Chapter 3: Which discourse cues are children sensitive to, and when?
Q3. Chapters 4-5: How do children integrate these cues together at different ages?

In some cases it will be necessary to first do some preliminary work concerning adult interpretations of these cues. While the set of person and number cues is well understood and their role in the mature grammar is, for the most part, agreed upon by theorists, the same is not true of discourse cues. What's more, since the term *discourse* is applied to basically anything larger than a sentence, what counts as a *discourse cue* can be a fairly heterogeneous grab-bag of information, both linguistic and non-linguistic. For the sake of concreteness, we adopt the theory of discourse articulated by Asher and Lascarides (2003), which spells out how linguistic and non-linguistic discourse information contribute to the resolution of ambiguities in the syntax and semantics, and we will focus specifically on the contribution made by inter-sentential semantic relations, or "discourse relations." Overt markers of these relations

include connectives specifying temporal relations (*before, after, while,* etc.), causal relations (*because, so, therefore*, etc.), comparison and contrast (*but, also*, etc.), elaboration (*moreover,* etc.) and many more. Discourse relations do not need to be overtly marked; they can be inferred by using verb semantics, real-world knowledge and other reasoning. However, our focus here is not on how children learn to infer discourse relations when these overt cues are absent, but instead on how children learn to use overt discourse relation cues, alongside person and number cues, to interpret pronouns. Therefore, all discourse relations will be overtly marked.

Chapter 2: Person and number features

The central question in this dissertation is whether children acquiring pronouns proceed bottom-up, from morphosyntax to discourse, or top-down, from discourse to morphosyntax. In the previous chapter we pointed out that despite the statistical reliability of morphosyntactic cues, it is not hard to imagine situations in which they are either absent or unhelpful, and that therefore children have every reason to begin acquiring higher-level discourse cues early on in life. We also articulated the possibility that knowledge at the discourse level can influence the acquisition and/or use of knowledge at the morphosyntactic level, or vice-versa. As a test case, this dissertation will examine the acquisition of pronouns in Spanish, a language with rich morphosyntactic information. The first step will be to examine children's sensitivity to pronominal person and number cues, the second step will be to examine their sensitivity to a select set of discourse cues, and the third will be to examine how the two types of cues interact during different stages of development.

The goal of this chapter is to accomplish the first step; that is, to establish what knowledge children have of person and number cues. Spanish is an ideal test case for this question, given its abundant person and number marking. The person and number features of subject pronouns are recoverable from verbal agreement markers (see Table 1), so that even in cases of pro-drop, overt markers of the subject's person and number features are always available, as illustrated in (1). Object pronouns are realized as clitics and encode person and number, as well as gender in the 3rd person (see Table 2). Spanish lacks object agreement, but object pronouns may not be dropped, hence overt person and number cues are always available.[2] Possessive pronouns encode the person and number of the possessor (except in the 3rd person where plural and singular are syncretic, see Table 3), as well as the number of the possessee. Finally,

[2] An alternative analysis is that dative and accusative clitics are themselves a species of agreement, and that the alternation between structures with and without clitic-doubling is analogous to the alternation between overt and null subjects. See Franco (2000) for a specific proposal in which object clitics head the projections AgrIO or AgrDO, and doubled DPs fill the specifier position of these projections. Regardless of the specific analysis, my point here is simply that, in the case of object pronouns as well as subject pronouns, an overt marker of person and number is always available to the child.

within the DP, nouns, adjectives and determiners agree in number and gender (2). Though DP-internal agreement is not directly relevant to the interpretation of pronouns per se, it is nevertheless another potential source from which phi-features can be extracted.

(1) *pro* tengo una manzana.
pro have-1Sg.Pres an apple
"I have an apple."

Table 1: Nominative pronouns and present-tense verbal agreement in Latin American Spanish

	pronoun		agreement	
	singular	plural	singular	plural
1st person	yo	nosotros	-o	-mos
2nd person	tú (informal)	--[3]	-s	--
	usted (formal)	ustedes	Ø	-n
3rd person	él (masc)	ellos (masc)	Ø	-n
	ella (fem)	ellas (fem)		

Table 2: Accusative and Dative object clitics in Latin American Spanish

	accusative		dative	
	singular	plural	singular	plural
1st person	me	nos	me	nos
2nd person	te	--	te	--
3rd person	lo (masc)	los (masc)	le	les
	la (fem)	las (fem)		

Table 3: Possessive pronouns

	weak		strong	
	singular	plural	singular	plural
1st person	mi	nuestro	mío	nuestro
2nd person	tu	--	tuyo	--
3rd person	su	su	suyo	suyo

(2) las niñas altas
the-3Pl.Fem girls-3Pl.Fem tall-3Pl.Fem
"the tall girls"

[3] Latin American varieties of Spanish do not use the informal second-person plural *vosotros* or its accompanying verbal agreement (Lipski 1994).

In sum, Spanish provides abundant person and number marking, and hence, if anyone has an opportunity to acquire these markers early in life, it is children acquiring Spanish. Throughout this chapter, we will address the following questions:

Q1. Can children link 1st and 2nd person pronouns to speaker and hearer, respectively?
Q2. Can children link 3rd person pronouns to a non-speaker, non-hearer antecedent?
Q3. Can children link singular and plural-marked pronouns to singular and plural antecedents, respectively?

Section 1 begins with a review of the cross-linguistic literature on children's production and comprehension of pronominal person and number features. To preview the discussion briefly, children's production of pronouns is early and accurate, but their performance in comprehension tasks varies depending on a number of factors, including (i) the morphosyntactic status of the pronoun encoding the person and number features, (ii) the semantic status of particular feature values, and (iii) the discourse situation, which specifically affects children's interpretation of 3rd person pronouns.

Sections 2-4 report studies on children's comprehension of the person and number cues encoded in agreement (Expt. 1-2), accusative clitics (Expt. 2), and possessive pronouns (Expt. 3) in a variety of different discourse situations.

1. Literature review

Not all pronouns are created equal. Therefore it is to be expected that not all pronouns are learned equally quickly. The following literature review is organized around three asymmetries that stand out in children's comprehension of pronominal person and number features: (i) asymmetries based on the type of pronoun tested (null subject, accusative clitic, possessive), (ii) asymmetries based on particular person and number values, and (iii) asymmetries caused by the discourse setup of the task, which affects 3rd person pronouns in particular. The goal of this chapter is not to *explain* why these asymmetries arise, but instead to *describe* in full what aspects of pronominal person and number are challenging for children acquiring Spanish, so that in future chapters we can examine how children overcome the challenge and what role, if any, is played by their developing sensitivity to discourse cues.

1.1. Asymmetries based on pronoun type

An important factor to consider when testing children's comprehension of pronominal person and number is the type of pronoun being tested. Subject pronouns, object pronouns, possessive pronouns, and so on, all encode the person and the number of their referent, but they all have different frequencies, phonological characteristics, and morphosyntactic characteristics, which could affect children's ability to extract and interpret these features. For instance, Deutsch et al. (2001) found that English-speaking children began producing possessive pronouns *my* and *your* before the corresponding personal pronouns *I/me* and *you*. And in French, Pirvulseku & Strik (2014) found that 3-to-5-year-olds were best at extracting the number features of object DPs, followed by strong pronouns (ex. *lui* 'him,' *eux* 'them'), followed by clitics (*le* 'him,' *les* 'them')[4], an asymmetry which they attribute to the structural deficiency of pronouns and clitics (per analyses by Cardinaletti & Starke 1999 and Déchaine & Wiltschko 2002).

Following this structural-deficiency based account, one would expect the comprehension of agreement to lag further still, and indeed this does appear to be true. Many studies have found that preschool children make poor use of agreement in comprehension tasks. With only a few exceptions (most notably French; Legendre et al 2010) picture-selection tasks have shown that young children fail to use number agreement to infer the cardinality of a masked or a null subject, in a variety of languages (English: Keeney & Wolfe 1972, Childers et al 2001, Johnson et al. 2005; Xhosa: Gxilishe et al 2009; Farsi: Rastegar et al 2012). This finding is very surprising, given that the literature shows early and error-free *production* of agreement, especially in morphologically rich languages (Phillips 2010, Clahsen et al. 2002).

[4] In fact the youngest children (3-yr-olds) seemed to ignore the features of object clitics altogether, choosing instead the most recent referent.

Spanish speaking children begin producing agreement early and accurately (Grinstead 2000, Clahsen et al. 2002). Given that Spanish is a language with significant rates of pro-drop,[5] one might expect children acquiring Spanish to quickly learn to extract the person and number features of *pro* from verbal agreement. However, the comprehension delay is attested in Spanish as well. For instance, Childers et al. (2001) found that Chilean 2 ½- and 3-yr-olds were unable to associate sentences like (3a) to pictures of the appropriate number, even when the procedure included one trial with an overt subject as in (3b). Pérez-Leroux (2005) found that Dominican children failed to associate plural-marked null subjects, as in (4), to a plural picture until at least 4;8, and failed to associate singular-marked null subjects to the singular picture as late as 6;6. Legendre et al. (2014) found a similar plural/singular asymmetry among Mexican children ages 2;6-3;11: no tendency to match singular-marked null subjects to a singular video and a weak tendency to match plural-marked null subjects to a plural video. Finally, in an act-out task, Miller & Schmitt (2014) found mixed results when testing Chilean and Mexican 3- to 5-year-olds. When acting out a puppet's wishes reported to them as in (5), children in both groups associated 2nd singular marking with themselves, (the hearer), Chilean but not Mexican children associated the 3rd plural to two or more dolls, and neither group associated the 3rd singular to a single doll.

(3) Childers et al. (2001) Study 3
   a. Come-n/ø los sándwiches.
      Eat-3P/3S the sandwiches
   b. Ellas/ella come(n) los sándwiches.
      They/she eat-3P/3S the sandwiches

(4) Enséñame…Duerme-n/ø en la cama.[Pérez-Leroux 2005, Legendre et al. 2014, Expt. 3]
   Show-me…Sleep-3P/3S in the bed

(5) Pepe quiere que salte-s/ø/n [Miller & Schmitt 2014, Expt.3]
   Pepe wants that jump-2S/3S/3P

[5] Lastra & Butragueño (2015) report an overall pro-drop rate of 78.3%, in Mexico City Spanish, the variety studied here.

Thus, it seems that in Spanish, despite the consistent availability of markers identifying the person and number features of *pro*, and despite children's ability to produce these markers accurately, they are delayed in their ability to use those markers in comprehension tasks.

It bears noting, however, that the severity of this apparent delay does not affect all agreement markers equally. In fact, the one task that included forms other than the 3rd person singular and plural (Miller & Schmitt Expt. 3) found that children were quite adept at interpreting 2nd person agreement. If children's difficulty with agreement is limited to 3rd person markers, then it could have more to do with semantic differences unique to the 3rd person. In the next section I look at studies explicitly comparing children's comprehension of 3rd person versus 1st and 2nd person pronouns.

1.2. Asymmetries based on certain feature values

Studies comparing children's comprehension of 1st, 2nd and 3rd person pronouns are limited mostly to English and French, but they are very consistent in finding that 3rd person is produced and comprehended later than 1st and 2nd person pronouns of all types. I will use three studies as an illustration of this point: Charney (1980), Brener (1983), and Girouard et al. (1997). (But see also Sharpless (1974), Deutsch & Pechmann (1978), Wykes (1981), Oshima-Takane (1992), Ricard et al. (1999), and others for similar results.)

Charney (1980) tested girls ages 1;6 to 2;4 on their comprehension of English possessive pronouns, in two sessions separated by two months. In both sessions, she used a hiding task that allowed more than one person to fill the role of speaker, hearer, and non-participant. Pictures of the child, mother, and tester were placed in front of the child, with a toy hidden behind one of them. In the addressed speech condition, the child filled the role of hearer and was addressed directly by the experimenter or the mother (e.g. *[Child], it's under my/your/her picture*); in the non-addressed condition, the mother and the experimenter filled the roles of speaker and hearer, addressing each other (e.g. *Mom, it's under my/your/her picture*), and the child filled the role of non-participant. Charney also examined children's spontaneous speech (i.e., in the role of speaker). The first finding was that children first became able to use pronouns indexing

speaker and hearer in situations where they themselves occupied that role, i.e., as speakers they produced 1st person pronouns earlier, and as listeners they produced 2nd person pronouns earlier. The second finding was that across all three modes (free production, direct speech, and indirect speech), 3rd person was consistently the last to be mastered. By the second visit, whereas at least 12 of the 17 girls successfully used *my* and *your* to locate the hidden object in direct and indirect speech conditions, only 3 successfully used *her* as a clue. And in free speech, children showed consistent use of 1st and 2nd person possessive and personal pronouns at least as early as 3rd person (both deictic and non-deictic uses).

Brener (1983) tested the comprehension of English singular subject, object, and possessive pronouns among children ages 2;8-5;7 in two sessions separated by four months. In contrast to Charney's design, neither the experimenter nor the child filled the role of speaker or addressee; instead, participants watched videos in which actors filled each of these roles in turn. The speaker would address the addressee in the presence of two non-participants with a sentence like, "I/You/He/She drank the milk," and the child's task was to answer the question "Who drank the milk?" For all age groups, significantly more errors were made for 3rd person (*he/she*) relative to 2nd person pronouns (*you*). And for the youngest two-thirds of children, significantly more errors were made for 3rd person (*he/she*) relative to 1st person pronouns (*I*). Within the 3rd person, Brener found that children's most common error was to choose the speaker or hearer of the same gender as the 3rd person pronoun being tested, suggesting that children rely on the gender information carried by 3rd person pronouns more heavily than their person information.

Finally, Girouard, Ricard and Décarie (1997) tested production and comprehension of subject and direct object pronouns among children acquiring French and English, beginning at age 1;6 and repeating every two months until complete acquisition was observed (between 2;4 and 3;10). Comprehension was tested in three tasks: (i) a pointing task (e.g. *Touch me/yourself/him/her on the head*.), (ii) a replication of Charney's hiding task, and (iii) a make-believe fishing task in which the experimenter, child, and parent each "fished" for different pictures (ducks, balloons, or bears) using a magnetized fishing pole, during which the experimenter asked what each person was fishing for (e.g. *What are you/am I/is she/is he taking?*). Production was tested using (i) spontaneous play and (ii) a version of the fishing task that

elicited pronouns directly (*Who has the ducks/balloons/etc.?*). When all production and comprehension tasks were grouped together, age of comprehension preceded age of production, with no statistically significant differences found between 1st 2nd and 3rd person in either language. However, when tasks were considered individually, differences emerged in the hiding task: children of both sexes and both languages consistently mastered 3rd person later than 1st and 2nd person pronouns in both addressed and non-addressed conditions, replicating Charney's result.

Why would children find 3rd person more difficult to interpret than 1st or 2nd person? One idea that has been forwarded is that children struggle to associate 3rd person to a non-speaker non-hearer referent because this association requires a pragmatic inference (Sauerland 2003). More generally, it is argued that 3rd person, the plural, and masculine are semantically unspecified for person, number and gender, respectively, and that this underspecification is itself interpreted as pragmatically meaningful by adults. Given the assumption that speakers generally use specified forms whenever possible (this assumption is called "Maximize Presupposition" by Heim 1991), the use of an underspecified form implies that the more specified counterpart is false (this implication is dubbed an "Implicated Presupposition" by Sauerland 2003). Children who lack adult-like assumptions will fail to recognize that the 3rd person pragmatically excludes the speaker and hearer, that the plural excludes singular referents, and that the masculine excludes feminine referents. Empirical support for this deficit in children's interpretation of pronouns comes from a study by Legendre et al (2010) on 30-month-old French-speaking children's comprehension of subject clitics. Replicating the fishing task from Girouard et al (1997), Legendre and colleagues found that children performed much better with 1st and 2nd singular subject clitics than with the 3rd person singular and also that their performance with singular clitics was overall much better than their performance with plural clitics. Moreover, children's pattern of errors was consistent with a failure to calculate the Implicated Presuppositions associated to the 3rd person and the plural. Children overextended 1st and 2nd person responses to 3rd person conditions and singular responses to plural conditions, but not the reverse.

1.3. Task effects specifically affecting 3rd person forms

A failure to calculate Implicated Presuppositions would certainly explain the cross-linguistic difficulty with 3rd person suggested by these studies. However, failure is always more difficult to interpret than success, since there can be multiple reasons that children fail to succeed at any given task. A second important potential factor in the interpretation of 3rd person forms is the influence of the discourse context. The importance of discourse in accurately assessing children's comprehension of pronouns has been illustrated most strongly in the literature on Principle B. Two studies in particular, Spenader et al. (2009) and Conroy et al. (2009), explicitly manipulated the surrounding discourse and found that it significantly decreased the prevalence of the classic Pronoun Interpretation Problem among Dutch- and English-speaking children, respectively. When the discourse goal was made more natural (Conroy et al.) or when the discourse placed the target antecedent in a prominent position (Spenader et al.) then children no longer allowed non-adult-like interpretations of classic Principle B sentences (ex. *Mama Bear is washing her*.) This is important because it shows not only that children's interpretation of 3rd person pronouns is sensitive to the effects of the surrounding discourse, but that this discourse sensitivity can override and/or mask sensitivity to other morphosyntactic phenomena.

The morphosyntactic phenomenon we are interested in here is not Principle B, but person information, encoded in the morphological contrast between 3rd person pronouns and 1st/2nd person pronouns. There is evidence that children's ability to use this contrast in comprehension is also affected by the naturalness of the discourse situation. Moyer et al. (2015) used a modified version of Charney's (1980) hiding task to test English-speaking 2-yr-olds' ability to link 1st, 2nd and 3rd person singular subject and possessive pronouns to speaker, hearer, and non-participant in both addressed and non-addressed conditions. The speaker (experimenter), listener (child) and non-participant (second experimenter) were each assigned a box, and the child's task was to find which box contained a hidden block inside, based on clues from the speaker (*I/You/She/He has it.* [occluder removed] *It's in my/your/her/his box.*) In the addressed-speech condition, the person in the 3rd person role is a second experimenter who is paying attention but is engaged in another task: a clear non-participant. In the non-addressed speech condition

this experimenter interrupts and initiates a conversation with the first experimenter, providing a natural transition to a context in which the child fills the non-participant, 3rd person role.

In Moyer et al.'s modified task, children showed much better comprehension of 3rd person in comparison to the original task, scoring reliably above chance in both the addressed speech condition (scoring in the range of 50-75%) and the non-addressed speech condition (scoring 70-75% correct). It is not entirely clear which of the modifications is responsible for this increase in accuracy: the switch from pictures of the participants to boxes belonging to the participants, the use of two rather than one pronominal cue (e.g. *she…her box* vs. *her picture*), the identity of the 3rd person participant in the addressed condition (a second experimenter, rather than the child's mother, who might be more naturally referred to as *Mommy* instead of *her*), or a combination of these and other factors. The fact that changes in the discourse situation affected children's performance shows that they are indeed sensitive to discourse, but it is still unclear which aspects they rely on. The experiments we report below will help to narrow down this question by contrasting comprehension of pronouns in which referents are available in the physical context (Expt.1) the visual context (Expt. 2) and the immediately preceding linguistic context (Expt. 3).

However, despite the improvement wrought by Moyer et al.'s more natural design, they still found that children's accuracy was slightly lower for 3rd person relative to 1st and 2nd person pronouns. Within the 3rd person, performance improved slightly in conditions where gender information could be leveraged (boys relative to girls in the non-addressed condition), consistent with Brener (1983). This may indicate that despite the improved discourse conditions, children still have a way to go in realizing that 3rd person excludes reference to speaker and hearer.

What this discussion makes very clear is that if we want to know whether children comprehend 3rd person pronouns we must answer not one but two questions: First, (i) do children recognize that 3rd person pronouns pick out a salient antecedent? And secondly, (ii) do children realize that this antecedent must be someone other than the speaker or hearer? The experiments reported in this chapter attempt to address both of these questions.

1.4. Production

The emphasis in this literature review has been on the comprehension of pronominal person and number. What about production? Production studies are less common and do not generally focus on person and number marking, with one exception: the spontaneous production of person and number agreement is fairly well studied. First, we will summarize findings on the production of verbal person and number agreement. Next, to the extent that it is possible, we will review findings for clitics and possessive pronouns.

For languages with rich subject-verb agreement, researchers have found that young children's spontaneous production is virtually perfect, for all persons and numbers (Greek: Doukas & Marinis 2012; Spanish: Clahsen et al. 2002). To the extent that errors do occur, they consist mostly of singular forms substituting for plurals; however, the severity of this type of error is hard to assess because the rate at which plural subjects naturally occur in spontaneous speech is very low (Bel & Rosado 2009).

Studies on the production of clitics have focused mainly on explaining the existence and duration of the so-called "null object stage," in which children omit direct and indirect object clitics (ex. Varlokosta et al. 2016). This stage is fairly long in some languages, such as French (Pérez-Leroux, Pirvulescu and Roberge 2008), but has been found to end by age 5 among Spanish-speaking children (Castilla and Pérez-Leroux 2010). Aside from this, only a few production studies focus on the correct production of person and number. One, a repetition study eliciting 1st and 3rd person singular clitics from typically developing Spanish-speaking children between the ages of 3 and 6 (Eisenchlas 2003), found that, while children often changed post-verbal clitic structures for pre-verbal clitic structures, they produced very few person or number errors (7% of all errors). Another study, comparing children with SLI to age- and MLU-matched controls on a number of measures including the production of accusative clitics (Bedore & Leonard 2001), found that the most common error among all three groups was either clitic omission or substitution of the clitic with a (grammatical) non-clitic form. The next most common error was replacement of feminine clitics by masculine ones and replacement of plural clitics by singular ones. Typically

developing children, who ranged in age from 4;0 to 5;6, produced between 5 and 12 such errors per 90 responses, more than reported by Eisenchlas but still a quite modest amount.

To my knowledge, no studies exist on the production of Spanish language possessive or nominative pronouns. However, studies on English have found earlier elicited production of possessives *my* and *your* than personal pronouns *I/me* and *you* (Deutsch et al. 2001) and earlier elicited and spontaneous production of first person relative to second person pronouns (Girouard, et al. 1997), although no asymmetry has been detected between 2nd and 3rd person.[6]

Thus, to the extent that production data exists for Spanish, it appears that the asymmetries found in comprehension tasks do not affect production to nearly the same extent. Typically developing children produce agreement early an accurately. And while they may omit or avoid clitics for a certain period, when they do produce clitics, they do so with a high rate of person and number accuracy.

1.5. Summary

In sum, the literature makes us aware of three potential types of asymmetries that could affect children's ability to use pronominal person and number features in comprehension tasks: 1) asymmetries based on the morphosyntactic status of a given pronoun (ex. *pro* versus clitics versus strong pronouns), 2) asymmetries based on the semantic status of a given feature value (ex. 3rd versus 1st and 2nd person, plurals versus singular), and 3) asymmetries based on the discourse context of a given task (affecting 3rd person in particular). The goal of this chapter is not to define the underlying causes of all these asymmetries[7], but instead to accurately describe them as they apply to the case of children acquiring Mexican Spanish. Where difficulties arise, there exists the possibility that children overcome them with the help of discourse cues. Which particular discourse cues children use for this will be the subject of subsequent chapters.

[6] See also Harley & Ritter (2002), section 3.2, for a cross-linguistic review of acquisition studies, which shows the same pattern.

[7] However, see Forsythe & Schmitt (submitted), for an attempt at explaining the developmental person and number asymmetries within the agreement paradigm.

To get a good sense of the picture, we will look at a variety of pronominal forms in a variety of discourse contexts. In particular, Experiment 1 asks whether children can extract the person and number features of *pro* from verbal agreement markers and associate them to a target referent present in the physical context. Experiment 2 asks whether children can do the same for both *pro* and accusative clitics, choosing from a set of pictured referents. And Experiment 3 asks whether children can associate possessive pronouns to a target referent that is prominent in the linguistic context.

2. **Experiment 1**: Children's interpretation of *pro*, using physical referents

Our first experiment is a replication of Miller & Schmitt's (2014) experiment 3, which asks whether children can associate 2nd singular-, 3rd plural-, and 3rd singular-marked *pro* to appropriate referents in the physical context. In brief, the experiment involves having the child choose between three potential referents—herself, a girl doll, or two parent dolls—to perform actions requested by a puppet named Chicho, as illustrated in (1). The child's interpretation of *pro* is revealed by the person(s) that she ends up choosing to perform the action.

(6) Chicho quiere que *pro* salte-s/n/ø
   a. Chicho wants that *pro* jump-2S/3P/3S
   b. 'Chicho wants you/them/her to jump.'

While Miller & Schmitt's main goal in using this task was to compare children's comprehension of agreement markers *across* dialects (Chilean versus Mexican Spanish), our goal is to reexamine the *within*-dialect differences that they found: namely, that children in both groups seemed to have more trouble comprehending 3rd person singular –ø relative to 3rd person plural /-n/ relative to 2nd singular marker /-s/. One potential factor in this asymmetry is the ambiguity of 3rd singular agreement: the 2nd singular formal pronoun *usted* also triggers 3rd singular agreement, in varieties of Spanish that have this pronoun. Thus, a sentence with a null subject and 3rd person singular agreement is ambiguous between a 3rd person singular and a 2nd person singular reading. This could explain children's low performance in the 3rd singular

condition. Though the authors reject this possibility, pointing out that the Mexican children did not provide a substantial number of 2nd singular responses in this condition, as would be expected, we would like to explicitly rule out this interpretation by testing within a dialect that lacks such ambiguity.

We therefore test children from the upper-middle class of Mexico City, where the informal *tú* is used almost exclusively. Teachers at the daycare where we recruited report that children (and their parents) address everyone, no matter how high their social status, using the informal 2nd singular *tú*. Appendix A reports a corpus study of child-directed speech from a similar private daycare in Mexico City, confirming that *usted* is vanishingly rare in the input to children of this SES. Another study, reported in Appendix B, addressed comprehension of the contrast between *tú* and *usted*, as well as their accompanying agreement forms, by children ages 2;2-7;5 at our daycare and by Mexican working- and middle-class adults. Given the choice between a child addressee and an adult addressee, adults chose the adult as the referent of *usted* and its null counterpart 95% and 88% of the time, respectively, and as the referent of *tú* and its null counterpart 25% and 17% of the time, respectively. Children, on the other hand, chose the adult referent between 46-55% of the time across conditions—no different from chance.

With regard to the 3rd person plural, the ambiguity between 3rd and 2nd person interpretations remains. This is because even though Mexican Spanish has lost the formal 2nd person singular *usted*, it still retains the plural variant, *ustedes* which triggers 3rd plural agreement (recall Table 1 above). Null subjects accompanied by the plural /-n/ can include reference to the addressee, so long as others are included as well. Thus, this condition can conveniently be used to test children's sensitivity to plural, disregarding person information.

In short, what this replication of Miller & Schmitt's Experiment 3 can show us is whether children can associate the 2nd singular /-s/ to the addressee (i.e., the child), the 3rd plural /-n/ to a plural referent (which may or may not include the child), and the 3rd singular –ø to a singular referent other than the addressee (i.e., a non-participant).

2.1. Method and Design

Methods were identical to those of Miller & Schmitt except for two changes. First, the verb *dibujar* ('draw') was judged to be difficult to act out with the dolls and therefore was replaced with *bailar* ('dance'). Second, blocks of items were tested in a single session rather than in three separate sessions. Children were introduced to a puppet, a girl doll, and two adult dolls who were tied together and introduced as the girl's parents. The puppet whispered a command to the research assistant who then repeated the sentence to the child, as in (2)a-c below. Children were instructed to listen to the researcher's instructions and carry out the action themselves, on the child-doll, or on the parent-dolls.

(7) Research assistant: *Este es Chicho (point to the puppet). Este es una niña (point to girl doll) y ellos son sus padres (point to parent dolls). Chicho me va a decir al oído lo que él quiere que tú hagas o lo que él quiere que esta niña haga o lo que él quiere que los padres hagan. Escucha muy bien y haz saltar or bailar a la persona que Chicho dice.* This is Chicho (point to the puppet). This is a child (point to the child doll) and these are his parents (point to the parent dolls). Chicho is going to tell me in my ear what he wants you to do and what he wants this child doll to do and what he wants the parents to do. You need to listen carefully and make the right person jump or dance just as Chicho says.

c. Research assistant: *Chicho quiere que saltes.* Chicho wants you to jump.
d. Research assistant: *Chicho quiere que salten.* Chicho wants them to jump.
e. Research assistant: *Chicho quiere que salte.* Chicho wants her to jump.

Target responses for each of these instructions are shown in the table below:

Table 4: Target responses for Experiment 1 conditions

person/number	verb agreement	target response(s)
2nd person singular	*-s*	child
3rd person singular	*ø*	girl doll
3rd person plural	*-n*	any plural response

We used a within-subjects design consisting of three blocks of four trials each, the first block testing 3rd singular inflection only, followed by 3rd plural in the second block, and lastly 2nd singular. Blocks were separated by items from the experiment reported in Appendix C. Each block used the same four verbs: *saltar*, ('jump'), *dormir* ('sleep'), and *aplaudir* ('clap'), and *bailar* ('dance').

2.2. Subjects

42 children (18 girls) ages 2;2 to 7;5 (mean: 4;3, SD: 14.7 months) participated. An additional 8 children did not finish, due to shyness (n = 4) or were excluded because of experimenter error (n = 4).

2.3. Procedure

The child was seated on the floor with the dolls in front of him/her. Testing was preceded by a three-item familiarization phase in which the experimenter used overt subjects instead of *pro* (8). This was followed immediately by the first block of trials.

(8) *Chicho quiere que {[Child name]/la niña/los padres} salte-{s/ø/n}.*
Chicho wants {[Child's name]/the girl/the parents} to jump-2S/3S/3P

2.4. Results

Children provided responses to 475 of the 504 trials (94.2%). One child tried to make the experimenter perform the action, and these trials were excluded (4 trials, 0.8%). The remaining responses are reported in Table 5. As a first-pass measure, ANOVAs were performed with number of target responses as the dependent variable, Condition (3S, 3P, 2S) as a within-subjects, within-items independent variable, and age in months as a continuous, between-subjects, between-items independent variable. Both factors were highly significant (Condition: $F1(2,80) = 44.24$, $p < 0.001$; $F2(2,3) = 12.31$, $p = 0.04$; Age in months: $F1(1,36) = 9.95$, $p = 0.003$, $F2(1,456) = 10.10$, $p < 0.002$).

Table 5: Frequency of response types (4 per child per condition; target responses in shaded cells)

	response type				
condition	**child**	**girl doll**	**parent dolls**	**all dolls**	**child and doll(s)**
2nd Sg. /-s/	122	4	18	5	7
3rd Pl. /-n/	50	15	52	36	7
3rd Sg. -ø	57	32	41	19	6

Subsequently, we divided children into two age groups, those at least the mean age of 4;3 (n = 22; 8 girls; mean: 5;3, SD: 8.8 months), and those below (n = 20; 10 girls, mean: 3;2, SD: 7.1 months). We compared their proportion of target answers out of the four trials in each condition to chance (one third), using two-tailed t-tests, which are summarized in Table 6. Both age groups showed above-chance performance in 2nd Sg. and 3rd Pl. conditions, but not in the 3rd Sg. condition; in fact, younger children performed significantly *below* chance in this condition.

These results replicate those of Miller & Schmitt, insofar as children provided the greatest proportion of target responses in the 2nd singular condition, followed by the 3rd plural and 3rd singular conditions. However, as can be seen already from Table 5 above, children were biased towards performing the action themselves, inflating our performance measure in the 2nd singular condition and deflating it in the 3rd person conditions. One way to mitigate this bias is to use a performance measure that controls for potential biases. Thus, Miller & Schmitt (following Johnson et al. 2005) calculate *sensitivity*, which is equal to the proportion of times a particular response was produced in the target environment, out of all the times it was produced in any environment[8]. As such, it is a measure of children's awareness that a particular response is called for in certain environments, even though they may be biased towards producing it in other environments as well. Bias and sensitivity are also reported in Table 6. Sensitivity also replicates the asymmetry found by Miller & Schmitt, with children showing the highest sensitivity to 2nd singular /-s/, followed by 3rd plural /-n/ and lastly 3rd singular –ø.

[8] For example, as a group children's sensitivity to 2nd singular marker /-s/ is equal to the number of times they produced a 2nd person response (122) in that condition, divided by the total number of times they produced that same response in any of the three conditions (229), i.e., $\frac{122\text{ 'child' responses in 2nd sg condition}}{122+50+57\text{ 'child' responses in all conditions}} = 0.53$. Sensitivity to each agreement marker was calculated for each child individually.

Table 6: Accuracy, bias and sensitivity for children in Experiment 1

	N	Accuracy (out of 1)			Bias (out of 12)			Sensitivity (out of 1)		
		2 Sg	3 Pl	3 Sg	child	parent dolls	girl doll	2 Sg	3 Pl	3 Sg
Older	22	0.80***	0.62***	0.26	5.2	4.4	1.5	0.63***	0.59***	0.54*
M = 5;3; R = 4;3-7;5		(0.4)	(0.49)	(0.44)	(2.2)	(2.3)	(1.6)	(0.24)	(0.29)	(0.44)
Younger	20	0.76***	0.50**	0.14***	5.7	4.1	0.9	0.58***	0.49*	0.29
M = 3;2; R = 2;2-4;2		(0.43)	(0.5)	(0.35)	(3.5)	(2.7)	(1.2)	(0.24)	(0.28)	(0.43)

Note: Scores are compared to chance behavior (33%) using two-sample t-tests (two-tailed).

* Significant at the $p < 0.05$ level.

** Significant at the $p < 0.01$ level.

*** Significant at the $p < 0.001$ level.

M = Mean Age; R = Age Range; SD in parentheses

2.5. Discussion

This experiment confirms that children's apparent trouble with the interpretation of the 3rd singular –ø extends beyond dialects in which *usted* ('you' formal) also triggers 3rd singular agreement. It also replicates Miller & Schmitt's finding that children struggle somewhat with the interpretation of the 3rd plural /-n/ in this task. Though their performance in this condition exceeds the chance level of 33% on both of the performance measures we used, it is clearly weaker than their performance in the 2nd singular condition. Returning to the questions posed at the beginning of this chapter, we have the following partial answers:

Q1. Can children link 1st and 2nd person pronouns to speaker and hearer, respectively?

Young children (under 4;3) are able to reliably associate a 2nd person-marked *pro* to the hearer.

Q2. Can children link 3rd person pronouns to a non-speaker, non-hearer antecedent?

Children have much more difficulty associating a 3rd singular *pro* to a singular, non-hearer referent than they do associating a 2nd singular *pro* to a singular, hearer referent, in both of the measures taken (accuracy and sensitivity). Accuracy in the 3rd singular condition never exceeded chance, and sensitivity exceeded chance only among children 4;3 and above. We can be fairly certain that this difficulty is *not*

due to syncretism with the formal 2nd person singular *usted* because that form is absent from the input to children in our sample (see Appendices A and B).

Q3. Can children link singular and plural markers to singular and plural referents, respectively?
For both age groups, children are better than chance at associating the plural marker /-n/ to a plural referent in the physical context. However, their ability to do so is slightly worse than their ability to associate 2nd person *pro* to the hearer.

This study also provides an interesting qualification to the literature on children's comprehension of person and number agreement. The finding that children are actually quite good at interpreting 2nd person agreement speaks against the suggestion that children's comprehension of person and number agreement *always* lags behind their production. So far, this apparent lag is limited to 3rd person singular and plural.

If children's interpretation of 3rd person singular and plural *pro* is less than perfect in this task, we must next ask whether this result will hold for other pronominal forms (ex. clitics) and different discourse situations. In particular, children were biased against providing a response involving the girl doll, and although we controlled for task bias by using sensitivity rather than accuracy as a measure of performance, we should also test using different tasks, preferably in which all referents are equally physically accessible. Thanks to the availability and convenience of digital photography we were able to do just that in the experiment reported next.

3. **Experiment 2:** Children's interpretation of *pro* and accusative clitics, using pictured referents

The second experiment uses a photo-selection paradigm to test children's comprehension of the full range of agreement markers, as well as their comprehension of accusative clitics, which inflect for person and number, as well as gender. The goal here is to ask whether children can associate, 1st, 2nd and 3rd

person singular and plural *pro* and accusative clitics to a photo of the target referent. If our findings from the previous experiment are replicated in this wider range of forms and in this different task, then we can be more confident that they truly reflect children's knowledge of person and number.

3.1. Method and Design

Subjects' interpretation of present-tense agreement and object clitics was tested using a photo-selection task consisting of 30 test items (15 testing agreement and 15 testing clitics), 14 fillers, and 14 distractors. 3rd person clitics inflect for gender, but only the feminine forms were tested, and accordingly all experimenters were female. Photos were taken of each person or persons corresponding to the five grammatical person/number combinations in Spanish, as shown in Table 7 (the subject, the experimenter, the subject and experimenter together, an adult woman, and two adult women together).

Table 7: Agreement and accusative clitic forms tested

person/number	verb agreement	accusative clitics	target photo
1st person singular	*-o*	*me*	primary experimenter
1st person plural	*-mos*	*nos*	primary experimenter & child
2nd person singular	*-s*	*te*	child
3rd person singular	[no suffix]	*la* (fem)	other female adult
3rd person plural	*-n*	*las* (fem)	two other female adults

For test items, subjects were presented with a photo array in which each of these person(s) performed the same action, and they were directed to select one of the photos using the prompts in (9)-(10). In agreement conditions, these actions included jumping, sleeping, clapping, drawing, and dancing. In the clitic condition, these actions included being kissed, combed, washed, covered, and touched on the cheek by a puppet named Nemo.

For filler items, subjects were presented with an array in which each person(s) performed a different action and were directed to choose one photo using the prompts in (11)-(12). The actions depicted were the same as in the test items, so as to check subjects' comprehension of the ten verbs used. The remaining four fillers included a photo in one of the person(s) was depicted either *sentado* ('seated') or *acostado*

('lying down'). For distractor items, subjects were asked to choose which of two cartoon characters had more of some object or substance.

Agreement and clitics were tested in separate blocks, with agreement first. Each block contained 15 test items (3 items x 5 person/number forms), followed by either a filler item or a distractor item, in alternating order. Filler items were presented in random order with the proviso that it used a different verb from the previous test item. In addition, fillers were re-ordered after every other subject to mitigate the possibility that any particular ordering of fillers would unfairly affect certain test items over others. The location of the target picture was randomized, and subjects were split between two different versions of the task, each with a different random ordering of test items.

(9) *Muéstrame la foto en donde salta**mos/o/s/n/Ø***.
Show me the photo in which jump-**1P/1S/2S/3P/3S**

(10) *Muéstrame la foto en donde Nemo está besándo-**nos/me/te/las/la***
Show me the photo in which Nemo es kissing-**1P/1S/2S/3P/3S**

(11) *Muéstrame la foto en donde hay alguien saltando/bailando…*
Show me the photo in which there-is someone jumping/dancing…

(12) *Muéstrame la foto en donde Nemo está besando/peinando… a alguien.*
Show me the photo in which Nemo is kissing/combing… someone.

3.2. Subjects

We tested 46 native Spanish-speaking children ages 2;3-6;7 (mean 4;2) from a daycare in Mexico City, Mexico; 4 were excluded from the final analysis. Adult subjects included 11 adults (6 women) recruited from among the teachers and administrators at the daycare (2 exclusions) and 14 adults (6 women) recruited from the Michigan State University community. All adults were born and raised in Mexico, with Spanish as their first language. Adults younger than 40 years old were recruited, to ensure the felicitous use of the informal 2nd person pronoun *tú*[9] during the task. Adult subjects in Mexico were not compensated, while those in the U.S. received $15 for their participation. The primary experimenter

[9] The formal 2nd person pronoun *usted* triggers 3rd person agreement. For this reason, we only included subjects young enough to be felicitously addressed by the experimenter using the informal 2nd singular.

in Mexico was a teacher from the school, and the primary experimenter in the U.S. was a native Spanish-speaking undergraduate at Michigan State University.

3.3. Procedure

Photos not including the subject were taken beforehand and pre-inserted into the arrays. Photos including the subject were taken during a short, 15-minute session and then inserted into the arrays. Testing occurred no more than one week later. The entire procedure, including taking the photos and testing, lasted approximately 30 minutes.

The test phase was preceded by a familiarization phase in which the subject was asked to identify each of the actors by name (the subject, the primary experimenter, and the other two adult women). For this, the primary experimenter used the photos of (i) Nemo touching the primary experimenter and the child and (ii) the two other adult women jumping. If the subject did not know the name of someone in these photos the experimenter told him or her.

After familiarization, the primary experimenter introduced the task and obtained consent through the following:

(13) *Vamos a ver algunas fotos de personas hacienda varias cosas y tú me vas a señalar la foto que yo te diga, ¿te parece? Pero sólo me vas a señalar una foto nada más, ¿bien?*
We're going to see some photos of people doing different things and you're going to point out the one I tell you to, sound good? But you can only pick one of the photos, okay?

Any child who refused or repeatedly displayed unwillingness to participate in any part of the test was excused. Halfway through each block, there was a short break in which the child was given a sticker. After the task was complete, child subjects received a piece of candy and adult subjects were debriefed and/or given compensation.

3.4. Coding and Analysis

Responses were recorded on a sheet of paper by the author and then transferred to a spreadsheet for coding. Any photo containing the target referent was considered a target response, regardless of whether it also included another referent as well. This means that in singular conditions, two target responses were possible. Three children failed to complete the task and one child was excluded due to an extremely low score on filler questions (50% correct of all responses given), leaving a total of 42 subjects. Two adults were excluded because they addressed the primary experimenter using the formal 2nd person pronoun *usted*, leaving a total of 23 subjects.

3.5. Results

Adult and child responses are reported in Tables 8 and 9 (highlighted cells represent expected target answers). For both adults and children, accuracy is well above the chance level of 20% in 1st Sg., 1st Pl. and 2nd Sg. conditions (91% or above for adults, 69% or above for children, all $p < 0.001$). However, accuracy in both the 3rd Sg. and 3rd Pl. is much lower relative to the 1st and 2nd person conditions, not just for children, but also for adults. In the next two sections we explore separately what these responses tell us about children's comprehension of person and their comprehension of number. For purposes of comparison with Experiment 1 we divide children into the same age groups: younger (n = 21, ages: 2;3-4;3) and older (n = 21, ages: 4;4-6;7).

Table 8: Adult responses and proportion of target responses (target responses in shaded cells)

adult responses (N = 23)	**agreement**					**clitics**				
	1Sg	**1Pl**	**2Sg**	**3Sg**	**3Pl**	**1Sg**	**1Pl**	**2Sg**	**3Sg**	**3Pl**
investigator	56	0	1	14	1	67	0	0	19	1
child & investigator	7	66	3	5	26	1	68	6	0	14
child	2	0	64	17	0	1	0	63	5	0
other female-Sg	4	0	0	30	3	0	0	0	44	0
other female-Plu	0	3	1	3	38	0	1	0	1	54
other	0	0	0	0	1	0	0	0	0	0
no answer	0	0	0	0	0	0	0	0	0	0
proportion target	0.91	0.96	0.97	0.48	0.55	0.99	0.99	1.00	0.65	0.78
(SD)	(0.22)	(0.15)	(0.13)	(0.37)	(0.27)	(0.06)	(0.06)	(0)	(0.35)	(0.31)

Table 9: Child responses and proportion of target responses (target responses in shaded cells)

child responses (N = 42)	**agreement**					**clitics**				
	1Sg	**1Pl**	**2Sg**	**3Sg**	**3Pl**	**1Sg**	**1Pl**	**2Sg**	**3Sg**	**3Pl**
investigator	57	9	2	15	12	88	11	5	29	6
child & investigator	54	86	31	33	44	23	90	39	9	40
child	6	14	88	39	34	4	14	77	28	22
other female-Sg	3	1	2	20	13	3	4	0	48	8
other female-Plu	5	15	3	17	21	8	6	5	11	49
other	1	0	0	0	2	0	0	0	1	1
no answer	0	1	0	2	0	0	1	0	0	0
proportion target	0.88	0.69	0.94	0.30	0.17	0.88	0.72	0.92	0.47	0.39
(SD)	(0.19)	(0.30)	(0.12)	(0.34)	(0.22)	(0.19)	(0.31)	(0.17)	(0.37)	(0.38)

3.5.1. Comprehension of person marking

To examine comprehension of person features, separate from number features, we looked at the number of hearer and/or speaker responses given in 1st and 2nd person conditions, and the number of non-speaker, non-hearer responses given in 3rd person conditions (ignoring number), disregarding number. We then used two-tailed t-tests to compare the proportion of person-compatible responses produced by adults, younger children, and older children to chance (3 out of 5 photos on average for 1st and 2nd person conditions, 2 out of 5 photos on average for 3rd person). Adults exceeded chance in all conditions (all $p <$ 0.02). Younger children exceeded chance in 1st/2nd person conditions (agreement: M=0.91, t(20)= 11.38, p < 0.001; clitic: M=0.92, t(20)= 11.92, p < 0.001) but not 3rd person ones (agreement: M=0.19, t(20)= -4.51, p = 0.99; clitic: M=0.38, t(20)= -0.25, p = 0.60). Older children exceeded chance in 1st/2nd person conditions (agreement: M=0.93, t(20)= 13.22, p < 0.001; clitic: M=0.94, t(20)= 17.33, p < 0.001), much lower but still above chance in 3rd person clitic condition, (M=0.53, t(20)= 2.06, p = 0.027) and not above chance in the 3rd person agreement condition (M=0.37, t(20)= -0.47, p = 0.68).

Despite above-chance performance across conditions, it is striking how much adult performance drops in the 3rd person. Chi-squared tests revealed that adults produced a significantly lower rate of person-compatible answers in the 3rd person conditions relative to 1st and 2nd person conditions, in both the agreement ($\chi^2(1) = 86.74$, $p < 0.001$) and the clitic block ($\chi^2(1)=59.65$, $p < 0.001$), and the same was true for the younger children (Agreement: $\chi^2(1)=163.38$, $p < 0.001$, Clitics: $\chi^2(1)=100.22$, $p < 0.001$) and for the older children (Agreement: $\chi^2(1)=108.18$, $p < 0.001$, Clitics: $\chi^2(1)=69.13$, $p < 0.001$). On the assumption that adults are perfectly able to link 3rd person pronouns with a 3rd person referent, there must be some other reason that they apparently fail to do so in this experimental situation.

As mentioned previously, 3rd person forms are dependent on an antecedent, and although this experiment provides the target antecedent via the visual context, it is possible that adults were looking for this antecedent within the preceding linguistic context instead. Looked at this way, the most salient antecedent is likely to be the most recently mentioned antecedent: that is, the person(s) depicted in the

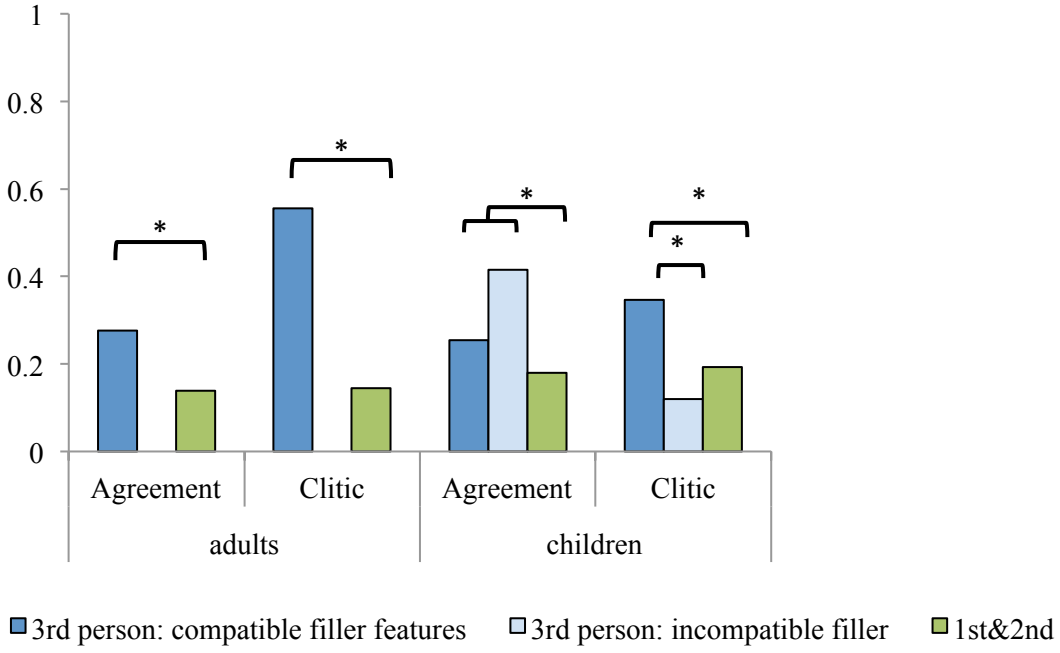
photo that was chosen in response to the immediately preceding filler item. Participants looking for this antecedent will therefore choose the same photo that they had selected in the immediately preceding filler[10]—so long as it has compatible number and gender features.

Figure 2 shows the proportion of responses in 3rd person conditions that match that participant's response from the preceding filler question, depending on whether or not that response was compatible in number and/or gender with the particular 3rd person form being tested. For the agreement block, only number was relevant because agreement markers do not carry gender; however, for the clitic block both number and gender were relevant. For example, if the preceding filler response was the photo of the experimenter and the participant together, and if the form being tested was the 3rd plural feminine clitic *las*, then the photo would be compatible in number with the tested form, but it would only be compatible in gender if the participant herself was female. (Recall that all experimenters were female, so only the gender of the participant him/herself could influence gender compatibility.)

Figure 2 also shows the proportion of responses in 1st and 2nd person conditions that match the preceding filler response. Because 1st and 2nd person forms do not select an antecedent from the preceding discourse, such repeat responses should be due to sheer coincidence. Indeed, the proportion of responses matching the preceding filler response in 1st and 2nd person conditions was not different from chance (20%) in either block for any age group (all $p > 0.12$). Therefore we use participants' proportion of matching responses in 1st and 2nd person conditions as a baseline against which to compare their proportion of matching responses elsewhere. All comparisons reported below are one-tailed t-tests.

[10] To examine this question we only consider items immediately preceded by fillers, which presented participants with photos of each person or group of persons performing a different action. The prediction is less clear for items immediately preceded by a distractor, which depicts two cartoon characters. In this situation, participants could do one of three things: 1) they could search even farther back in the discourse for an appropriate antecedent, selecting the photo from the preceding test item, provided it had compatible number and/or gender features; 2) they could allow the 3rd person null subject or clitic to refer deictically to one of the photos in the array, or 3) they could use metalinguistic reasoning to infer which photo the experimenter intended.

Figure 2: Proportion of responses depicting the same actor(s) as the preceding filler response, compared across: 1st & 2nd person conditions (baseline), 3rd person conditions in cases where the preceding response was compatible with the number and/or gender features of the clitic or agreement form being tested, and 3rd person conditions where the preceding response was incompatible with these features.



If adults use both grammatical features and discourse prominence to locate the antecedent of 3rd person null subjects and object clitics, then we would expect them to repeat their immediately preceding response more often than baseline (i.e., more often than occurred in 1st and 2nd person conditions), but only when that response is compatible with the number and/or gender features of the clitic or agreement form being tested. Indeed, this was the case: when the preceding filler response was compatible in number and/or gender with the form being tested, then adults chose this photo significantly more often than baseline (Agreement: $M1 = 0.27$, $M2 = 0.14$, $t(78.46) = 1.79$, $p = 0.04$, Clitics: $M1 = 0.55$, $M2 = 0.15$, $t(73.11) = 4.63$, $p < 0.001$). But when the preceding filler response was incompatible in number and/or gender with the form being tested, adults never once chose this photo.

In the clitic block, children showed the same pattern as adults: when the response from the preceding filler was compatible in number and gender with the 3rd person form being tested, then children chose this photo significantly more often relative to baseline ($M1 = 0.36$, $M2 = 0.19$, $t(60.69) = 2.12$, $p = 0.02$), and

significantly more often relative to when it was incompatible with those number and/or gender features (*M1* = 0.36, *M2* = 0.13, *t*(72.87) = 2.78, *p* = 0.003). Thus, in the clitic block, we have evidence that children, like adults, are sensitive to both grammatical features and discourse salience when locating the antecedent of a 3rd person object clitic.

In the agreement block, however, children showed only part of the adult pattern: the effect of feature compatibility disappeared. Here, children were no more likely to repeat the preceding filler response when it was compatible in number with the form being tested than when it was incompatible (*M1* = 0.25, *M2* = 0.42, *t*(104.01) = -1.91, *p* = 0.971). Collapsing across these two groups, however, children were more likely *overall* in 3rd person agreement conditions to repeat the preceding filler response, relative to baseline (*M1* = 0.32, *M2* = 0.18, *t*(229.85) = -2.74, *p* = 0.007). Thus, in the agreement block we have evidence that children rely on discourse salience, but not on number marking when choosing the antecedent of a null subject accompanied by agreement.

In sum, adults tend to choose the antecedent of a 3rd person clitic or null subject by looking to the most recently mentioned photo compatible with its number and gender features. Children also look to the most recent photo for an antecedent, but they are more willing than adults to accept an antecedent with incompatible features, at least when it comes to interpreting *pro*.

3.5.2. Comprehension of number marking

Let us now examine children's knowledge of pronominal number. To answer this question, we rely on sensitivity instead of accuracy, given that the coding scheme inflates accuracy in singular conditions. (In singular conditions, plural responses were counted as correct so long as they included the target referent.) Johnson et al. (2005) point out that children may be biased towards producing one type of response (ex. choosing plural pictures) yet still be aware of the fact that this response is required in some contexts but not others (ex. plural but not singular conditions); sensitivity provides a measure of this awareness, controlling for bias. Sensitivity to the singular is the proportion of times that children chose a

singular picture in response to a singular form, out of the total number of singular responses given overall. A totally chance distribution of singular responses would lead to a proportion of 0.6 (even distribution of singular responses over 3 singular and 2 plural conditions, or 3/5 correct use of singular responses). Sensitivity to plural was calculated in a similar manner; chance here is equal to 0.4 (even distribution of plural responses results in 2 out of 5 correct uses). Following Johnson et al. (2005) I also report bias: the number of times out of 15 items in each block that a singular or plural photo was chosen. If subjects are completely unbiased, then we expect an average of 9 singular responses (3 trials each for 1st singular, 2nd singular, and 3rd singular) and 6 plural responses (3 trials each for 1st plural and 3rd plural). Bias is reported in Table 10 and sensitivity in Table 11.

Table 10: Number bias (out of 15)

age group		agreement		clitics	
		singulars (out of 9)	**plurals (out of 6)**	**singulars (out of 9)**	**plurals (out of 6)**
adults *N* = 23	mean	8.35	6.61	8.70	6.30
	SD	1.07	1.08	0.82	0.82
younger children *N* = 21, Ages: 2;3-4;3	mean	7.33	7.52	8.48	6.38
	SD	2.33	2.25	2.14	2.25
older children *N* = 21, Ages: 4;4-6;7	mean	7.67	7.19	8.05	6.95
	SD	2.20	2.09	1.24	1.24

Table 11: Sensitivity to number marking (out of 1) in all conditions

age group		agreement		clitics	
		singulars (chance = 0.6)	**plurals** (chance = 0.4)	**singulars** (chance = 0.6)	**plurals** (chance = 0.4)
adults *N* = 23	mean	0.98	0.88	1.00	0.94
	SD	0.05	0.14	0.02	0.09
		t(23)=37.17, p < 0.0001	t(23)=17.03, p < 0.0001	t(23)=91, p < 0.0001	t(23)=28.67, p < 0.0001
younger children *N* = 21, Ages: 2;3-4;3	mean	0.67	0.47	0.75	0.60
	SD	0.16	0.17	0.11	0.14
		t(20)=1.73, p = 0.09	t(20)=2.63, p < 0.01	t(20)=6.74, p < 0.0001	t(20)=6.96, p < 0.0001
older children *N* = 21, Ages: 4;4-6;7	mean	0.80	0.61	0.88	0.72
	SD	0.17	0.22	0.13	0.17
		t(20)=5.1, p < 0.0001	t(20)=5.1, p < 0.0001	t(20)=9.54, p < 0.0001	t(20)=8.87, p < 0.0001

Children in both age groups appear biased towards choosing plural photos. For adults and for older children, sensitivity to both singular and plural is above chance in both the agreement and the clitic conditions. For younger children, sensitivity exceeds chance in all conditions except singular agreement, where it is marginal ($t(20) = 1.73$, $p = 0.09$).

These results seem to indicate a fairly high level of sensitivity to both singular and plural. However, given participants' unexpected behavior in the 3rd person in this experiment, it makes sense to separate out sensitivity to singular and plural in 3rd person conditions from 1st and 2nd person conditions. I therefore recalculated sensitivity separating 3rd from 1st and 2nd person conditions, and this is reported in Tables 12-13. Interestingly, asymmetries arose in opposite directions: within the 1st and 2nd person, children seem to develop sensitivity to singular marking earlier than plural marking, consistent with claims about Implicated Presuppositions, but within the 3rd person the asymmetry is reversed, inconsistent with such claims. Children older than 4;3 show above-chance sensitivity to number in their interpretation of *pro* and

accusative clitics, with the single exception of 3rd person singular *pro*. Younger than this, children are not above chance in their sensitivity to 3rd person singular and plural *pro* or 1st person plural *pro*.

Table 12: Child sensitivity to number marking (out of 1) in 1st and 2nd person conditions

age group		agreement		clitics	
		singulars (chance = 0.6)	**plurals** (chance = 0.4)	**singulars** (chance = 0.6)	**plurals** (chance = 0.4)
younger children (2;3-4;3)	mean	0.79	0.44	0.82	0.51
	SD	0.16	0.14	0.14	0.24
		$t(20)=3.14$, $p = 0.0052$	$t(20)=1.03$, $p = 0.3143$	$t(20)=8.18$, $p < 0.001$	$t(20)=2.38$, $p = 0.0275$
older children (4;3-6;7)	mean	0.94	0.62	0.89	0.61
	SD	0.12	0.25	0.14	0.22
		$t(20)=13.42$, $p < 0.0001$	$t(20)=4.99$, $p < 0.0001$	$t(20)=9.48$, $p < 0.0001$	$t(20)=4.82$, $p < 0.0001$

Table 13: Child sensitivity to number marking (out of 1) in 3rd person conditions

age group		agreement		clitics	
		singular (chance = 0.6)	**plural** (chance = 0.4)	**singular** (chance = 0.6)	**plural** (chance = 0.4)
younger children (2;3-4;3)	mean	0.52	0.53	0.66	0.75
	SD	0.24	0.30	0.20	0.28
		t(20)=-0.87, p = 0.3972	t(20)=1.61, p = 0.1226	t(20)=2.31, p = 0.0315	t(20)=6.28, p < 0.0001
older children (4;3-6;7)	mean	0.59	0.60	0.85	0.87
	SD	0.33	0.30	0.19	0.18
		t(20)=-0.28, p = 0.7831	t(20)=3.38, p = 0.003	t(20)=6.51, p < 0.0001	t(20)=12.36, p < 0.0001

3.6. Discussion

The purpose of this experiment was to reexamine children's knowledge of pronominal person and number features by eliciting their interpretations of *pro* and accusative clitics in a context where all

referents are more or less equally salient in the visual field. How well did we succeed, and what new answers do we have for the questions posed at the beginning of this chapter? Adult behavior in this experiment shows us that despite roughly equal visual salience, not all referents were considered by subjects to be equally salient potential antecedents for 3rd person pronouns. Being recently mentioned in the discourse of the experiment made a referent more likely to be chosen as an antecedent; thus, even photos depicting the speaker or hearer could serve as an antecedent if they were the most recently mentioned photo and had the proper number and gender traits.

This unexpected state of affairs complicates our ability to answer our original question about children's knowledge of 3rd person (***Q2.****Can children link 3rd person pronouns to a non-speaker, non-hearer antecedent?*) but it allows us to answer a different, relevant question, raised in our discussion of Moyer et al. (2015). Namely, can children link 3rd person pronouns to a salient antecedent? The fact that children showed the same tendency as adults to choose the most recently mentioned photo as the antecedent for a 3rd person clitic or null subject indicates that the answer is yes. In fact, the only difference between adults and children is that children allowed recency of mention to trump number marking when interpreting *pro*. Their willingness to do so could arise either because (i) they have not yet acquired the association between the agreement markers ø and /-n/ and the features singular and plural, respectively, or (ii) they prioritize discourse salience over number marking.

As for children's comprehension of number, children younger than 4;3 failed to show sensitivity to the number features of the 1st plural agreement marker /-mos/ and the 3rd person singular and plural agreement markers ø and /-n/. Children's difficulty with the former is consistent with the claim that children have difficulty calculating the Implicated Presupposition associated to the plural, but it is also compatible with mere frequency effects, as the 1st plural is less frequent than either 1st or 2nd person singular (Bel & Rosado 2009). As noted in the preceding paragraph, children's difficulty with the latter two may indicate a true lack of knowledge of the number semantics attached to ø and /-n/, or it may simply reflect a greater prioritization of the other requirement of 3rd person pronouns: to refer to a salient antecedent.

Finally, children younger than 4;3 show an ability to link 1st and 2nd person *pro* and accusative clitics to speaker and hearer.

This experiment suggests that children and adults search for the antecedent of a 3rd person pronoun primarily in the linguistic discourse, over and above the physical or visual context. If this is true, then to really get a good picture of children's knowledge of 3rd person pronouns we need to test them in an environment that provides a linguistically salient antecedent. This is what the final experiment of this chapter does.

4. **Experiment 3:** Children's interpretation of possessive pronouns, using linguistic antecedents

Twice so far we have replicated the literature's finding that children allow 3rd person pronouns to refer to the speaker and the hearer, and we have found evidence that at least some of this behavior is triggered by the need to find an antecedent that is salient in the linguistic discourse. However, what we do not know yet is whether children also struggle with the morphological aspect of 3rd person forms, namely, that it requires not only a salient antecedent, but also that under normal circumstances this antecedent is not the speaker or the hearer. In an effort to answer this question, we will next test children's comprehension of 3rd person pronouns in a context that provides a highly salient linguistic antecedent; if children *still* persist in allowing 3rd person to refer to speaker and hearer even in such ideal discourse conditions then we have evidence for the role of a morphological delay.

In this next experiment, we test children's interpretation of 1st, 2nd, and 3rd person pronouns in a context that provides the most linguistically salient antecedent possible: a c-commanding antecedent within the same clause. Since Principle B prohibits object pronouns from taking such antecedents we instead test possessive pronouns, as in (4). We also take advantage of the opportunity to test the 1st person plural possessive as in (5).

(14) *Chicho quiere mi/tu/su pato*.
Chicho wants my/your/his duck.

(15) *Chicho quiere nuestros patos*.
Chicho wants our ducks.

4.1. Method and Design

Children's interpretation of 1st singular, 2nd singular, 3rd singular, and 1st plural possessive pronouns was tested in an act-out task consisting of 12 items in 3 blocks. In the act-out task, the experimenter, the child, and a puppet named Chicho were each given a set of plastic toys, and the child's job was to pass the correct toy to a blindfolded Chicho, who would whisper his request into the experimenter's ear. The experimenter would then report Chicho's request, as in (4) and (5). To succeed at the task, the child would have to know (i) which toy to pick, and crucially (ii) which person's pile to pick from.

Each pronoun was tested three times, once per block. The 3rd person possessive was always presented first in its block, when the discourse was fresh, i.e., before any other people had been mentioned yet, so that the intra-sentential antecedent (*Chicho*) was the only potential competitor.

The toys were all common objects that would be known to the children, and they were chosen to include two grammatically feminine, regular nouns (*manzana* 'apple' and *pera* 'pear'), two grammatically masculine, regular nouns (*carro* 'car' and *pato* 'duck'), and two irregular nouns, one masculine (*dulce* 'candy') and one feminine (*llave* 'key'). The order in which each type of toy was requested by Chicho was randomized for every subject.

4.2. Subjects

82 children (43 girls) ages 2;11 to 6;5 (mean: 4;6, SD: 12.1 months) participated. Two additional children were tested but excluded because of refusing to follow directions (n = 2).

4.3. Procedure

Before beginning the task the experimenter introduced the child to the puppet and explained that Chicho had brought some toys to play a game, during which the puppet would be blindfolded so he could not see. The child was then asked to name all of the objects and to help Chicho by handing out one of each to Chicho, the experimenter, and herself. Lastly, the child was asked who each of the toy piles belonged to. Once it was clear that the child knew all of the relevant objects and their owners, the game was then explained and consent obtained through the following:

(16) *Chicho me va a pedir unas cosas aquí en el oído, te las voy a decir a ti, y se lo vas a dar en sus manos, ¿sale?*
Chicho is going to speak in my ear here and ask for some things. I'll tell them to you, and you hand them to him, sound good?

In between each block of this experiment, children participated in picture-selection tasks reported in chapters 4 and 5. This was done to break up the monotony of the picture-selection task and maintain the child's interest.

4.4. Coding and analysis

Responses were recorded on a sheet of paper by the secondary experimenter and then transferred to a spreadsheet for coding. Responses in which the child passed the incorrect toy to Chicho were excluded from analysis (0.9% of data).

4.5. Results

Responses are reported in Table 14. As in experiment 1, an ANOVA was performed with number of target responses as the dependent variable, using the two independent variables of Condition (3S, 3P, 2S) as a within-subjects factor and age in months as a continuous, between-subjects factor. Both factors were significant (Condition: $F(3,240) = 29.23$, $p < 0.001$; Age in months: $F(1,74) = 4.19$, $p = 0.044$).

Table 14: Frequency of response types (3 per child per condition; target responses in shaded cells)

	response type				
condition	**experimenter**	**child**	**Chicho**	**experimenter & other**	**child & Chicho**
1st Sg. *mi* ('my')	150	59	32	1	1
2nd Sg. *tu* ('your')	1	225	17	0	0
3rd Sg. *su* ('his')	1	82	160	0	0
1st Pl. *nuestro* ('our')	10	92	18	116	6

For purposes of comparison with experiments 1 and 2, we divided children into two groups with the same age range: those at least 4;3 (n = 49; 23 girls; mean: 5;3, SD: 7.3 months), and those below (n = 33; 20 girls, mean: 3;6, SD: 4.2 months).

4.5.1. Comprehension of number features

Children's comprehension of the plural feature of the 1st person plural *nuestros* was measured by the proportion of plural responses, regardless of the person(s) included. This proportion was then compared to chance (one half). The proportion of number-accurate responses was significantly below chance for younger children ($M = 0.36$, $t(94)=-2.64$, $p = 0.009$), and significantly greater than chance for older children ($M = 0.59$, $t(146)=2.26$, $p = 0.025$).

Children's comprehension of the singular feature appears to be perfect in this study. In the singular conditions, children provided singular responses virtually all the time (727 out of 729 responses). This estimate is probably inflated, since the task is inherently biased towards producing singular responses. Unfortunately, we are unable to use sensitivity to control for the bias towards singular responses because this calculation presupposes at least some variability in response types.

4.5.2. Comprehension of person features

We consider children's comprehension of person, first in the singular conditions, and second in the plural condition. In singular conditions, children provided only singular responses, meaning that virtually all variation in their responses is due to differences of person. Therefore, response accuracy provides a

transparent measure of children's sensitivity to person features. Accuracy, bias, and sensitivity are reported in Table 15, along with the results of two-tailed comparisons against chance (one third). Children in both age groups were biased towards choosing the object in front of themselves, nevertheless, sensitivity to the 2nd person marker, as well as the 1st person marker, remained above chance for both age groups, replicating the results of the previous two experiments.

Children's comprehension of the person feature of the 1st plural possessive *nuestros* ('our') was measured by the proportion of responses including the speaker (the experimenter), regardless of whether the response was plural or singular. The proportion of such person-accurate responses was no greater than chance (one third) among younger children ($M = 0.40$, $t(94)=1.32$, $p = 0.19$), but greater than chance among older children ($M = 0.60$, $t(146)=6.54$, $p < 0.001$). This shows that it takes longer for children to associate the 1st person feature of *nuestros* ('our') to the speaker than it does to associate the 1st person feature of *mi* ('my') to the speaker.

Table 15: Accuracy, bias, and sensitivity for singular conditions in Experiment 3

	N	Accuracy			Bias (out of 9)			Sensitivity (out of 1)		
		1 Sg	2 Sg	3 Sg	experi-menter	child	puppet	1 Sg	2 Sg	3 Sg
Older	49	0.69***	0.94***	0.68***	2.2	5.4	2.6	0.77***	0.73***	0.71***
M = 5;3;										
R = 4;3-6;5		(0.47)	(0.23)	(0.47)	(1.3)	(3.4)	(2.4)	(0.42)	(0.31)	(0.42)
Younger	33	0.51***	0.90***	0.62***	1.7	5.9	3.0	0.63***	0.67***	0.52*
M = 3;6;										
R = 2;11-4;2		(0.5)	(0.3)	(0.49)	(1.7)	(3.8)	(3.4)	(0.48)	(0.37)	(0.44)

Note: Scores are compared to chance behavior (33%).

* Significant at the $p < 0.05$ level.

** Significant at the $p < 0.01$ level.

*** Significant at the $p < 0.001$ level.

M = Mean Age; R = Age Range; SD in parentheses

Children's sensitivity to the 3rd singular is much higher here than in previous experiments. Most notably, sensitivity rose to 52% for younger and 71% for older children, as compared to 29% and 54%,

respectively, in Experiment 1. In fact, even the youngest 12 individuals (age range: 2;1-3;4, mean: 3;1) showed above-chance accuracy ($M = 0.72$, $t(35) = 5.14$, $p < 0.001$) and marginally significant sensitivity ($M = 0.60$, $t(11) = 2.12$, $p = 0.0587$) to the 3rd singular. Nevertheless, sensitivity to the 3rd person still lags slightly behind sensitivity to 1st and 2nd person.

This slight lag is confirmed by a look at individual response patterns. Children who made no distinction between person categories (defined as those providing identical responses in at least 10 out of the 12 trials) were separated from those who made at least some distinction between persons. Those who remained were identified as showing either (i) some knowledge of each person feature, as evidenced by their providing least one correct response out of 3 trials, or as showing (ii) no knowledge of that person feature (zero target responses). The number of children showing at least some knowledge of each person feature is reported in Table 16. Every child who showed at least some knowledge of 3rd person also showed some knowledge of either 1st or 2nd person, except for one child. Meanwhile, 5 children showed some knowledge of 1st person without any knowledge of 3rd person, and 8 children showed some knowledge of 2nd person without any knowledge of 3rd person.

Table 16: Experiment 3: Number of subjects showing some knowledge (1-3 target answers) or no knowledge (0 target responses) of 1st, 2nd and 3rd singular possessive pronouns

		1st person		2nd person	
		1-3 target responses	0 target responses	1-3 target responses	0 target responses
3rd person	1-3 target responses	53	1	54	0
	0 target responses	5	3	8	0

4.6. Discussion

The goal of this study was to test children's knowledge of 1st, 2nd and 3rd person pronouns in a context that satisfies the 3rd person pronoun's need for a linguistically salient antecedent. It appears that we have succeeded, insofar as children's ability to associate the 3rd person singular possessive *su* to this antecedent was much improved compared to their ability to associate 3rd person null subject and clitic pronouns to an

appropriate antecedent from either the physical context (Experiment 1) or the visual context (Experiment 2). Nevertheless, younger children's success with the 3rd person pronoun in this experiment still lags slightly behind their success with 1st and 2nd person pronouns. This gives us reason to believe that children younger than 4;3 are not yet done acquiring the other important aspect of 3rd person pronouns; namely, that they exclude reference to the speaker and hearer.

We also took advantage of the opportunity to look at children's comprehension of the person and number features of the 1st person plural *nuestros*. We found reliable comprehension of both of these features among children older than 4;3, but not younger children. This replicates our finding from Experiment 2 that children younger than 4;3 are insensitive to the plural feature of the 1st person plural *pro*. These results are compatible with a frequency-based account.

5. General discussion

Returning to the questions originally posed at the beginning of this chapter, we now have a more complete picture of Mexican children's knowledge of pronominal person and number features. Let us take a moment to revisit each question in turn.

Q1. Can children link 1st and 2nd person pronouns to speaker and hearer, respectively?

All three experiments point to the conclusion that young children (under 4;3) are able to reliably associate 1st and 2nd person-marked pronouns (*pro*, accusatives, and possessive) to the speaker and hearer, respectively.

Q2. Can children link 3rd person pronouns to (i) a salient antecedent that (ii) excludes the speaker and hearer?

As the discourse context changed over the course of experiments 1-3, children's interpretations of 3rd person pronouns changed, indicating that they are aware of the discourse-dependency of the 3rd person.

The results of experiment 2 show more specifically that children, like adults, appear to prefer a *linguistically* salient antecedent over and above choosing a salient referent from the physical or visual context. In fact, in the case of *pro*, children appear to be even more concerned with finding a recently mentioned antecedent than they are with finding an antecedent of the correct cardinality. (Although, to be fair, it is still possible that this simply reflects a lack of knowledge about the number features associated to the particular agreement markers involved, –ø and /–n/.)

Experiment 3 further confirms children's discourse sensitivity: when provided with a linguistically salient 3rd person antecedent (an intra-sentential c-commanding antecedent) they are able to reliably associate the 3rd person possessive to this antecedent, from the earliest ages tested. This finding opens the door to ask how children represent salience in the linguistic discourse. In both of these experiments, discourse "salience" was operationalized as recency of mention, which was reasonable enough for a start. In subsequent chapters we ask whether children have a more sophisticated notion of what counts as a linguistically salient antecedent.

Discourse dependency aside, we can also ask whether children are able to associate 3rd person pronouns to a non-speaker, non-hearer referent. Previous literature that failed to adequately account for discourse sensitivity may have over-exaggerated the depth of children's difficulty with this aspect of the 3rd person; nevertheless, it does appear that this is indeed challenging, at least for the younger kids in our study. Despite the ideal discourse conditions of Experiment 3, younger children *still* showed weaker performance in 3rd person relative to 1st and 2nd person conditions.

Q3. Can children link singular and plural markers to singular and plural referents, respectively?

Our answer to this question is a little more fragmented than our answer to the previous two: sensitivity varies depending on the form tested. Three findings are consistent across experiments. First, across all three experiments, children appear to succeed early on at interpreting not just the person features but also the number features of 1st and 2nd person singular pronouns. Second, children in experiments 2 and 3 were less sensitive to the 1st plural as compared to 1st person singular forms. This

applies not only to their number feature, but to their person feature as well, and may be due to the scarcity of 1st person plural forms in the input. And third, children in experiments 1 and 2 struggled with comprehension of the number features of 3rd person *pro*, especially the 3rd person singular. Interpreting this finding, however, is complicated by the fact that children did just fine with the number features of 3rd person clitics (Experiment 2) and the 3rd person singular possessive (Experiment 3), albeit under different discourse conditions. Two interpretations of this last finding are possible, one being that children under 4;3 are as yet unaware that the agreement morphemes ø and /–n/ carry singular and plural number features, respectively, the other being that this sensitivity was overwhelmed by the need for a salient antecedent.

In sum, it appears that early in development, children can reliably associate the full range of singular 1st and 2nd person pronouns to referents of the correct person and number, though it is not until somewhat later in development that they are able to do the same with plural 1st person pronouns. Equally early in development, children are aware that 3rd person pronouns are discourse dependent, but their ability to extract the person and number features of these pronouns varies: comprehension of singular *pro* lags behind that of plural *pro*; both of these lag behind comprehension of singular and plural clitics; and even under ideal discourse conditions, comprehension of the person features of the 3rd person possessive still lags behind comprehension of 1st and 2nd person possessives.

Children's early success in production of verbal agreement (Clahsen et al. 2002) and clitics (Eisenchlas 2000) show that in principle they have acquired abstract representations of person and number features and have mapped these representations to their phonological forms. But the studies reported here indicate that this knowledge does not automatically produce full competence. Comprehension of the person features of 1st person singular pronouns does not automatically lead to the same level of success with 1st person plural pronouns. And acquiring a representation of singular and plural number in 1st and 2nd person pronouns does not automatically lead to the same level of success in 3rd person pronouns. In other words, despite having the requisite feature inventory, the mapping between

these features and their surface representations is either incomplete or unreliable in some way that interrupts comprehension but not production. Despite beginning early, the process of pronoun acquisition seems to be rather protracted.

The focus of the rest of this dissertation is on how children complete the acquisition process. What kind of information do children recruit to move from a stage in which person and number morphology is used unreliably, to one in which children use this information like adults? The first step, which we take in Chapter 3, is to examine what other knowledge children have about pronouns. We have seen already that even young children know that 3rd person pronouns are discourse dependent, but what exactly does this mean? What kind of information do children extract from the discourse? Does the kind of information they extract change over time? The second step, which we take in Chapters 4 and 5, is to ask how discourse information interacts with person and number information. Can children combine these two pieces of information, or even use one to facilitate the other?

Chapter 3: Discourse cues

In the last chapter we asked what children acquiring Mexican Spanish know about the person and number features encoded in their pronominal system. We found consistent, early use of some cues (1st person, 2nd person) but inconsistent use of others (the fact that 3rd person excludes the speaker and hearer, the distinction between 3rd person singular and plural), though we found evidence of early awareness that 3rd person pronouns are discourse dependent. In this chapter we will be examining two types of discourse cues which children can potentially use to guide their interpretation of 3rd person pronouns. In particular, we will be looking at: (i) the semantic relations that hold between the clause containing the pronoun and the surrounding discourse, and (ii) the form of the pronoun itself.

The first type of cue has been approached from a variety of theoretical perspectives, under such names as Rhetorical Relations (Asher 1993, Asher & Lascarides 2003, Grosz & Sidner 1986, Thompson & Mann 1987), Coherence Relations (Kehler 2002), or Rhetorical Structure Schemas (Mann & Thompson 1988) all referring to the intuitive notion that the way in which sentences relate to each other affects the interpretation of ambiguous elements within those sentences. To illustrate, the example below shows that the interpretation of a grammatically ambiguous pronoun like *he* can differ depending on whether the events denoted by the two clauses are interpreted as occurring in parallel (in which case, *he* = Cheney) or whether they form a cause-effect chain (in which case, *he* = Powell).

(1) Powell defied Cheney, and Bush punished him. [Kehler (2002)]
   a. Parallel interpretation: Both Powell and Bush did something to Cheney. *he* = Cheney
   b. Cause-effect interpretation: Bush punished Powell for defying Cheney. *he* = Powell

Theories differ as to where in the cognitive system such inter-sentential relations are represented. My own perspective is most closely aligned with that of Asher & Lascarides (2003), who consider them to be part of the linguistic representation of discourse. My aim is not to support Asher & Lascarides' theoretical approach over other accounts but instead to use their framework to better articulate the learning question for children. So I will adopt Asher & Lascarides' framework as my point of departure but I will attempt to

remain as theory-neutral as possible. Accordingly, I will refer to inter-sentential semantic relations using the neutral term "discourse relations."

The second type of cue we will look at is the alternation between null and overt subject pronouns, a defining property of pro-drop languages like Spanish. This alternation is only one small part of the wider range of DP forms available to a native speaker for referring to entities of type *e*, a choice whose discourse effects many authors have commented on (Almor 1999, Arnold 1998, Ariel 1988, 2001, Gundel et al. 1993, among others). In particular, it is commonly observed that the more phonologically and semantically reduced a referring expression is, the more strongly it tends to pick out salient referents from the discourse. Results from Experiment 2 are certainly consistent with this observation. Recall that children were more likely to ignore the number features of 3rd person *pro*, which is null, than 3rd person clitics, which are overt, in order to allow it to refer to the most recently mentioned antecedent. This can be interpreted as evidence that children are sensitive to the fact that a more reduced form (*pro*) exerts a stronger demand for a discourse-salient antecedent relative to a less reduced form (accusative clitics).

The null/overt subject distinction in pro-drop languages has been treated from a number of different angles. It is traditionally described as a difference of emphasis or contrast (Luján 1999). Some more recent accounts attribute it to a difference in the level of attention or activation enjoyed by their referents (Ariel 2001, Blackwell & Quesada 2012). Others attribute it to a processing difference, with null and overt subjects preferring antecedents in different syntactic positions (Carminati 2002). Finally, syntactic accounts link the contrast to a difference in the syntactic position of the pronouns themselves (Luján 1985, Rigau 1988, Frascarelli 2007). In this chapter I will not be able to definitively support any one of these accounts—in fact, not all of them are mutually exclusive. Nevertheless, I do hope to provide empirical support for some accounts over others, insofar as they make differing predictions about how the null/overt contrast interacts with discourse relations. Having observed how the interaction works for adults, we will then be able to ask about children's sensitivity to these same two cues and their interaction.

In sum, the main questions under consideration in this chapter are as follows:

Q1. When do children become sensitive to discourse relations, and to the null/overt pronoun distinction?
Q2. How does the null/overt distinction interact with discourse relations in adult Spanish?
Q3. How do children integrate cues from the null/overt distinction with cues from discourse relations?

In Section 1 I outline my assumptions about the nature of discourse relations, adopted from Asher & Lascarides (2003). In section 2 I present experimental evidence from the psycholinguistic literature for the relevance of discourse relations to pronoun resolution, in both adults and children. Section 3 reviews existing theoretical accounts of the null/overt distinction, spelling out their predictions for how this distinction should interact with discourse relations. Section 4 reviews literature on children's knowledge of the null/overt distinction. And section 5 presents an experiment testing how Spanish-speaking adults and children interpret grammatically ambiguous pronouns, crossing the null/overt contrast with the contrast between two different discourse relations: *Occasion* (defined by a narrative sequence) and *Result* (defined by a cause-effect sequence).

1. Discourse relations in adult language: Theoretical and experimental literature

Language is full of ambiguities, not only pronominal ambiguities, but also ambiguities of scope, ellipsis, temporal relations, lexical ambiguity, and so on, all of which are resolved with the help of context. "Context," however, is a very heterogeneous notion, encompassing not just linguistic information but also information from the physical environment, shared knowledge, generalized real-world knowledge, interlocutors' conversational goals, and so on. It is therefore helpful to first clarify my assumptions about how discourse relations are organized and how they interact with other contextual information.

There are many different ways that the notion of inter-sentential semantic relations, or discourse relations, can be implemented. For the sake of concreteness, I adopt the architecture defined by Asher &

Lascarides (henceforth A&L) in their 2003 book *Logics of Conversation*, which enriches Discourse Representation Theory (Kamp & Reyle 1993), with the notion of inter-sentential semantic relations, or Rhetorical Relations, to produce what they dub Segmented Discourse Representation Theory (SDRT). The basic premise of SDRT is that there is a level of representation at which speakers decide how the different segments of a discourse relate to one another, a level which interacts with but is ultimately separate from the semantic content of those segments. This level of representation accounts for why speakers can share intuitions about how utterances are related to each other, even without always knowing whether those utterances are true or false, what their logical consequences are, or even what all of the words mean! This can be illustrated with a simple modification of Kehler's example from above. Consider the contrast between (2) and (3). One does not need to know who Bush, Cheney, and Powell are, or even what *glorping* is, to share the intuition that (3) is strange in comparison to (2). Instead, the source of the deviance is discourse-related: one does not typically contrast two instances of the same event type. To provide another example, consider (4) and (5), taken from A&L. In (4) the intuition is that the events described in the first sentence precede those of the second, while in (5) they occur in the reverse order. This contrast exists despite the lack of any difference in the temporal semantics of either of the individual sentences.

(2) Powell glorped Cheney, and Bush glorped Cheney.
(3) ?Powell glorped Cheney, but Bush glorped Cheney.

(4) Max fell. John helped him up.
(5) Max fell. John pushed him.

To sum up the intuition behind SDRT, the logic of information *packaging* is separate from the logic of information *content*. Next I will sketch how SDRT characterizes the nature of this packaging and how it interfaces with non-linguistic contextual information. The next two subsections summarize A&L's account of information packaging, and their answer to questions: (i) what is the nature of discourse relations—their place in the grammar, and the kind of information that they provide—and (ii) how does

the information provided by discourse relations interact with other types of contextual information in order to resolve linguistic ambiguities?

1.1. What is the nature of discourse relations?

A&L consider discourse relations to be linguistic in nature. They are formal representations that operate over linguistic objects at LF, and like the objects they manipulate, they too have a syntax and a semantics. Their syntactic function is to link LFs to one another and their semantic function is to say something about the nature of that link, which in turn constrains the semantics of underspecified elements within those LFs, as was illustrated above in (1). Below I will provide a few more specifics about the syntactic and semantic information that they provide.

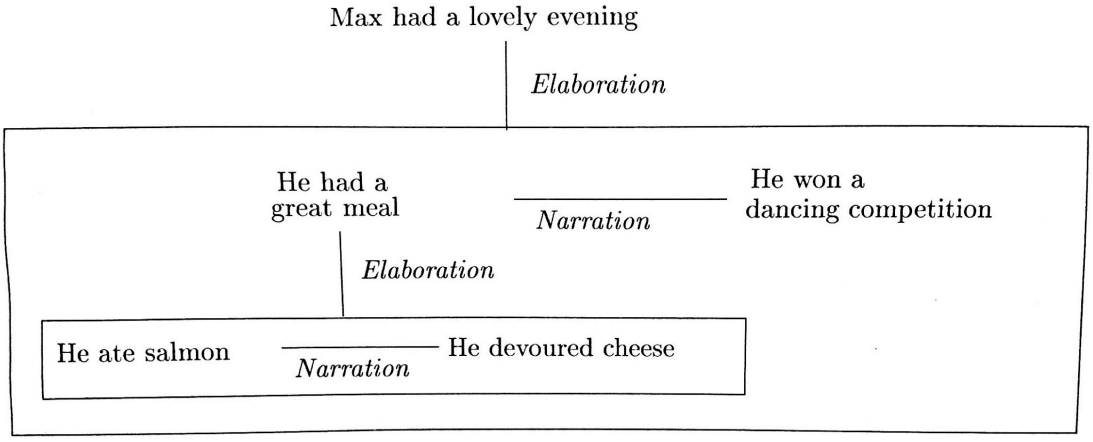
In standard DRT, the basic discourse unit is known as Discourse Representation Structure (DRS). In A&L's enriched system, discourse relations operate over partial DRSs, or Segmented DRSs (SDRSs). In practice, these segments usually correspond to propositions (type *t*). Strictly speaking, discourse representations do not operate directly over the SDRSs themselves, but over *labels* applied to SDRSs; however, that will be glossed over here.

The links that discourse relations establish between SDRSs form the structure of the discourse. This structure is not flat: some discourse relations are hierarchical. To illustrate, consider the short narrative in (6). Despite the lack of overt discourse connectors, the reader or listener has the intuition that the event described in (6)b is a subpart of the larger event described in (6)a and that the events of (6)c and (6)d are further subparts of the event described by (6)b, though neither (6)c nor (6)d are subparts of each other. The relation that the reader or listener intuits between Max's lovely evening in (6)a and Max's fantastic meal (6)b and between the meal in (6)b and the eating of salmon and cheese in (6)c-d is an *Elaboration*, since the latter sentences elaborate on the former. In contrast, the relation between the individual salmon- and cheese-eating events in (6)c-d is one of *Narration*, since it involves a sequence of separate events, as opposed to one being contained in the other. *Elaboration* is just one of several subordinating relations, which establish a relation of dominance between one LF and another, in contrast to coordinating relations

like *Narration* which have a flat structure. This structure can be represented graphically as in Figure 3 (taken from A&L pg. 9).

(6) Illustration of hierarchy in discourse structure
   a. Max had a lovely evening last night.
   b. He had a fantastic meal.
   c. He ate salmon.
   d. He devoured lots of cheese.

Figure 3: Graphical representation of the hierarchical organization of discourse (6)



(7) Possible and impossible continuations of discourse (6).
   a. It was a dill Havarti. [*it* = the cheese]
   b. ?? It was a lovely shade of pink. [*it* = the salmon]
   c. It was very filling. [*it* = the meal]
   d. It was the best time he had had in a while. [*it* = the evening]

The hierarchy established by discourse relations constrains not only the temporal relations between events, as we have seen, but also the interpretation of anaphoric elements. This can be seen in (7) by looking at what the pronoun *it* in an incoming sentence may or may not refer to. For instance, it is possible for an incoming sentence to establish an anaphoric connection to the *cheese* mentioned in the last-mentioned sentence (6)d, or to the *meal*, located in (6)b, which dominates (6)d, or to the *evening*, located in (6)a, which dominates (6)b. But *it* may not refer to the *salmon* in (6)c, which instead of dominating (6)d is attached to it with a coordinating relation. This is just one example of a broader

generalization noted by many authors, which has come to be known as the Right Frontier Constraint: anaphors in the current clause must find their antecedent in the propositions that lie on the right frontier of the discourse structure. The right frontier is, roughly, the proposition introduced by the immediately preceding clause and any propositions that dominate it.

In sum, the minimal syntactic requirement for any given discourse relation is to find an attachment point for each new proposition that enters the discourse, placing it within the structure of the overall discourse. This structure is not necessarily overtly realized, but it nevertheless has real consequences for the interpretation of elements within discourse segments. This includes anaphora, which are interpreted in accordance with the Right Frontier Constraint, as well as presupposition projection, lexical disambiguation, bridging, and other ambiguities. (See Asher & Lascarides Chapter 1.) In our investigations of children's discourse competence, we will only be dealing with very short, two-sentence discourses, and so we will not have a chance to test children's knowledge of the Right Frontier Constraint[11]. Instead, we will be focusing on the anaphoric constraints imposed by the semantics of these discourse relations.

While the Right Frontier Constraint dictates which antecedents are accessible to anaphoric elements, it is the semantics of individual discourse relations that determine which of those potential antecedents is the intended one. Here, I summarize the semantics of the discourse relations that we will be testing in children: *Narration, Result, Parallel,* and *Contrast.*

Narration, also referred to as *Occasion* (Kehler 2002), applies to SDRSs whose events form a narrative sequence that matches the sequence of utterance. The prototypical overt marker of this relation is *then* (*después* in Spanish), but another marker which we test in Chapter 5 is *and now* (*y ahora*), accompanied by a switch from past to present tense. This discourse relation carries two formal semantic requirements. The first is that the events be physically connected: the end of one event overlaps spatiotemporally with the beginning of the next (8a). The second is that they be thematically connected.

[11] Nevertheless, children's knowledge of the Right Frontier Constraint is a very important point for further investigation. If children are aware of dominance relations within sentences, and the constraints that they impose, then they may well be aware of dominance at the discourse level as well.

The two clauses must share a common topic, defined as shared material, and the more shared material, the greater the coherence of the discourse (8b).

(8) Formal semantic requirements of *Narration/Occasion* [Asher & Lascarides 2003, pg. xxx]
   a. $\phi_{Narration}(\alpha, \beta) \Rightarrow overlap(prestate(e_\beta), poststate(e_\alpha))$
      The end of e_a overlaps spatiotemporally with the beginning of e_b.
   b. $\phi_{Narration}(\alpha, \beta) \Rightarrow \neg\Box(K_\alpha \sqcap K_\beta)$
      The content shared by a and b does not consist merely of logical necessities, and the more shared content the better.

A&L's definition of topichood in (8)b is meant to capture the intuition that narrative sequences tend to be about the same actors and events. This notion of topic continuity is distinct from the widely referenced notion of sentential topic (Reinhart 1981, Vallduví 1993, Zubizarreta 1998, Erteschik-Shir 2007). For one thing, sentential topics are calculated within a single sentence, rather than between sentences, and for another, sentential topics are individuals of type *e* rather than anything up to type *t*.

A&L acknowledge that the operator which calculates the common topic of two discourse segments, ⊓, is difficult to define in practice (see A&L pg. 164, footnote 30). So to be on the safe side, I will stick to cases where both notions of topic continuity make the same predictions for pronoun resolution. Consider the example below. Here we have a pronoun in subject position, *he*, which by default makes it the sentential topic. By the sentential-topic definition of topic continuity, the pronoun should preferentially maintain reference to the preceding sentential topic, *Juan*. By A&L's notion of topic continuity, there is also a preference for resolving the pronoun towards antecedent *Juan* because this choice maximizes the common content of both sentences to include not only *Juan*, but the fact that Juan *did something,* or filled the role of agent, in both events. Note that in neither case is the pronoun prohibited from referring to the non-topic antecedent *Pedro*; this interpretation merely makes for a less coherent discourse, and so it is dispreferred.

(9) Juan sings for Pedro. And then he dances.
   a. Sentential topic 1: *Juan*
   b. Sentential topic 2: *he*
      By Sentential Topic Continuity *he* = *Juan* is preferred.

c. Common content if *he* = *Juan*: *Juan does something*
d. Common content if *he* = *Pedro*: *Pedro*
By Topic Continuity as defined in (8b), *he* = *Juan* is preferred.

Result applies to SDRSs describing sequences of causally related events described in the order in which they happened (as opposed to *Explanation*, in which the order of description is reversed). Typical overt markers of this relation are *so* and *therefore* (*por eso* in Spanish). This relation only carries one semantic requirement: that the two events be causally related (10). Example (11) illustrates how this requirement affects the interpretation of grammatically ambiguous pronouns. *He* is preferentially interpreted as referring to *Pedro*, since a plausible effect of Pedro being sung to is that he will decide to dance. Again, the opposite pronoun interpretation is not ruled out; it is simply dispreferred since the cause-effect relation between signing to someone and dancing is less readily available than that between being sung to and dancing.

(10) Formal semantic requirement of *Result*
$\phi_{Result}(\alpha, \beta) \Rightarrow cause(e_\alpha, e_\beta)$

(11) Juan sings for Pedro. And so he dances. *he* = Pedro

Parallel applies to structurally similar SDRSs that are similar in meaning, and *Contrast* applies to structurally similar but semantically different SDRSs. Typical overt markers include *also* or *too* (*también* in Spanish) for *Parallel* and *but* (*pero* in Spanish) for *Contrast*. Like *Narration*, these discourse relations are gradable: the more structural similarity and the more semantic similarity (or dissimilarity, in the case of *Contrast*), the better. That is, the more structural isomorphism there is between two SDRSs, the more likely it is that the hearer will assume that they are related via *Parallel* or *Contrast*, since this makes for a coherent discourse. Underspecified semantic elements within those structures are likewise resolved in accordance with maximal discourse coherence. For *Parallel*, this means that elements in the same structural positions will refer to the same individuals or events (or at least to similar individuals or events), as illustrated in (12). For *Contrast*, the opposite is true, as illustrated in (13).

(12) Sara hugged Maria, and Pedro hugged her, too. *her* = Maria
(13) Sara hugged Maria, but Pedro hugged her. *her* = Sara

Other relations that we will not study here include *Explanation* (the mirror image of *Result*), *Consequence, Continuation, Alternation, Elaboration* and *Background*, and a host of relations specific to dialogue. A&L do not claim that theirs is a definitive list of all the discourse relations that exist, but Kehler (2002) provides conceptual arguments that the list of discourse relations should at least be limited to three categories: (i) those asserting similarity/difference between events (ex. *Parallel, Contrast*), (ii) those asserting cause-effect relationships between events (ex. *Explanation, Result*), and (iii) those asserting contiguity between events (ex. *Occasion/Narration*). Resolving the question of how many and what kinds of discourse relations exist is of course beyond the scope of this dissertation, but we will at least be able to test children's knowledge of at least one relation from each category.

1.2. How are discourse relations integrated with other sources of contextual information?

Discourse relations are linguistic in nature, but extra-linguistic information, such as world knowledge, conversational goals, and the physical context, is relevant to the choice of relation. In SDRT, extra-linguistic information enters at the point of discourse update, when the hearer (or reader) infers which discourse relation is intended by the speaker (or writer) and where it attaches the incoming discourse segment to the existing discourse structure.

Sometimes the intended discourse relation is clear because the speaker includes an unambiguous discourse connector, as in (14); other times, the hearer has to do a little more work, such as in (15). Regardless, every time a new discourse segment arrives, the hearer goes through the same steps to update the discourse. These steps are summarized in (16). During every step of the process, the hearer strives to arrive at the interpretation (or set of potential interpretations) that maximizes discourse coherence, making use of both linguistic and non-linguistic information to do so.

(14) Max fell. And then John pushed him.
(15) Max fell. John pushed him.

(16) Discourse Update
   a. Identify possible attachment sites for the incoming discourse segment.
   b. For each possible site, infer a discourse relation and use it to resolve underspecifications within discourse segments.
   c. Update the overall discourse structure with this new set of potential discourse relations. If any potential relations from the previous round of Discourse Update are incompatible with the current set of potential relations, eliminate them.

Let's illustrate the process of discourse update with the simple example (15). The first step is easy because there is only one available attachment site for the second sentence; it must be connected to the first. The second step involves a real decision, however. The pushing event of the second sentence could be the cause of the falling event described in the first sentence, in which cases the two propositions are related via *Explanation*, or it could simply be the next event in the story, and what we have is a case of *Narration*. Which choice produces a more coherent discourse? In the absence of disambiguating information as in (14), A&L claim that more specific relations are favored over less specific ones. Since a cause-effect relationship is a more specific relationship between events than simple temporal precedence, *Explanation* will be deemed a more coherent choice. In general, *Result*, *Explanation*, and *Elaboration* will always override *Narration* just in case the semantic requirements of both relations are satisfied.

Next, the underspecified pronoun *he* is interpreted in a way that satisfies the semantic requirements of *Explanation* and that maximizes discourse coherence. Principle B rules out *John* as an antecedent, so the decision lies between *Max* and some other unnamed singular masculine referent. Real-world knowledge provides the information that there can be a cause-effect relation between someone falling (Max) and that same person being pushed, but that there is probably no such relation between someone falling and a different person being pushed. Hence, we infer that *Max* is the antecedent that is most compatible with the semantic requirements of an *Explanation* relation.

Finally, the overall discourse representation is updated in preparation for the next discourse segment. Since *Explanation* is a dominating relation, both the last segment (sentence 2) and the one dominating it (sentence 1) are marked as potential attachment points for the next segment.

In sum, extra-linguistic information like real-world knowledge and the physical context of utterance may influence which discourse relation is inferred, and the semantics of individual discourse relations may make reference to non-linguistic knowledge (ex. real-world knowledge about falling and its causes and consequences may affect the resolution of pronoun ambiguities in an *Explanation* sequence). Nevertheless, this knowledge is not itself what causes a discourse to cohere. Discourse coherence is a product of discourse relations: strictly linguistic representations that arrange, package, and constrain the semantic content of discourse.

2. Experimental literature: Pronoun resolution in adult and child language

Researchers working in psycholinguistics and artificial intelligence have long developed their own independent lines of inquiry into the factors affecting pronoun resolution, and they have documented a number of commonly used pronoun-resolution heuristics. If this experimental work converges in any way with the account of discourse relations articulated above, then this is further evidence that discourse relations play an important role in adults' interpretation of pronouns, and therefore that they could potentially have a role in child language as well. Indeed, Kehler et al. (2008) make the case that the particular pronoun-resolution heuristic used by speakers in any given moment is a function of the discourse relation in force at that moment. Here I present the outline of their argument, and in the next section I look at what evidence there is in the developmental literature for children's sensitivity to discourse relations.

2.1. Psycholinguistic evidence for discourse relations in adult language

Psycholinguists have shown that the interpretation of grammatically ambiguous pronouns is not completely random: pronouns exhibit certain well-documented preferences. Probably the least surprising of these is that adults prefer for pronouns to refer to pragmatically plausible antecedents. Real-world plausibility aside, however, there is also a preference for antecedents that are in subject position and/or

mentioned first. This is reflected in the greater likelihood of subject/first-mentioned antecedents to be pronominalized in subsequent sentences (Stevenson et al. 1994), faster recognition of subject- than of object-related probes in cross-modal priming studies (McDonald & MacWhinney 1995), and faster reading times for sentences with pronouns referring to subject antecedents than to non-subject antecedents (Crawley, Stevenson & Kleinman 1990). However, researchers have also documented contradictory preferences, such as the preference for pronouns to refer to antecedents in the same grammatical role as the relevant pronoun (Chambers & Smyth 1998), especially when sentences exhibit parallel constituent structure (Smyth 1994). Finally, researchers have documented what is called the Implicit Causality of certain verbs (Garvey & Caramazza 1974, Brown & Fish 1983), which refers to the observation that certain verbs bias subsequent discourse towards continuing reference to either their internal or their external argument. This bias affects pronoun resolution by increasing the likelihood that subsequent pronouns will refer to either that verb's subject or to a non-subject argument. Clearly then, adults display a variety of pronoun-resolution strategies, not all of them compatible. As yet, however, no consensus has emerged on what mechanism ultimately drives these strategies or resolves conflicts between them.

The architecture provided by A&L offers a potential answer. All of these above-mentioned strategies are permitted in A&L's system, but they are constrained by the semantics of the discourse relation in force. For example, the semantic requirements of the *Occasion/Narration* relation (see 18) require continuity of space, time, and topic between events, and in examples like (17) this promotes a pronoun resolution strategy of reference to the preceding topic. Since topics are frequently placed in subject position, this may be what underlies the observed pattern of subject/first-mention pronoun resolution[12].

[12] This is not to say that *Occasion* always enforces a subject strategy; sometimes the spatiotemporal constraint can favor the opposite strategy, such as when the preceding discourse segment contains a verb of transfer in which the Goal is realized in a non-subject position (ex. *give, toss, hand,* etc.). In this case, the end of the transfer event coincides with the spatiotemporal index of the Goal, and a subsequent pronoun is therefore more likely to make reference to the antecedent in non-subject position.

Experimental evidence for this is provided by Kehler et al. (2008), who report a sentence completion task in which subjects were instructed to complete two-sentence discourses as in (i).

(i) John handed a book to Bob. He…

The subjects' answers were then annotated by independent judges for (i) whether the pronoun referred to the Source or Goal, and (ii) the discourse relation between the two sentences. They found that use of *Occasion* strongly favored

(17) Juan sings for Pedro, and then he dances. *he* = Juan → subject strategy
(18) Semantic requirements of *Narration/Occasion*:
    a. The end of the singing overlaps with the beginning of the dancing.
    b. Maximize the common topic: *he* = *Juan*

The effect of discourse relations on pronoun resolution strategies can be seen even more clearly when we enforce a *Result* relation between the same two clauses, as in (19). In this case, the discourse relation imposes the requirement that the pronoun be interpreted in a way that is compatible with our real-world knowledge concerning the most likely causal relation between a singing event and a dancing event (20), triggering a pragmatic pronoun-resolution strategy. Finally, the syntactic and semantic requirements imposed by the *Parallel* relation (22) align with a parallel pronoun-resolution strategy, as in (21).

(19) Juan sings for Pedro, and so he dances. *he* = Pedro → pragmatic strategy
(20) Semantic requirement of *Result*
    a. The dancing happens because of the singing.
    b. World knowledge: Being sung to is a likely reason for dancing. (But singing to someone else is not.)
(21) Sara hugged Maria, and Pedro hugged her. *her* = María → parallel strategy
(22) Syntactic and semantic requirement of *Parallel*
    a. More structural similarity increases likelihood of a *Parallel* relation.
    b. Maximize semantic similarity: *her* = *María*

Thus, it is possible that the pronoun resolution strategies observed in the psycholinguistic literature are a byproduct of the underlying discourse relations that comprehenders assume. In fact, this is just what Kehler et al (2008) argue for. Using sentence-completion and pronoun resolution tasks, Kehler et al. argue that discourse relations determine the likelihood of a given referent being mentioned in subsequent clauses, giving rise to both Implicit Causality effects and the different pronoun resolution patterns that have been observed in the literature.

We will start with the phenomenon of Implicit Causality (IC), first observed in sentence-completion studies (Garvey & Caramazza 1976, Brown & Fish 1983). These studies observed that following certain

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a non-subject pronoun resolution strategy (82% non-subject resolution) in contrast to the next most commonly used relation, *Elaboration*, which strongly favored a subject resolution strategy (98% subject resolution).

verbs (ex. *impress, scare*) participants tended to refer to the verb's subject, while for other verbs (ex. *fear, admire*) participants tended to refer to the verb's object. For example, using sentence completion prompts like (23a) Fukumura & van Gompel (2010) found that stimulus-experiencer verbs, such as *scare*, triggered reference to the preceding subject about 76% of the time, while experiencer-stimulus verbs, such as *fear*, triggered reference to the subject only 23% of the time. The explanation given for this observation was that comprehenders tend to focus their attention on the causally implicated referent, rather than on the experiencer, hence the term "Implicit Causality." This is not surprising, given that the original IC studies prompted participants to provide an explanation of the psychological event, using continuations like *This was because…*. Indeed, when Fukumura & van Gompel used the connective *so* (23b) to prompt participants to talk about the event's consequences rather than its cause, they found that the original IC bias was reversed.

(23) Sentence completion prompts from Fukumura & van Gompel (2010) Experiments 1 & 2

a. Gary scared/feared Anna after the long discussion ended in a row. This was because _____.

b. Gary scared Anna after the long discussion ended in a row because/so _____.

While the original IC studies focused on the contribution of the verb to next-mention biases, Kehler et al. reframe the effect as an interaction between verb semantics and discourse relations. Verbs that place causality on one of their arguments will generate a focus on that argument in the context of an *Explanation* relation because that relation is concerned with identifying causes. In the context of relations concerned with other things (ex. *Result, Elaboration*, etc.) there may be different biases, or no bias. To test this, they explicitly contrasted a *because…* condition with a full stop condition (24) that allowed subjects to choose for themselves the discourse relation they wished to establish. Independent judges coded the resulting discourses for both pronoun reference and, in the full stop condition, discourse relation. When participants chose to establish an *Explanation* relation, the rate of reference to the causally implicated referent was comparable to the IC biases found in the *because…* condition, as well as to the IC

biases documented in the literature. However, when *Result* or *Elaboration* was adopted, the next-mention bias reversed or disappeared, respectively.

(24) Sentence completion items testing Implicit Causality bias (Kehler et al. 2008, Expt. 3)
   a. Tony disappointed Courtney because _____.
   b. Tony disappointed Courtney. _____.

While this experiment shows the effect of discourse relations on next-mention biases, regardless of the form of referring expression used, another experiment shows its effect on pronoun resolution in particular. In a second experiment, Kehler et al. elicited interpretations of grammatically ambiguous pronouns embedded in context favoring *Parallel* (25) versus *Result* (26) interpretations, as determined by whether the second event was semantically similar to the first or a plausible consequence of the first (although no explicit discourse connectors were included.) The *Result* stimuli were designed such that a pragmatic resolution strategy would elicit non-subject interpretations of both subject and object pronouns, so that they could be distinguished from the parallel pronoun resolution strategy. They found that subjects employed a parallel pronoun-resolution strategy in cases like (25) and an object-resolution strategy in cases like (26).

(25) *Parallel*-favoring stimuli (Kehler et al. 2008, Expt.1)
   a. Samuel threatened Justin with a knife, and Erin blindfolded him.
   b. Samuel threatened Justin with a knife, and he blindfolded Erin.

(26) *Result*-favoring stimuli
   a. Samuel threatened Justin with a knife, and Erin stopped him.
   b. Samuel threatened Justin with a knife, and he alerted security.

The fact that the authors found absolutely no overall preference for subject interpretations is a fairly convincing rebuttal to claims that the subject/first-mention strategy is a default heuristic that always affects the pronoun resolution process to some degree. But because the real-world events described change from one condition to the next, one could argue that subjects are actually employing a pragmatic pronoun-resolution strategy throughout, and that the contrast in their behavior is simply a response to the changing pragmatics. In this chapter, we will test subjects with stimuli in which *only* the relation between

events is changed, not the events themselves. This provides stronger evidence for the crucial role of discourse relations in pronoun resolution.

In sum, Kehler et al. advance the claim that specific pronoun resolution strategies are a by-product of discourse relations, whether that relation is overtly marked with connectives like *because* and *so* or inferred on the basis of verb semantics. If this is true, then it implies that, in order for children to disentangle the complex surface patterns of pronoun resolution in the input, children must eventually gain access to discourse relations.

2.2. Psycholinguistic evidence for discourse relations in child language

To my knowledge, no one has ever explicitly studied children's comprehension or production of discourse relations. Nevertheless, relevant evidence does exist for their use of many of the same pronoun resolution patterns exhibited by adults. In order, I will review evidence for children's use of (i) pragmatic, (ii) parallel, and (iii) first-mention strategies.

Wykes (1981) provides two experiments that shed light on children's ability to use a pragmatic pronoun-resolution strategy. His first experiment studies how English-speaking 5-year-olds use grammatical gender and real-world plausibility to interpret pairs of sentences like those in (23), which appear to be related via an implicit *Result* relation[13]. In the first set of trials, children would listen to an introductory sentence naming two puppets and a toy and then act out a subsequent sentence, which contained either zero, one, two, or three pronouns. In the zero- and single-pronoun conditions, the child need only remember which puppet was which in order to succeed. With greater numbers of pronouns, the child could either rely on the grammatical features of those pronouns (feminine *she* vs. masculine *he* vs. inanimate *it*), or on the real-world knowledge that someone in need of an object is more likely to get that object than to give that object to someone else. A week later, the same children acted out the same set of

[13] As Wykes did not provide the full list of experimental materials, we can only assume that the other prompts were similar to the example he gives.

sentences, except now with two female puppets, so that gender information was no longer a useful cue to the interpretation of the animate pronouns *she* and *her*.

(27) John needed Susan's pencil. [Wykes 1981, Expt.1: Gender-contrast condition]
a. Control: Susan gave the pencil to John.
b. 1 pronoun: She gave the pencil to John.
Susan gave the pencil to him.
Susan gave it to John.
c. 2 pronouns: She gave the pencil to him.
She gave it to John.
Susan gave it to him.
d. 3 pronouns: She gave it to him.

In both gender-contrast and gender-ambiguous conditions, the overall rate of target responses was well above chance (above 70%). But in the gender-contrast condition, children's performance decreased only slightly as the number of pronouns increased from one (97% correct) to three (90% correct), while in the gender-ambiguous condition it decreased more (84% to 74%). The most dramatic drop occurred between sentences with only one gender-ambiguous animate pronoun (*she* or *her*: 85%) and those with two (*she* and *her*: 69%).

Wykes' second experiment asked whether the difficulty lay in performing the inference or rather in remembering the requisite information, i.e., which puppet was which. In one condition a filler was inserted in between the initial and final sentences, increasing the likelihood that children would forget who was who in the initial sentence. This manipulation did *not* affect the number of correct responses, suggesting that children's difficulty lay with the inference itself, rather than retaining the background information[14]. In sum, we have evidence that using real-world inferences to resolve pronouns is possible for 5-year-olds, though more difficult than using gender information.

[14] Another condition of the experiment tested the effect of whether or not the inference resolved the subject pronoun to a subject antecedent. However, since the list of items is not provided, it is not clear what the operative discourse relation was, or whether the target response corresponded to a parallel pronoun-resolution strategy or to a subject/first-mention strategy. The manipulation did yield a significant effect: children performed better than chance when the real-world inference favored a subject interpretation of the subject pronoun (66.6%) and no better than chance when it did not (50.5% correct), but it is not clear how to interpret this effect.

As for children's use of a parallel interpretation strategy, Maratsos (1974), used an act-out task to elicit interpretations of grammatically ambiguous stressed and unstressed pronouns in parallel contexts like (28), among English-speaking children ages 3 to 5. For items with unstressed pronouns, where a parallel resolution strategy is the target, children of all age groups acted out the sentence pairs in accordance with a parallel interpretation, more often than chance (3-yr-olds: 87% parallel responses, 4-yr-olds: 83%, 5-yr-olds: 93%). For items with stressed pronouns, where a reverse-parallel strategy is the target, younger children actually displayed a bias towards the parallel response, before switching to a non-parallel preference by around age 5.

(28) Parallel pronoun interpretation, Maratsos (1974)
   a. Susie jumped over the old woman, and then Harry jumped over her/HER.
   b. Susie jumped over the old woman, and then she/SHE jumped over Harry.

This seems to indicate that the effects of *Parallel* discourse relations are known very early by children (at least English-speaking children) and *Contrast* not until later. However, it is not clear whether subjects' responses were actually the result of a parallel interpretation, or of the natural inertia of the task. Maratsos himself points out literature indicating that children tend to perform non-linguistic tasks like stacking cups in a "parallel" fashion (Greenfield et al. 1972), preserving agents and patients in the same roles. A picture-selection task might provide a more accurate assessment of children's interpretations, and in fact we will do just this in the next chapter.

By far the most attention has been paid to children's use of the so-called "first-mention preference," which is the preference to resolve pronouns toward the antecedent that has been mentioned first in the discourse. Studies examining this preference vary in the discourse relations they employ; what remains consistent is that the "first-mentioned" antecedent usually appears in subject position, which is by default the position in which sentential topics appear. Thus, this literature can shed light on children's sensitivity to topic continuation across a variety of discourse relations which have been shown to trigger a topic preference in adults. A more detailed review of this literature is found in section 2 of Chapter 5, but for now suffice it to say that English-speaking children appear sensitive to the subject- or first-mention

preference by age 5. Song & Fisher (2005) have found sensitivity to first-mentioned, subject antecedents among 5- and even 3-year-olds (Song & Fisher 2007). Pyykkönen, Mathhews and Järvikivi (2010) found that this preference is strengthened in 3-year-olds when this antecedent is also an agent. One study (Arnold et al. 2007) failed to find evidence from children's eye movements that they preferred the first-mentioned character in passages with grammatically ambiguous pronouns, as in (29), in contrast to conditions in which pronoun reference is disambiguated via gender marking. However, Hartshorne, Nappa & Snedecker (2015) showed that a first-mention preference *is* detectable so long as children are given enough time for the effect to emerge (approximately 1400-1500ms after pronoun onset, in their study).

(29) Donald is bringing some mail to Mickey, while a big rainstorm is beginning.
He is carrying a big umbrella, and it looks like they're both going to need it.

Together, these eye-tracking studies seem to indicate that even though children may be slow to process the discourse cues that trigger a topic-continuation strategy, they are certainly sensitive to these cues.

In sum, though not all pronoun resolution strategies are equally well studied, what evidence there is points towards an incipient ability to infer the appropriate discourse relation and use it to apply the adult-like pronoun resolution strategy. If children were freed from the first step (having to infer the appropriate discourse relation) then we might see even clearer effects of the second step (use of discourse relation to resolve pronouns). In the rest of this dissertation, we always provide an explicit marker of the intended discourse relation, so that we can examine how children use this information to interpret pronouns in their first language.

3. The null/overt contrast in adult language: Differing predictions

Despite their careful articulation of the interplay between discourse relations and other linguistic and extra-linguistic information, Asher & Lascarides are disappointingly silent on one point: the role of the form used to achieve reference (weak pronoun, strong pronoun, name, etc.) in determining its intended referent. This is an important and unresolved question. Many authors have commented on the fact that language provides different ways to refer to the same individual, and that a speaker's choice of referring expression says something about how salient that individual is within the larger discourse. But opinions differ widely on how "salience" is to be defined. Is salience a property of linguistic antecedents, and if so, is it bestowed by virtue of each antecedent's syntactic position, by its information status, or by something else? Is salience a property of referents, determined by more general cognitive representations of objects in the world? If we knew what salience was, then we could more clearly ask how children learn to map different levels of salience to different language-specific referring expressions. Or if at least we knew how salience interacted with discourse relations in adult language, then we could ask whether child language is similar. In this chapter, we will be able to make some progress on these questions with respect to two referring expressions: null and overt pronominal subjects.

The alternation between null and overt subjects in Spanish, and in pro-drop languages more generally, has been approached from a wide variety of theoretical perspectives. Here I will review three different families of accounts, each of which link the null/overt contrast to a different part of the cognitive system: (i) null/overt as pronouns filling different syntactic positions and therefore fulfilling different semantic functions, (ii) null/overt as triggers of different processing-based preferences towards antecedents in different syntactic positions, and (iii) null/overt as direct markers of a referent's level of activation in the mind of the speaker. For each approach reviewed, I will spell out its predictions for the interaction between the null/overt contrast and discourse relations. We will see that these predictions differ in empirically testable ways, so that in the final part of this chapter we can begin to differentiate between some of these accounts using experimental methods.

3.1. Syntactic accounts of the null/overt distinction

One potential explanation for the difference in behavior between null and overt subjects is that they are in different syntactic positions. Many have voiced the intuition that the overt pronoun is emphatic or contrastive in some sense that the null pronoun is not (Luján 1999), but Montalbetti (1984) and Luján (1985, 1986) were the first to point out and account for some of the formal differences in their interpretation, and to link these differences to their syntactic positions. Montalbetti (1984), for instance, showed that the null variant may be bound by a c-commanding antecedent, while the overt variant resists such an interpretation (30). Luján further noted that the overt pronoun supports question-answer focus, similar to stressed pronouns in non-pro-drop languages like English, while the null pronoun does not, similar to unstressed pronouns (31).

(30) Binding behavior of null/overt pronominal subjects

a. *Nadie$_i$ cree que ø$_i$ ha pasado el examen*.
No one$_i$ thinks that *pro*$_i$ has passed the exam.
LF: ¬ ∃x [x thinks x passed the exam]

b. *Nadie$_i$ cree que él$_j$ ha pasado el examen.*
No one$_i$ thinks that he$_i$ has passed the exam.
LF: ∃x [¬ ∃y [y thinks x passed the exam]]

(31)

a. Q: *¿<u>Quién</u> cree Juan que ganará el premio?*
Who does Juan think will win the prize?
A: *Juan cree que {él/*ø} ganará el premio.*
Juan thinks that {HE/*he} will win the prize.

b. Q: *¿<u>Qué</u> cree Juan que ganará en ese concurso?*
What does Juan think he'll win in that contest?
A: *Juan cree que {*él/ø}ganará <u>el premio</u>.*
Juan thinks that {*HE/he} will win the prize.

This and other similarities between overt pronominal subjects in pro-drop languages and stressed pronouns in non-pro-drop languages led Luján to posit that the overt pronoun is located in a higher syntactic position, FocusP. This higher position would explain why the overt pronoun falls outside the scope of binding, as illustrated in the informal semantics given below (30b), in contrast to the null

pronoun, which falls within the scope of binding, as illustrated in (30a). At LF, the null subject is located in SpecIP of the embedded clause, while the overt subject *él* is located in FocusP, somewhere above the matrix IP. Hence the overt subject falls outside the scope of the matrix subject *nadie*, preventing *nadie* from binding *él*. Hence the interpretation of (30b) is that there exists someone (*él*) who thinks that no one (*nadie*) passed the exam, rather than that there exists no person (*nadie*) with the belief that he himself (*él*) passed the exam.

In addition to capturing the formal differences in (30), this proposal makes the very testable prediction that the Spanish null/overt distinction behaves like the distinction between stressed and unstressed pronouns in English. Thus, the two contrasts should interact with discourse relations in the same manner. What exactly does this interaction look like? Answering this question amounts to answering how discourse relations affect the focus/background partition. Luckily, someone already has an answer for us. Kehler (2005) proposes that discourse relations place material into the Background, and that therefore elements referring to that material (including pronouns) must be defocalized, and conversely, that focused elements must not refer to this material. To illustrate, consider the parallel interpretation of (32). Two propositions in a *Parallel* relation must share a certain level of semantic similarity, and Kehler proposes that their common semantic content enters the background, as in (32)a. Since elements referring to backgrounded material must be defocalized (Schwarzchild 1999), this explains why *Pedro* cannot be accented, as shown in (32)b. Replacing DPs with pronouns in (33) and (34), the idea is the same. A defocalized pronoun refers to something in the background (preferentially, *Pedro*, in line with parallelism), while a focused pronoun cannot.

(32) Juan hit Pedro and Diego hit Pedro.
   a. Background: *hit*(*x,y*), *y* = *Pedro*
   b. Prosodic realization: JUAN HIT PEDRO, and DIEGO hit{Pedro/*PEDRO}

(33) Juan hit Pedro and Diego hit $him_{[-F]}$. *him* = *Pedro*
   Background: *hit*(*x,y*), *y* = *Pedro*

(34) Juan hit Pedro and Diego hit $HIM_{[+F]}$. *HIM* ≠ *Pedro*
   Background: *hit*(*x,y*)

When a *Result* relation holds between two clauses, stress again prevents the pronoun from referring to the same individual as the unstressed pronoun. In (35), assuming that the falling event is a result of the hitting event, *he* preferentially refers to *Pedro*. However, stressing the pronoun reverses this interpretation: *HE* preferentially refers to *Juan*.

(35) Juan hit Pedro and $he_{[-F]}$ fell.
Background: normally, *hit*(*x,y*) → *fall*(*y*), *y* = *Pedro*

(36) Juan hit Pedro and $HE_{[+F]}$ fell.
Background: normally, *hit*(*x,y*) → *fall*(*y*)

Thus, if the null/overt subject distinction is a [-/+ focus] distinction, and if discourse relations alter the focus/background partition, this leads to the prediction that a change in discourse relation should have the opposite effects on a null subject than it does on an overt subject in the same position. If the switch from one discourse relation to another increases the likelihood that a null subject refers to the preceding subject, then it should likewise *de*crease the likelihood that an overt subject in the same position refers to the preceding subject. This prediction will be tested in Experiment 4 below.

Luján's was one of the earliest proposals placing null and overt pronominal subjects in different syntactic positions. As study of the left periphery progressed in the wake of Rizzi's influential split CP hypothesis (Rizzi 1997), different proposals emerged about the precise location of these pronouns within the extended CP projection, as well as the specific semantics associated with those positions. For example, Mayol (2010) uses a corpus of Catalán to argue that overt pronominal subjects in pro-drop languages are contrastive topics (located in a Contrastive Topic Phrase). And Frascarelli (2007) proposes for Italian that the overt subject appears in multiple places, including not only FocusP but also two different kinds of TopicP, each time associated with a different prosody and semantics. In contrast, the null subject is restricted to a ContinuingTopicP, where it is obligatorily bound by the preceding topic.

What these later accounts have in common with Luján's is that they place the overt pronominal subject in a higher syntactic position than the null subject, compatible with the binding facts illustrated above. They also assume (explicitly, in Frascarelli's case) that the null subject refers to the preceding

topic, which can account for its resistance to question-answer focus. Where they differ from Luján is that they no longer assume strict complementarity between the positions—and hence, preferred interpretations—of null and overt subjects. The overt pronoun is no longer obligatorily focused, but can also be a topic, potentially coreferential itself with the preceding topic. Thus, these accounts no longer make the prediction that the null/overt distinction behaves like the corresponding stressed/unstressed distinction in English. By comparing the null/overt distinction in Spanish to the stressed/unstressed distinction in English, Experiment 4 allows us to test this prediction.

3.2. Null/overt as markers of structural salience

Focusing on the different syntactic positions of null and overt pronouns is only half the story. The syntactic position of the antecedents themselves is the other. Carminati (2002) proposes that part of what makes an antecedent salient is its syntactic position: the higher in the structure an antecedent is, the more salient it is. She further proposes that the difference between null and overt subjects is that the former prefer antecedents in subject position (specifically, antecedents in SpecIP), and the latter disprefer this option. This proposal is dubbed the Position of Antecedent Strategy.

(37) The Position of Antecedent Strategy (PAS) for intra-sentential anaphora in Italian:
The null pronoun prefers and antecedent which is in the SpecIP position, while the overt pronoun prefers and antecedent which is not in the SpecIP position.

Using questionnaires and reading time studies, Carminati provides experimental support for the PAS in Italian. For example, she shows that participants are faster at reading sentences like (38) and (39) with a null subject when the null subject is pragmatically disambiguated towards the preceding subject, and vice-versa when the overt subject pronoun *lei* ('she') is disambiguated towards the preceding object.

(38) *Quando Vanessa ha visitato Giovanna in ospedale, ø/lei le ha portato un mazzo di fiori.*
When Vanessa visited Giovanna in the hospital, *pro*/she brought a bunch of flowers.
(39) *Quando Vanessa ha visitato Giovanna in ospedale, ø/lei era già fuori pericolo.*
When Vanessa visited Giovanna in the hospital, *pro*/she was already out of danger.

Though the PAS was originally proposed only for intra-sentential reference in Italian, since then, other authors have found evidence for the PAS in other pro-drop languages, as well as in extra-sentential contexts. For example, Alonso-Ovalle et al. (2010) found that native speakers of Peninsular Spanish preferred the subject interpretation of the null subject about 73% of the time in contexts like (40), compared to no preference for the overt subject. Replicating Carminati's experiment above in both Italian and Peninsular Spanish, Filiaci et al. (2010) found a reading-time boost for null subjects disambiguated towards the preceding subject in both languages, although the boost for an object-referring overt pronoun was only found in Italian. In a similar but better controlled reading-times experiment with Mexican Spanish speakers, Keating et al. (2016) found PAS effects for both null and the overt subject pronouns.

(40) *Juan pegó a Pedro. ø/Él está enfadado.*
Juan hit Pedro. *pro*/He is mad.

How does the PAS interact with discourse relations? It doesn't, really. The PAS is formulated as a preference implemented during processing, which may or may not affect the ultimate interpretation that a pronoun receives. All other things being equal, null subjects are more easily processed when they refer to a subject antecedent, but this preference can ultimately be overridden by pragmatics, syntactic constraints such as Principle B, featural constraints, and of course, the semantics of discourse relations. This predicts that, in contexts where syntactic and featural constraints are irrelevant, offline measures should be able to detect the effects of both the PAS and of discourse relations working orthogonally to each other, so long as the effects of the latter are not so strong as to overwhelm those of the PAS. Experiment 4 is therefore designed so that the semantics of the discourse relations tested will introduce weak preferences. The prediction is that, over and above the effects of discourse relations on pronoun resolution, there will also be an overlaid effect of pronominal form such that the use of a null subject will *in*crease the likelihood of the precedent subject being chosen as the antecedent, while the use of an overt subject pronoun will *de*crease this likelihood.

3.3. Null/overt as markers of cognitive salience

A different approach to the notion of salience is that it is a property not of antecedents, but of referents. That is, if a pronoun picks as its antecedent a DP in subject position, this is not due to the structural salience of the subject position, but instead because the individual to which that subject refers is salient in the mind of the speaker. Gundel, Hedberg & Zacharski (1993) were the first to formalize this notion of cognitive salience in what they call the Givenness Hierarchy.

(41) The Givenness Hierarchy (Gundel, Hedberg & Zacharski 1993)

in focus	<	activated	<	familiar	<	uniquely identifiable	<	referential	<	type identifiable
it		*this* *that* *this N*		*that N*		*the N*		indefinite *this N*		*a N*

Each level on the Givenness Hierarchy corresponds to a distinct cognitive status, and use of a particular referring expression indicates that the speaker believes this referent to have that status in the mind of the speaker. For example, the definite article *the* signals "you can identify this," *this* signals "this is in your short-term memory" and *it* signals that the referent is not only in short-term memory, but is in the current focus of attention. Cognitive statuses are implicationally related, with higher statuses (left) entailing all lower statuses (right). Thus, high-status referents can always be referred to with lower-status referring expressions, even though this is avoided for Gricean reasons.

These authors identify both null and (unstressed) overt pronominal subjects as markers of the cognitive status "in focus," apparently assuming that the distinction between the two is a question of some other linguistic property. However, Blackwell & Quesada (2012) attempt to account for the difference in terms of cognitive status by proposing a more fine-grained analysis of the upper rungs of the Givenness Hierarchy. They split the top two cognitive statuses into four, as described below.

(42) Revision of the cognitive statuses *In focus* and *Activated* (Blackwell & Quesada 2012)
   a. *In focus*: the most salient entity from the previous utterance and the topic of the current utterance.
   b. *Activated-recoverable*: an entity (i) in short-term memory due to being the topic of the immediately preceding event sequence, and (ii) recoverable from context without the use of any overt forms.
   c. *Activated*: an entity (i) in short-term memory due to having been mentioned in the preceding utterance, (ii) not the topic in focus, and (iii) not recoverable from context if a null pronoun were used.
   d. *Activated-non-recoverable*: an entity (i) in short-term memory due to having been mentioned in the preceding utterance, (ii) not the topic of the current utterance, and (iii) not recoverable from context even if a definite pronoun were used.

In a corpus of loosely guided narratives, Blackwell & Quesada find that native Mexican Spanish speakers tend to produce null subjects when referring to referents with the first two statuses (in focus: 90.5% of referring expressions used, activated-recoverable: 82%), and that they tend to use overt subjects or definite DPs for the third status (activated: 41% overt subjects, 26% definites). For referents in the fourth category, they tend to use "semantically general NP expressions" (activated-not recoverable: 44% general NPs), although a fair number of definite DPs were also used here (30% of referring expressions used).

Assuming one accepts the success of Blackwell & Quesada's attempt to define the null/overt distinction in terms of cognitive status, we then need to answer how cognitive status interacts with discourse relations. This is not easy, since A&L say nothing explicit about how discourse relations raise or lower the level of attention directed at a given referent. Nevertheless, we can look at specific examples of pronoun reference under different discourse conditions and use Blackwell & Quesada's schema above to predict whether a native speaker would find the overt form or the null form more felicitous.

In the *Occasion* discourse below (43), resolving *he* toward *Juan* (the preferred interpretation) means that the pronoun is referring to an entity that is highly salient by virtue of being the topic of both utterances. In other words Juan is an entity "in focus," so in Spanish the pronoun should be realized as a null subject. If *he* is resolved toward *Pedro* (dispreferred, but still possible), then the pronoun refers to a non-topic entity from the preceding utterance, i.e., an "activated" referent, which in Spanish must be realized with the overt pronoun. In a *Result*-type discourse like (44), where the preferred interpretation is

one in which Juan's singing leads to Pedro's dancing, one could argue that the causal relationship between the singing and the dancing shifts the focus of attention toward Pedro. A pronoun referring to Pedro must therefore be realized as a null subject (44a). If on the other hand the dispreferred interpretation in which *he* refers to Juan is actually the intended meaning, this interpretation is not easily recoverable from context. This gives Juan the status of "activated" instead of "in focus" and therefore the pronoun referring to him must be overt.

(43) Juan sings for Pedro. And then he dances.
   a. if *he* = Juan → In focus → null (*pro*)
   b. if *he* = Pedro → activated → overt (*él*)

(44) Juan sings for Pedro, and so he dances.
   a. *he* = Pedro → In focus → null (*pro*)
   b. *he* = Juan → activated → overt (*él*)

In Experiment 4, we test these predictions by working backwards, first providing the pronoun realization and then asking what the listener's interpretation is. One will notice that these predictions happen to be the same as the predictions made by Luján's [+/- focus] account; the overt and the null subject have opposite antecedent preferences. Indeed, Experiment 4 will not be able to adjudicate between Luján's focus account and Blackwell & Quesada's cognitive status account. However, the linguistic notion of focus is <u>not</u> to be confused with the cognitive status "In focus." For one thing, linguistic focus applies to linguistic objects (ex. *pro*, *él*) while cognitive status applies to cognitive representations of real objects (ex. the guys Juan and Pedro). For another, it is actually the [-focus] null subject which is predicted to end up referring to the "In focus" referent.

4. The null/overt contrast in child language

The vast majority of research on children's sensitivity to form of referring expression comes from production, both elicited and spontaneous. It is well known that children acquiring non-pro-drop languages go through a null subject stage (Hyams 2011, Valian 1990), but subject drop is not categorical:

Hughes and Allen (2013) have shown crucially that the rate of subject drop, relative to the use of pronominal, demonstrative, or lexical DPs, is sensitive to several discourse factors, including linguistic salience due to prior mention of the referent, as well as situational salience due to physical presence of the referent and joint attention directed towards it. In elicited production (Campbell et al. 2000, Matthews et al. 2006) English-speaking children produce null pronouns, which of course are non-target for that language; nevertheless their early productions of the null form occur only for linguistically salient referents, such as those that have received prior mention. Slightly later, children also show sensitivity to non-linguistic salience factors, such as their interlocutor's attentional state.

There is a large body of work examining children's production of definite versus indefinite referential forms, which in the adult grammar is at least partly governed by the distinction between discourse-new and discourse-old referents (the former tend to be realized with indefinites and the latter with definites). It is commonly found that children overextend definites to refer to discourse-new and indefinites to discourse-old referents until fairly late in development (Karmiloff-Smith 1985, Maratsos 1973). Nevertheless, de Cat (2011) provides an important qualification to this by examining the relationship between the definiteness distinction and a different linguistic marker of the given-new distinction: the use of dislocated topic structures versus focus structures. In elicited story production by French-acquiring children, she found that, as early as 2, children overwhelmingly produced indefinites in focus position to introduce new information, while allowing old information to be realized in either focus or topic structures, consistent with the adult grammar. Children's most common mistake consisted in realizing old information using indefinite morphology. However, this error *never* occurred within topic structures, only within focus structures. This shows that, while children may occasionally misclassify an old referent as new and therefore refer to it using an indefinite in focus position, they refrain from using indefinites within a structure that indicates Givenness. In other words, while children may occasionally misclassify the status of a referent, they nevertheless understand *how* that status is encoded in both the morphology and the focus-topic articulation of their language.

Evidence of children's ability to use pronominal form in comprehension is more limited. Maratsos'

study mentioned earlier shows that by age 5 children are able to use pronominal stress to reverse a parallel pronoun interpretation strategy. For Spanish-speaking children, Shin & Cairns (2012) found that 8-9-year-olds, like adults, preferred null subjects when referring to the preceding subject antecedent, but that even adolescents failed to show a preference for overt subjects when referring to non-subjects. Both findings suggest late development; however, this may have been due in part to the authors' use of a metalinguistic judgment task, something that can be very difficult for younger children.

In sum, the literature suggests that English-speaking preschoolers are sensitive to the correlation between the form of a referring expression and the salience of its linguistic antecedent in the preceding discourse. The evidence for Spanish-speaking children is less clear, but if they are indeed sensitive to the null/overt distinction, this is more likely to be detectable in a task that does not require explicit metalinguistic judgments. Thus, our experiment will use a forced-choice picture selection paradigm.

5. **Experiment 4a:** The *Occasion*/*Result* and strong/weak contrasts in adult Spanish and English

Our main question for adults is how the weak/strong contrast interacts with the contrast between different discourse relations, and whether this interaction is the same in Spanish as it is in English. The nature of this interaction will help us to differentiate between different accounts of the null/overt contrast in Spanish, and it will allow us to then ask at what age children become sensitive to each of these two discourse cues. Experiment 4a tests the effects of *Occasion* and *Result* discourse relations on the interpretation of grammatically ambiguous null and overt subjects in Spanish and stressed and unstressed subjects in English. Experiment 4b compares Spanish-speaking children at different ages to adults.

5.1. Hypotheses and predictions

Though the effects of pronominal form may differ across English and Spanish, we expect the effects of discourse relation to remain constant across the two languages. (Though Asher & Lascarides rely

entirely on English-language examples to make their points, there is nothing in their account to suggest that discourse relations are anything but universal.) *Occasion* favors topic continuity, and as noted before, the items in this experiment have been designed so that A&L's definition of topic continuity coincides with continuity of sentential topics: pronouns in the default topic position (subject pronouns) should favor antecedents in the same position within the preceding sentence (subject antecedents). This relation contrasts with *Result*, which favors whichever pronoun interpretation supports a cause-effect relationship between the two events. In this particular experiment, items have been designed so that a *Result* interpretation produces a weak preference for the object antecedent. Thus, we predict that on the whole the *Occasion* condition should produce more subject interpretations overall relative to the *Result* condition.

(45) Example item: *Occasion* condition
   a. *Juan canta para Pedro y después {ø/él} baila.* Spanish
   b. Juan sings for Pedro, and then {he/HE} dances. English

(46) Example item: *Result* condition
   a. *Juan canta para Pedro y por eso {ø/él} baila.* Spanish
   b. Juan sings for Pedro, and so {he/HE} dances. English

Regarding the effects of pronominal form, predictions differ for English and Spanish. In English we expect strong (stressed) and weak (unstressed) forms to exhibit opposite preferences. In Spanish, Luján's +/- focus account, and Blackwell & Quesada's cognitive status account make the same prediction: the strong form (overt) "flips" the preferred interpretation of the weak form (null), producing a crossover interaction between discourse relation and pronominal form. In contrast, newer accounts like those of Frascarelli and Mayol no longer demand such complementarity; Carminati's PAS specifically proposes that use of an overt subject simply decreases the likelihood of an object interpretation across the board. This predicts that the effects of discourse relation and pronominal form are not interacting but additive; in other words, they predict a main effect of discourse relation and of pronominal form, with no interaction.

5.2. Method and Design

We probed subjects' preferred interpretations of ambiguous 3rd person singular subjects, as in (45) and (46), using a picture-selection task consisting of 16 test items in a 2 (null, overt) x 2 (*Occasion, Result*) design. Items were blocked by condition; blocks were separated by items from a different experiment reported in the next chapter (Expt. 6), which used some of the same characters. Blocks with null subjects always preceded those with overt subjects, so that participants could decide on an interpretation of the null subject before reversing the interpretation. The remaining four presentation orders—two in which *Occasion* blocks preceded *Result* blocks, and two in which the order was reversed—were counterbalanced across participants.

A list of 8 different items was created which contained verbs that (i) were easily depicted, (ii) were likely to be understood by preschoolers, and (iii) produced only a weak pragmatic bias towards either a subject or an object reading when presented in *Occasion* or *Result* contexts. This list can be found in Appendix C. Items were counterbalanced across the four versions of the experiment, such that each subject saw each item in 2 of the 4 conditions. Order of presentation was randomized within each block, and the position of the first-mentioned character (left or right side of the screen) was counterbalanced across items.

5.3. Subjects

Native Spanish-speaking adults included 40 participants (34 women) recruited from among the teachers and administrators at the daycare; 1 additional participant was excluded for failing to learn characters' names and 1 more due to technical failure. English-speaking adults included 54 participants recruited from linguistics classes at Michigan State University, with 2 exclusions due to failure to learn names. Spanish-speaking adults were rewarded with either a sticker or a piece of candy; English-speakers received extra credit.

5.4. Procedure

The picture-selection task was administered via Psychopy version 1.82.01 (Pierce 2007). Adult participants listened via headphones to pre-recorded prompts read by a native speaker of Mexican Spanish and then selected the picture of their choice by pressing either the 4 key (left-hand picture) or the 9 key (right-hand picture).

The characters mentioned in the prompts were all school-age children with common Mexican names, two male and two female (*María, Sara, Juan, Pedro*). Before beginning the experiment, participants were taught the names of the characters and given a 4-item name-recognition task. Learning the characters' names was not technically necessary to complete the task, since it was possible to infer who was who from just looking at the pictures and hearing the prompts. However, we reasoned that familiarity with character names facilitates processing and therefore excluded any participant that did not provide at least 2 out of 4 correct answers. The remaining Spanish-speaking adults scored an average of 3.6 (SD 0.5), and English-speaking adults an average of 3.5 (SD 0.64).

As mentioned above, this task was also interleaved with experiment 6, reported in the next chapter, which used the same female characters, plus a teacher, a group of girls, and a group of boys. The first block of that experiment was also preceded by a picture-selection task checking familiarity with the characters' names.

5.5. Results

The proportion of subject responses in each condition is reported in Figure 4. To model the likelihood of a subject response among English- and Spanish-speaking subjects, we fit two separate multilevel mixed effects logistic regression models to English- and Spanish-speaking adults, with relation (*Occasion*, *Result*) and pronominal form (weak, strong) as level-1 fixed effects and items and subjects as level-2 random intercepts. Models including random slopes for subjects and items failed to converge and were therefore not considered. Results are reported in Table 17. For both groups, the *Result* relation was

associated with a decrease in the likelihood of a subject interpretation (both beta < 0, both $p < 0.001$). For English-speaking adults, however, there was a significant interaction between discourse relation and pronominal form such that the combination of Result relation with the strong pronominal form was associated with an *in*crease in the likelihood of a subject interpretation (beta > 0, $p < 0.001$). For Spanish-speaking adults, there was no such interaction: use of the overt pronoun decreased the likelihood of a subject interpretation across both discourse relations.

Figure 4: Experiment 4a subject antecedent responses by English- and Spanish-speaking adults

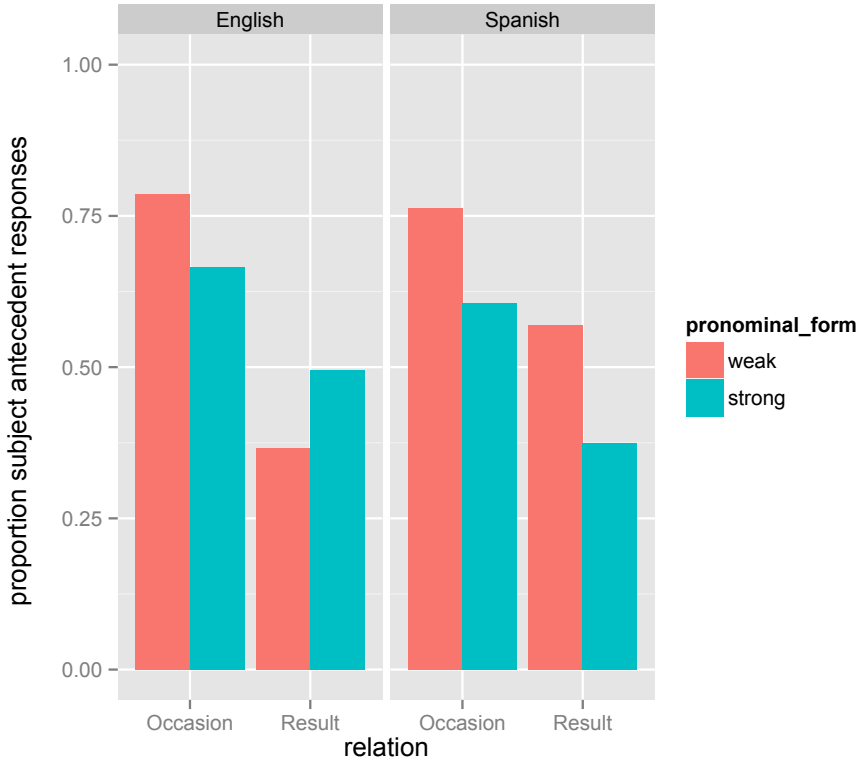


Table 17: Fixed effects estimates for the multilevel logistic regression model of subject responses, with pronominal form and discourse relation as predictor variables. Model was fit using the *glmer()* function of the *lme4* package in R (R Core Team, 2013), with the following formula: `subj.response ~ form * relation + (1| item) + (1| subject)` (English: N=54, Spanish N=40)

English		*β Estimate*	*Std. Error*	*z value*	*p-value*
	(intercept)	1.5401	0.2653	5.804	< 0.0001***
	pronominal form	-0.7086	0.2380	-2.978	0.0029
	discourse relation	-2.2294	0.2450	-9.099	< 0.0001***
	relation × form	1.3728	0.3221	4.262	< 0.0001***
Spanish					
	(intercept)	1.41904	0.33587	4.225	< 0.0001***
	pronominal form	-0.87671	0.27276	-3.214	0.0013
	discourse relation	-1.09530	0.27071	-4.046	< 0.0001***
	relation × form	-0.07367	0.36912	-0.200	0.84180

5.6. Discussion

The results from adults' offline interpretation of grammatically ambiguous subject pronouns are consistent with Asher & Lascarides' semantics for the discourse relations *Occasion* and *Result*. In both

English and Spanish, establishing an *Occasion* relation between two events encouraged more subject interpretations than establishing a *Result* relation between the same two events. This result builds on the evidence drawn from Kehler et al. (2008) Experiment 1, in establishing the importance of discourse relations on pronoun resolution preferences. Unlike that study, this experiment controls for event content, modifying only the relations between events, not the events themselves, providing stronger evidence for the specific role of discourse relations.

Adult results are also compatible with the predictions of the Position of Antecedent Strategy: the use of an overt subject produced an overall decrease in reference to the preceding subject. This contradicts the predictions of Luján's focused-based account, since the null/overt distinction was not treated by Spanish-speaking subjects in the same way as the unstressed/stressed distinction was treated by English-speaking subjects. In English, the interaction between discourse relations and pronominal form produced a crossover interaction, while in Spanish there was no interaction. This is more consistent with those syntactic accounts that allow the overt pronoun to appear in locations other than FocusP (Frascarelli 2007, Mayol 2010). Finally, the results are inconsistent with Blackwell & Quesada's cognitive status account because we found that using an overt subject in the *Result* conditions did not produce an increase in reference to the lower-status referent, in fact, in accordance with the PAS, it resulted in a further decrease.

It bears noting that the English results are not picture-perfect. Even though stress produced a significant decrease in subject responses in the *Occasion* condition and a significant increase in *Result* condition, it never produced an *absolute* preference in either direction. This suggests that the semantics of contrastive focus in English incorporates more information than just the preferred interpretation of the non-contrastive item, as argued by DeHoop (2003), contra Kameyama (1999). Nevertheless, the contrast between English and Spanish, and the effects of the PAS in Spanish, remain clear.

6. **Experiment 4b:** The *Occasion*/*Result* and null/overt contrasts in child Spanish

The question for children is when they become sensitive to the information provided by discourse relations and pronominal form. There are three logical possibilities for the timing of acquisition: (i) children acquire discourse relations first, (ii) children acquire the null/overt distinction first, or (iii) children are sensitive to both but at different ages.

6.1. Methods and Design

The same methods were used for children as for adults, except for minor changes to the procedure to accommodate shorter attention spans (see Procedures section).

6.2. Subjects

The same children who participated in Experiment 3 also participated in this experiment. Of the original 82 children, 73 (39 girls) ages 2;11 to 6;4 (mean: 4;6, SD: 11.5 months) completed the task. An additional 3 were tested but excluded from analysis because of failure to learn the characters' names.

6.3. Procedure

Items were presented on a screen in the same manner reported for adults, with two exceptions: (i) children did not hear recorded prompts, but instead listened to an experimenter read them, and (ii) halfway through the experiment children were given a break.

Before beginning, the experimenter introduced the four characters used in the stories, using laminated cards. Once the child could identify all four by name, the same characters were introduced again on the screen and the child once again was prompted to identify each one. Finally, the task itself was introduced and consent obtained through the following:

(47) *Te voy a contar unas historias acerca de mis amigos. Al final de cada historia, vas a ver dos fotos, y tú me tienes que decir cuál es la foto que corresponde, ¿sale?*
I'm going to tell you some stories about my friends. After each story, you're gonna see two pictures, and you have to tell me which is the right one, sound good?

Children listened to the experimenter read each item out loud and then indicated their choice by pointing, after which the experimenter pressed the appropriate key.

6.4. Exclusions

The exclusion criterion was the same for children as for adults. Those with fewer than two correct answers out of four were excluded. The remaining children answered correctly an average of 3.37 out of 4 (SD 0.73) items. Individual responses were eliminated for reasons including inattention, failure to select only one picture, or experimenter error in presenting items (1.7% of total data).

6.5. Results

The main question for children acquiring Spanish is when they begin to show the main effects of pronominal form and discourse relation evident among Spanish-speaking adults. Since not enough 4- or 6-year-olds participated to constitute their own separate age groups, we divided children into two groups at the median age of 4;5 (Younger: n = 40, 22 girls, ages 2;11-4;5, mean = 3;9, SD = 5.8 months; Older: n = 33, 17 girls, ages 4;6-6;4, mean = 5;5, SD = 5.1 months) and fit separate models to each group, with level-1 main effects of pronominal form (null, overt) and discourse relation (Occasion, Result) and level-2 random intercepts for subjects and items. Results are reported in Table 18. Younger children showed sensitivity to the effect of discourse relation, with Result decreasing the likelihood of a subject response (beta <0, $p = 0.03$). In contrast, older children showed sensitivity to the effect of pronominal form, with overt subjects decreasing the likelihood of a subject response (beta <0, $p < 0.01$).

Figure 5: Experiment 4b subject antecedent responses by children (Younger: N = 40, 2;11-4;5; Older: N = 33, 4;6-6;4)

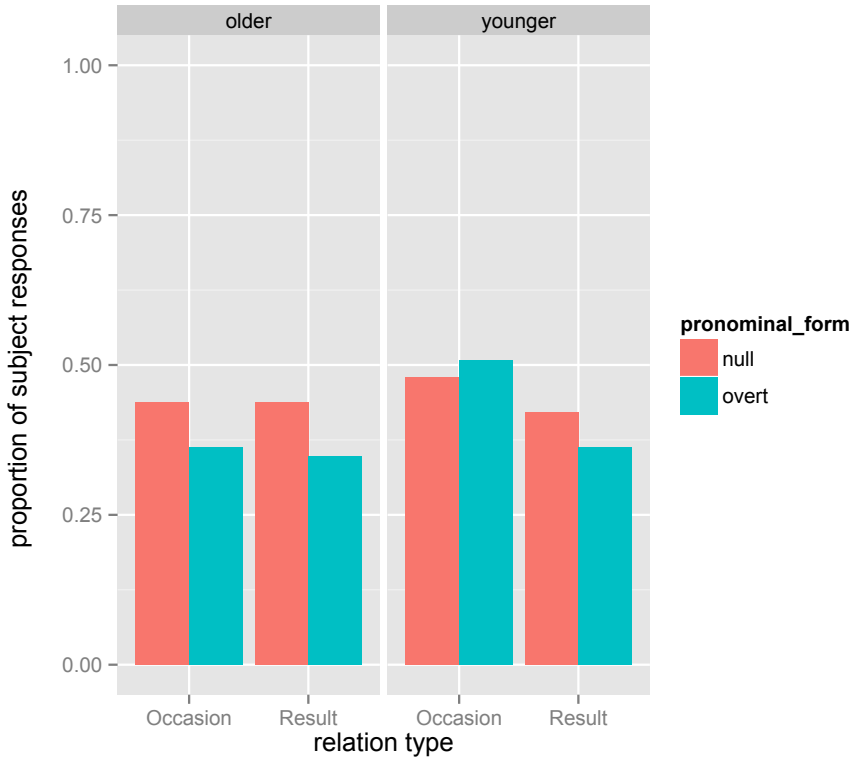


Table 18: Fixed effects estimates for the multilevel logistic regression model of subject responses, with pronominal form, discourse relation, and age as main effects. Model was fit using the *glmer()* function of the *lme4* package in R (R Core Team, 2013), with the following formula: `subj.response ~ form + relation + (1| item) + (1| subject)` (younger: N=40; older: N=33)

younger		*β Estimate*	*Std. Error*	*z value*	*p-value*
	(intercept)	-0.033588	0.203676	-0.165	0.8690
	pronominal form	0.006493	0.168240	0.039	0.9692
	discourse relation	-0.358928	0.168494	-2.130	0.0332 *
older					
	(intercept)	-0.31915	0.30652	-1.041	0.29778
	pronominal form	-0.58060	0.20162	-2.880	0.00398 **
	discourse relation	-0.03595	0.20043	-0.179	0.85765

6.6. Discussion

The results from children's interpretation are very interesting. Contra Shin & Cairns (2012) we find that children even younger than 5 are sensitive to the null/overt distinction if a non-metalinguistic task is

used. Consistent with other authors' findings for English (Song & Fisher 2005, 2007, Hartshorne et al. 2015, Wykes 1981), we find evidence that Spanish-speaking preschoolers are sensitive to cues related to discourse relations. But our findings suggest that the path to acquiring both types of discourse cues is U-shaped. Children younger than 4 ½ show sensitivity to the distinction between *Occasion* and *Result*, but not to the null/overt distinction. Children over this age have acquired the null/overt distinction but apparently "forgotten" about discourse relations. And somewhere between 6 years and adulthood, they apparently learn to integrate both cues together.

One more interesting aspect of the child data is that children in both age groups seem to have a slight overall preference for the object antecedent, in contrast to adults, who showed an overall subject preference. There are two possible explanations for this. One possibility is that children begin with a bias towards the most recently mentioned antecedent, perhaps because they have trouble suppressing recent information, as suggested by Hartshorne et al. (2015). A different possibility is that children's preference for the object interpretation is due to a preference for the *Result* interpretation, even in *Occasion* conditions. Notice that the *Occasion* conditions are, technically speaking, compatible with a *Result* interpretation. In the example below, it is asserted that the leaving event occurs after the hitting event, an assertion that is compatible with a scenario in which the leaving was caused by the hitting. For the most part, adults did not choose this interpretation, but it is possible that children did.

(48) *Juan le pega a Pedro y después se va*.
Juan hits Pedro and then *pro* leaves
Occasion interpretation: Juan's hitting precedes Juan's leaving.
Result interpretation: Juan's hitting causes Pedro's leaving.

In the following chapters, we will remove the *Occasion/Result* ambiguity, testing children's sensitivity to other discourse relations, such as *Parallel* and *Contrast* (Chapter 4), or to only one discourse relation at a time (*Occasion*, Chapter 5). Removing the *Occasion/Result* ambiguity will allow us to decide between these two hypotheses about children's object preference. But we will also continue to pursue our

main goal, which is to ask how discourse cues interact with pronominal person and number features in children's comprehension.

Chapter 4: Number versus Discourse cues

Chapters 2 and 3 set the stage by testing children's sensitivity to grammatical cues and discourse cues separately. In these next two chapters, we can begin putting the two together, by looking at how children combine information from number marking with information from the discourse relations *Parallel* and *Contrast.* These relations, which trigger parallel and anti-parallel pronoun resolution, respectively, will be overtly marked with the connectives *también* ('too') and *pero* ('but').

(1)	*María abraza a Sara y ø abraza a Juan también.* Maria hugs Sara and *pro* hugs Juan too.	Parallel, *pro* = María
(2)	*María abraza a Sara pero ella abraza a Juan*. María hugs Sara but she hugs Juan.	Contrast, *ella* = Sara

Our method of approach will involve two steps. First, we will examine children's sensitivity to *Parallel* and *Contrast* discourse relations when interpreting ambiguous pronouns, as in (1) and (2). Second, we will examine children's interpretation of pronominal number in the context of a *Parallel* relation, comparing cases where number marking and *Parallel* marking are congruent, against cases where these cues are pitted against each other. This will allow us to determine four things: first, the age at which children associate number-disambiguated pronouns to the target referent; second, whether and when this association is affected by the presence of (in)congruent discourse cues; third, whether children weight discourse cues or number cues more strongly; and finally, the timing of cue sensitivity.

In order to complete the first step in this chapter, we will have to separate out the effects of alternating *Parallel* and *Contrast* discourse relations from the effects of alternating strong and weak pronouns. (As we discovered in the last chapter, children become sensitive to the latter cue at around 4 ½ years old.) Once again, however, this question has not been resolved for adults. Though much work has been done on the alternation between null versus overt subject pronouns, much less attention has been paid to strong versus weak object pronouns. And in this chapter we can no longer afford to ignore object pronouns because they are crucial for distinguishing between a parallel resolution strategy—in which

subject pronouns prefer subject antecedents and object pronouns prefer object antecedents—and a mere across-the-board preference for subject antecedents. Experiment 5a will thus examine adult interpretations of strong and weak subject and object pronouns, attempting to separate the effects of pronominal from the effects of *Parallel* and *Contrast* discourse cues.

Having established how adults use *Parallel* and *Contrast* discourse relations as distinct from pronominal form, we will then probe children's sensitivity to these relations in Experiment 5b. As we will see, the experiment provides only very weak evidence of any sensitivity to these relations when interpreting grammatically ambiguous pronouns. However, this does not mean that discourse sensitivity cannot still aid in the comprehension of number features. Thus, Experiment 6 alternately pits *Parallel* cues against number marking (incongruent condition) and aligns them (congruent conditions) to see how children integrate the two kinds of information. If children are sensitive to *Parallel* discourse cues, then performance should improve in congruent conditions and suffer in incongruent conditions. And if discourse sensitivity has a developmental effect, then the appearance of this congruence effect should trigger an overall improvement in the use of number cues.

Finally, by changing our focus in this chapter from *Occasion* and *Result* discourse relations to *Parallel* and *Contrast* relations, we will be able to resolve an outstanding question from chapter 3. Recall from Experiment 4 that children were much more likely than adults to choose the preceding object as the antecedent of both null and overt subject pronouns. A simple explanation for this is that the children were biased towards the most recently mentioned antecedent, perhaps because their limited processing capacity makes it difficult to suppress recent information, as suggested by Hartshorne et al. (2015). This would certainly be consistent with children's behavior in Experiment 2, in which they allowed 3rd person pronouns to refer to the most recently mentioned antecedent even at the cost of violating feature compatibility. However, a different potential explanation is that children were simply responding to an ambiguity in the stimuli. Items in the *Occasion* condition could still be felicitously interpreted as having a *Result* relation—which favored an object interpretation. It is possible that children's preference for a *Result* interpretation is what caused the overall object bias. Studying children's pronoun resolution in the

context of *Parallel* and *Contrast* relations removes this ambiguity. If children's object preference persists, then we will have evidence for a bias towards recently mentioned antecedents.

In sum, the questions for this chapter are as follows (listed in the order in which they will be addressed):

Q1. What is the role of pronominal form versus *Parallel* and *Contrast* discourse markers in adult interpretations of subject and object pronouns?
Q2. Are children sensitive to the semantics of *Parallel* and *Contrast* discourse relations when choosing antecedents?
Q3. Are children biased towards the most recently mentioned antecedent?
Q4. How does the *Parallel* relation interact with children's developing use of number marking?

1. Literature Review

Before pursuing these questions, let us take a moment to review the semantics of *Parallel* and *Contrast* as proposed by Asher & Lascarides (A&L), and whether there is already any existing experimental evidence for this proposal in either adult or child psycholinguistic research.

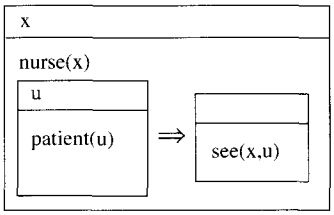
Recall from Chapter 3 that *Parallel* and *Contrast* have a structural component and a semantic component, both gradable in nature. First, the structural component: discourse segments connected via these two relations must be structurally "similar," and the more so the better. Asher, Hardt & Busquets (1997, 2001) operationalize structural similarity as the existence of a Maximal Common Theme, defined as in (3). The Maximal Common Theme of any two DRSs, K and J, is essentially the most highly specified DRS that can be constructed by simplifying K and J until they contain the same material. Simplification, expressed by the symbol $\rightsquigarrow$ can be achieved by deleting or generalizing parts of a DRS (see Asher et al. 1997 and 2001 for formal details).

(3) *Maximal Common Theme* [Asher, Hardt & Busquets (1997)]
Given two DRSs *K* and *J*, the Maximal Common Theme is the DRS *T* such that
a. $K \rightsquigarrow T$ and $J \rightsquigarrow T$, and
b. for any other *T'* such that $K \rightsquigarrow T'$ and $J \rightsquigarrow T'$, then also $T \rightsquigarrow T'$

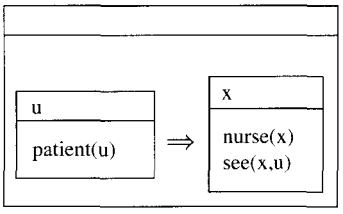
Parallel and *Contrast* are gradable in the sense that they have a preference for maximizing the Maximal Common Theme shared by their constituent DRSs. That is, to make the discourse more coherent, any structural ambiguities within DRSs joined by *Parallel* or *Contrast* should be resolved in such a way as to maximize their isomorphism. As an illustration, look at how the *Parallel* relation constrains the scope of its clausal constituents in example (4) below. When read in isolation, the first sentence in (4) has two potential readings, a wide-scope reading in which there is a single specific nurse who sees all the patients, and a narrow-scope reading in which a different nurse sees every patient. The second sentence in (4) of course has no such scope ambiguity because the subject *Dr. Smith* is a definite DP and therefore cannot vary with every single patient; only the wide-scope reading is available. When these two sentences are joined in a *Parallel* relation, as indicated by the discourse marker *too*, the first sentence is preferably interpreted as having the same scope as the second sentence. Asher, Hardt, & Busquets' explanation for this fact is that imposing the same scope on both clauses allows them to have partially isomorphic DRSs (4a-b), which in turn allows for their Maximal Common Theme to contain a greater amount of structure (5) than it would have had if the two constituent DRSs each had different scope structures.

(4) A nurse saw every patient. Dr. Smith did, too. [Sag (1976), cited by Asher et al. (1997)]

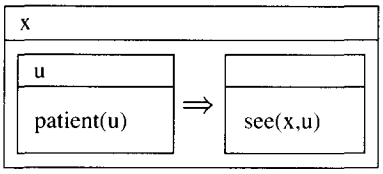
a) DRS for wide-scope reading of S1



b) DRS for narrow-scope reading



(5) Maximal Common Theme for (4), assuming the wide-scope reading of both sentences.



Second, let's consider the semantic requirements of *Parallel* and *Contrast* relations. Assuming that two DRSs have been interpreted in such a way as to maximize their structural parallelism, the *Parallel* relation additionally requires that any remaining ambiguities be resolved in such a way as to maximize their semantic similarity, while *Contrast* prefers the opposite. When two clauses are structurally parallel and the only ambiguity concerns the resolution of a pronoun, then *Parallel* and *Contrast* will affect pronoun resolution in opposite directions, as we saw in examples (1) and (2) above with subject pronouns, as well as examples (6) and (7) below with direct object pronouns.

(6) *María abraza a Sara y Juan la abraza también.* Parallel, *la* = Sara
Maria hugs Sara and Juan hugs her too.

(7) *María abraza a Sara pero Juan la abraza a ella.* Contrast, *la…a ella* = María
María hugs Sara but Juan CL-fem hugs her.

The parallel pronoun resolution strategy is certainly well documented in the experimental literature (ex. Chambers & Smyth 1998, Kehler et al. 2008), but what is interesting is not so much the fact that it exists, as the circumstances under which it becomes more or less likely. For example, arguing against the primacy of the subject resolution strategy (Crawley et al. 1990), Smyth (1994) showed that the parallel resolution strategy becomes the dominant strategy when sentences have the same constituent structure and verb types (86% object resolution of object pronouns in prompts like (8a-b)) relative to sentence pairs lacking this kind of parallelism (37% object resolution for sentences like (9a-b)). In another two experiments Smyth also showed that parallelism of semantic roles (Smyth 1992) and the presence of parallel adjuncts—even adjuncts devoid of pronouns (Smyth 1994 Expt. 2)—also increase the likelihood of a parallel resolution strategy. These findings support the view that syntactic and semantic parallelism

increase the discourse coherence of a *Parallel* relation, thereby increasing the likelihood that readers will infer this relation and hence employ a parallel resolution strategy.

(8) Clauses with full structural parallelism [Smyth (1994), taken from Crawley et al. (1990) Expt. 2]
   a. John pushed Sammy and Evelyn kicked him.
   b. Sara visited Cathy at home and Charles phoned her at work.

(9) Clauses without full parallelism
   a. Patricia gave Martha a present and Nicholas smiled at her.
   b. Mary helped Julie change the wheel and Peter talked to her.

How do children resolve pronouns in *Parallel* and *Contrast* contexts? Two experiments provide relevant data for English-speaking children. First, Maratsos (1974), which we briefly reviewed in Chapter 3, used an act-out task to elicit interpretations of grammatically ambiguous pronouns in syntactically parallel contexts like (10). Adult intuitions dictate a parallel interpretation for unstressed subject and object pronouns, and an anti-parallel strategy for stressed pronouns. All age groups acted out the adult-like interpretation of the unstressed pronouns, but only 5-year-olds showed a preference for the anti-parallel interpretation of stressed pronouns.

(10) Prompts eliciting parallel and anti-parallel pronoun interpretations [Maratsos (1974)]
   a. Susie jumped over the old woman, and then Harry jumped over her/HER.
   b. Susie jumped over the old woman, and then she/SHE jumped over Harry.

Children's use of the parallel resolution strategy by are 3 and the anti-parallel strategy by age 5 in this study suggests that these are the ages at which sensitivity to *Parallel* and *Contrast* emerge. However, as we noted in Chapter 3, an act-out task might not be the best way to measure children's sensitivity to these relations, since, as noted by Maratsos himself, children tend to perform even non-linguistic tasks like stacking cups in a parallel fashion (Greenfield et al. 1972). If children's default strategy is to perform tasks in a parallel manner, act-out tasks will overestimate children's sensitivity to *Parallel* and underestimate their sensitivity to *Contrast*.

More evidence for the default nature of parallel behavior comes from a second experiment, Sheldon (1974), which used an act-out task to elicit children's interpretations of subject and object relatives like

(11) and (12). As one might expect, sentences containing relative clauses were very difficult to act out; however, the children were significantly better at producing a target response when the grammatical function of the relative pronoun matched that of the relative clause as a whole, i.e., when subject relatives appeared in subject position (11a), or when object relatives appeared in object position (12b). This "parallelism" effect has nothing to do with discourse parallelism: there is no *Parallel* or *Contrast* relation, overt or covert, between the relative clause and the matrix clause. Either the facilitatory effect of parallelism is due entirely to a non-linguistic preference for parallel actions, or, if it has any linguistic basis at all, it indicates that the processing of embedding is facilitated by syntactic parallelism.

(11) Subject relative clauses in subject and object position [Sheldon (1974)]
   a. [The dog that *e* jumps over the pig] bumps into the lion. Parallel function
   b. The pig bumps into [the horse that *e* jumps over the giraffe]. Non-parallel function

(12) Object relative clauses in subject and object position
   a. [The lion that the horse bumps into *e*] jumps over the giraffe. Non-parallel function
   b. The dog stands on [the horse that the giraffe jumps over *e*]. Parallel function

Finally, even if Maratsos' design does tell us something valid about children's linguistic interpretations of pronouns, it still does not separate out the effects of discourse relation from the effects of pronominal form. There may be a direct and transparent relationship between pronoun realization and discourse relations in English, as argued by Kehler (2005), but this is probably not the case for Spanish. As we saw in the last chapter, discourse relations and pronominal form exert separate effects on the interpretation of pronouns embedded in *Occasion* and *Result* discourses, and children are sensitive to this fact beginning around age 4 ½. So if we want to measure children's sensitivity to the fact that *Parallel* and *Contrast* relations trigger parallel and anti-parallel resolution strategies, respectively, we need to make sure that we factor out whatever effect pronominal form has in these contexts. The next two sections are dedicated to separating out these two effects for adults, so that we may then turn to children.

2. *Parallel*, *Contrast*, and the role of pronominal form

In A & L's discussion of *Parallel* and *Contrast*, there is no mention of the impact of pronominal form, so we once again find ourselves in need of a little preliminary research on adults before we can examine children. In this section I will review what the literature has to say about the alternation between strong and weak object pronouns in Spanish, which turns out to be much less than it had to say about strong and weak subjects. In the following section, therefore, we will take matters into our own hands, using a picture-selection task (Experiment 5a) to tease apart the effects of pronominal form versus discourse relations on the likelihood of a parallel or anti-parallel pronoun resolution strategy, for adult Mexican Spanish speakers.

The strong/weak alternation appears to work in a very similar fashion for direct objects as it does for subjects. For instance, Luján reports that both overt subject pronouns (13) and clitic-doubled accusative object pronouns (14) have the same emphatic flavor. Using Catalán data, Rigau (1988) proposes that both overt subject pronouns and clitic-doubled object pronouns are in a dislocated, or A' position. Among other evidence, he cites the fact that the strong form of both subject (16) and object (15) pronouns resists binding by a topicalized constituent. Finally, according to my Mexican Spanish speaking consultants, the strong object exhibits some of the same formal semantic characteristics as were observed for the strong subject, including a resistance to sloppy identity (17) and compatibility with question/answer focus (18).

(13) *Tú trabajas demasiado.* [Luján 1999]
You work-2S too.much
'YOU work too much.'

(14) *Las quiero trasladar a ellas el próximo mes.*
CL want-1S to.move A them.F the next month
'I want to move THEM next month.'

(15) *A en Pere, li van regalar un cavall {ø/*a ell}.* [Rigau 1988]
to the Peter, CL will-3P give a horse {*pro*/*to him}
"Peter, they will give him a horse."

(16) *En Pere, de compliments, {ø/*ell} no en fa.*
the Peter, of compliments, {*pro*/he} neg of-them make-3S
"Peter, compliments he does not pay."

(17) Strict/sloppy identity in ellipsis [Mexican Spanish]
a. *Marco cree que la maestra lo favorece y Pedro también.* (strict/sloppy identity)
Juan thinks that the teacher CL-masc favors and Pedro too.
b. *Marco cree que la maestra lo favorece a él y Pedro también.* (strict identity only)
Juan thinks that the teacher CL-masc favors him and Pedro too.

(18) Question/answer focus [Mexican Spanish]
Q: *Llegó una llamada a la casa de José. ¿A quién buscan?*
Arrived a call to the house of Jose. A whom look.for-3P
'There was a call to Jose's house. Who are they looking for?'
A: *Lo buscan {a él/*ø}.*
CL-masc. look.for-3P (A him/*pro*).
'They're looking for him."

Recall that Luján used the parallels between strong pronouns in Spanish and stressed pronouns in English to argue that Spanish strong pronouns carry focus. This same superficial similarity exists in cases of *Parallel* and *Contrast* relations, which are the focus of interest in this chapter. In order to reverse the parallel resolution strategy, for example, it is not enough to use a *Contrast* relation marker like *pero*; the strong pronouns must still be used (19-20). In fact, Luján (1999) provides data suggesting that pronominal form alone can trigger the switch (21-22), just as it does in English.

(19) *María$_i$ abraza a Sara pero {*ø$_i$/ella$_i$} abraza a Juan.*
María hugs A Sara but (*pro*/she) hugs Juan.
'Maria hugs Sara, but {*she/SHE} hugs Juan.'

(20) *María abraza a Sara$_i$ pero Juan la$_i$ abraza {*ø$_i$/a ella$_i$}.*
María hugs A Sara but Juan CL-fem hugs (*pro*/her).
'Maria hugs Sara, but Juan hugs {*her/HER}.'

(21) *Ana ama a Elsa y Delia la odia.* *la* = Elsa [Luján 1999]
Ana loves Elsa and Delia CL-fem hates.
'Ana loves Else and Delia hates her.'

(22) *Ana ama a Elsa y Delia la odia a ella.* *ella* = Ana
Ana loves Elsa and Delia CL-fem hates her.
'Ana loves Else and Delia hates HER.'

Nevertheless, even though it may be true that the strong/weak alternation works in the same way for Spanish object pronouns as it does for Spanish subject pronouns, we know that whatever this mechanism is, it cannot be the same as the mechanism constraining the English stressed/unstressed pronoun

alternation. In the last chapter, we saw that the Spanish alternation between strong and weak subjects behaves differently from the English stressed/unstressed alternation. And despite the fact that strong pronouns are required in *Contrast* contexts (19-20), the opposite is not true: both strong and weak pronouns are acceptable in *Parallel* contexts (23-24).

(23) *María abraza a Sara y {ø/ella} abraza a Juan también.*
Maria hugs Sara and (*pro*/she) hugs Juan too.
(24) *María abraza a Sara y Juan la abraza {ø/a ella} también*[15].
Maria hugs Sara and (*pro*/she) hugs Juan too

If strong pronouns don't carry contrastive focus in Spanish, what then explains the data in (19-22)? Amaral & Schwenter (2005) provide data suggesting that, even though strong pronouns may license contrast, they are not necessarily themselves the source of the contrast. Speaker-oriented adverbials like *honestamente* (25), topic-introducing adverbials (26), and locatives like *aquí* ('here') and *allí* ('over there'), (27) can all appear in contrastive contexts, and when they do, the strong pronoun is suddenly no longer obligatory. Amaral & Schwenter show that the important thing in these contexts is not the presence of an overt pronoun per se, but simply for some element that is available to (i) host tonic stress, and (ii) to establish reference—whether directly through a pronoun or indirectly through adverbials and locatives—to a discourse referent that will then be contrasted with another referent. This suggests that the strong pronouns in our *Contrast* examples above (19-20) do not actually contribute a contrastive feature (unless we wish to say that the phrases in (25)-(27) also carry such a feature, which seems unlikely.)

Non-pronoun licensers of contrast [Amaral & Schwenter 2005]

(25) Speaker-oriented adverbials
Los amigos de Ana siempre llegan tarde a las fiestas. ***Honestamente*** *(ø/nosotros) perferirimos llegar temprano.*
Ana's friends always arrive late at parties. Honestly, (we) prefer to arrive early.

[15] Some speakers prefer for *también* to appear in penultimate position:
(i) *María abraza a Sara y Juan también la abraza*.
(ii) *María abraza a Sara y Juan la abraza también a ella*.

(26) Topic-introducing adverbials
Mis padres veranean en la playa. ***Por mi parte****, {ø/yo} prefiero ir a la montaña.*
My parents summer at the beach. As for me, (I) prefer to go to the mountains.

(27) Locative prepositions
Nosotros siempre estamos lavando el coche. ***Allí*** *(tú) no lo lavas nunca.*
We always are washing the car. Over there (you) never wash it.

As for the effect of the strong object in (22), it is not clear that this data is characteristic of Mexican Spanish. Luján is a speaker of Rioplatense Spanish, in which clitic doubling is extremely common and is argued to have a special discourse status (Belloro 2007). Clitic-doubled object pronouns may have a different status in Mexican Spanish, something which will be experimentally examined in the next section.

Of course, this data shows what strong pronouns are *not*, not what they *are*. Though Amaral & Schwenter show that strong pronouns are not necessarily contrastively focused, they stop short of providing a semantic account for them. Nevertheless, we can still make some progress towards teasing apart the effects of pronominal form from the effects of discourse relations by experimentally probing adult Mexican speakers' interpretations of strong and weak subject and object pronouns in the context of *Parallel* and *Contrast* discourse relations.

3. **Experiment 5a**: Adults: strong and weak pronouns in *Parallel* and *Contrast* contexts

Setting aside the question of the exact theoretical status of strong versus weak subject and object pronouns, we can still make progress towards our ultimate goal of understanding children's sensitivity to *Parallel* and *Contrast* relations if we can at least separate out the effects of these relations from the effects of pronominal form. This is exactly what Experiment 5a does for adults and 5b does for children. We compare cases in which both pronominal form and overt discourse markers *también* ('too') and *pero* ('but') serve as cues to pronoun resolution, against cases in which pronominal form is the only cue, as exemplified in (28).

(28) Example items from Experiment 5a-b
a. *María saluda a Sara y ø saluda a Juan (también).*
María greets Sara and *pro* greets Juan (too).
b. *María saluda a Sara y Juan la saluda (también).*
María greets Sara and Juan CL-fem greets (too).
c. *María saluda a Sara (y/pero) ella saluda a Juan.*
María greets Sara (and/but) she greets Juan.
d. *María saluda a Sara (y/pero) Juan la saluda a ella.*
María greets Sara (and/but) Juan CL-fem greets her.

First let us spell out the hypothesis for adults. In the explicitly marked cases, we would expect weak subjects and objects accompanied by parallel marker *también* (28a-b) to refer to the preceding subject and object, respectively, and we would expect strong pronouns accompanied by contrast marker *pero* (28c-d) to exhibit the opposite preferences. In cases without explicit discourse markers, pronominal form will show its effect. Yet the literature cited above gives us no reason to expect any such effect. The strong/weak alternation in Spanish is not an alternation between presence and absence of contrastive focus, as it is in English, and therefore we would not expect this alternation to reliably trigger an alternation between parallel and anti-parallel pronoun resolution strategies, as it does in English. The only effect we expect is the PAS, which should encourage null subjects to select subject antecedents.

3.1. Methods and Design

We probed subjects' preferred interpretations of ambiguous 3rd person singular subject and object pronouns in both *Parallel* and *Contrast* contexts, using a picture-selection task consisting of 16 test items (4 trials x 4 conditions) blocked by condition. Blocks were separated by items from Experiment 7, to be reported in following chapter, which used the same four characters. Each block used the same items with the following verbs: *abrazar* ('hug'), *lavar* ('wash'), *mirar* ('look at'), *saludar* ('greet'). Order of presentation was randomized within each block.

3.2. Subjects

42 native Mexican Spanish-speaking adults (35 women) participated, with two exclusions for failure to learn character names (n = 2) or failure to understand the task (n = 1).

3.3. Procedure

This task was administered along with Experiment 7, reported in Chapter 5 and it was followed a day or two later by Experiment 4 from Chapter 3 and Experiment 6 from the current chapter. This experiment used the same 4 characters described in the methods from Experiment 4 (*María, Sara, Juan, Pedro*), and participants were tested on character names using a 7-item name-recognition practice task administered before the experiment began in earnest. Participants scored an average of 5.14 out of 7 (SD 1.4). Anyone scoring below 3/7 correct was eliminated (N =1 adult).

3.4. Results

Adults' proportion of subject responses in each version of the experiment is shown in Figure 6. For each version, the likelihood of a subject response was modeled using a multilevel mixed effects logistic regression model, with the independent variables of discourse relation (*Parallel*=0, *Contrast*=1) and pronoun position (subject=0, object=1) as interacting level-1 fixed effects and subjects and items as level-2 random intercepts. Model results are reported in Table 19. Finally, within each individual condition, the proportion of subject responses was compared to chance using 1-tailed t-tests.

The model results were very similar for both versions. Pronoun position exerted a significant effect, with object pronouns eliciting fewer subject interpretations overall; discourse relation was significant, with *Contrast* eliciting fewer subject interpretations overall; and there was a significant interaction between the discourse relation and pronoun position. However, t-tests revealed an important difference between the two versions. Participants exposed to explicit discourse marking employed a parallel resolution strategy for weak pronouns accompanied by the *Parallel* marker *también* (null subject: $M = 0.78$, $t(79) = 5.85$, $p < 0.001$; accusative clitic: $M = 0.41$, $t(79) = -1.58$, $p = 0.059$) and an anti-parallel strategy for strong pronouns accompanied by the *Contrast* marker *pero* (overt subject: $M = 0.33$, $t(79) = -3.32$, $p < 0.001$; doubled object: $M = 0.73$, $t(79) = 4.48$, $p < 0.001$). Participants exposed to no explicit discourse markers showed a preference for null subjects to refer to the preceding subject ($M = 0.89$, $t(79) = 11.14$, $p < 0.001$), but no preference in any other condition (all $p > 0.4$).

Figure 6: Experiment 5a subject antecedent responses by adults; contexts with explicit markers of discourse relation (left) and without (right).

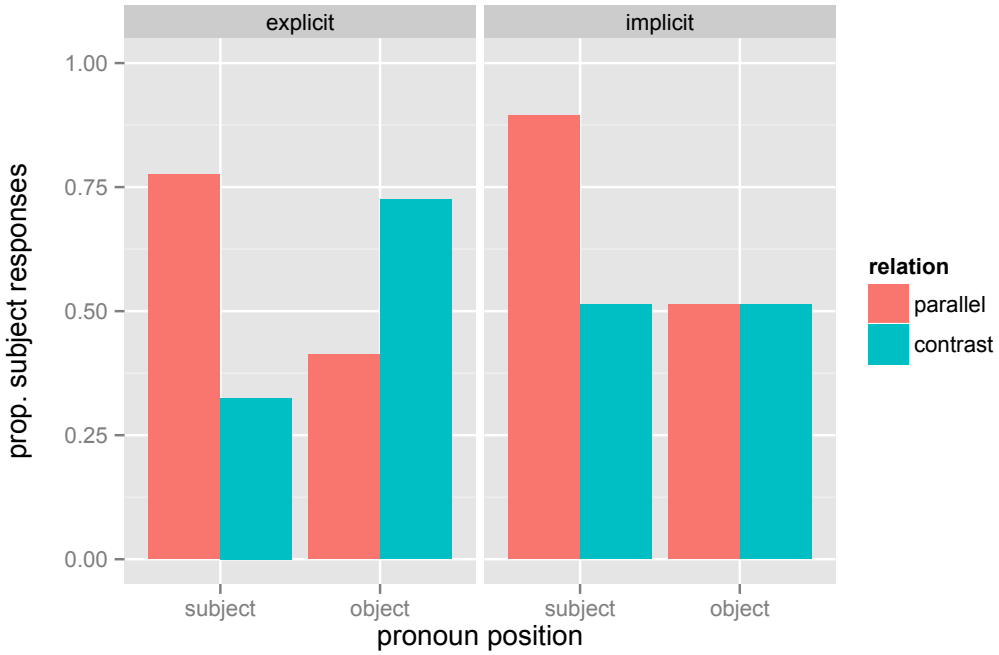


Table 19: Fixed effects estimates for the multilevel logistic regression model of subject responses, with pronominal form and discourse relation as predictor variables. Model was fit using the glmer() function of the lme4 package in R (R Core Team, 2013), with the following formula: `subj.response ~ relation * pronoun + (1|item) + (1| subject)` (explicit discourse marking: N=20, no marking: N = 19)

Adults: explicit marking	*β Estimate*	*Std. Error*	*z value*	*p-value*
(intercept)	1.3572	0.3202	4.239	2.25e-05 ***
discourse relation	-2.1596	0.3834	-5.632	1.78e-08 ***
pronoun position	-1.7428	0.3720	-4.685	2.80e-06 ***
relation × pronoun	3.6149	0.5347	6.760	1.38e-11 ***
Adults: no marking				
(intercept)	2.4483	0.4540	5.393	6.93e-08 ***
discourse relation	-2.3912	0.4751	-5.033	4.82e-07 ***
pronoun position	-2.3912	0.4751	-5.033	4.82e-07 ***
relation × pronoun	2.3912	0.5913	4.044	5.26e-05 ***

3.5. Discussion

These results show that adult speakers of Mexican Spanish do not use the alternation between strong and weak pronouns to establish a parallel or anti-parallel pronoun resolution strategy, in contrast to

Luján's intuitions for Argentinian Spanish, as well as English-language intuitions for similar sentences. Only when weak pronouns were accompanied by parallel discourse marker *también* and strong pronouns by contrast marker *pero* did participants employ such strategies. In cases without explicit discourse marking, the only detectable strategy was to assign null subjects to the preceding subject antecedent, in accordance with the PAS (Carminati 2002).

This result is consistent with a more general version of the claim defended in Chapter 3. There, we argued that the Spanish null/overt subject distinction is *not* a question of presence or absence of focus, and we supported this claim by showing that, in *Occasion* and *Result* contexts the English stressed/unstressed distinction behaves differently from the Spanish null/overt distinction. Here, we have evidence that not only strong versus weak subjects but also strong versus weak object pronouns behave differently in Spanish than they do in English. In English, thanks to the more or less direct connection between focus and stress, the use of a stressed subject or object pronoun is enough to signal a change in the focus/background partition, indicating a switch from a *Parallel* relation to a *Contrast* relation, which then triggers a switch from parallel to anti-parallel pronoun resolution. In Spanish, however, the form of a subject or object pronoun is not directly constrained by the focus/background partition, and therefore pronominal form is a poor cue to the speaker's intended discourse relation, hence its failure to trigger a parallel or anti-parallel resolution strategy.

4. **Experiment 5b:** Child sensitivity to *Parallel* and *Contrast*

The adult results show that, in syntactically parallel contexts, adults rely on explicit discourse markers, and not pronominal form, to trigger a parallel or an anti-parallel pronoun resolution strategy, and that in the absence of these markers they rely on the PAS to guide pronoun resolution. Now we can ask whether children are sensitive to these same cues. We know from the preceding chapter that children over 4 ½ are sensitive to the PAS. If this is the only cue that they are sensitive to, then we should see a similar distribution of responses by this age group in both versions of the experiment. That is, regardless of the presence or absence of discourse cues, children over 4 ½ should prefer for null subjects to select a subject antecedent.

If children in are also sensitive to the discourse relations *Parallel* or *Contrast*, however, then in the version of the experiment with explicit markers of these relations, we should observe an alternation between parallel and anti-parallel resolution strategies. Or at minimum, we should at least observe a distinction between the two different discourse relations, whereby subject pronouns are more likely to prefer subject antecedents in the *Parallel* relative to the *Contrast* condition, and object pronouns are less likely to prefer subject antecedents in the *Parallel* relative to *Contrast* condition, i.e., we should observe an interaction between pronoun position and discourse relation.

Finally, if children are biased towards selecting the most recently mentioned antecedent, as it seems they might be from their behavior in Experiment 4, then we should observe an overall preference for the preceding object antecedent, though this preference may be stronger or weaker depending on the particular experimental condition.

4.1. Methods and Design

The same methods were employed for children as for adults, save that the four characters were first introduced to the children using laminated cards instead of directly on the computer screen. Children scored an average of 4.5 out of 7 (SD 1.5) on the character name recognition test, and anyone scoring below 3/7 was eliminated (N = 6). As this was the first experiment to be administered, children were also asked to re-identify the characters throughout the experiment, at the beginning of each block. One child was eliminated for repeatedly forgetting the characters' names despite having done well in the practice task.

4.2. Subjects

75 children (36 girls) ages 3;0-6;5 (M = 4;7, SD = 12.1 months) completed the task. An additional 7 were tested but excluded from analysis because of failure to learn the characters' names.

4.3. Coding

Some responses were eliminated for reasons including inattention, failure to select only one picture, or experimenter error in presenting items, totaling 1.7% of total data.

4.4. Results

We divided children into the same two age groups as in experiment 4: younger children ages 3;0-4;5 (SD = 5.6 months), n = 38 (20 girls), and older children ages 4;6-6;5 (SD = 5.5 months), n = 37 (16 girls). The same multilevel logistic regression model reported for adults was fit to children's responses in each version of the experiment, for each age group. Results are reported in Table 20 for younger children and Table 21 for older children.

Figure 7: Experiment 5b subject antecedent responses by younger children (N = 38, 3;0-4;5)

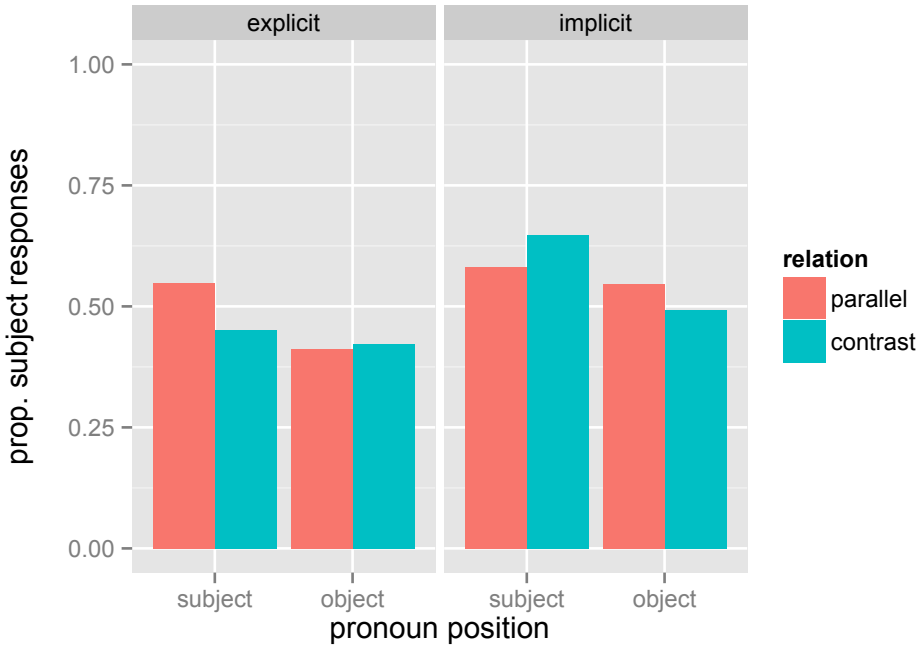


Table 20: Fixed effects estimates for the multilevel logistic regression model of subject responses, with pronominal form and discourse relation as predictor variables. Model was fit using the *glmer()* function of the *lme4* package in R (R Core Team, 2013), with the following formula: `subj.response ~ relation * pronoun + (1|item) + (1| subject)` (explicit discourse marking: N=21, no marking: N = 17)

explicit		*β Estimate*	*Std. Error*	*z value*	*p-value*
	(intercept)	0.2101	0.2678	0.784	0.433
	discourse relation	-0.4137	0.3276	-1.263	0.207
	subj/obj pronoun	-0.5946	0.3317	-1.793	0.073
	relation × pronoun	0.4502	0.4657	0.967	0.334
implicit					
	(intercept)	0.3360	0.2794	1.202	0.229
	discourse relation	0.2814	0.3577	0.787	0.431
	subj/obj pronoun	-0.1538	0.3533	-0.435	0.663
	relation × pronoun	-0.4948	0.5011	-0.988	0.323

Figure 8: Experiment 5b subject antecedent responses by older children (N = 38, 4;6-6;5)

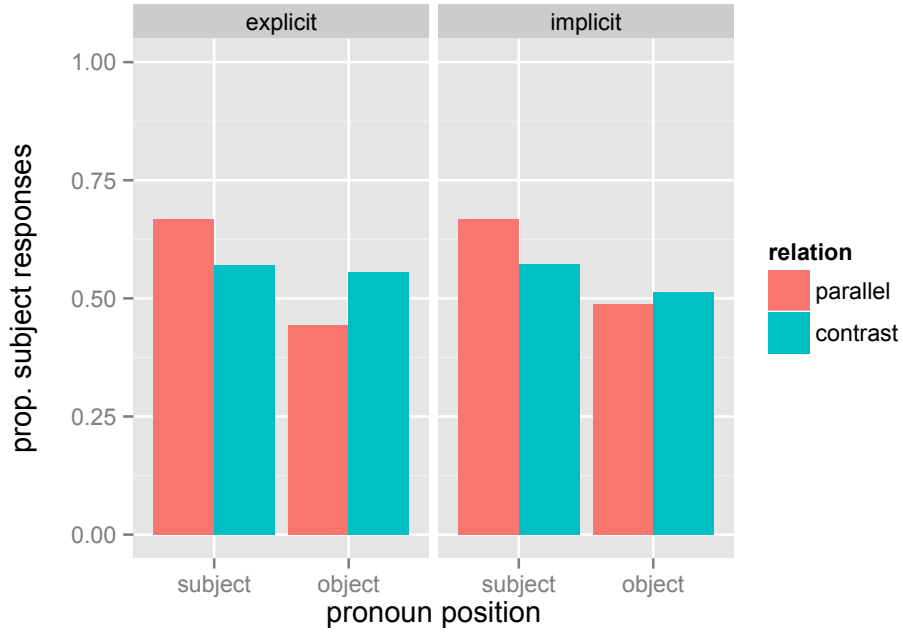


Table 21: Fixed effects estimates for the multilevel logistic regression model of subject responses, with pronominal form and discourse relation as predictor variables. Model was fit using the *glmer()* function of the *lme4* package in R (R Core Team, 2013), with the following formula: `subj.response ~ relation * pronoun + (1|item) + (1| subject)` (explicit discourse marking: N=18, no marking: N = 19)

explicit		*β Estimate*	*Std. Error*	*z value*	*p-value*
	(intercept)	0.8551	0.3058	2.796	0.00517 **
	discourse relation	-0.5077	0.3817	-1.330	0.18353
	subj/obj pronoun	-1.1554	0.3926	-2.943	0.00326 **
	relation × pronoun	1.0855	0.5400	2.010	0.04443 *
implicit					
	(intercept)	1.1955	0.3999	2.990	0.00279 **
	discourse relation	-0.6966	0.4381	-1.590	0.11185
	subj/obj pronoun	-1.2651	0.4460	-2.837	0.00456 **
	relation × pronoun	0.8593	0.6063	1.417	0.15641

For younger children, there were no significant effects in either version of the experiment. For the older children, those in the implicit group showed an effect of pronoun position, with subject pronouns eliciting more subject responses overall. And those in the explicit group showed this same effect, as well as an interaction between relation and pronoun position.

To explore these effects, as well as to test for the presence of an object bias, the proportion of subject responses in each individual condition was compared to chance using 2-tailed t-tests. Older children were more likely than chance to assign a subject interpretation to the null subject, in both the implicit and explicit group (Implicit: $M = 0.66$, $t(71) = 2.98$, $p = 0.004$; Explicit: $M = 0.66$, $t(71) = 2.98$, $p = 0.004$). For all other age groups and conditions, children were no different from chance in either direction (all $p > 0.11$)

4.5. Discussion

The fact that the object bias observed in the *Occasion* and *Result* contexts of Experiment 4 disappears in the *Parallel* and *Contrast* contexts of the present study is inconsistent with the claim that children chose antecedents solely on the basis of recency of mention. Though it may be difficult for them to suppress recent information in favor of older information, as suggested by Hartshorne et al. (2015), this experiment shows that they can certainly do so when they want to. This suggests that the reason for the object bias observed in Experiment 4 from the preceding chapter is most likely that children overextended a *Result* interpretation—and hence, an object resolution strategy—to *Occasion* items in that experiment.

However, despite children's sensitivity to the difference between the *Occasion* and *Result* relations of Experiment 4 and the *Parallel* and *Contrast* relations presented here, there seems to be weak evidence at best that children use these latter relations to resolve pronouns in a way similar to adults. True, children in the older group showed the predicted interaction between pronoun position and discourse relation when they were given explicit *Parallel* and *Contrast* cues, compared to no interaction when these cues were absent, which indicates that these discourse cues had at least some effect on their interpretation of ambiguous subject and object pronouns. However, they fell short of demonstrating an adult-like parallel resolution strategy in *Parallel* contexts or anti-parallel resolution strategy in *Contrast* contexts. The only absolute preference that was detected was a subject antecedent preference for null subjects in both versions of the experiment—in accordance with the PAS.

Nevertheless, even if children don't use *Parallel* and *Contrast* to interpret grammatically ambiguous pronouns, it is still worth asking whether these discourse relations can still facilitate the processing of pronominal features. This is the issue we turn to in Experiment 6, where we examine the effect of *Parallel* discourse relations on children's comprehension of pronominal number.

5. **Experiment 6:** *Parallel* vs. Number

In this experiment we ask whether the *Parallel* discourse marker *también* can facilitate children's processing of singular- versus plural-marked *pro* and accusative clitics, despite their failure to show a clear pattern of parallel pronoun resolution in the *Parallel* conditions of the preceding experiment. We compare cases in which pronominal number and parallelism both point to the same antecedent, as in (29a) and (29c), to cases in which these cues are pitted against each other, (29b) and (29d). If children are sensitive to *Parallel* discourse cues and are able to integrate them together with number cues, then the former should have a facilitatory effect on the latter in congruent conditions, relative to incongruent conditions. Moreover, if this facilitation has a developmental effect, then the onset of discourse sensitivity should trigger better overall sensitivity to number marking, in both conditions.

(29) Example items from Experiment 6 (singular items)
- a. *La maestra tapa a las niñas y ø tapa a Sara también.* [subject, congruent]
  the teacher covers the girls and *pro* covers-3S Sara too
- b. *Las niñas tapan a la maestra y ø tapa a Sara también.* [subject, incongruent]
  the girls cover the teacher and *pro* covers-3S Sara too
- c. *Las niñas tapan a la maestra y Sara la tapa también.* [object, congruent]
  the girls cover the teacher and Sara CL-3S covers her too
- d. *La maestra tapa a las niñas y Sara la tapa también.* [object, incongruent]
  the teacher covers the girls and Sara CL-3S covers her too

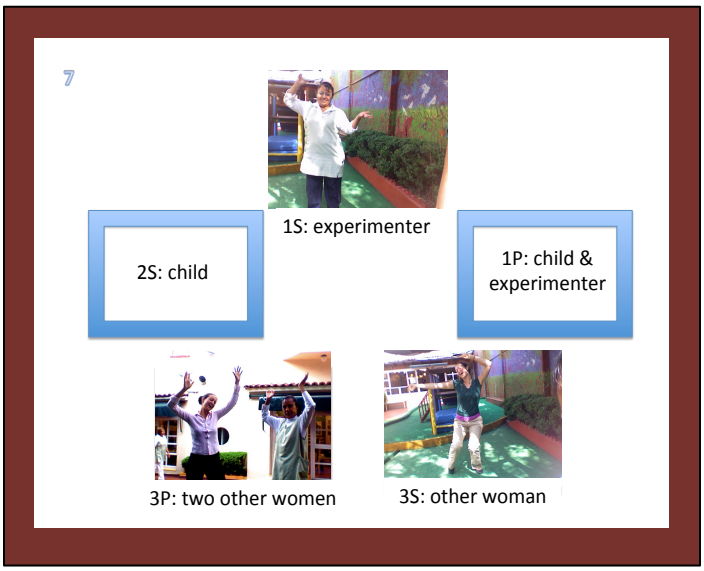
For the subject examples (29a-b), there are actually two relevant discourse cues at work: both parallelism and the PAS favor the preceding subject antecedent. For the object examples, *Parallel* is the only discourse cue. Hence, if the *Parallel* relation does have a facilitatory effect on children's processing of pronominal number, then we should observe an improvement in children's ability to link both subject *and* object pronouns to the target antecedent in the congruent conditions relative to incongruent

conditions. In other words, we should observe a main effect of congruence on the proportion of target responses in both subject and object conditions, though the effect may be larger in the subject condition, thanks to the PAS.

Since adults are clearly sensitive to the *Parallel* discourse marker, they may also be affected by congruence between discourse cues and number cues, especially in the subject cases, where both the PAS and parallelism are at work. In general, however, we expect the categorical cue of number to override probabilistic discourse cues.

This experiment also contains an important revision that helps to minimize bias toward plural pictures. Recall that in experiment 2, the target referent of a singular item was actually present in two pictures (ex. the child is depicted in both the 2nd Sg and in the 1st Pl picture in the example array below). Thus, we were forced to accept plural responses as correct, and we corrected for potential bias towards plural pictures using sensitivity rather than percent correct as a measure.

Figure 9: Example prompt from Experiment 2



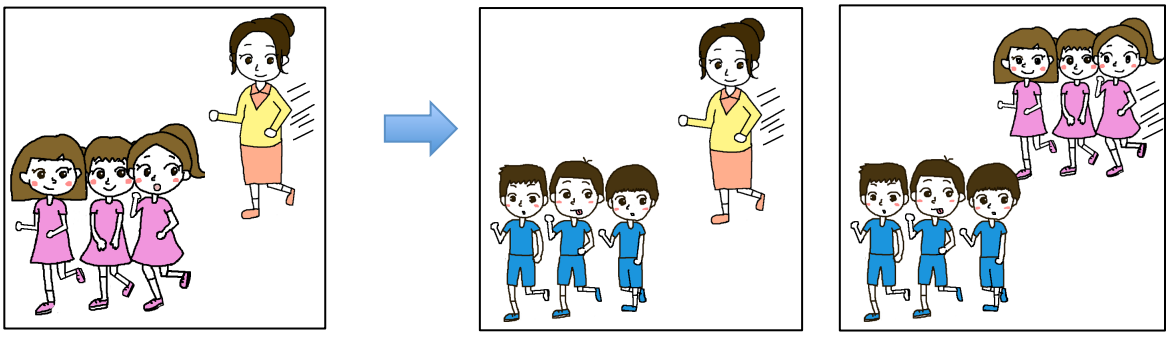
(30) *Muéstrame la foto en donde bailas* [subject, 2nd singular]
Show-me the photo where (you) dance-2S

This experiment reduces the imbalance between singular and plural conditions in three different ways. First, and most importantly, it includes a preceding linguistic context that explicitly provides a choice between one singular and one plural antecedent. This is important because Chapter 2 showed us that children, like adults, prefer for 3rd person pronouns to pick out *linguistically* salient antecedents, rather

than merely visually salient referents. Second, the singular antecedent was not a subset of the plural antecedent, thereby avoiding a situation like the one described above in which a child could have the correct, singular antecedent in mind but still point to (a part of) the plural picture. And third, the collective nature of the plural antecedent was emphasized visually by depicting individual referents dressed in the same clothes and acting in concert (see example prompt (31) below), further avoiding the likelihood of children focusing on just one part of the plural antecedent.

(31) Preamble: *Todos salen al patio a correr.*
Everyone goes to the playground to run
Prompt: *La maestra persigue a las niñas…*
The teacher chases the girls…
[A or B]: *…y persigue a los niños también.*
…and chase-3S the boys too

Figure 10: Example prompt from Experiment 6. Singular, congruent condition



A B

5.1. Methods and Design

We probed subjects' interpretations of 3rd person singular and plural pronouns in *Parallel* contexts, using a picture-selection task consisting of 12 fillers and 16 test items. Half of the subjects heard subject pronouns and half heard object pronouns. Experimental items all followed the format exemplified in (31) above, with a preamble, followed by two parallel clauses, the second of which contained a subject or object pronoun that was number-disambiguated towards either the preceding subject antecedent or the preceding object antecedent. Fillers followed the same format except that pronouns were replaced with names.

A list of 16 subject items and 16 object items was created using four verbs: *abrazar* (‘hug’)*, tapar* (‘cover)*, mirar* (‘look at’)*, perseguir* (‘chase’), in each of the 4 conditions: singular, congruent; plural, congruent; singular, incongruent; plural, incongruent. Each participant saw all 16 experimental subject or object items, with order of presentation counterbalanced across different versions of the experiment. The location of the target response (left, right) was counterbalanced across items.

Characters included one singular antecedent (a teacher), one plural antecedent (a group of girls), and a third character that varied from item to item, including either *Sara*, *María*, or a group of boys.

5.2. Subjects

23 native Mexican Spanish-speaking adults (22 women) participated, with no exclusions. 44 children (25 girls) ages 2;11-5;10 (*M* = 4;5, SD = 10.8 months) completed the task. An additional 4 were tested but excluded from analysis because of failure to identify the characters.

5.3. Procedure

Prior to beginning the experiment, participants were introduced to the characters and to the task through the following story.

(32) *Un día, Sara y María van a una escuela. Cuando llegan, ven llegar a unas niñas y unos niños. Escucha la historia y escoge la foto que corresponde*.
“One day, Sara and María go to a school. When they arrive, they see some girls and some boys arriving. Listen to the story and choose the picture that matches.”

Children were additionally asked to identify each of the characters (the teacher, the girls, the boys, Sara and María) by pointing to the screen. Adults skipped this step and proceeded directly to a 5-item character recognition task using the same format as the experimental items and fillers (see 31).

5.4. Exclusions

Character recognition was not strictly necessary to succeed at this task, since the difference between singular and plural antecedents was always clear from looking at the pictures. Nevertheless, as in the previous experiments, we excluded any participant that failed to produce at least 3 out of 5 correct

responses on the character-recognition task on the reasoning that familiarity with the characters facilitates overall processing. The remaining children answered correctly an average of 4.4 out of 5 (SD 0.74) items, and adults an average of 4.7 out of 5 (SD 0.5).

Individual child responses were eliminated for reasons including inattention, experimenter error in pronouncing prompts, totaling 4.1% of all data. All adult responses were retained.

5.5. Results

Children were divided into the same age groups as in the preceding experiments: n = 23 younger children (14 girls) ages 2;11-4;5 (mean = 3;9, SD = 5.9 months); and n = 17 older children (11 girls) ages 4;6-5;10 (mean = 5;3, SD = 4.7 months). For all age groups, the average proportion of target responses to filler items far exceeded chance (younger children: $M = 0.73$, $t(22) = 5.24$, $p < 0.001$, older children: $M = 0.81$, $t(16) = 8.52$, $p < 0.001$, adults: $M = 0.92$, $t(22) = 11.25$, $p < 0.001$).

The proportion of target responses to experimental items is reported for each age group in Figure 11. To model the likelihood of a target response for each of these groups, we fit a multilevel mixed effects logistic regression model using the predictors of congruence (incongruent = 0, congruent = 1), pronoun position (subject = 0, object=1), and number (singular = 0, plural = 1) as level-1 fixed effects and subjects and items as level-2 random intercepts. Model results for each age group are reported in Table 22.

Figure 11: Experiment 6 target responses by adults (N = 23), older children (N = 17, 4;6-5;10), and younger children (N = 23, 2;11-4;5)

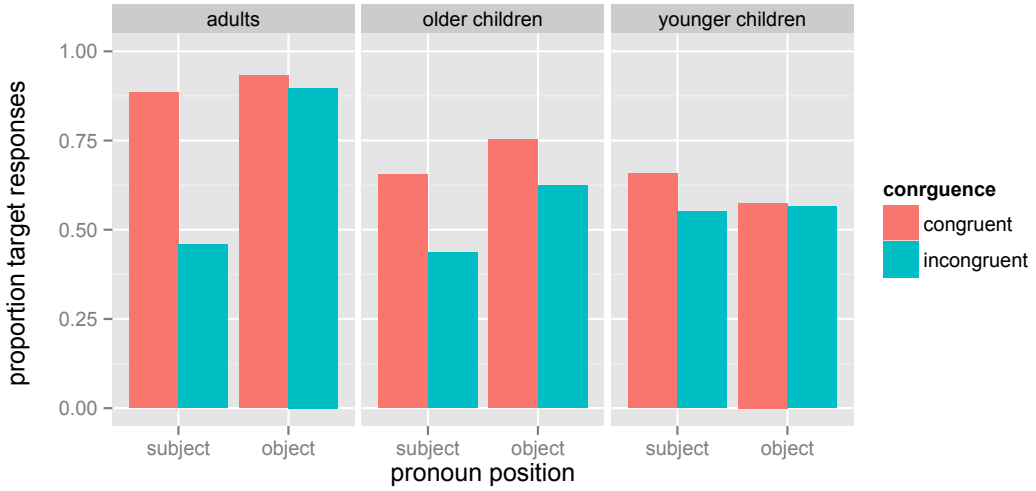


Table 22: Fixed effects estimates for the multilevel logistic regression model of target responses, with pronominal form and discourse relation as predictor variables. Model was fit using the *glmer()* function of the *lme4* package in R (R Core Team, 2013), with the following formula: `correct ~ congruent + pronoun + number + (1|item) + (1| subject)` (adults: N=23, older children: N = 17, younger children: N = 23)

adult		*β Estimate*	*Std. Error*	*z value*	*p-value*
	(intercept)	-0.01805	0.4.743	-0.038	0.969637
	congruent	2.020	0.3448	5.858	4.68e-09 ***
	subj/obj pronoun	2.801	0.8193	3.419	0.000629 ***
	number	0.0000045	0.3117	0.000	0.999988
older children					
	(intercept)	-0.09829	0.27815	-0.353	0.72380
	congruent	0.77876	0.26433	2.946	0.00322 **
	subj/obj pronoun	0.59396	0.26289	2.259	0.02386 *
	number	-0.11625	0.26236	-0.443	0.65769
younger children					
	(intercept)	0.22869	0.29433	0.777	0.437
	congruent	0.31115	0.22647	1.374	0.169
	subj/obj pronoun	-0.05079	0.34118	-0.149	0.882
	number	-0.02101	0.22613	-0.093	0.926

None of the groups showed any effect of number. This was further confirmed by two-tailed t-tests comparing the proportion of target responses in singular versus plural conditions, for adults, older children, and younger children, none of which revealed a significant difference (all $p > 0.7$).

Adult responses showed strong effects of congruence and position, both of which appear to be driven by a very low proportion of target responses in the incongruent subject condition. This was confirmed when 1-tailed t-tests revealed that congruent items elicited significantly more target responses than incongruent ones in the subject condition ($M1 = 0.89$, $M2 = 0.46$, $t(38) = 5.96$, $p < 0.001$) but not in the object condition ($M1 = 0.93$, $M2 = 0.90$, $t(42) = 0.45$, $p = 0.21$).

For older children, the multilevel model revealed the same effects of congruence and pronoun position as it did for adults, but this time t-tests revealed a significant effect of congruence in both the subject ($M1 = 0.66$, $M2 = 0.45$, $t(30) = 2.08$, $p = 0.023$) and the object ($M1 = 0.75$, $M2 = 0.62$, $t(34) = 1.90$, $p = 0.032$) conditions.

For younger children, the model revealed no significant effects, although t-tests did reveal a marginally significant improvement in performance for congruent items within the subject condition ($M1 = 0.66$, $M2 = 0.52$, $t(42) = 1.44$, $p = 0.079$).

The presence of a congruence effect indicates an improvement in participants' use of pronominal number, but it does not necessarily indicate adult-like performance. For this, we must compare participants' proportion of target answers in congruent conditions to chance (0.5). Two-tailed t-tests revealed that, in congruent conditions, both adults and older children were more likely than chance to choose the antecedent whose cardinality matched that of the subject (adults: $M = 0.89$, $t(23) = 10.47$, $p < 0.001$; older children: $M = 0.66$, $t(15) = 2.09$, $p = 0.053$) or object (adults: $M = 0.93$, $t(21) = 8.66$, $p < 0.001$; older children: $M = 0.75$, $t(17) = 4.90$, $p < 0.001$) pronoun that they heard. For younger children, this was true for subject pronouns ($M = 0.66$, $t(21) = 2.47$, $p = 0.022$) but not object pronouns ($M = 0.58$, $t(23) = 1.14$, $p = 0.27$).

5.6. Discussion

In this task, *Parallel* discourse marking had a facilitatory effect on children's ability to use pronominal number in an adult-like fashion. Specifically, children over 4 ½ were more likely to choose the target antecedent of a number-marked pronoun when that antecedent was congruent with the parallel

resolution strategy than when it was located in a non-parallel position. This was true for both subject and object pronouns and therefore cannot simply be the result of the PAS, or of an overall bias towards subject or object antecedents.

For younger children, there was also a marginal improvement in performance for subject pronouns whose number marking was congruent with parallelism—although this must be interpreted with caution, since the multilevel model revealed no overall effect of congruence. If this result is real, it could be due to either (i) an overall bias toward subject antecedents, (ii) sensitivity to the PAS, or (iii) sensitivity to the *Parallel* discourse marker. The first explanation is the least likely—if children were biased towards subjects we would have observed a preference for *non*-parallel antecedents in the object condition. The second one is also unlikely, given younger children's insensitivity to the PAS in the two previous experiments. This leaves sensitivity to parallelism as the most likely explanation. Nevertheless, this result should be replicated before we can make any firm conclusions.

Zeroing in on the object condition, it is interesting to note that the onset of the congruence effect coincides with the onset of adult-like use of number marking. One could have imagined that children develop the ability to use number marking to interpret pronouns before they develop the ability to use to parallelism. In fact, an ideal learner would be expected to take this path given the greater statistical reliability of number marking over *Parallel* discourse markers. However, that is not what appears to have happened. Only when children showed sensitivity to the effects of the *Parallel* relation on pronoun resolution at age 4 ½ did they also begin to show an above-chance ability to use object number in this task. This is consistent with the hypothesis that discourse sensitivity has a developmental effect, actively aiding children's ability to use number to disambiguate pronouns.

Finally, a word is in order about our adult controls. Like children, they too were affected by whether or not number marking was congruent with parallelism, but the effect was much more dramatic and appeared only in the subject condition. While the presence of a congruence effect does not necessarily contradict our hypothesis for adults, its size and its restriction to subject pronouns is surprising and deserves explanation. Unfortunately, the design of this particular experiment does not give us the tools to

identify a single explanation because there are *many* potentially relevant differences between the subject and object pronouns tested here. First of all, number marking in the subject condition is achieved via subject-verb agreement, in contrast to the object condition where number is realized on the pronoun; and studies of agreement attraction show that even fully grown native speakers are capable of misperceiving number agreement. Second, the subject pronoun is affected not only by discourse relations but also by the PAS; thus the incongruent subject condition presents the listener with not one but two discourse violations, potentially explaining the large congruence effect in the subject condition. Third, because object pronouns are realized as pre-verbal clitics, they are not *syntactically* parallel with the preceding object antecedent, and therefore violating parallelism may not be as costly as it was in the subject condition, potentially explaining the lack of a congruence effect in the object condition. Finally, there exists the possibility that object clitics really do have a different discourse status than *pro*, whether because they are overt, as Ariel (1988) claims is important, or because, being objects rather than subjects, they are not located in a default topic position.

6. General discussion

In this chapter, we have learned about how adults and child use pronominal form and discourse relations to resolve pronouns located within contexts of structural parallelism. To see what progress we have made, let's return to our questions from the beginning of this chapter:

Q1. What is the role of pronominal form versus *Parallel* and *Contrast* discourse markers in adult interpretations of subject and object pronouns?

In structurally parallel contexts, Mexican Spanish-speaking adults used *Parallel* and *Contrast* markers, rather than pronominal form, to establish parallel and anti-parallel pronoun resolution strategies, respectively. In the absence of such discourse markers, they consistently associated null subjects with the preceding subject, consistent with the PAS, but otherwise showed no preferences.

Q2. Are children sensitive to the semantics of *Parallel* and *Contrast* discourse relations in choosing antecedents?

We have some evidence for children over 4 ½ using these discourse relations to help them choose antecedents for grammatically ambiguous pronouns, though they do not behave quite like adults yet. Children over 4 ½ did not employ a fully adult-like parallel resolution strategy in response to the *Parallel* discourse marker or an anti-parallel resolution strategy in response to the *Contrast* marker; however, they did show sensitivity to these markers insofar as their antecedent choices were affected by the interaction between pronominal position and discourse relation. That is, their pattern of antecedent choices more closely resembled a parallel resolution strategy in the *Parallel* condition than it did in the *Contrast* condition, despite failing to reach a full-blown parallel or anti-parallel pattern in either case.

Q3. Are children biased towards the most recently mentioned antecedent?

No. For both age groups, children's overall preference for the most recently mentioned (object) antecedent observed in Experiment 4 disappeared when children were presented with a different set of discourse relations in Experiment 5. Given that most of the children who participated in the former experiment also participated in the latter, it is unlikely that this change in preference is due to differences in subjects' ability to suppress recent information in favor of earlier information. Instead, it is more likely due to the fact that Experiment 5 removed the ambiguity between a subject-favoring *Occasion* relation and an object-favoring *Result* interpretation.

Q4. How does the *Parallel* relation interact with children's developing use of number marking?

Despite children's limited use of the *Parallel* discourse relation to interpret grammatically ambiguous pronouns, we do have clear evidence that this relation facilitates their comprehension of number-marked pronouns. Children over 4 ½ were significantly more likely to associate number-marked subject and object pronouns to the target antecedent when that antecedent was in line with the preferences of the

Parallel relation. What's more, the appearance of this facilitatory effect at age 4 ½ coincided with an overall improvement in number comprehension in this task.

From a broader perspective, this chapter converges with the preceding two to produce a clearer picture of children's discourse competence. Not only are children sensitive to the surrounding discourse, but it turns out that their sensitivity has a certain level of sophistication. From chapter 2 we learned that in the process of pronoun resolution, children, like adults, are attuned to linguistic discourse cues, over and above cues from the physical or visual context. In chapter 3, we discovered that they can use more than one kind of discourse cue to resolve pronouns—discourse relations and pronominal form—though these cues appear to be weighted differently at different stages of development. In this chapter we confirmed that children do not simply choose the last antecedent they heard mentioned, but that their preferences change depending on the discourse relation in force. And finally, we found that children's sensitivity to the *Parallel* relation coincides with a growing ability to interpret pronominal number markers. The next chapter will add to this growing body of evidence by examining the interplay between children's sensitivity to the *Occasion* relation and the interpretation of pronominal person markers.

Chapter 5: Person versus Discourse cues

The purpose of this chapter is to examine children's sensitivity to the *Occasion* discourse relation and the role that this sensitivity has to play in their use of pronominal person markers. According to theoretical accounts (Asher and Lascarides 2003, Kehler 2002) the *Occasion* relation triggers a topic-continuation strategy, meaning that for the most part pronouns will refer to the preceding topic. Let's spend a moment motivating our return to this particular discourse relation.

Recall from Chapter 3 that younger children showed sensitivity to the contrast between *Occasion* and *Result* when interpreting ambiguous pronouns, while older children paid attention instead to the contrast between null and overt pronominal subjects. What do we stand to gain by returning to a discourse relation that children seem to ignore after age 4 ½? Just because older children failed to show sensitivity to the contrast between *Occasion* and *Result* relations does not mean that they no longer have access to this information. Indeed, as we saw in the Chapter 4, older children hardly showed any sensitivity to the contrast between *Parallel* and *Contrast* relations when resolving ambiguous pronouns, yet they were still able to use the *Parallel* relation to facilitate the use of pronominal number in comprehension. Thus, it is possible that despite their apparent insensitivity to the *Occasion* relation, older children can still use it to facilitate the comprehension of pronominal person markers. If this turns out to be the case, then we have evidence for a more general claim about the interaction between discourse relations and grammatical markers.

As in other chapters, we will need to first examine the adult grammar to distinguish between the effects of the *Occasion* relation and those of pronominal form. Recall that pronouns in subject position are influenced by the PAS, according to which null subjects—in contrast to overt pronominal subjects—preferentially refer to the preceding subject antecedent. Since the preceding subject is by default also the preceding topic, the effects of the PAS and the *Occasion* relation are often confounded when examining null subjects. However, object pronouns are not subject to anything like the PAS: as we saw in Chapter 4, the alternation between strong and weak object pronouns does not alter adults' pronoun resolution

strategies, in contrast to the alternation between null and overt subjects. By testing the effects of the *Occasion* relation on not only subject but also object pronouns, therefore, we will be able to verify that the topic-continuation strategy triggered by this relation affects adult pronoun resolution independently of the PAS. And this in turn will allow us to test whether *Occasion* marking has a facilitatory effect on children's use of person marking, over and above the potential facilitatory effects of the PAS.

In addition to teasing apart the effects of the *Occasion* relation from those of the PAS, we must be careful to avoid reintroducing the ambiguity between *Occasion* relations, which trigger a topic-continuation strategy, and *Result* relations, which trigger a pragmatic plausibility strategy. This is difficult, since it is often possible—and maybe even preferred—to impute a causal connection to any two spatiotemporally contiguous events, and the results of Experiment 4 suggest that children are particularly attracted to this option. Since this ambiguity is hard to avoid, we will instead neutralize it. That is, we will design our experimental prompts such that imputing a *Result* interpretation to a sequence of events will not bias the direction of pronoun resolution in either direction. For example, the mini-discourse in (1) below can have both causal and non-causal interpretations. On the non-causal *Occasion* interpretation—the intended interpretation given the use of *y ahora* ('and now')—the preference will be for the pronoun to maintain reference to the preceding topic, which is by default the subject antecedent (*Sara*). On the causal *Result* interpretation, a real-world plausibility strategy is favored, but in this case neither antecedent is preferred over the other, as both *Sara* and *María* have completed the exact same action during the first event (arriving) and are therefore equally plausible patients of the next event (greeting). Thus, as long as participants infer an *Occasion* relation at least <u>some</u> of the time, the prediction is that on the whole a subject-antecedent preference should emerge.

(1) *Sara llega a la casa con María y ahora Chicho está saludándola*.
Sara arrived to the house with María and now Chicho is greeting-CL.Fem3S

Having probed children's sensitivity to the *Occasion* relation on the interpretation of subject and object pronouns, the next question will be to ask how this relation interacts with children's use of

grammatical cues. In this case, we will be focusing on 1st person and 3rd person markers. Recall from chapter 2 that, though children appear to be pretty adept at linking 1st person pronouns to the speaker/s (as well as 2nd person pronouns to the addressee/s), they find it difficult to link 3rd person pronouns to non-speaker, non-addressee antecedents. If children are sensitive to discourse relations and can integrate them together with information from person features, then this difficulty should be mitigated in contexts in which the target antecedent is also the antecedent favored by the *Occasion* relation.

Lastly, we will ask whether sensitivity to discourse cues aids in the actual development of children's use of person markers across discourse contexts. If this is the case, then not only should children be better at interpreting person features when these features are congruent with the *Occasion* relation, but the age at which this facilitatory effect occurs should trigger a new stage in which children show an *overall* improvement in their sensitivity to person features, even in incongruent conditions.

In sum, the questions for this chapter are as follows:

Q1. In the context of an *Occasion* relation, do children employ the topic-continuation strategy?
Q2. How does the *Occasion* relation interact with children's developing use of person marking?

1. Literature Review

No studies have explicitly mentioned child sensitivity to the *Occasion* relation, yet many studies do shed light on the question, either because they just so happen to embed the target pronoun within an *Occasion* discourse, or because they demonstrate children's developing sensitivity to topichood, which is a prerequisite for making use of the *Occasion* relation. This section reviews in greater detail two such studies, which were mentioned briefly in Chapter 3: Song and Fisher (2005) and Hartshorne et al (2015).

The *Occasion* relation triggers a topic-resolution strategy, but as discussed in Chapter 3, there is as yet no clear consensus on what defines a topic. We have chosen to examine those cases in which A&L's definition of discourse topic coincides with the more traditional notion of a sentential topic. From A&L's definition we have the requirement that the antecedent be shared in common between the two discourse

segments—in other words, that it be "given." And from the literature on sentential topics we have the observation that in the absence of an explicitly topical structure (ex. "hanging" topic structures, clitic left-dislocation, etc.) sentential topics appear by default in subject position. Both of the studies reviewed here place the target antecedent in subject position, and each provides a different set of cues to givenness, including repeated reference to the target antecedent and pronominalization of one or more of those mentions (pronominalization itself being a cue to givenness).

Song and Fisher (2005) probed 3-year-old children's sensitivity to a cluster of topic cues, in the context of an *Occasion* relation. Using looking time as a measure, they tested pronoun resolution preferences for a temporarily ambiguous pronoun, as compared to an unambiguous DP, as in (2d) and (3d) below. The authors compared children's looks to the target referent (the turtle) versus a competitor (the tiger) and manipulated the preceding discourse to provide a cluster of cues raising or lowering the topic status of the target antecedent. In the topic-continuation condition (2), the authors promoted the target antecedent to topic status by (i) introducing it in topic position not once but twice, and (ii) pronominalizing one of those instances. In the topic-shift condition (3) the authors demoted the target antecedent by topicalizing the competitor antecedent instead. Children's frame-by-frame looks to the target antecedent were recorded during the 4-second period of ambiguity following the pronoun. Though children's looks never showed an *absolute* preference for the target antecedent, they nevertheless showed a greater preference for the target antecedent in the topic-continuation relative to the topic-shift condition, beginning in the 1-2 second window. Two follow-up experiments systematically reduced the number of topicalization cues: Experiment 3 exchanged the pronoun in (2c) and (3c) for another DP, and Experiment 4 removed the sentence altogether, leaving only one cue to topichood in (2b) and (3b). Looking patterns remained basically the same: no absolute preference for the target antecedent, but nevertheless a greater preference for the target antecedent when it was a topic relative to when it was not a topic.

(2) Topic-continuation condition [Song & Fisher 2005, Expt. 2]
a. See the turtle and the tiger!
b. The turtle goes downstairs with the tiger.
c. And he finds a box with the tiger.
d. Now what does *he/the turtle* have? (ambiguous pronoun/unambiguous DP)
e. Look, he has a kite! (disambiguating information)

(3) Topic-shift condition
a. See the tiger and the turtle!
b. The tiger goes downstairs with the turtle.
c. And he finds a box with the turtle.
d. Now what does *he/the turtle* have? (ambiguous pronoun/unambiguous DP)
e. Look, he has a kite! (disambiguating information)

Though the authors did not explicitly address discourse relations, they just so happen to have designed a discourse connected via a series of *Occasion* relations, the last of which is even explicitly marked by the connective *now*. Thus, this experiment shows that in the context of an *Occasion* relation children are sensitive to the contrast between topical and non-topical antecedents (despite failing to show an absolute preference towards the former). This result complements our finding in Experiment 4 from Chapter 3 that children are sensitive to the contrast between *Occasion* and *Result* relations (despite failing to show an absolute topic preference).

It is interesting to compare these results to those of a very similar study, which differed from Song & Fisher's experiment 4 in that it did not provide an *Occasion* relation. In short discourses like those in (4) below, Arnold, Brown-Schmidt & Trueswell (2007) also provided children with one cue to topichood (the target antecedent *Puppy* is in subject position), but the clauses were attached instead with an implicit *Elaboration* relation: the first clause describes an event of which the second clause denotes a sub-part, rather than a continuation. Unlike Song & Fisher, Arnold et al. failed to find evidence of a subject preference, either in offline pointing or online looking, despite children being slightly older (between 3 ½ and 5). This suggests that the presence of the *Occasion* relation in particular taps children's sensitivity to topicality.

(4) Puppy is having lunch with Panda Bear. He wants some milk. [Arnold et al. 2007, Expt. 1]
Prompt: Can you tell me who wants the milk in this story?
Target antecedent: Puppy

Finally, a study by Hartshorne, Nappa and Snedecker (2015) shows evidence of 5-year-olds' sensitivity to topic cues in the context of what appears to be an *Elaboration* relation. Much like (4) above, the final clauses in (5a-c) describe sub-events of the event in the first clause. Though a full list of stimuli is not given, I assume that the other prompts were similar in structure. In the "First-mention" condition (5), the target antecedent was introduced in subject position, providing one cue to topichood. In the "repeated-mention" condition the target antecedent was introduced alongside the competitor in a conjoined subject, but it was also mentioned a second time in subject position, thus providing two cues to topichood. (Yet another version of this condition, not reviewed here, placed additional material between the pronoun and the two antecedents.) In the control condition, the target antecedent contrasted in gender with the competitor.

(5) Conditions [Harthshorne et al. (2015)]
   a. First-mention (1 cue): Emily ate dinner with Hannah. She skipped her salad and only ate dessert. Can you point to her?
   b. Repeated-mention (2 cues): Emily and Hannah are going to Disneyland. {…} Emily has never been to Disneyland. She is really excited about going to Disneyland. Can you point to her?
   c. Control: Emily played baseball with Michael. She/He hit five homeruns. Can you point to her/him?

In all conditions, 5-year-olds showed a preference for the target antecedent in their picture selection choices, and this preference was greater in the two-cue "Repeated-mention" condition (80% offline choices) than in the one-cue "First-mention" condition (65% offline choices). Children also showed a preference for the target antecedent in their looking behavior, although this preference arose much more slowly after pronoun onset than did their preference for the gender-disambiguated target antecedent in the control condition. Thus, it seems that eventually children do develop an absolute preference for the topic antecedent in the presence of the *Elaboration* relation as well.

These two studies already help to answer part of our first question. In the context of an *Occasion* relation, English-speaking children show sensitivity to topichood at age 3, even if they do not employ a full-blown topic-resolution strategy. By 5, they do clearly employ a topic-continuation strategy, though albeit our evidence comes from cases in which *Elaboration* is the operative relation. The two studies we

report in this chapter will now address the question for Spanish-speaking children, who unlike English-speaking children must balance considerations of topichood with the effects of the PAS. Our studies will also begin to address the second question.

Experiment 7 will look at children's sensitivity to a single cue to topicality (subjecthood), within the context of an explicit *Occasion* relation (marked with the connective *y ahora* 'and now'), and Experiment 8 study will pit this discourse cue against the grammatical cue of person marking. To control for the effects of the PAS as discussed above, we will test for a topic-continuation preference for both subject and object pronouns. Based on the literature above, as well as our previous results, we expect the following:

In the context of an *Occasion* relation, we expect that younger children will show a preference for grammatically ambiguous pronouns to refer to the preceding subject. Older children, who are sensitive to the PAS, will show this preference only when the relevant pronoun is a null subject. For adults, who are sensitive to both, we expect a subject preference for both subject and object pronouns, though perhaps more strongly for the null subject.

Despite older children's apparent insensitivity to *Occasion*, we nevertheless hypothesize that this knowledge is still available to them and in particular, that it is used to facilitate the processing of grammatical cues, such as person marking. Thus, we expect that in the context of an *Occasion* relation, older children's use of person marking will improve when it is congruent with a topic-resolution strategy.

Finally, if sensitivity to *Occasion*—and discourse relations more generally—leads to better overall deployment of children's knowledge of grammatical features, then we would expect the appearance of the above-predicted congruence effect to trigger a new stage of development characterized by better *overall* use of grammatical features in comprehension, regardless of discourse context.

2. **Experiment 7:** Adult and child sensitivity to *Occasion*

Experiment 7 uses a picture-selection paradigm to examine children and adults' resolution of grammatically ambiguous null subjects (6) and object clitics (7), in the context of an *Occasion* relation. The topic antecedent (*María*) is introduced in subject position while the competitor (*Sara*) is introduced in an adjunct headed either by *con* ('with') or *igual que* ('same as'). The connective *y ahora* ('and now') and the switch from imperfect to present tense explicitly signal that the clauses are related via *Occasion*.

(6) *María bailó con Sara y ahora ø canta.* [subject]
María danced with Sara and now *pro* sings-3S

(7) *María llegó a la casa con Sara y ahora Juan está saludándola.* [object]
Maria arrived home with Sara and now Juan is greeting-CL-3S

In contrast to our previous experiments involving these characters, this task is more difficult because it requires successful memorization of character names. By design, both the topic and the non-topic referent perform the same action during the course of the first event, and therefore it is not possible to distinguish one from the other by merely looking at the pictures. As we will see, this dramatically reduced the amount of useable data from participants, and therefore the results reported here are only preliminary.

2.1. Methods and Design

We probed adults' and children's preferred interpretations of grammatically ambiguous subject and object pronouns in *Occasion* contexts, using a forced-choice picture-selection task consisting of 8 test items in 2 conditions (subject, object).

Items were created following the template in (1) and (2), with one feminine antecedent in subject/topic position and a second feminine antecedent in a prepositional (*'con* [nombre]*'* 'with [name]') or adverbial ('*igual que* [nombre]' 'same as [name]') phrase. 8 different items were created by pairing easily depictable verb phrases compatible with an *Occasion* interpretation; that is, pairs of events that could plausibly occur in sequence without necessarily having a cause-effect relationship. For the subject condition, these event pairs were *pintar-dibujar* ('paint'-'draw'), *bailar-cantar* ('dance'-'sing'), the reverse pairing *cantar-bailar* ('sing-'dance'), and *tener hambre-comer* ('be hungry'-'eat'). For the object

condition, these pairs were *llegar-saludar* (‘arrive’-‘greet’), *tener frío-tapar* (‘be cold’-‘cover’), *hablar-escuchar* (‘speak’-‘listen’), and *embarrarse-lavar* (‘get dirty’-‘wash’). Each participant saw all items in all conditions.

The identity of the topic antecedent (*Sara* vs. *María*) and the ordering of subject and object blocks was counterbalanced across versions, and the placement of the first-mentioned character (right vs. left side of screen) was counterbalanced across items. Order of presentation within each block was randomized.

2.2. Subjects

46 children (27 girls) ages 2;11-6;10 (M = 4;4, SD = 11 months) and 22 adults (21 women) completed the task, of which 32 children and 10 adults were excluded because of failure to learn the characters’ names (see section 3.4).

2.3. Procedure

These items were presented alongside items from Experiment 5 and used three of the same characters (*Sara, María, Juan*).

2.4. Exclusions

Unlike the experiments in the preceding two chapters, this task required participants to know the characters’ names in order to successfully distinguish between the topic and non-topic antecedent. Therefore, any participant scoring below 4/7 on the original character recognition task was eliminated. This dramatically reduced the number of participants: 10 of 22 adult participants and 32 of 46 child participants were excluded. Hence the results reported in section 3.5 should be taken as preliminary until a task can be designed which does not depend on memorizing character names.

2.5. Results and discussion

Table 23 reports the proportion of topic antecedent responses in each condition, for each age group, along with the results of a two-tailed t-test comparing this proportion to chance (50%). In both conditions,

adults showed a numeric preference for the preceding topic, though this preference only became marginally significant in the subject condition. Older children show a slight numeric preference for the preceding topic antecedent in the subject condition, as would be expected, but it again fails to reach significance. Finally, younger children also have a numeric preference for the preceding topic in both conditions, as would be expected, but only in the object condition does this preference reach significance.

Table 23: Experiment 7: Proportion of topic antecedent (= preceding subject) responses and difference from chance

	adults (N = 12)	older children (N = 7, 4;6-6;10)	younger children (N = 7, 2;11-4;5)
subject condition	0.73 $t(11) = 1.96$, $p = 0.076$	0.57 $t(6) = 0.47$, $p = 0.65$	0.64 $t(6) = 1.08$, $p = 0.32$
object condition	0.58 $t(11) = 0.72$, $p = 0.49$	0.49 $t(6) = -0.07$, $p = 0.95$	0.82 $t(6) = 4.50$, $p = 0.004$

Given the small number of participants, the general lack of significant preferences is inconclusive. Nevertheless, we can still check for the expected asymmetries: that is, we can check (i) whether adults show a stronger topic preference in subject *relative to* object conditions, and also (ii) whether children's topic preference remains *stable* across age groups in the subject condition while *decreasing* with age in the object condition. Regarding the first question, a multilevel logistic regression with condition as the level-1 factor and subjects and items as level-2 random intercepts reveals a marginally significant effect of condition on adults' responses, such that object pronouns are less likely overall to trigger a topic-preference ($\beta = -0.85$, $z = -1.709$, $p = 0.087$). Regarding the second question, a multilevel logistic regression model with condition, age in years, and a condition x age interaction as level-1 factors and subjects and items as level-2 random intercepts reveals a significant effect of condition on children's responses, such that object pronouns are more likely overall to show a topic preference ($\beta = 5.27$, $z = 2.085$, $p = 0.037$), as well as a significant interaction such that this advantage decreases with age ($\beta = -1.22$, $z = -2.035$, $p = 0.042$). The model's predictions, reported in contingency Table 24, suggest that the

likelihood of a topic response in subject conditions remains stable or even increases slightly with age, while in the object conditions this likelihood falls with age.

Table 24: Model predictions for the probability of a topic response

age in years	subject condition	object condition
3	$P = 0.60$	$P = 0.88$
4	$P = 0.64$	$P = 0.72$
5	$P = 0.67$	$P = 0.48$

In sum, while the overall trends in the data conform to expectations, no absolute preferences arise, other than in the object condition. To make firmer conclusions, we must either run more participants or design a task that is not predicated on successful memorization of character names.

3. **Experiment 8:** *Occasion* vs. Person

Despite the inconclusive answer to this chapter's first question, we can still make progress towards answering the second question, namely, whether the *Occasion* relation aids in children's use of person markers. The idea of this next experiment is very similar to Experiment 6 from the preceding chapter. In that experiment, we pitted the *Parallel* relation against number to determine whether children's ability to use number marking to select a target antecedent would improve when number marking was compatible with a parallel resolution strategy. Here, we pit *Occasion* against 1st and 3rd person markers to see whether children's performance when person marking is compatible with a topic-continuation strategy (8a, 8c) is improved relative to when the two are incongruent (8b, 8d).

(8) Example items from Experiment 8 (only 3rd person items shown)

a. *Ana bailó conmigo y ahora ø canta.* [subject, congruent]
Ana danced with-me and now *pro* sings-3S

b. *Yo bailé con Ana y ahora ø canta.* [subject, incongruent]
I danced with Ana and now *pro* sings-3S

c. *Ana llegó a la casa conmigo y ahora Chicho está saludándola.* [object, congruent]
Ana arrived home with-me and now Chicho is greeting-CL-3S

d. *Yo llegué a la casa con Ana y ahora Chicho está tapándola.* [object, incongruent]
I arrived home with Ana and now Chicho is greeting-CL-3S

Along with this congruence effect, we will be looking for a simultaneous increase in children's *overall* comprehension of person. Because of children's documented difficulty with 3rd person (see chapter 2), we expect 3rd person subject and object forms in particular to benefit from the facilitatory effects of *Occasion*.

3.1. Methods and Design

We probed adults' and children's preferred interpretations of 1st person and 3rd person singular subject and object pronouns as in (8)a-d above, using a forced-choice picture-selection task consisting of 16 test items in a 2 (subject, object) x 2 (3rd person, 1st person) x 2 (congruent, incongruent) within-subjects design. The two characters depicted in the visual prompts were (i) the primary experimenter (the speaker) and (ii) a secondary experimenter named Ana.

The same list of verb pairs from the preceding experiment was used, and all participants saw all items in all possible conditions. For each item, the relative ordering of congruent and incongruent versions was counterbalanced across 4 different versions of the experiment.

3.2. Subjects

42 native Mexican Spanish-speaking adults (35 women) participated, with no exclusions. 82 children (43 girls) ages 2;11-6;5 (M = 4;6, SD = 12.1 months) completed the task, with no exclusions.

3.3. Procedure

Both of the stories' characters were physically present during the entire study. The speaker (the primary experimenter) sat next to the child, reading the prompts and recording the child's responses by pressing the corresponding key on the laptop. The other character depicted in the pictures (a secondary experimenter named Ana) was seated on the other side of the primary experimenter, double-checking the primary experimenter's choices. Prior to beginning the experiment, the child was introduced to Ana and asked to identify both Ana and the primary experimenter on screen. All children successfully identified them.

In the adult version, the primary experimenter introduced herself in a pre-recorded audio clip, played at the same time as her photo was projected on screen. Then she introduced Ana and explained the task.

Before beginning the prompts, adults and children both took a 7-item character recognition task to verify that they had learned who the speaker was and who Ana was. Adults scored an average of 5.64 out of 7 (SD = 1.6) and children an average of 5.10 (SD = 1.4).

3.4. Exclusions

No child or adult participants were excluded. Some individual child responses were eliminated for reasons including inattention, experimenter error in pronouncing prompts, etc., totaling 1.52% of all data.

3.5. Results

Children were divided into the same age groups as in the preceding experiments: 43 younger children (25 girls) ages 2;11-4;5 (SD = 5.8 months), and 39 older children (18 girls) ages 4;6-6;5 (SD = 5.4 months).

The proportion of target responses to experimental items is reported for each age group in Figures 12 and 13. To model the likelihood of a target response for each of these groups, we fit a multilevel mixed effects logistic regression model using the predictors of congruence (incongruent = 0, congruent = 1), pronoun position (subject = 0, object=1), and person (3^{rd} = 0, 1^{st} = 1) as level-1 fixed effects and subjects and items as level-2 random intercepts. Model results for each age group are reported in Table 25.

Additionally, for each age group we compared the proportion correct in each condition in to chance (50%), using a two-tailed t-test. All age groups performed well above chance in 1^{st} person conditions, congruent and incongruent alike (all $p < 0.003$); therefore we focus on differences in performance in the 3^{rd} person condition (Fig. 2).

Figure 12: Experiment 8: target responses in the 1st person condition

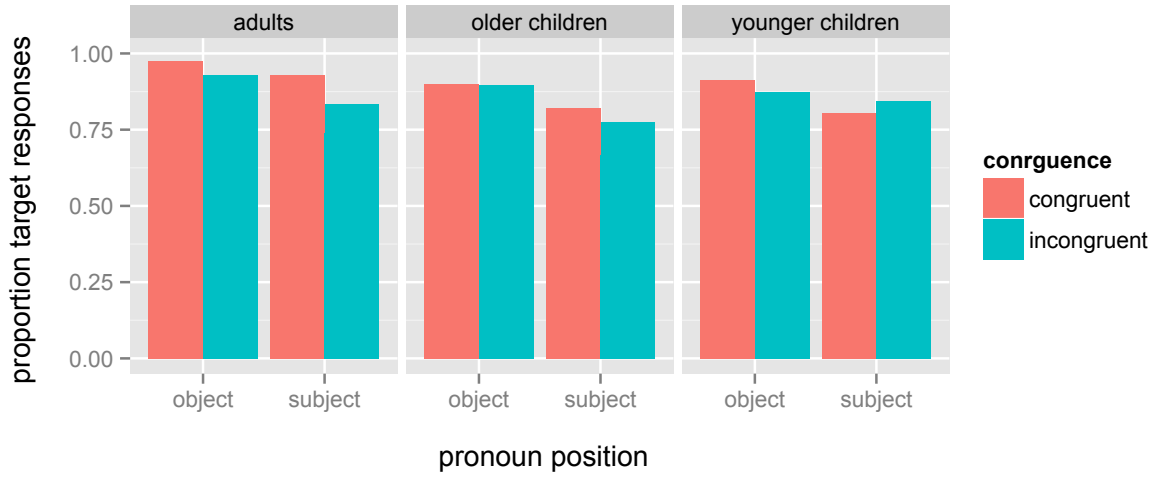


Figure 13: Experiment 8: target responses in the 3rd person condition

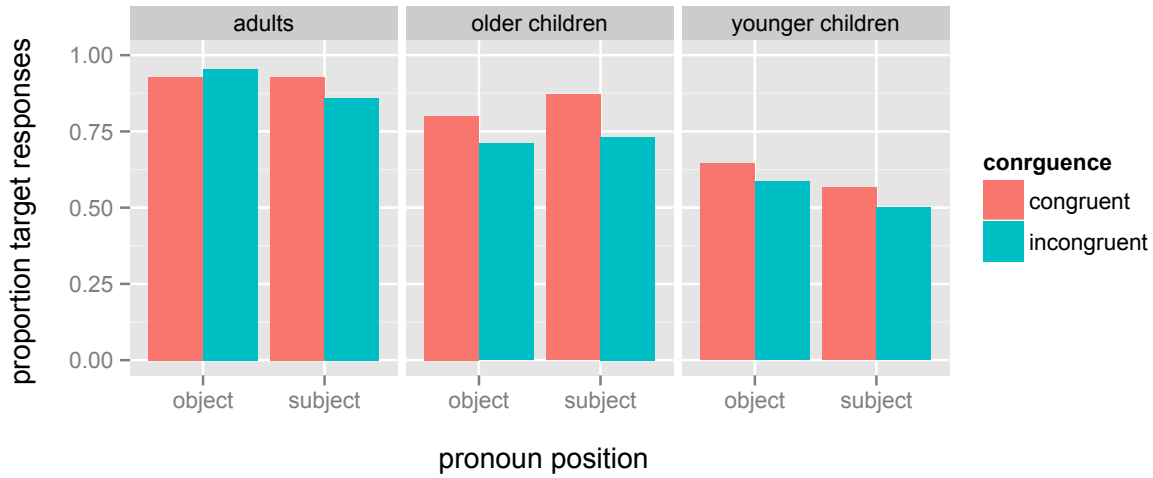


Table 25: Fixed effects estimates for the multilevel logistic regression model of target responses, with pronominal form and discourse relation as predictor variables. Model was fit using the *glmer()* function of the *lme4* package in R (R Core Team, 2013), with the following formula: `correct ~ congruent + person + pronoun + (1|subject/item)` (adults N = 42, older children N = 39, 4;6-6;5, and younger children N = 43, 2;11-4;5)

adult		*β Estimate*	*Std. Error*	*z value*	*p-value*
	(intercept)	8.40126	1.02346	8.209	2.24e-16 ***
	congruent	0.91247	0.47332	1.928	0.0539 .
	person	0.02717	0.78752	0.035	0.9725
	subj/obj pronoun	-0.47026	0.79963	-0.588	0.5565
older children					
	(intercept)	1.7828	0.5709	3.123	0.001793 **
	congruent	1.0002	0.3029	3.302	0.000961 ***
	person	0.8216	0.4396	1.869	0.061628 .
	subj/obj pronoun	0.4088	0.4142	0.987	0.323720
younger children					
	(intercept)	-0.3673	0.2521	-1.457	0.1452
	congruent	0.2243	0.1971	1.138	0.2552
	person	1.9114	0.2622	7.289	3.12e-13 ***
	subj/obj pronoun	0.5649	0.2235	2.528	0.0115 *

Adults performed well above chance in the 3rd person (all $p < 0.001$). The model revealed a small effect of congruence ($\beta = 0.91$, $p = 0.054$), but no other effects. Older children also performed above chance in the 3rd person condition (all $p < 0.001$). The model revealed a clear effect of congruence ($\beta = 1.00$, $p < 0.001$), and a marginal effect of person ($\beta = 0.82$, $p = 0.062$), with slightly better performance for 1st person. Younger children performed no better than chance in any of the 3rd person conditions (all $t < 0.73$; all $p > 0.24$), and, crucially, the model revealed no effect of congruence ($\beta = 0.22$, $p = 0.26$). Instead, there were significant effects of person, (3rd person showing much poorer performance relative to 1st) and pronoun position (slightly better performance for objects relative to subjects).

The appearance of a congruence effect among older children is consistent with our hypothesis that discourse cues facilitate the processing of person cues. However, we must check that the relevant cue here is indeed *Occasion*, which affects both subject and object pronoun resolution, rather than the PAS, which affects only subjects. Thus, we repeated the same regression model for subjects and object separately. For older children, there was a significant effect of congruence in both subject ($\beta = 2.74$, $p < 0.002$) and

object (β = 1.79, p = 0.01) conditions. In contrast, for younger children there was no effect of congruence (both $p > 0.3$), but instead a strong effect of person (Subject condition: β = -1.45, $p < 0.001$; Object condition: β = -2.77, $p < 0.001$).

3.6. Discussion

Two findings stand out. First, the *Occasion* relation facilitates older children's ability to link 3rd person subject and object pronouns to the only available non-speaker antecedent, despite their apparent lack of sensitivity to this relation in the interpretation of grammatically ambiguous pronouns in experiment 4. This shows that children are able to integrate information from both cue types.

Second, the age at which this facilitatory effect arises coincides with an *overall* improvement in children's interpretation of the 3rd person, independent of discourse conditions. This is consistent with the general top-down hypothesis, that this facilitatory effect helps drive learning forward.

4. General discussion

Returning to the questions posed at the beginning of this chapter, we now have the following complete picture.

Q1. In the context of an *Occasion* relation, do children employ the topic-continuation strategy?

Before 4 ½, Spanish-speaking children are able to distinguish between *Occasion* and *Result* relations, insofar as the former triggers a higher prevalence of the topic-continuation strategy. However, evidence that they show an *absolute* preference for this strategy, like adults do, is as yet inconclusive. Results from the literature on English-speaking children suggest that this absolute preference emerges around 5; however, English-speaking children may take a slightly different learning path than Spanish-speaking children, since they do not have to contend with the null/overt subject distinction.

Q2. How does the *Occasion* relation interact with children's developing use of person marking?

Despite lack of evidence that children use *Occasion* to interpret grammatically ambiguous pronouns, we do have clear evidence that this relation facilitates their comprehension of grammatically disambiguated pronouns. Children over 4 ½ were significantly more likely to associate 3rd person subject and object pronouns to the target antecedent when that antecedent was in line with the preferences of the *Occasion* relation. This is consistent with the hypothesis that children are sensitive to both cue types and are able to integrate them together. What's more, the appearance of this facilitatory effect at age 4 ½ coincided with an overall improvement in children's comprehension of 3rd person, consistent with the hypothesis that discourse sensitivity has an actual developmental effect on children's use of person cues.

This facilitatory effect did not extend to 1st person; as we saw in Chapter 2, children's comprehension of 1st person forms reached ceiling quite early, and thus it seems that discourse relations have no role to play in their acquisition. In the next chapter, we will take stock of the overall pattern of results from chapters 2 through 5 and address what they have to say about the central question of this thesis: do children acquire pronouns bottom-up or top-down? Once we have decided which hypothesis is most consistent with the body of evidence, we will propose a learning model to capture that pattern.

Chapter 6: Discussion and proposed learning model

This dissertation has traced the development of children's comprehension of pronouns, focusing specifically on grammatical person and number cues on the one hand and discourse cues on the other, with the ultimate goal of discerning whether acquisition proceeds bottom-up or top-down. We approached this goal by pursuing the following three sub-questions:

Q1. At what age can children use person and number cues to guide pronoun resolution?
Q2. At what age can children use discourse cues to guide pronoun resolution?
Q3. How do children integrate these cues together at different stages in development?

The second question required something of a detour into the adult grammar, since the discourse cues under consideration—discourse relations and pronominal form—have not been studied in combination before. Specifically, though the literature is clear that both discourse relations and the choice between strong versus weak pronouns constrain adult pronoun resolution in Spanish, it was not clear how the two cues interact with each other.

In this chapter, we will take stock of what answers we now have to these three questions and draw some conclusions regarding our main question: whether children acquiring Spanish pronouns proceed bottom-up, from grammatical person and number cues to discourse cues, or top-down, from discourse to grammatical cues. In Section 2, we summarize our results, including adult results where appropriate. In Section 3, we compare these results against the bottom-up and strictly top-down learning hypotheses, ultimately coming down in favor of a weak version of the top-down hypothesis. We argue that discourse relations facilitate the interpretation of pronouns with semantically and/or morphologically underspecified person and number features. Finally, in Section 4 we make steps toward developing a computational model of the learning process, adapting an existing Bayesian model of adult pronoun resolution (Rohde (2008), Rohde & Kehler (2013), and Kehler et al (2008)) to the case of child Spanish.

5. Summary of results

Q1. At what age can children use person and number markers to guide pronoun resolution?

In Chapter 2, we discovered that the answer to this question varies according to the pronoun studied, with early and accurate use of 1st and 2nd person pronouns and more variable behavior with 3rd person pronouns. Children acquiring Spanish are capable of linking 1st and 2nd person pronouns to speaker and addressee referents by 3 years old, whether they be null subject pronouns accompanied by agreement (Experiments 1 and 2), accusative clitics (Experiment 2), or possessive pronouns (Experiment 3). Additionally, children were able to associate these pronouns to a referent of the correct cardinality by age 4;3, with the single exception of the 1st person plural agreement marker (Experiments 2 and 3).

In contrast, children's ability to associate a 3rd person pronoun to a non-speaker, non-hearer referent of the correct cardinality appears to vary across different pronominal forms and discourse contexts. For possessive pronouns c-commanded by a 3rd person DP antecedent, as in (1) (Experiment 3), adult-like performance arises early. For null subjects and clitics not c-commanded by a linguistic antecedent, as in (2) (Experiment 2), children tend to select the most recently mentioned referent, even if this referent includes the speaker or hearer or has the wrong cardinality. And finally, for null subjects neither c-commanded by a linguistic antecedent nor preceded by a recently mentioned referent, as in (3) (Experiment 1), even the oldest children experienced problems.

(1) Example prompt from Experiment 3, 3rd person condition
Chicho quiere su dulce.
Chicho wants POSS-3S sweet
"Chicho wants his candy."

(2) Example prompts from Experiment 2, 3rd person agreement and clitic conditions
a. *Muéstrame la foto en donde baila/bailan*.
show-me the photo where dance-3S/3P
"Show me the photo where (she/they) is/are dancing."
b. *Muéstrame la foto en donde Chicho está lavándola/lavándolas.*
*s*how-me the photo where Chicho is washing-CL.3S.Fem/CL.3P.Fem
"Show me the photo where Chicho is washing her/them."

(3) Example prompt from Experiment 1, 3rd person singular and plural conditions
Chicho quiere que salte/salten.
Chicho wants that jump-3S/3P
"Chicho wants her/them to jump."

This variation across discourse contexts suggests that children are sensitive to the fact that 3rd person pronouns are discourse dependent, but that they do not consistently take advantage of the fact that these pronouns also carry morphological person and number information.

Q2. At what age can children use discourse cues to guide pronoun resolution?

If children are sensitive to the fact that 3rd person pronouns are discourse dependent, what cues are they picking up from the discourse? We considered two potential sources of discourse-level information: (i) inter-sentential discourse relations and (ii) pronominal form. Discourse relations dictate how different sentences are semantically related, thereby constraining the interpretation of pronouns within those sentences, while pronominal form—weak, strong, demonstrative, etc.—indicates how salient the speaker believes the pronoun's referent to be, with more reduced expressions typically being reserved for more salient referents.

However, while the literature provides fairly detailed accounts of both of these cues individually, it is still unclear how they interact with each other in adult Spanish, and thus we were forced to do a little background work. Adult findings are reviewed in 2.1 and children's results in 2.2.

5.1. Adult findings

In Chapter 3, we asked how the contrast between null and overt subjects in Spanish interacts with the contrast between *Occasion* and *Result* discourse relations when interpreting grammatically ambiguous pronouns as in (4) (from Experiment 4). Our central question was whether the preferences of the null versus the overt variant would be altered in any way if the discourse relation were to be altered. On the one hand, accounts that cast the null/overt contrast in terms of a contrast in focus (Luján 1986) or in referent salience (Blackwell & Quesada 2012) make the prediction that null and overt subjects should

react in *opposite* directions to a change in discourse relations. On the other hand, the hypothesis known as the Position of Antecedent Strategy (PAS), which casts the null/overt contrast in terms of a processing difference, predicts that the null variant will have a stronger preference for the preceding subject antecedent relative to the overt variant, regardless of how discourse relations alter listeners' baseline preferences.

(4) Example prompts from Experiment 4a (adults) and 4b (children)
   a. *Juan le pega a Pedro y después {ø/él} se va.* *Occasion* condition
      "Juan hits Pedro and then *pro*/he leaves."
   b. *Juan le pega a Pedro y por eso {ø/él} se va.* *Result* condition
      "Juan hits Pedro and so *pro*/he leaves."

Ultimately, the evidence came down in support of the latter hypothesis: changing discourse relations altered subjects' baseline preference toward either the preceding subject (4a) or non-subject (4b) antecedent, yet the null pronoun continued to elicit a relatively stronger bias towards the preceding subject antecedent across both relations. In English, where stressed pronouns in this position are interpreted as In Focus (Schwarzschild 1999), the contrasting preferences of stressed relative to unstressed pronouns actually changed directions, with the stressed pronoun showing a weaker subject bias than the unstressed pronoun in *Occasion* contexts and a stronger subject bias in *Result* contexts. In short, the answer to how discourse relations and pronominal form interact in Spanish is that they don't; rather, they have additive effects.

In Chapter 4 we again tested the contrast between strong and weak pronouns, this time in the context of syntactically and semantically parallel sentences, as in (5) (from Experiment 5a). A focus-based account would predict that substituting the strong variant should cause the default *Parallel* interpretation of subject and object pronouns to be reversed, as is the case in English. As can be seen in the translations of (5a) and (5b), focusing pronouns reverses their bias in favor of the antecedent in the *opposite* syntactic position.

(5) Example prompts from Experiment 5a (adults) and 5b (children), conditions without explicit discourse markers

a. *María abraza a Sara y {ø/ella} abraza a Juan*. subject condition
Maria hugs Sara and *pro*/she hugs Juan.
"María hugs Sara and she/SHE hugs Juan."

b. *María abraza a Sara y Juan la abraza {ø/a ella}*. object condition
Maria hugs Sara and Juan CL hugs *pro*/her.
"María hugs Sara and Juan hugs her/HER."

The question was whether Spanish strong and weak pronouns would behave similarly. They did not. For subject pronouns, the null variant favored the preceding subject antecedent, while the overt variant showed no preference, consistent with the PAS. For object pronouns, neither the weak nor the strong variant showed a preference. In other words, the only biases that adult Spanish-speakers showed were those predicted by the PAS.

In sum, these two experiments show that the strong/weak alternation in Mexican Spanish operates differently from the focused/unfocused alternation in English. For subject pronouns, Mexican adults appear to use something like the Position of Antecedent Strategy (PAS), probabilistically associating the null variant to the preceding subject antecedent. For object pronouns, no similar strategy appears to apply (at least not in the parallel contexts studied here).

5.2. Child findings

Armed with this information about adults, we were then able to accomplish three goals with children. First, in Chapter 3 we were able to test for the onset of sensitivity to the PAS and to *Occasion* vs. *Result* discourse relations, (see (4) above). Second, in Chapters 4 and 5, we were able to study children's sensitivity to *Parallel, Contrast*, and *Occasion* discourse relations (see (6)-(7) below), controlling for the PAS by testing both subject and object pronouns. These results are summarized in this section. And finally, we were able to pit these discourse relations against grammatical person and number cues, controlling for the PAS in the same manner. These results are summarized in the next section.

First, Experiment 4b from Chapter 3 showed that children under 4 ½ demonstrated sensitivity to the contrast between *Occasion* and *Result* relations, in the same direction as adults. Children over 4 ½ on the

other hand, demonstrated sensitivity to the contrast between null and overt subjects. (Incidentally, both age groups showed an overall bias towards the preceding non-subject, in contrast to adults, who preferred the preceding subject antecedent. While this difference may appear to indicate that children are biased towards the most recent antecedent, this explanation was ruled out when, in subsequent experiments using different discourse relations, the non-subject preference disappeared. We suggested that the behavior was caused by the ambiguity between *Occasion* and *Result* readings in this task.)

Second, Experiment 5 in Chapter 4 posed the question of whether children could use the explicit markers of *Parallel* and *Contrast* discourse relations, *también* ('too') and *pero* ('but'), to establish parallel and anti-parallel pronoun resolution biases, respectively. Younger children showed no sensitivity to either. Older children showed a weak sensitivity to the contrast, although they failed to produce a full-blown parallel or anti-parallel pronoun resolution strategy like adults. Additionally, older children showed behavior consistent with the PAS, associating null subject pronouns to the preceding subject antecedent and thus replicating the findings from Chapter 3.

(6) Example items from Experiment 5, conditions with explicit discourse markers
   a. *María saluda a Sara y ø saluda a Juan también.* Parallel condition
      María greets Sara and *pro* greets Juan too.
   b. *María saluda a Sara y Juan la saluda también.*
      María greets Sara and Juan CL-fem greets too.
   c. *María saluda a Sara pero ella saluda a Juan.* Contrast condition
      María greets Sara but she greets Juan.
   d. *María saluda a Sara pero Juan la saluda a ella.*
      María greets Sara but Juan CL-fem greets her.

Finally, Experiment 7 in Chapter 5 examined children's sensitivity to explicit markers of the *Occasion* discourse relation *y ahora* ('and now'), as in (7). We failed to find reliable evidence of sensitivity to this cue. (However, see Chapter 5 section 3.5 for a discussion of the limitations of that particular experiment).

(7) Example items from Experiment 7
   a. *María bailó con Sara y ahora ø canta.* Subject
      María danced with Sara and now *pro* sings-3S
   b. *María llegó a la casa con Sara y ahora Juan está saludándola.* Object
      Maria arrived home with Sara and now Juan is greeting-CL-3S

In sum, children appear to be aware of and use discourse cues, but these cues are used at different ages and are used differently from adults. With respect to the cue of pronominal form, Chapters 3 and 4 indicate that children become sensitive to the biases of null versus overt subject pronouns sometime around 4 ½ years of age. With respect to discourse relations, the picture is more complex. Chapter 3 indicates that children younger than 4 ½ are sensitive to the contrast between *Occasion* and *Result*. After that age, this sensitivity is no longer detected, which could mean that this cue loses importance for them or that it is being used differently. Chapter 4 indicates that children over 4 ½ show sensitivity to the contrast between *Parallel* and *Contrast* but do not show the same absolute preferences as adults in either condition.

Despite the complexity of these findings, the picture becomes much more consistent when children are tasked with *integrating* discourse relation cues with grammatical person and number cues.

Q3. How do children integrate discourse and grammatical cues at different stages in development?

The main goal of Chapters 4 and 5 was to test children's ability to combine discourse relations with person and number cues. Experiments 6 and 8 used forced-choice picture selection to alternately align and pit these cues against one another, which allowed us to determine three things: first, whether children can link person- and number-disambiguated pronouns to their antecedents at a rate greater than chance; second, whether this ability is at all affected by the presence of congruent versus incongruent discourse cues; and third, whether the onset of sensitivity to person/number cues precedes, follows, or coincides with sensitivity to the presence of (in)congruent discourse cues.

In Chapter 4, we found that after age 4 ½ children's ability to link 3rd person singular and plural pronouns to referents of the correct cardinality was significantly better when the target response was congruent with the *Parallel* discourse relation, relative to when it was incongruent (Experiment 6). Similarly, in Chapter 5 we found that after age 4 ½, children's ability to link singular 3rd and 1st person pronouns to referents of the correct status (+/-speaker) was significantly better when the target response was congruent with an *Occasion* relation, relative to when it was incongruent (Experiment 8). Both times,

this result held across subject and object pronouns and was therefore not attributable to the PAS alone. Thus, despite the flimsy use of discourse relations in the previous experiments, here we have clear and consistent evidence that children over 4 ½ do in fact use discourse relations when interpreting pronouns.

(8) Example items from Experiment 6, singular condition
   a. *La maestra persigue a las niñas y persigue a los niños también* Subject, congruent
      The teacher chases the girls and chase-3S the boys, too.
   b. *Las niñas persiguen a la maestra y persigue a los niños también* Subject, incongruent
      The girls chase the teacher and chase-3S the boys, too.
   c. *Las niñas persiguen a la maestra y María la persigue también* Object, congruent
      The girls chase the teacher and Maria chases CL-3S, too.
   d. *La maestra persigue a las niñas y María la persigue también* Object, incongruent
      The teacher chases the girls and Maria chases CL-3S, too.

(9) Example items from Experiment 8, 3rd person condition
   a. *Ana bailó conmigo y ahora ø canta.* Subject, congruent
      Ana danced with-me and now *pro* sings-3S
   b. *Yo bailé con Ana y ahora ø canta.* Subject, incongruent
      I danced with Ana and now *pro* sings-3S
   c. *Ana llegó a la casa conmigo y ahora Chicho está saludándola.* Object, congruent
      Ana arrived home with-me and now Chicho is greeting-CL-3S
   d. *Yo llegué a la casa con Ana y ahora Chicho está tapándola.* Object, incongruent
      I arrived home with Ana and now Chicho is greeting-CL-3S

More importantly, however, the age at which children first displayed the congruence effect coincided with an *overall* improvement in use of singular, plural, and 3rd person markers—precisely the morphological markers that they appeared to ignore in the studies reported in Chapter 2. Children under 4 ½ successfully interpreted 1st person singular null subjects and clitics, but they failed to show any sensitivity whatsoever to the person and number information encoded in 3rd person singular and plural pronouns. Starting at 4 ½, however, when the congruence effect became significant, children's use of these person and number cues also exceeded chance, in both congruent and incongruent conditions. That is, once children began to show sensitivity to the (mis-)match between discourse relations and person and number cues, their use of the latter improved *regardless of whether or not these person and number cues were congruent* with the relevant discourse relations. This is consistent with discourse sensitivity having a facilitatory effect on sensitivity to person and number cues.

6. Bottom-up or top-down?

To return to our main question, does this body of evidence point towards a bottom-up or a top-down learning path? The evidence does not fall neatly into either camp, so in this section we will try to refine the picture a little more.

The intuition behind the bottom-up hypothesis was the common-sense notion that children will first learn to use those cues that are most statistically reliable. Person and number cues, being both abundant and categorical, should therefore be acquired before discourse cues, which are less abundant and probabilistic in nature. Our evidence is inconsistent with this view. Children younger than 4 ½ showed no sensitivity to the grammatical person and number of 3rd person pronouns in Experiments 5-8, yet in Experiment 4 they *did* show sensitivity to the contrast between *Occasion* and *Result* discourse relations. What's more, the age at which children first showed sensitivity to these person and number cues was the same age at which they showed sensitivity to discourse relations in the same task. That is, sensitivity to discourse relations coincides with or even precedes sensitivity to the person and number cues of 3rd person pronouns.

If children do not proceed bottom-up from person and number cues to discourse cues, the other possibility is that they proceed top down. The strongest version of this claim would be that children first acquire discourse relations and then use that knowledge to acquire grammatical person and number representations. This strong version of the top-down hypothesis, however, is also inconsistent with the body of available evidence. Despite their difficulty with 3rd person pronouns, children make early use of the grammatical cues encoded in 1st and 2nd person pronouns. And even in the case of 3rd person pronouns, it is not the case that children have absolutely no understanding of their features. Previous literature reveals that their *production* of these forms is overwhelmingly accurate. The problem seems to lie only in the deployment of this knowledge in comprehension tasks. Thus, we come down in favor of a weak version of the top-down hypothesis, that children's knowledge of discourse facilitates the

deployment, rather than the outright acquisition, of the person and number cues encoded in 3rd person pronouns.

If children fail to deploy their knowledge of cues that are not only abundant and statistically reliable, but that they demonstrably deploy in production, the question then becomes why these cues, in particular, are not deployed in comprehension and how children eventually do learn to deploy them. The answer one gives to this question depends on one's theoretical analysis of the affected pronouns (3rd person singular and 3rd person plural null subjects and object clitics). According to the theoretical assumptions made in Chapter 1, what these pronouns all share in common is that they are either semantically underspecified, morphologically underspecified, or both. First, following Sauerland (2003) I have assumed that the plural is semantically underspecified for number and the 3rd person is semantically underspecified for person. And second, following common assumptions in Distributed Morphology (ex. Harley & Ritter (2002)) I have assumed that singular vocabulary items are morphologically underspecified for number and 3rd person vocabulary items are morphologically underspecified for person. In other words, for these pronouns, the mapping between the morphophonological form and its ultimate meaning is empty at one or more levels of representation. Thus, it is not so much that children fail to access or deploy the correct mappings when interpreting these pronouns, but that *there is no mapping there*. Instead, the comprehension of these pronouns requires children to interpret the lack of a mapping itself as meaningful by comparing these underspecified items with more specified members in the same set. For singular pronouns, the relevant comparison is with vocabulary items that carry a number feature, i.e., plurals. For plurals, which carry morphological number but are nonetheless semantically vacuous, the relevant comparison is with items that carry a presupposition about referent cardinality, i.e., singulars. For third person, the comparison must be made at both the morphological and semantic levels. It is this pragmatic ability, I suggest, that children deploy with the help of discourse cues.

We can call this version of the weak top-down hypothesis the "facilitation of pragmatic inference" hypothesis. Before closing, I would like to discuss and dismiss two other potential versions of the weak top-down hypothesis.

The first possibility is that children fail to use 3rd person singular and plural markers simply because they are difficult to perceive. The explanation for the correlation between discourse sensitivity and improved use of these person and number cues would then be that discourse cues help to direct children's attention toward the intended referent, thereby increasing the likelihood that they will perceive the match between this referent and the pronoun used by the speaker. However, this explanation would predict a more dramatic effect of discourse on children's comprehension of phonologically reduced markers, such as agreement markers. However, in our studies, the congruence effect holds equally well for clitics as for agreement markers, inconsistent with this prediction.

The second possibility is that children are able to perceive and interpret all person and number cues but that initially they do not assign them the proper weight. Recall that children appear to be aware of the discourse-dependency of 3rd person pronouns early on (Chapter 2); so perhaps this awareness leads them to initially place greater weight on discourse cues than on person and number cues. Unfortunately, this is also inconsistent with the results from Chapters 4 and 5. If it were simply a problem of cue weighting, we would expect children to initially place greater weight on discourse cues than on person and number cues. In fact, what we observe is that when children become sensitive to discourse and person/number cues at 4 ½, their rate of target answers exceeds chance, across congruent and incongruent conditions. They choose the person/number appropriate antecedent more often than chance—even if that choice is incongruent with discourse cues. That is, even where person and number cues disagree with discourse cues, children are aware that the former outweigh the latter.

In sum, the results are consistent neither with a strictly bottom-up nor a strictly top-down learning path. We cannot say that children make adult-like use of the full set of person and number cues before demonstrating any sensitivity at all to discourse cues. Neither can we claim that fully adult-like use of discourse cues is achieved before any knowledge of person and number cues is in place, either. Instead, the evidence points toward a weak version of the top-down hypothesis. Specifically, that discourse relations facilitate the pragmatic interpretation of morphologically and/or semantically underspecified person and number cues.

7. Proposal for a learning model

In this section, we make some preliminary steps towards a model of how children may use their sensitivity to discourse to facilitate the pragmatic interpretation of 3rd person singular and 3rd person plural pronouns. We do this by first adopting an existing model of adult pronoun resolution, identifying the component of the model where children initially differ from adults, and suggesting how discourse sensitivity triggers more adult-like behavior.

Rohde & Kehler (2013) propose the Bayesian formula in (10) as a model of adult pronoun resolution. To calculate the probability of a referent given that the speaker has used a pronoun, $P(ref|pro)$, this model claims that listeners rely on Bayes' law, which systematically relates $P(ref|pro)$ to the product of the prior, $P(ref)$, and the likelihood, $P(pro|ref)$. In other words, for every potential pronoun interpretation, listeners decide how likely that interpretation is by calculating: (i) $P(ref)$, the prior likelihood of that referent being mentioned next, and (ii) $P(pro|ref)$, the likelihood that this reference will be achieved with that pronominal form (as opposed to, e.g., a strong pronoun, a demonstrative, an NP, etc.). Since the product of these probabilities is proportional to $P(ref|pro)$, listeners can calculate the value of $P(ref|pro)$ by averaging $P(ref)\times P(pro|ref)$ for this referent over $P(ref)\times P(pro|ref)$ for every potential referent, i, in the set of eligible referents, I.

(10) $$P(ref|pro) = \frac{P(ref)P(pro|ref)}{\sum_{i\in I} P(ref_i)P(pro|ref_i)}$$

Crucially, different discourse and grammatical cues contribute to the calculation of each component of the model. Using sentence-completion and pronoun resolution tasks, Rohde & Kehler (2013) show that the prior, $P(ref)$, is sensitive to discourse relations, while the likelihood, $P(pro|ref)$, is sensitive to the structural location in which ref was mentioned last. And of course, the grammatical features of the pronoun determines which referents may be included in the set of potential referents, *I*, in the first place. Using an item from our Experiment 4 to illustrate, the claim would be that the presence of an *Occasion*

relation in (11) helps to determine the likelihood that *Juan* will be mentioned in the second clause, $P(Juan)$, while the syntactic position of this antecedent (subject position) helps to determine the likelihood that the speaker would have chosen a null subject to achieve this reference $P(\text{ø}|Juan)$. Next, the person and number features of the null subject determine that the other antecedent *Pedro* is also a potential antecedent, and therefore must also be assigned some probability by calculating $P(Pedro)$ and $P(\text{ø}|Pedro)$.

(11) *Juan le pega a Pedro y después ø se va.* *Occasion* condition
"Juan hits Pedro and then *pro* leaves."

This model of how adults integrate discourse and grammatical cues can be used to explore how children integrate discourse and grammatical cues. One particularly attractive part of the model is the qualitative difference between the contribution of discourse cues one the one hand and morphosyntactic cues on the other. Discourse cues *probabilistically* inform $P(ref)$ and $P(ref)P(pro|ref)$, while person/number cues *categorically* determine the original set of potential antecedents, *I*: either a given referent is in the set *I* or it is not. This implies that, as soon as children incorporate grammatical person/number cues into their model, they will use them categorically. This is consistent with the pattern of behavior observed in Chapters 4 and 5, where children who acquired sensitivity to 3rd person singular and plural cues did so in an all-or-nothing fashion. Younger than 4 ½, they showed no sensitivity to these grammatical cues, older than 4 ½ they not only showed sensitivity to these grammatical cues but they prioritized them over discourse cues.

7.1. Our proposal

Adopting this model as our basis, we would like to propose a method by which children's sensitivity to discourse cues can facilitate the deployment of 3rd person singular and 3rd person plural morphological cues. We propose that because 3rd person singular and 3rd person plural pronouns are morphosyntactically and/or semantically underspecified, children do not initially use their person/number features to restrict the set of potential referents, *I*. Instead, children initially allow any salient referent to enter *I*, so that in

situations with more than one such referent, children will be forced to rely on discourse cues to make their decision. In the vast majority of cases, these discourse cues will point children toward a referent with compatible person/number properties, and we propose that this is what guides children toward the realization that, despite being underspecified and therefore *technically* compatible with any number of referents, in *practice* 3rd person singular and 3rd person plural pronouns conventionally pick out non-speaker, non-hearer singular and plural referents, respectively. This realization, we suggest, is what triggers children to automatically perform the pragmatic inferences that allow them to use 3rd person singular and 3rd person plural morphology in an adult-like way.

In contrast, discourse sensitivity is not necessary for the adult-like use of 1st and 2nd person cues. As soon as children have mapped these morphophonological cues to their underlying semantic representations, no extra work is required to interpret them. Their semantics will automatically restrict the set of potential referents, *I*, and discourse cues will not even need to be consulted to arrive at the intended interpretation.

While very preliminary in nature, this proposal at least captures the developmental differences observed between 1st and 2nd person pronouns on the one hand and 3rd person pronouns on the other and generates the testable prediction that preschoolers can distribute probability over multiple referents, rather than "locking in" on a single referent.

8. Remaining questions and future directions:

This thesis has only just begun a conversation that remains to be finished. Not all discourse relations have been studied (the most important gap perhaps being *Explanation*, which is encoded by *because*); we have not crossed *Occasion* with number marking or *Parallel* with person marking; we have not tested enough children yet to get a fine-grained developmental picture; we have not explored the strong/weak object alternation in contexts other than *Parallel* and *Occasion*; and we have not even touched the question of frequency.

Of the many questions that remain, I would like to address one that pertains specifically to what may look like an inconsistency between Chapter 3 and Chapters 4 and 5. In Chapter 3, (Experiment 4), we found evidence of sensitivity to discourse relations *before* 4 ½ and not after, while in Chapters 4 (Experiments 5-6) and 5 (Experiments 7-8) we found evidence of sensitivity to discourse relations *after* 4 ½ and not before. Why the discrepancy? One potential reason is that Chapter 3 tested children's ability to distinguish between *Occasion* and *Result*, while the latter chapters either tested different relations altogether (*Parallel* and/or *Contrast* in Chapter 4) or tested *Occasion* by probing for a subject bias (Chapter 5 Experiment 7) or by pitting it against a grammatical cue (Chapter 5 Experiment 8), which is arguably a different task.

Another potential factor to consider is that these experiments measured offline pointing decisions. When working with adults it is safe to assume a straightforward link between the referents they consider probable and the pictures they point to, but with children, whose executive control is not fully developed, the link is less straightforward. Thus the fact that we do not always detect sensitivity to discourse relations before 4 ½ is not in itself evidence that the sensitivity is not there. In fact, looking-times measures have revealed evidence of a subject bias among children as young as 2 ½ (Song & Fisher 2007). Future research can address this by using looking times or similarly sensitive measures of children's comprehension.

APPENDICES

APPENDIX A: Availability of *tú* and *usted* in the input

It has been informally reported that use of the formal 2nd person pronoun *usted* is declining among high-SES speakers of Mexico City Spanish. If this characteristic is true of child-directed speech, then it means that children acquiring this dialect of Spanish may receive little evidence in their input for the existence of a formal 2nd person pronoun. Given that *usted* triggers 3rd person singular agreement, this would also imply that children acquiring this dialect of Spanish also receive very little evidence for 3rd person singular agreement ever referring to the addressee. The purpose of this study is to compare the availability of these two pronouns in the input of high-SES children acquiring Mexico City Spanish, both their overt versions and their null versions, which are identified through agreement.

1. Methods

The speech of 13 children-caretaker dyads was analyzed. Children of high-SES backgrounds were recruited from a private daycare in Mexico City. Children's ages, MLU and gender are reported in the table below.

Table 26: Subject ages and MLUs

child	age	mlu
MRL	1;7	1.60
JGAV	2;11	2.89
SRL	2;2	2.02
IARV	2;5	1.90
EAAT	2;7	2.41
CEMV	3;0	2.73
JCMG	3;8	3.35
YGSZ	3;9	3.64
EAMR	4;3	4.72
PLG	4;10	5.57
SLV	4;10	4.66
APA	5;1	3.41
MBJ	5;3	2.27
mean (SE)	3;6.8 (14.6)	3.17 (1.22)

To compare the rates of use of the overt *usted* and *tú* in child speech and child-directed speech, as compared to adult-to-adult speech, all tokens of these two pronouns were counted using the Freq command of the CLAN program (MacWinney 2000), available on the CHILDES website. Additionally, to check for the presence of null addressee-referring subjects in children's input, all verbs with 2nd and 3rd person singular morphology were extracted from child-directed speech, using the KWAL command. Due to the large number of tokens, a subset of 100 tokens (50 of each) was chosen at random for coding. Each token was coded for presence of a null vs. overt subject, and all null subjects were coded as to whether or not they referred to the addressee, to a third person, or other type (ex. generic). Ambiguous and frozen expressions were excluded and replaced with another randomly chosen token.

2. Results and discussion

The number of overt *tú* and *usted* tokens is reported in Table 27. The rate of co-occurrence between 3rd singular or 2nd singular verbs and null addressee-referring subjects, is reported in Table 28.

Table 27: Frequency of overt addressee-referring subjects in the speech of high-SES Mexico City residents

	N	total words	tú	usted
parent-adult	13		145	41
parent-child	13		768	3
child	13		335	0

Table 28: Frequency of subject types out of a randomly selected 100 tokens of child-directed speech

verbal morphology:	2nd Sg	3rd Sg
addressee-referring null subjects	49	0
total null subjects	49	26
total subjects	50	50

The findings show that the formal addressee-referring pronoun is present to some extent in parents' speech to other adults, but vanishingly rare in their speech to children (3 tokens out of 770), as well as the speech of children (0 tokens out of 336). It also appears that the null counterpart of *usted* is exceedingly

rare in child-directed speech. Whereas 100% of 2nd person singular null subjects referred to the addressee and could therefore be considered a covert form of the informal pronoun *tú*, 0% of 3rd person singular null subjects could be analyzed as a covert form of the formal pronoun *usted*.

These findings are consistent with the claim that high-SES children growing up in Mexico City receive little evidence in their input for the existence of either *usted* or its covert counterpart.

APPENDIX B: Comprehension of tú vs. usted

The purpose of this experiment is to test children's comprehension of the contrast between the informal 2nd person pronoun *tú*, which triggers 2nd person singular verbal agreement, and the formal 2nd person pronoun *usted,* which triggers 3rd person singular agreement, as illustrated in (1)-(2) below.

(1) ¿Adónde vas (tú)?
to-where go-2S you.informal
"Where are you (informal) going?"

(2) ¿Adónde va (usted)?
to-where go-3S you.formal
"Where are you (formal) going?"

The task reported here tests whether children listening to a puppet using the sentences in (1) and (2) are able to use the contrast between *tú* and *usted*, to infer whether the addressee of the question is a child (informal) or an adult (formal). It also tests children's ability to make this inference when a null subject is used, in which case the only cue to formality is encoded in the verbal inflection. Participants in this experiment watched and listened as a puppet produced the sentences in (1) and (2), with and without overt subjects, while looking at a screen depicting a child on one side and an adult teacher on the other. Then the participant was asked to identify which person the puppet had talked to: the child or the adult.

1. Hypotheses and predictions

Given that the formal *usted* and its null counterpart are exceedingly rare in the input to children of high SES living in Mexico City (see Appendix A), we would expect them to be unaware of the formality contrast between *tú* and *usted* and unable to use verbal agreement as a cue to this contrast. Adult controls, however, should be able to make this distinction. Since adults use both *tú* and *usted* to address other adults but only use *tú* to address children, we expect the informal condition to elicit both "child" and "teacher" type responses and the formal condition to elicit only "teacher" type responses. This pattern is

expected regardless of the realization of the subject, though the effect may be stronger in the overt condition, given that it provides two cues rather than one.

2. Methods

2.1. Subjects

Children who participated in Experiment 1 of Chapter 2 participated in this experiment. Adult participants were 19 undergraduate students from the Universidad Autónoma Metropolitana Iztapalapa.

2.2. Design and stimuli

Participants took a 16-item forced-choice picture selection task in a 2 (formal, informal) x 2 (overt subject, null subject) within-subjects design. The null subject condition was presented before the overt subject condition, and within these conditions the presentation of formal and informal items was randomized.

Eight different drawings were used: four teachers and four students, half male and half female. Four student-teacher pairs were made, counterbalancing for gender, and each pair was presented once in each condition, counterbalancing for the side of the screen.

2.3. Procedure

Children were seated in front of a screen that showed a drawing of a teacher on one side and a drawing of a student around the same age as the child on the other. A puppet named Chicho sat on the child's head and read the sentences in (1) and (2), and the child was asked to guess which person Chicho had talked to. A second experimenter recorded the child's responses on a sheet of paper.

In the interest of time, adults were tested as a group. Participants sat in their seats, viewing a screen at the front of the room and listening to audio recordings of sentences (1) and (2) played through speakers. Before beginning, participants were told that they would be hearing the voice of a character named

Chicho and asked to identify who they thought Chicho was talking to, marking their response on a sheet of paper.

2.4. Exclusions and data analysis

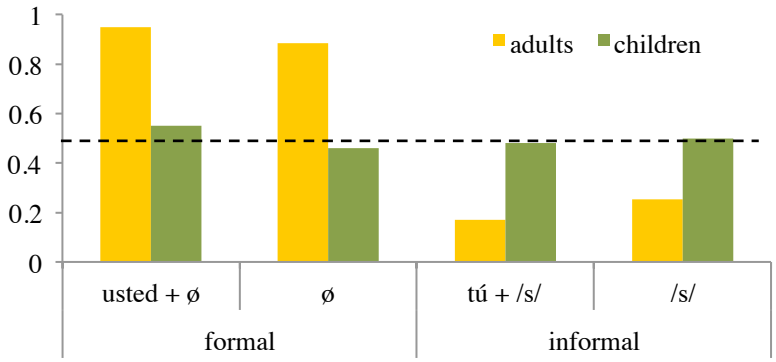
All children were included in the analysis, and only 3 individual responses were discarded due to inattention. Some adults chose both the child and the teacher in some of their responses; these were counted as two responses (one of each). Data from each individual condition was compared to the others using chi-squared tests.

3. Results

The proportion of times out of 16 that adults and children chose the teacher as the interlocutor is shown in Figure 14 below. Adults showed a strong preference for the teacher picture in the formal condition (overt: 95%, null: 88%), and an almost equally strong preference for the child picture in the informal condition (overt: 83%, null: 75%). Chi-squared tests revealed a difference in response counts between formal and informal conditions (overt: $\chi(1) = 4.58$, $p = 0.032$; null: $\chi(1) = 4.16$, $p = 0.041$) but no significant differences between null and overt conditions (informal: $\chi(1) = 1.21$, $p = 0.27$; formal: $\chi(1) = 1.34$, $p = 0.25$)

In contrast to the adults, children showed no preference in either condition (between 46-55% teacher responses in all conditions). Chi-squared tests revealed no significant effect of formality or subject type on the response counts (all $\chi < 0.51$, all $p > 0.47$).

Figure 14: proportion of "teacher" responses by adults and children



4. Discussion

Adult responses are consistent with our hypothesis that the formal pronoun, in both its null and its overt forms, would pick out out the adult as the addressee. It also appears that they had a strong preference to associate the informal pronoun to the child addressee. Importantly, child responses conform to our hypothesis that children do not make either of these associations. This is unsurprising given the near complete absence of *usted* and its null counterpart in children's input.

APPENDIX C: Experimental items

Experiment 1

1. *Chicho quiere que salte-{ø/s/n}.*
   Chicho wants her/you/them to jump.
2. *Chicho quiere que baile-{ø/s/n}.*
   Chicho wants her/you/them to dance.
3. *Chicho quiere que duerma-{ø/s/n}.*
   Chicho wants her/you/them to sleep.
4. *Chicho quiere que aplauda-{ø/s/n}.*
   Chicho wants her/you/them to clap.

Experiment 2

Agreement items:

1. *Muéstrame la foto en donde saltamos/salto/saltas/saltan/salta.*
   Show me the photo where we/I/you/they/she jump(s).
2. *Muéstrame la foto en donde dormimos/duermo/duermes/duermen/duerme.*
   Show me the photo where we/I/you/they/she sleep(s).
3. *Muéstrame la foto en donde aplaudimos/aplaudo/aplaudes/aplauden/aplaude.*
   Show me the photo where we/I/you/they/she clap(s).
4. *Muéstrame la foto en donde dibujamos/dibujo/dibujas/dibujan/dibuja.*
   Show me the photo where we/I/you/they/she draw(s).
5. *Muéstrame la foto en donde bailamos/bailo/bailas/bailan/baila.*
   Show me the photo where we/I/you/they/she dance(s).

Clitic items:

6. *Muéstrame la foto en donde Nemo está besándo-nos/me/te/las/la.*
   Show me the photo where Nemo is kissing us/me/you/them/her.
7. *Muéstrame la foto en donde Nemo está peinándo-nos/me/te/las/la.*
   Show me the photo where Nemo is kissing us/me/you/them/her.
8. *Muéstrame la foto en donde Nemo está lavándo-nos/me/te/las/la.*
   Show me the photo where Nemo is kissing us/me/you/them/her.
9. *Muéstrame la foto en donde Nemo está tapándo-nos/me/te/las/la.*
   Show me the photo where Nemo is kissing us/me/you/them/her.
10. *Muéstrame la foto en donde Nemo está tocándo-nos/me/te/las/la.*
    Show me the photo where Nemo is kissing us/me/you/them/her.

Fillers:

11. *Muéstrame la foto en donde hay alguien saltando/durmiendo/aplaudiendo/dibujando/bailando/sentado/acostado.*
    Show me the photo where someone is jumping/sleeping/clapping/drawing/dancing/seated/lying down.

Experiment 3

1. *Chicho quiere {mi/tu/su/nuestros} pato(s).*
   Chicho wants my/your/his/our duck(s).
2. *Chicho quiere {mi/tu/su/nuestros} carro(s).*
   Chicho wants my/your/his/our car(s).

3. *Chicho quiere {mi/tu/su/nuestros} manzana(s).*
   Chicho wants my/your/his/our apple(s).
4. *Chicho quiere {mi/tu/su/nuestros} pera(s).*
   Chicho wants my/your/his/our pear(s).
5. *Chicho quiere {mi/tu/su/nuestros} llave(s).*
   Chicho wants my/your/his/our key(s).
6. *Chicho quiere {mi/tu/su/nuestros} dulce(s).*
   Chicho wants my/your/his/our sweet(s).

Experiment 4

1. *Juan canta para Pedro y {después/por eso} {ø/él} baila.*
   Joey sings for Peter and {then/so} {he/HE} dances.
2. *Juan le pega a Pedro y {después/por eso} {ø/él} se va.*
   Joey hits Peter and {then/so} {he/HE} leaves.
3. *Sara toca a María y {después/por eso} {ø/ella} se ríe.*
   Sara pokes Mary and {then/so} {she/SHE} laughs
4. *Pedro habla con Juan y {después/por eso} {ø/él} sonríe.*
   Peter talks to Joey and {then/so} {he/HE} smiles.
5. *María alegra a Sara {después/por eso} {ø/ ella} aplaude.*
   Mary cheers Sara up and {then/so} {she/SHE} claps.
6. *Pedro asusta a Juan y {después/por eso} {ø/él} grita.*
   Peter scares Joey and {then/so} {he/HE} yells.
7. *María se pelea con Sara y {después/por eso} {ø/ ella} llora.*
   Mary quarrels with Sara and {then/so} {she/SHE} cries.
8. *Sara persigue a María y {después/por eso} {ø/ ella} se cansa.*
   Sara chases Mary and {then/so} {she/SHE} gets tired.

Experiment 5

Items with explicit Parallel and Contrast:

1. *María {abraza/lava/mira/saluda} a Sara y ø {abraza/lava/mira/saluda} a Juan también.*
   María {hugs/washes/looks at/greets} Sara and *pro* {hugs/washes/looks at/greets} Juan too.
2. *María {abraza/lava/mira/saluda} a Sara y Juan la {abraza/lava/mira/saluda} también.*
   María {hugs/washes/looks at/greets} Sara and Juan CL-fem {hugs/washes/looks at/greets} too.
3. *María {abraza/lava/mira/saluda} a Sara pero ella {abraza/lava/mira/saluda} a Juan.*
   María {hugs/washes/looks at/greets} Sara but she {hugs/washes/looks at/greets} Juan.
4. *María {abraza/lava/mira/saluda} a Sara pero Juan la {abraza/lava/mira/saluda} a ella.*
   María {hugs/washes/looks at/greets} Sara but Juan CL-fem {hugs/washes/looks at/greets} her.

Items without explicit Parallel and Contrast:

5. *María {abraza/lava/mira/saluda} a Sara y ø {abraza/lava/mira/saluda} a Juan.*
   María {hugs/washes/looks at/greets} Sara and *pro* {hugs/washes/looks at/greets} Juan.
6. *María {abraza/lava/mira/saluda} a Sara y Juan la {abraza/lava/mira/saluda}.*
   María {hugs/washes/looks at/greets} Sara and Juan CL-fem {hugs/washes/looks at/greets}.
7. *María {abraza/lava/mira/saluda} a Sara ella {abraza/lava/mira/saluda} a Juan.*
   María {hugs/washes/looks at/greets} Sara she {hugs/washes/looks at/greets} Juan.
8. *María {abraza/lava/mira/saluda} a Sara Juan la {abraza/lava/mira/saluda} a ella.*
   María {hugs/washes/looks at/greets} Sara Juan CL-fem {hugs/washes/looks at/greets} her.

Experiment 6

Singular items

1. *La maestra tapa a las niñas y ø tapa a Sara también.* [subject, congruent]
   the teacher covers the girls and *pro* covers-3S Sara too
2. *Las niñas tapan a la maestra y ø tapa a Sara también.* [subject, incongruent]
   the girls cover the teacher and *pro* covers-3S Sara too
3. *Las niñas tapan a la maestra y Sara la tapa también.* [object, congruent]
   the girls cover the teacher and Sara CL-3S covers her too
4. *La maestra tapa a las niñas y Sara la tapa también.* [object, incongruent]
   the teacher covers the girls and Sara CL-3S covers her too

Plural items

5. *Las niñas tapan a la maestra y ø tapan a Sara también.* [subject, congruent]
   the girls cover the teacher and *pro* covers-3S Sara too
6. *La maestra tapa a las niñas y ø tapan a Sara también.* [subject, incongruent]
   the teacher covers the girls and *pro* covers-3S Sara too
7. *La maestra tapa a las niñas y Sara las tapa también.* [object, congruent]
   the teacher covers the girls and Sara CL-3P covers them too
8. *Las niñas tapan a la maestra y Sara las tapa también.* [object, incongruent]
   the girls cover the teacher and Sara CL-3P covers them too

Experiment 7

1. *María bailó con Sara y ahora ø canta.* [subject]
   María danced with Sara and now *pro* sings-3S
2. *María llegó a la casa con Sara y ahora Juan está saludándola.* [object]
   Maria arrived home with Sara and now Juan is greeting-CL-3S

Experiment 8

3rd[a] person items

1. *Ana bailó conmigo y ahora ø canta.* [subject, congruent]
   Ana danced with-me and now *pro* sings-3S
2. *Yo bailé con Ana y ahora ø canta.* [subject, incongruent]
   I danced with Ana and now *pro* sings-3S
3. *Ana llegó a la casa conmigo y ahora Chicho está saludándola.* [object, congruent]
   Ana arrived home with-me and now Chicho is greeting-CL-3S
4. *Yo llegué a la casa con Ana y ahora Chicho está tapándola.* [object, incongruent]
   I arrived home with Ana and now Chicho is greeting-CL-3S

1st person items

5. *Yo bailé con Ana y ahora ø canto.* [subject, congruent]
   I danced with Ana and now *pro* sings-1S
6. *Ana bailó conmigo y ahora ø canto.* [subject, incongruent]
   Ana danced with-me and now *pro* sings-1S
7. *Yo llegué a la casa con Ana y ahora Chicho está saludándome.* [object, congruent]
   I arrived home with Ana and now Chicho is greeting-CL-1S
8. *Ana llegó a la casa conmigo y ahora Chicho está tapándome.* [object, incongruent]
   Ana arrived home with-me and now Chicho is greeting-CL-1S

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