Is children's comprehension of subject-verb agreement universally late? Comparative evidence from French, English, and Spanish

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Abstract
Previous research has suggested that comprehension of agreement morphology is surprisingly late (e.g. compared to production), prompting hypothesized explanations attributing acquisition difficulty to various universal or language-particular features of agreement. In this paper we synthesize research from three languages—French, Spanish, and English—to argue that (i) comprehension of subject-verb agreement is not universally late, and (ii) morpho-phonological and interpretive differences present a promising explanation of cross-linguistic asymmetries. We review evidence from preferential looking and pointing tasks showing that French-speaking children master (liaison-based) agreement by the age of 30 months (Legendre et al., 2010b). By contrast, we present novel results using these same methods, and identical visual stimuli, that indicate a failure of comprehension in English and only partial success in Spanish at a comparable age. The latter results confirm the comprehension delay identified previously in Johnson et al. (2005) and Pérez-Leroux (2005). Our working hypothesis attributes this later comprehension to the differences in perceptual saliency and cue reliability of singular –s and plural –n in English and Spanish, respectively, as compared to the markers tested in French (the singular /l/ and plural /z/ liaison consonants).

Keywords: Subject-verb agreement, acquisition, English, Spanish, French

1. Introduction

Subject-verb (S-V) agreement is pervasive in many languages and its successful acquisition represents an important milestone in grammatical development. Recent experimental studies have, however, revealed some uncertainty concerning precisely *when* this particular dependency is mastered by children. According to Brown (1973) English-learning children spontaneously produce 3rd person *–s* in 90% of obligatory contexts relatively early—between age 2;2 and age 3;10. In contrast, a study using a picture-selection task has shown that children do not in fact comprehend verbal *–s* until age 5-6 (Johnson, de Villiers, & Seymour, 2005). Such late comprehension was also found in (Dominican) Spanish (Pérez-Leroux, 2005) and Xhosa/Bantu (Gxilishe, Smouse, Xhalisa, & de Villiers, 2009), using the same picture-selection task. This production-comprehension asymmetry has led to proposals ranging from the poverty of the English present tense agreement system (Johnson et al., 2005) to the difficulty of interpreting verbal agreement markers because of their purely formal nature (de Villiers & Gxilishe, 2008), the challenge of mastering the mapping from syntax to semantics (Pérez-Leroux, 2005), and differences in processing facilitation of null compared to overt marking (singular *–s* vs. plural *–∅* in English and plural *–n* vs. singular *–∅* in Spanish, Pérez-Leroux, 2005).

These experimental results challenge the traditional view that comprehension precedes production (Clark & Hecht, 1983; Winitz, Sanders, & Kort, 1981) and call for further cross-linguistic studies to determine whether late comprehension of S-V agreement is a universal developmental phenomenon or not. If it is, the explanation for the delay is likely to be due to universal properties of language and/or the process of acquisition. If it is not universal, then explanations for differences are likely to reside in methodological and/or language-particular factors and their consequences for processing S-V agreement.

In this paper we compare comprehension of S-V agreement in three languages—English, Spanish, and French—holding the experimental methodology constant. We find, as in previous studies, a failure of comprehension for English, and only partial success for Spanish in children 2;6-3 years old. However, French children succeed at this task as early as 2;6, showing that in fact S-V agreement comprehension is not *universally* late. These apparent cross-linguistic differences suggest the need for an explanation of the time course of agreement acquisition attributable to the language-particular morpho-phonological realization of S-V agreement, which affects children's ability to detect and interpret agreement markers in fluent speech. Children are likely to have the grammar of agreement in place early in the three languages (e.g. per their spontaneous production) but the strength of the interpretive cue measured as the degree of perceptual saliency of number marking and its overall reliability (as a marker of particular person/number features) in the language may facilitate or hinder the detection of S-V agreement during processing. We focus on the phenomenon of liaison (or resyllabification of a latent consonant) as a marker of number in French and bring to bear prior results from adult processing by native speakers of French and L2 learners, as well as child processing.

In Section 2 below we proceed by first summarizing three experimental studies of a (liaison-based) subsystem of S-V agreement in French reported elsewhere (Legendre, Barrière, Goyet, & Nazzi, 2010b; Barrière, Nazzi, Legendre, Goyet, & Kresh, 2011). In Sections 3 and 4, we present novel evidence replicating the comprehension failure for English and finding only partial

success in Spanish, using identical visual stimuli and experimental methodologies (preferential looking in English vs. pointing in Spanish). Finally, in Section 5 we discuss a number of previously proposed explanations for late comprehension of agreement, and offer our new (working) hypothesis for why the discrepancy we find is observed cross-linguistically.

2. Previous work on comprehension of S-V Agreement in French

In this section we summarize previous studies which have shown that, at 30 months of age, French-learning children show successful comprehension of S-V agreement. These studies focus on a particular agreement subsystem in French, the particular properties of which will be crucial for our discussion of the morpho-phonological differences between French on the one hand and English and Spanish on the other. For this reason, we will first provide a brief description of the subsystem of interest.

2.1 Prefixal S-V Agreement in French

Spoken French currently has two co-existing subsystems of S-V agreement, a 'regular' one involving the phonological fusion of a subject clitic pronoun with the verbal root, as in (1a), and an 'irregular' one inherited from a system of Romance conjugation classes, as in (1b-c).

(1) a. Il arrive vs. Ils arrivent   b. Il lit vs. Ils lisent   c. Il prend vs. Ils prennent
         /i.l̲a.ʁiv/   /i(l).z̲a.ʁiv/   /i.li/   /i.liz̲/   /i(l).pʁɑ̃/   /i(l).pʁɛn/
         'he arrives' vs. 'they arrive'   'he reads' vs. 'they read'   'he takes' vs. 'they take'

The former is prefixal, the latter is suffixal (similar to English and Spanish, except for the varied phonological realization of the plural inflection). We follow previous studies in focusing on 3rd person agreement. In the prefixal agreement system of Spoken French—the focus of the acquisition studies reported in this paper (see Nazzi, Barrière, Goyet, Kresh, & Legendre, 2011 for a study on early sensitivity to the suffixal irregular system) —3rd person singular and plural agreement is contrastive when the combination of a subject clitic pronoun and a vowel-initial verb results in phonological 'liaison' (Encrevé, 1988). In this case, the latent final consonant of the pronoun signaling for example plurality, /z/, is obligatorily resyllabified and integrated into the beginning of the verbal root (see 1a). Before proceeding to any discussion of experimental results, we first briefly justify our decision to treat subject clitics in adult Spoken French—the input to children—as agreement markers and refer the reader to the detailed studies mentioned for additional discussion.

Young children acquiring French as their native language are exposed to *Spoken* French, whose syntax of agreement differs from that of *Standard* French, the register assumed in most studies of adult syntax. Simply stated, Standard French is a language in transition with respect to the status of subject clitics[1] while Spoken French represents the end stage of their

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[1] Traditionally subject clitics (*je*, *tu*, *il*, etc.) in the Standard register are held to be theta-role-bearing elements in canonical subject position, cliticizing phonologically onto the verb (e.g. Cardinaletti & Starke, 1999; Côté, 2001; De Cat, 2005, 2007; Kayne, 1975; Rizzi, 1986) and resulting in a host of properties of prosodically weak elements documented in Kayne (1975). The traditional analysis has been challenged in favor of assigning them the status of agreement

grammaticalization to agreement markers. In detailed analyses of Child Directed Speech (CDS), Legendre, Culbertson, Barrière, Nazzi, & Goyet (2010a) and Culbertson (2010) show that Spoken French does not exhibit the syntactic properties which traditionally support an argumental analysis of subject clitics. Rather, these elements exhibit properties common to agreement affixes, including fixed-position relative to the verb (with the impossibility of non-affixal material intervening), phonological fusion with the verb, and *doubling* (frequent and in some cases obligatory co-occurrence with a DP subject). Further, a number of studies have shown that acquisition of subject clitics proceeds very differently from the acquisition of true (pronoun and DP) subjects in terms of interaction with finiteness, positioning, and order of acquisition (Pierce, 1992; Hamann et al., 1996; Paradis & Genesee, 1996; Jakubowicz & Rigaut, 1997; Legendre et al., 2010a). In sum, these elements are indeed a subsystem of prefixal S-V agreement in both the adult and child grammar, which will be the target of the studies discussed below. We return to the French irregular agreement system in the conclusion.

2.2 Experimental evidence for early S-V agreement acquisition in French

In this section we review the evidence that at 30 months of age, French-learning children can successfully comprehend the S-V agreement subsystem of interest. Legendre et al. (2010b) report results from an Intermodal Preferential Looking Paradigm (IPLP; Golinkoff, Hirsh-Pasek, Cauley, & Gordon, 1987) task in which children must match auditorily presented utterances with dynamic videos based on number agreement information. Example audio stimuli from the task are shown in (7) below. Crucially, all verbs were vowel-initial, thus the agreement distinction was realized only as liaison between the final consonant of the agreement prefix, /il/ or /iz/, and the following initial vowel of the verb. This is highlighted in the transcriptions in (2). All verbs denoted transitive actions (e.g. *attraper* 'to catch', *embrasser* 'to kiss', *ouvrir* 'to open'), and nonce objects were used as discussed below in the English study. Examples of still images from the videos are shown in Fig. 1.

(2)   a. Il embrasse le /gef/: /il̃ɛ̃bʁasləgef/
             'He kisses the /gef/'
        b. Ils embrassent le /tak/: /iz̃ɛ̃bʁaslətak/.
             'They kiss the /tak/'

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markers generated directly on the verb in either the lexicon or post-syntactically (e.g. Auger, 1994; Ferdinand, 1996; Jakubowicz & Rigaut, 1997; Kaiser, 1994; Legendre, Vainikka, Hagstrom, & Todorova, 2002; Miller, 1992; Pierce, 1992; Roberge, 1900; Zribi-Hertz, 1994).

Fig. 1. Example video stimuli in the singular (left screen) and plural (right screen) conditions, used in French IPLP experiment with known verbs (Legendre et al., 2010b).

The result of the task, from 20 monolingual 30-month-old French-learning children (*M* = 30 months; range = 28-35 months) revealed that, compared to a silent baseline, children looked significantly longer at the matching videos when auditory stimuli were presented. No significant difference was found between singular and plural trials. These results, shown in Fig. 2, demonstrate that 30-month-old children acquiring French are able to distinguish the singular and the plural marking expressed as the linking consonants /l/ versus /z/ in onset position of otherwise phonologically identical verbs. In particular, they were able to match these forms to the target visual stimuli, in the absence of any additional morpho-syntactic or lexical cues.[2]
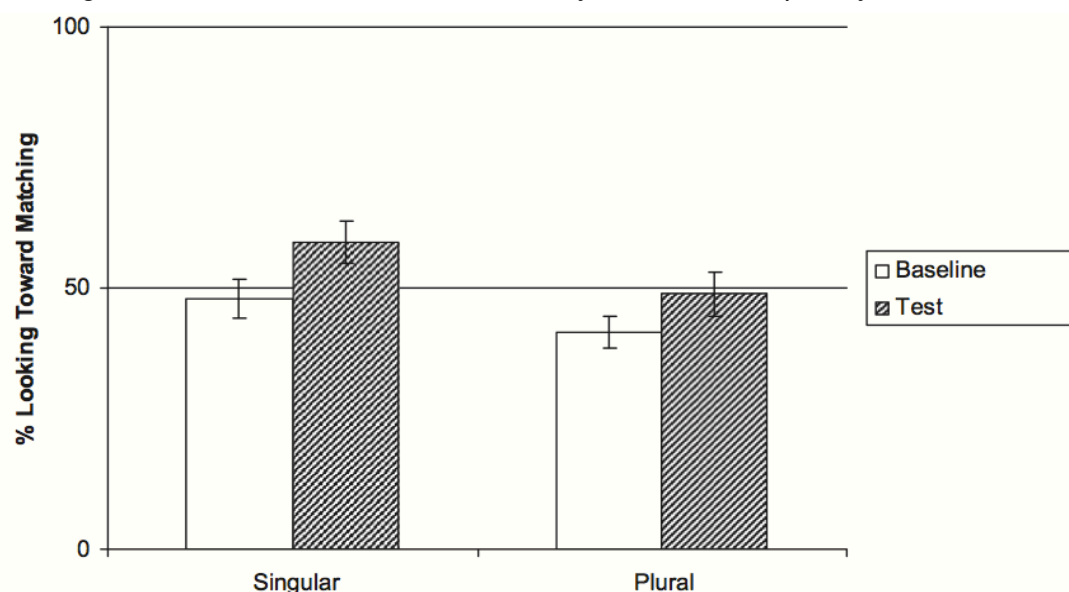

Fig. 2. Mean % looking times (and SEs) towards the matching video in silent baseline and at test, broken down by the number of the target, at 30 months of age (French IPLP study with known verbs).

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[2] These findings are typical of IPLP results for this age group in producing small effects in this range (Golinkoff et al., 1987; Hirsh-Pasek & Golinkoff, 1996).

In a second, potentially more demanding task, using the same auditory and visual stimuli[3], children were required to *point* to matching videos. The result of this pointing task, from 16 monolingual 30-month-old French children (M=30 months; range= 28-32 months) revealed that children were significantly more likely than chance to point at the matching video for both singular and plural utterances. These findings, shown in Fig. 3 below, confirm that even under increased decisional and motor demands, French-learning 30-month-olds are able to distinguish between third person singular and plural and match both the plural and singular expressions of liaison to the target visual stimuli. The representations of S-V agreement of the type tested thus appear to be stable and robust at this age. Even more strikingly, in a similar pointing task using *novel verbs* representing unfamiliar actions (Barrière et al., 2011), French-learning 30-month-olds were again found to show successful comprehension: children were significantly more likely to point at the matching videos for both singular and plural versions of the novel verbs. Examples of the stimuli from this task are shown in (3).

(3)   a. Il arrouve le /sif/: /iḻaʁuvləsif/
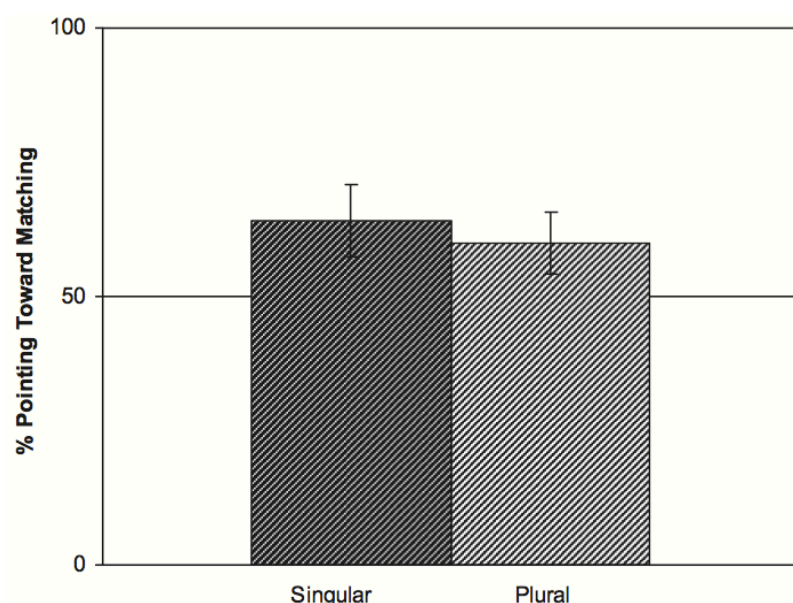   b. Ils arrouvent le /mik/: /iḻzaʁuvləmik/

Fig. 3. Mean % pointing (and SEs) towards the matching video at test, broken down by the number of the target, at 30 months of age (French pointing study with known verbs).

Taken together, the results from these three studies provide clear evidence that French 30-month-olds have morphosyntactic representations of this subtype of S-V agreement that enable them to robustly comprehend number agreement of familiar verbs expressed through liaison (in both singular and plural) *and* generalize their understanding to novel verbs. Importantly, these

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[3] There was one difference, which we return to in Section 5 below. Due to the experimenter's preference, the plural clitic was produced as /ilz/ rather than /iz/ as in the previous experiment—the two alternatives being grammatical in French.

results present a challenge to the claim that S-V comprehension is universally late-acquired (Johnson et al., 2005; Pérez-Leroux, 2005; Gxilishe et al., 2009), suggesting that at least in some languages, successful production *and* comprehension are developed early on. The findings also raise the possibility that early comprehension might be revealed in other languages if the same methodology is used. In the following sections, we report two new experiments from English and Spanish children, which investigated this possibility.

3. Child comprehension of S-V agreement in English[4]

The French results stand in contrast with what is known about children's comprehension of S-V agreement in English (Johnson et al., 2005). While Brown (1973) reports that children use 3rd person –*s* agreement in at least 90% of obligatory contexts between ages 2;2-3;10 and Rice & Wexler (1996) show that children reach 90% target insertion of 3rd person –*s* in an elicited production task by age 4, comprehension appears to be surprisingly late. For example, Johnson et al. (2005) used a picture-selection task to investigate comprehension of English number agreement. By using s-initial verbs to phonologically mask the number of the subject DP, as in (4), Johnson et al. (2005) forced children to rely on verbal inflection to correctly choose, e.g., either one cat or two cats sleeping. Only 5- and 6-year-olds, not 3- and 4-year-olds, performed above chance.

(4)   a. The cat sleeps on the bed.
       b. The cats sleep on the bed.

A null experimental result is inherently difficult to interpret: it could be that children do not have the underlying knowledge, it could be that the task failed to tap into that knowledge, or it could be that subjects have the knowledge but failed to perceive the number inflection and process agreement. We reasoned that a 'passive' preferential looking study placing fewer demands on young subjects (in terms of motor control and cooperation) than an 'active' pointing task of the sort used in Johnson et al. (2005), coupled with a dynamic, video presentation of the visual stimuli—less potentially ambiguous than still drawings as to the intended contrast—would be particularly informative in evaluating the possible effect of methodological differences.

3.1 Method
3.1.1 Participants

The participants in this study were 21 English-learning children (11 male, 10 female; M = 35 months, range = 28 months to 46 months). An additional 5 children were tested but were excluded due to excessive fussiness (1), poor video quality (3), or experimenter error (1). Participants had no documented developmental disorders. They were all tested in Baltimore, Maryland.
3.1.2 Stimuli

Video stimuli. The video stimuli used here were identical to those used by Legendre et al. (2010b) for French children. Two 8-year-old boys recruited for this purpose were filmed

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[4] The material discussed in this section is the work of Erin Zaroukian.

performing each of ten simple actions on unfamiliar objects for which the French and English children tested did not have a name (see Fig. 1). For each action, either one boy performed the action alone while the other boy was standing immobile next to him (singular video), or the two boys performed the action together and simultaneously (plural video). For each action, different unfamiliar objects were used in the singular and plural conditions (a total of twenty unfamiliar objects were used). Thus, the same action was performed on different objects by a single boy (singular video) versus two boys (plural video). Different objects were used in each scene in order to block a collective interpretation of the whole display (i.e., in which a plural auditory stimulus could be understood to refer to all the actions on the screen). All video sequences lasted 6 seconds.

<u>Verbal stimuli</u>. Ten verbs, referring to the ten actions in the videos, were used: *hang*, *tie*, *catch*, *kiss*, *take*, *wipe*, *dress, pull, throw,* and *wrap*. These verbs were chosen because they are known by many children according to previously collected MCDI data (Dale & Fenson, 1996), they can all be used transitively, and they provide a balance between the three different possible allophones of the third-person singular –*s* (three [s], four [z], three [Iz]). All speech stimuli were recorded by the same female speaker using CDS.

The verbs were embedded in short sentences as in (5), using the same subject in either singular (*the boy*) or plural (*the boys*). The names for the twenty novel objects were monosyllabic and, to facilitate naturalness, were designed to have high-frequency English phonological neighbors.

(5)   a. The boys kiss the /dajt/.
        b. The boy kisses the /naj/.

Note that in this study, unlike Johnson et al. (2005), we made no attempt to phonologically mask the number marking on the subject. In fact, the choice of subject type resulted in two number cues (nominal –*s* and verbal -∅, or nominal -∅ and verbal –*s*), which might make the task easier (as suggested by Kouider, Halberda, Wood, & Carey, 2006).

3.1.3 Procedure

Each child was tested individually in a soundproof room for approximately ten minutes. Children sat on a parent's lap during the whole session. Parents wore headphones streaming two simultaneous children's songs such that the audio stimuli were rendered inaudible to the parent. Each child was presented with six to eight trials (depending on the number of test verbs reported to be known to the child by their parent). All trials consisted of the sequence of events described below.

In the French study the visual stimuli appeared on two separate monitors with a central light drawing the child's attention before each trial. In the English study the visual stimuli appeared instead on opposite sides of one large monitor, with a geometric sun appearing in the center of the screen to redirect children's gaze. Once the child was paying attention, the baseline phase started, in which two videos were simultaneously displayed in silence for six seconds. Both videos depicted the same action, one side showing a version with a singular subject (one boy) and the other with a plural subject (two boys). After this video presentation, the sun reappeared.

The test phase started, consisting of the auditory presentation of a speech stimulus matching one of the two scenes, immediately followed by a six-second-long presentation of the same two videos presented during the baseline phase. Once the test phase was over, a three-second-long eye-catching video (a "dance" performed by the two boys) was displayed on the side which played the *matching* video at test to mark the end of the trial (following Kouider et al., 2006). The general hypothesis behind the IPLP method is that children will tend to look longer at the side matching the speech stimulus during test compared to baseline if they comprehend that stimulus (Golinkoff et al., 1987; Naigles, 1990).

For half of the trials, the speech stimulus corresponded to the singular video, while it corresponded to the plural video for the other half of the trials. The side on which the matching video was presented was counterbalanced within participants. Children who knew only six verbs (instead of eight) were tested on the same number of singular (3) and plural (3) videos.

3.1.4 Coding and Reliability

A digital video camera placed above the screen was used to record the child's looks during the baseline and test phases. The videos were coded offline frame-by-frame using SuperCoder (Hollich, 2005). For each frame, a trained coder blind to the condition (i.e. whether the audio-stimuli were the singular or the plural) coded whether the child was looking at the left video, at the right video, or away. Then, for each trial, the percentage of time that the child spent looking at the matching video was compared to time spent looking at the non-matching video. Trials in which children only looked at one video during baseline were discarded from the analysis. Overall, we analyzed a mean of 6.4 trials (out of a mean of 7.9 trials actually presented) per subject. Ten percent of the data were recoded by a different trained coder, with an average inter-coder agreement of 99%.

3.2 Results

An ANOVA was conducted which revealed no significant main effect of phase, $F(1, 20) = .935$, $p = .336$ (baseline: $M = 47.735$, $SE = 2.809$; test: $M = 51.067$, $SE = 3.963$), or condition, $F(1, 20) = .145$, $p = .704$, and no interaction between phase and condition, $F(1, 20) = 1.339$, $p = .240$. As suggested by Fig. 4, children failed to look longer at matching videos when auditory stimuli were played compared to baseline for both singular and plural trials. In order to determine whether performance improved for the older children in our sample, we tested for a correlation between age and task performance. No significant correlation between the two variables—age and increase in looking time over baseline—was found (singular $r^2 = .003$, $p = .803$; plural $r^2 = .009$, $p = .687$). Subsequent analyses also failed to reveal any significant correlation between production scores on MCDIs (comprehension scores were near ceiling) and looking time differences (singular $r^2 = .052$, $p = .501$; plural $r^2 = .045$, $p = .533$). This suggests that children within this age range in fact uniformly failed on the task.
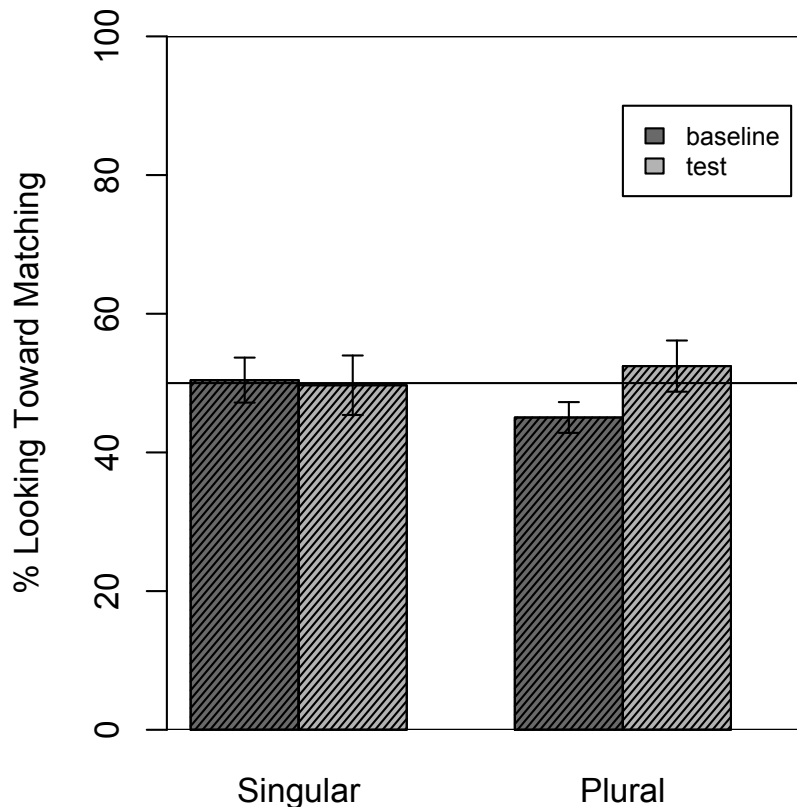
Fig. 4. Mean % looking times (and SEs) towards the matching video in silent baseline and at test, for both singular and plural, at 28-46 months of age (English IPLP with known verbs).

Because this IPLP study is the first of its kind, and at first glance the results are strikingly different from those found for French-learning 30-month-olds, a number of additional analyses were conducted in an effort to ensure that comprehension was not being masked by other factors. For example, analyses were conducted to determine whether particular (frame-by-frame) portions of each trial might reveal significant differences. The moment in which the singular and plural videos can be distinguished (e.g. when something is caught by either one or two boys) occurs within the first four (or often even two) seconds of each video, therefore we considered the possibility that children may have looked longer at matching videos during this initial window but subsequently allowed their gaze to wander. However, an ANOVA conducted using the first four seconds of test again revealed no significant effect of phase (F(1, 20) = 2.855, p = .095).

The pattern of results reported here is consistent with previous claims that English-speaking children do not understand 3rd person number agreement in this age range, even with overt number marking on the subject. In particular, our findings are in line with the results reported in Johnson et al. (2005), despite using an arguably more engaging task (preferential looking with dynamic videos compared to still line drawings). We have thus confirmed that, while French-children of the same age succeed in a task using the same methodology, comprehension of S-V agreement in English in the presence of two number cues is nevertheless not found by age 3.

Although here we are primarily interested in the possible differences between languages which show late S-V agreement comprehension and those which do not, future work remains necessary to establish precisely the age at which English-speaking children *do* show success in this task.

4. Child comprehension of S-V agreement in Mexican Spanish[5]

Like English-speaking children, Spanish-speaking children reportedly do not use S-V agreement morphology in comprehension until the age of 4;8 (Pérez-Leroux, 2005) without supplementary cues to number, i.e. an overt subject. This may be a surprising finding, given that the Spanish S-V agreement paradigm is richer than the English one. Unique forms exist for most combinations of person and number, as shown in Table 1, and the examples in (6) below illustrate the part of the paradigm tested here—3rd person.

	Singular	Plural
1st	nad-o	nad-a-mos
2nd	nad-a-s	nad-a-n
3rd	nad-a	nad-a-n

Table 1. Spanish present tense paradigm (non-Castilian dialects).

(6) a. Nada en el charco
          '(It) swims in the pond'
     b. Nada**n** en el charco
          '(They) swim in the pond'

Several other features of the full morphological paradigm are relevant here. First note that, unlike English, Spanish has bound roots which never appear in isolation, but always co-occur with a suffix indicating person/number information. In all forms except 1st singular, a thematic vowel (e.g. *–a* or *–e*) is added to the root (together these are often called the stem, Harris, 1969). Following the stem, an additional suffix is added to indicate person/number in all forms but the 3rd singular. As Table 1 suggests, in non-Castilian dialects of Spanish (including the variety spoken by the population tested here), the 2nd plural form is homophonous with the 3rd plural form (e.g. *ellos/ustedes nadan* 'they/you (pl.) swim'; Lipski, 2012), a point we return to in our discussion.

As in English, the 3rd person contrast is claimed to emerge markedly early in production, by 1;6-1;7 (Montrul, 2004; although see Mueller Gathercole et al., 1999), and errors, such as those involving root infinitives, are very rare (between 0% and 3%: Bel, 2001), rendering the documented failure to comprehend that distinction even more striking. In her investigation of the comprehension of the 3rd person singular contrast, Pérez-Leroux used the same visual stimuli and task as the one used in the English study by Johnson et al. (2005). Again, the null results in the younger group (3;2-4;5) of Spanish-speaking children in Pérez-Leroux (2005) may or may

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[5] The material discussed in this section is the work of Lisa Hsin.

not be due to the particular task used or to perceptual factors; it is therefore important to replicate these results. We tested monolingual Mexican children in a pointing task (identical to the French pointing study discussed in Section 2.2) rather than in a preferential looking task because videotaping of child participants is prohibited in Mexican child care centers.

4.1 Method
4.1.1 Participants
Participants included 31 monolingual, middle-class Spanish-speaking children (16 female, 15 male, mean age 36.6 months, range 30-47 months) who attended daycare in San Luis Potosí, Mexico. An additional 2 children were run but excluded from analysis for failure to contribute data for at least 2 trials for both singular and plural. Participants had no documented developmental disorders.

4.1.2 Stimuli
<u>Video stimuli</u>. The video stimuli were the same as in the French and English studies; see Fig. 1.
<u>Verbal stimuli</u>.
Eight verbs, referring to the eight actions in the videos, were used: *amarrar* 'to tie', *agarrar* 'to catch', *besar* 'to kiss', *quitar* 'to remove', *limpiar* 'to wipe', *parar* 'to stop', *llevar* 'to carry', and *sacar* 'to open'. These verbs were chosen to match the French verbs; they can all be used transitively and follow only the most regular pattern of Spanish verbal morphology (ending in –*ar*). All speech stimuli were read aloud from a script as naturally as possible by a female native speaker.

The verbs were embedded in short null-subject sentences as in (7), thereby masking the nominal expression of number and resulting in one number cue only, as in the French study; each sentence described a transitive action performed on a novel object noun. These short sentences were in turn embedded in indirect questions as described in the next section. The sixteen novel object nouns were disyllabic and, to facilitate naturalness, were designed to have high-frequency Spanish phonological neighbors. Like real masculine nouns, all novel nouns ended in –*o*.

(7)   a. Besa el micho*.*
        kiss.3sg the 'micho'
        'He kisses the micho'
    b. Agarra<u>n</u> el duco.
        catch.3pl the 'duco'
        'They catch the duco'

4.1.3 Procedure
The procedure for testing the comprehension of subject-verb agreement in Mexican Spanish-speaking children was largely the same as in the French pointing experiment. Each child was tested individually in a daycare center, in a quiet room either before or after naptime. Because testing was carried out in the daycare center during the workday, the children were not

accompanied by their parents and instead sat on a chair beside a female experimenter. The child was seated directly in front of the display, while the experimenter sat off to the side. A day care staff person was always present nearby. The visual stimuli were the same as those used in French but due to the need for portable materials they were displayed on a single laptop computer with a 17-inch screen (each image 5" by 5"), the centering light replaced by a still image of a geometric sun (as in the English study). Behind the computer, a large cardboard screen was erected so that a coder blind to the video condition could record the child's pointings on a score sheet without being seen by the child.

Training and test trials were administered as in the French pointing study, with all verbal stimuli translated into (Mexican) Spanish. The experimenter prompted the child to point after both training images were displayed once, and before the images reappeared on their respective sides (e.g., *¿Viste? ¿Dónde está la manzana? Muéstrame con el dedo dónde está la manzana. Dime dónde está la manzana.* "Did you see? Where is the apple? Show me with your finger where the apple is. Tell me where the apple is."). The same procedure was used at test, with known verbs and novel objects (e.g. *¿Viste? ¿Dónde agarran el miso? Muéstrame con el dedo dónde agarran el miso. Dime dónde agarran el miso.* "Did you see? Where are they catching the miso? Show me with your finger where they are catching the miso. Tell me where they are catching the miso").[6] Also as in the French study, if the child did not point during the first seconds, the invitation to point was repeated; if the child still did not respond, the experimenter proceeded to the next trial. Up to 4 training trials were presented, followed by 8 novel randomized test trials, 4 singular and 4 plural.

4.1.4 Coding and Reliability

All coding was carried out during the experiment, by the experimenter sitting next to the child and simultaneously by a blind coder sitting behind a screen. Very few disagreements were observed; they were always resolved in favor of the blind coder.

4.2 Results

The results of the experiment are illustrated in Fig. 5. Overall, children pointed at the matching video 53.94% (SD = 18.72%) of the time, which is not different from the 50% chance level ($t(30)$ = 1.71, p = .251, 2-tailed, d = .62). The difference between performance on the singular and plural conditions was marginally significant ($t(30)$ = 1.83, p = .077, 2-tailed, d = 0.66).[7] Assuming that this marginally significant difference warrants further investigation, singular and plural performance was analyzed separately. Performance on plural trials was above chance (M = 59.68%, SD = 25.92%; $t(30)$ = 2.08, p = .046, 2-tailed, d = .76), while performance on singular trials was at chance (M = 48.66%, SD = 24.26%; $t(30)$ = .31, p = .760, 2-tailed, d = .11).

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[6] While in adult Spanish the plural agreement marker /n/ is resyllabified when followed by a word beginning with a vowel, the experimenter inserted a pause to avoid this resyllabification and increase the salience of the /n/ at the end of the verb.

[7] This marginal difference was confirmed by analyzing the effect of number on pointing accuracy using mixed-effects logistic regression, with subjects as a random effect (β = –0.11 ± 0.06, p = 0.07).
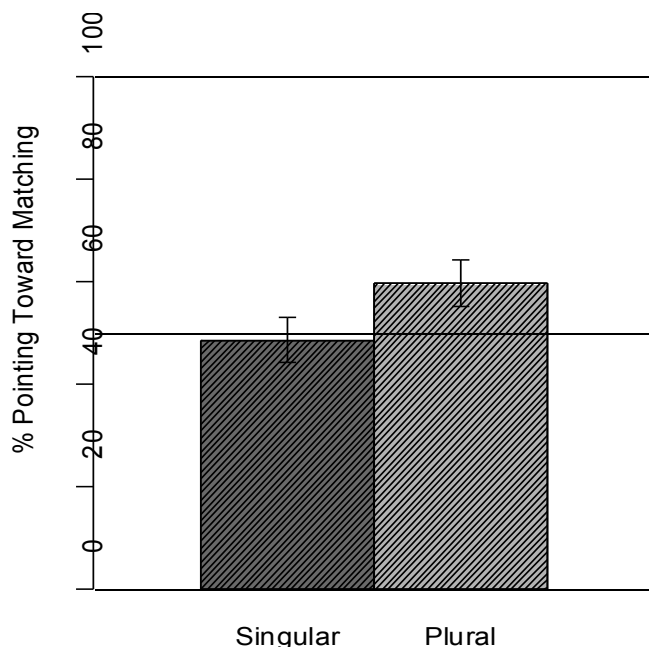
Fig. 5. Mean % pointing (and SEs) toward the matching video at test, broken down by the number of the target, for all Spanish-speaking children.

Note that failure to show comprehension in the singular cannot be due to a misinterpretation of the postverbal DP as the subject rather than the direct object since we exclusively used transitive verbs. While Spanish has optional VSO word order, for, say, *el micho* to be interpreted as the subject in (7a) the sentence would have to include another DP as in *Mira como agarra el micho la bola* 'look how el micho catches the ball'. An omitted object would have to be represented by an object clitic, as in *Lo agarra el micho* 'the micho catches it', if a transitive verb were used with a postverbal subject. The set-up of the prompt sentences therefore did not allow for an interpretation in which the nonce word labeled a subject.

Overall, the experimental results suggest that 3.5-year-old Spanish-speaking children may be approaching sensitivity to the difference between singular and plural 3rd person verbal inflection at this age, as there is a trend in this direction, but they cannot yet reliably discern the correct referent for a verb in the singular. These results confirm the findings of Pérez-Leroux (2005) who found that children before 4;8 were unable to use suffixal agreement on the verb uniquely to distinguish between two possible referents.

5. Discussion and conclusions

The findings reported here for English- and Spanish-speaking children confirm, as previous studies have suggested, that comprehension of S-V agreement is indeed comparatively late in children acquiring either language. In particular, parallel IPLP and pointing tasks requiring children to match a 3rd person singular or plural audio stimulus with one of two brief dynamic videos of corresponding actions, revealed no evidence of comprehension by 3-year-old English speaking children and evidence of comprehension of only the plural form by three-year-old

Spanish speakers. This contrasts with findings reported in Legendre et al. (2010b) which show that French 30-month-olds succeed in both IPLP *and* pointing tasks using the very same video stimuli (as well as with videos depicting novel actions matched with novel verbs, Barrière et al., 2011). A comparison of the effect sizes found for each of these studies confirms the difference among them. For the French studies, analyses revealed η_p^2 = 0.32 (for the IPLP study), and *d* = 1.74 (for the pointing study)—both large effects—compared to η_p^2 = 0.03 (for the English study), and *d* = 0.62 (for the Spanish study)—a small effect in English and a medium size one in Spanish. Even where the Spanish children appear to succeed in the task, namely in the plural, the effect was not large (*d* = 0.76). In sum it seems that at comparable ages, French-speaking children's comprehension of S-V agreement is robust enough to be extended to novel stimuli and support generalization, while English- and Spanish-speaking children lag behind.

Future research is necessary to determine when exactly, using these methods and stimuli, English and Spanish children do in fact fully succeed. Importantly, however, the cross-linguistic asymmetry revealed by these results taken together *cannot* overall be attributed to methodological differences since all children in these experiments were tested using the same dynamic videos within the same methodologies (but the screen size was smaller in the Spanish study). This suggests that the null results we have found here—for English overall, and for singular in Spanish—are interpretable in the context of the French children's clear success (at a younger age). The relatively early success of the latter population, then, can be taken to show that comprehension of S-V is not *universally* late. Thus the apparent delay in comprehension for English-speaking and Spanish-speaking children cannot be attributed to universal properties of verbal agreement, in particular their purely formal or uninterpretable nature (Johnson et al., 2005; de Villiers & Gxilishe, 2008).[8] The underlying explanation must then make reference to particular properties of the different agreement systems. We evaluate a number of previously suggested such properties and then propose an alternative which, as previewed in Section 1, appeals to perceptual and distributional features of the morphemes in question.

5.1 Possible explanations for late comprehension of S-V agreement
5.1.1 Richness of the morphological paradigm

Pérez-Leroux (2005) suggests that late comprehension in English and Spanish might be tied to morphological factors: (a) the conflation of multiple features (person and number) in a single morpheme, or (b) the impoverishment and/or lack of uniformity of the morphological paradigm.[9] However, as she notes, these factors predict that comprehension should systematically appear earlier in Spanish compared to English, and this does not appear to be the case—Pérez-Leroux (2005) finds comparable performance in the two languages, and our results support only a rather weak difference in comprehension. Further the Spanish and French S-V agreement

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[8] In Minimalist terms, the T head is endowed with an unvalued number feature which must find an appropriate goal, the subject DP, and be valued under Agree. Young children might not be capable of such computation. Such an account cannot explain the French comprehension results, nor can it explain early production of S-V agreement found in the three languages.

[9] See also Phillips (1995) and Crago and Allen (2001) on production tied to morphological richness of the language.

subsystems targeted here differ only minimally—if anything, the French agreement subsystem may be less rich than the Spanish since for *consonant-initial* verbs the liaison consonant is not present, and thus no distinction is made between the phonological realization of singular and plural in the 3rd person (sg. *Il parle* /ilpaʁl/ vs. pl. *Ils parlent* /ilpaʁl/). Nevertheless, French children were shown to succeed fully in the pointing task, while Spanish children did not.

5.1.2 Overt vs. non-overt forms

The two earlier studies on English (Johnson et al., 2005) and Spanish (Pérez-Leroux, 2005), both relying on the same set of visual stimulus drawings, revealed a potentially interesting asymmetry. Mean accuracy in English was consistently higher for singular, compared to plural forms: 64% vs. 47% (4-year-olds), 79% vs. 61% (5-year-olds), and 74% vs. 63% (6-year-olds). However, Spanish showed the reverse pattern (50% for singular vs. 67% for plural in 5-year-olds), a pattern confirmed (although somewhat weakly) by our results. Pérez-Leroux (2005) thus hypothesizes that overt vs. null morphological status may predict the order of comprehension of the two number categories, claiming that in both languages it is the overtly marked category that is comprehended first: singular –*s* in English vs. plural –*n* in Spanish.

The distinction between overt and non-overt morphology is quite clear in the case of English—a bare root form like *swim* does not offer any person/number information, while adding the suffix –*s* to the verbal root indicates both person and number. This differs to some extent from the Spanish case; a 3rd person singular form like *nada* containing a (bound) root plus final theme vowel (e.g. –*a*) alone could be thought of as providing *some* person/number information. In particular, because the theme vowel is not uniformly present (e.g. 1st singular *nad-o* 'I swim'), and all other forms in the paradigm involve adding other person/number suffixes, the root plus theme vowel stem does not have the ambiguity of the English bare root. Whether Spanish-learning children *treat* the 3rd singular form as non-overt in the way English children likely treat the 3rd plural is not clear. However, the reliability of the order of comprehension predicted by an overt-non-overt contrast and found in Pérez-Leroux (2005) (and our study) is challenged by the results of a pointing task conducted with slightly older Chilean Spanish-speaking children. Childers et al. (2001) found that 36-month-olds show a strong preference for *singular* rather than plural forms. This was found for progressive forms (e.g. *está corriendo* 'he running' (73% correct points) vs. *están corriendo* 'they are running' (33%)), and for lexical verbs (*come* 'he eats' (71%) vs. *comen* 'they eat' (43%)).

The characterization of Spanish 3rd singular we have suggested is as non-overt in some sense but also as offering somewhat more featural information than the English non-overt 3rd plural. If this is on the right track, then how should the French forms of interest here be characterized? Recall that the forms tested in Legendre et al. (2010b) IPLP task were /il–/ and /iz–/, and in the pointing task /il–/ and /ilz–/, alternative pronunciations used by different experimenters. In the first case, the vowel /i/ is unambiguously associated with 3rd person (in this paradigm), and the addition of the (overt) liaison consonant /l–/ or /z–/ indicates singular or plural number. In the second case /il/ can be taken to indicate 3rd person, adding no additional phonological content indicates singular, and adding /z–/ indicates plural. Thus no form parallel to the English uninformative bare root exists, however in the latter variant pronunciation there is

one form (/ilz/) that conveys both person and number overtly, while the other (/il/) conveys only person overtly.

One might then predict the following: (i) better comprehension of the French compared to Spanish and English since both pronunciation variants involve overt unambiguous marking of at least person, and (ii) better comprehension of the plural in the pointing task where only that form includes overt person *and* number information. The first prediction is clearly borne out—French 30-month-olds succeed fully in both IPLP and pointing tasks while English and Spanish 30-month-olds do not. However, equally successful comprehension was found for singular and plural in the pointing task wherein only one form was fully overt. Although the distinction between overt and non-overt morphology is intriguing, we believe the characterization suggested by Pérez-Leroux (2005) is likely oversimplified. Here we have suggested a more fine-grained way to distinguish among the relevant English, Spanish and French forms, related to the amount of phonological content which overtly indicates person and number features. This gradient notion of featural information supplied overtly does indeed predict some important differences found among these languages. In Section 5.2 below we will discuss an additional dimension on which they differ (e.g. cue reliability) which we believe ultimately provides the clearest explanation for why French learners show relatively *early* success in this task, English learners show relatively *late* success, and Spanish learners fall in between.

5.1.3 Distributional knowledge without semantic competence

First however, we consider another possible explanation put forward by Pérez-Leroux (2005) for the overall comprehension delay in English and Spanish. In particular in terms of separate layers of acquisition (distribution vs. syntax-semantics mapping) according to which young children could have mastered the morphology and the syntactic distribution of number marking without arriving at a complete understanding of where number is interpretable in the language. In the three target languages, spontaneous grammatical *production* of S-V agreement has been found at an earlier age than comprehension: by age 2 in French (though root infinitives are also found, Hamann et al., 1996; Legendre et al., 2002; Pierce, 1992), compared with 2;6 for comprehension; age range 2;2-3;10 in English (Brown, 1973), compared with 5-6 for comprehension; age range 1;6-1;7, or perhaps 1;11, in Spanish (Bel, 2001; López Ornat et al., 1994), compared with 4;8 for comprehension. [10] This pattern of early production is compatible with the claim that children have S-V agreement competence early only if an alternative explanation is provided for their failure to show comprehension in English and Spanish. Such an alternative is particularly imperative if one adopts a hypothesis in line with Grammatical Conservatism (Snyder, 2011), which holds that children spontaneously use structures only when "they have both determined that the structure is permitted in the adult language, and

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[10] Results from elicited tasks, especially those involving novel forms, should be interpreted cautiously because of task demands. In her classic study, Berko (1958) found poor production of S-V agreement in novel elicitation tasks through the age of 7 in English (56% accuracy in inflecting the novel verb in e.g. "*This is a man who knows how to lodge. He is lodging. He does it every day. Every day he* – "). Knowledge might be masked due to demands placed on children's computational resources. As mentioned above, Rice & Wexler (1996) report a 90% level of target insertion in an elicited production task by age 4.

identified the adults' grammatical basis for it." The fact that children spontaneously produce 3rd person –s in 90% of obligatory contexts between 2;2-3;10 months of age (Brown, 1973) indicates that they are confident about S-V agreement. Below, we put forward an alternative hypothesis that the contrast in comprehension between French on the one hand and English/Spanish on the other derives from a relative ease at detecting the target number cues in the French experimental stimuli, compared to the English and Spanish ones.

Note, however, that early production is also compatible with lack of grammatical competence if one adopts the usage-based view that young children memorize (lexical) frames that are frequent in the input (Theakston et al., 2003). Previous analyses of French corpora reveal three patterns that are indicative of only a loose relationship between input forms and child performance (Legendre et al., 2010b; Barrière et al., in revision). First, liaison-based S-V agreement is not common in the input (less than 20% of the time; this is presumably tied to the fact that it is found only with vowel-initial verbs, which make up less than 12% of the total number of verbs). Second, the input contains a strong singular–plural asymmetry, with plural forms of liaison-based S-V agreement being very rare, while there is no such asymmetry in our experimental results. In an elicited production task French–speaking children, age 2;0-2;7, have been shown to produce prefixal agreement (subject clitics) 83.6% of the time vs. 16.4% omissions (Jakubowicz & Rigaut, 1997). In French then, all results (spontaneous production, elicited production, and comprehension) converge on the conclusion that French-speaking children have mastered (at least one subtype of) S-V agreement, despite the fact that the liaison-based pattern tested is rare in the adult input. Finally, the verbs used in the experiment exhibit low frequencies: out of 10,596 lexical tokens in the input to which 18 and 24 month olds children are exposed (extracted from the CHILDES corpus), twelve occurrences (i.e. 0.001%) of two of the experimental verbs were identified, including eight tokens of *ouvrir* 'open' and four tokens of *attraper* 'catch'. Since comparative analyses of the input have yet to be carried out for English and Spanish, we must consider two options. If the input is poor in S-V agreement forms in English/Spanish, children must be assumed to have grammatical competence to account for their production. If on the other hand the input were found to be rich in S-V agreement forms, then further work would be required to establish whether children's productions mirrored input items or instead are based on more abstract grammatical knowledge. In this case an explanation as to why there would be no competence in the presence of rich input (English/Spanish) but competence in the absence of rich input (French) is difficult to envision on the usage-based account.

5.2 Perceptual differences and cue reliability in agreement morphology

These remarks, however, leave open the possibility that differences in comprehension of S-V agreement are due to the relative perceptual or interpretive strength of the S-V agreement system tested in French compared to English or Spanish. An explanation based on perceptual salience for example would entail that English- and Spanish-speaking children have the competence to *interpret* the number cues, but they do not *detect* the number cue on the inflected verb with perfect reliability. There are in fact several properties of the French agreement subsystem tested that arguably make it salient and therefore likely to be easier to

perceive in comprehension tasks. Interestingly, independent evidence from English has shown that the relative position of –s in a sentence matters for discrimination.

One obvious surface difference between the French subsystem tested compared to its Spanish and English counterparts is that the former is prefixal while the latter are suffixal. Is this advantageous? We do not believe so, for two main reasons. First, theories of processing typically hold that suffixation has a processing advantage because, simply stated, left-to-right parsing of suffixes does not interfere with lexical access. This is reflected in the preference for suffixation cross-linguistically. Cutler, Hawkins, & Gilligan (1985), for example, argue that word onsets are more psychologically salient than other parts of the words and that stems and affixes are processed separately. Under this prominent view, the French S-V agreement tested should be harder, rather than easier, to comprehend. Second, there is evidence from Xhosa, a Southern Bantu language of South Africa, that prefixation of the subject marker does not facilitate comprehension of S-V agreement. Xhosa is a rich agreement, pro-drop language with fifteen noun classes and distinct agreement markers in the singular and the plural. The order of morphemes is: subject marker–tense–(object marker)–verb root.

(8)   a. **U**-nukisa   amablomu
             3SM-sniff flowers
          '(The rabbit) sniffs at the flowers'
        b. **Oo**-nukisa   amablomu
             3PL-sniff   flowers
          '(The rabbits) sniff at the flowers'

In a pointing study Gxilishe et al. (2009) found that Xhosa-speaking children, age range 4-6, do not comprehend singular and plural S-V agreement. Their average 'sensitivity' (computed as the number of singular pictures chosen when singulars were presented divided by the total number of times a singular is presented, and likewise for the plural) hovered around chance, both for the singular and the plural. Smouse et al. (forthcoming) followed up with an act-out task, which revealed somewhat better performance, as measured by their 'sensitivity' (as described above)— above chance for 4-year-olds— but not by accuracy.[11] Overall, these results cast doubt on a simple prefixation vs. suffixation-related explanation for the comprehension contrast between English and Spanish on the one hand vs. French on the other.[12]

Interestingly enough, Gxilishe et al. (2009) and Smouse et al. (forthcoming) compared comprehension of number contrasts between agreement markers (poor overall) vs. pronouns in both 3-5-year-old English-speaking and 4-year-old Xhosa-speaking children. Both groups revealed greater success on comprehending number when carried by overt pronouns (in Xhosa, the overt pronoun co-occurred with a subject agreement marker). Clearly then, not all number

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[11] De Villiers & Gxilishe (2008) report that Xhosa-speaking children spontaneously produce the right number agreement on verbs from an early age: 80% of the time for plural agreement vs. 50% for singular agreement at the age of 24-30 months; by the age of 36 months their level of singular agreement production reaches 65% (with plural level unchanged).
[12] Other factors may play a role in Xhosa, including the presence and learning of other morphemes between the subject marker in initial position and the verbal root.

cues are equal when it comes to comprehension. In line with this idea, in the remainder of the paper we will argue that the best explanation for cross-linguistic comprehension contrasts lies in differences in morpho-phonological structure—in particular, differences in perceptual salience and cue reliability. In a nutshell, the interpretive S-V agreement cue is weak in English and Spanish but strong in the French subsystem tested. Support for this claim draws from a diverse array of previous studies as well as new corpus evidence, considered in turn below.

First, independent evidence has shown that English children's perception of verbal –s is not always robust, but is affected by its position in the sentence. Sundara, Demuth, & Kuhl (2011) compared sentence-final verbal –s with sentence-medial position. Twenty-two- and 27-month-olds were tested on a preferential listening task whereby children saw a cartoon accompanied by a grammatical (e.g. *he cries now*) or ungrammatical sentence (e.g. *he cry now*) presented repeatedly. Both 22- and 27-month-olds showed an ability to detect the presence vs. absence of –s in the sentence-final condition but not in the sentence-medial condition.[13] This study did not test comprehension, however it points to the relative difficulty children have in identifying a morpho-phonological cue in natural speech, depending on its position in the sentence. In the stimuli used in the English and Spanish comprehension studies, the S-V agreement marker was in sentence-medial position (e.g. *the cat sleep-s on the bed*; *nada-n en el charco* '(the ducks) swim in the pond') and thus constitutes a relatively weak interpretive cue. We explore below some suggestive and convergent evidence that by contrast, the interpretive cue in French is strong.[14]

Specifically, we propose that the comprehension advantage observed in French comes from the relative perceptual salience and most importantly the distribution of /z/ liaison compared to English /–s/ and Spanish /–n/.[15] At first glance, the idea that liaison would present an advantage for French learners is perhaps surprising; liaison is one of several sandhi phenomena in French, which result in widespread resyllabification and massive mismatches between word boundaries of words in isolation (listed in the mental lexicon), and syllable-based units of speech segmentation. See for example, *ouvre* /uvʁ/ 'opens' vs. *ils ouvrent* /i(l).zuvʁ/ 'they open' in the verbal domain, *animaux* /a.ni.mo/ 'animals' vs. *les animaux* /le.za.ni.mo/ 'the animals' in the nominal domain. However, a number of studies investigating the processing of liaison have

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[13] This positional evidence contrasts with headturn preference results on infants' sensitivity to verbal –s inflection discussed in Soderstrom (2008). Presented with grammatical sentences like *A team bakes bread* vs. ungrammatical *A team bake bread* infants age 1;7 showed a preference for the grammatical sentences despite the sentence-medial position of the inflection.

[14] Two caveats are in order here. First, Sundara et al. (2011) did not test whether the perception of /s/ or /z/ in roots (e.g. *nose*, *kiss*) is similarly affected by sentence position. One might want to verify this in order to show that the effect is truly acoustic or perceptual in nature. Second, no analogous study has been done in French, but note that children's success in the comprehension tasks discussed here already suggests perception of /z/ liaison in non-final position does not pose an insurmountable problem at this age.

[15] Two factors, however, are potentially confounded in French—resyllabification and syntactic status of subject clitics. To tease these two factors apart, future studies are planned to test Haitian S-V agreement because the language has a resyllabification process similar to that of French but with subject clitics functioning as arguments.

concluded that French adult speakers have no difficulty processing it in diverse tasks, despite the mismatch (e.g. Matter, 1986; Wauquier-Gravelines, 1996; Gaskell, Spinelli, & Meunier, 2002; Spinelli, McQueen, & Cutler, 2003).[16]

Experimental studies also reveal that non-native speakers do not experience liaison as a major challenge, contrary to intuitive expectations. In a cross-modal word-monitoring task with eye tracking using the visual world paradigm Tremblay (2011) found that English learners of French across three proficiency levels recognized liaison-initial words (*fameux élan* /fa.mø.**z**e.lã/ 'infamous swing') more rapidly than /z/-initial words (*fameux zélé* /fa.mø.**z**e.le/ 'infamous zealous one'), whether or not a lexical competitor was present in the display, suggesting that segmenting liaison-initial words does not develop gradually as proficiency increases, but rather abruptly. In Stridfeldt (2005), Swedish learners of French at the introductory level were exposed to the ambiguous novel phrase /lezava/ produced by a French native speaker based on spelling –either *les avas* or *les zavas*–; they judged it to correspond to *les avas* 89% of the time vs. *les zavas* 7% of the time, revealing a bias toward interpreting /z/ as a liaison consonant. It is not surprising then that young French-speaking children would master this dominant trait of the language early.

Studies of spontaneous production of liaison in children support this general conclusion. Young French children are known to make liaison errors in nominal contexts, producing *le nours* /lə.nurs/'the teddy bear' instead of the adult target *l'ours* /lurs/ (Chevrot, Dugua, & Fayol, 2009). This is typically viewed as a consequence of misparsing *un ours* /œ̃.nurs/ 'a teddy bear': the /n/ liaison consonant in indefinite contexts is reanalyzed as the word-initial consonant. Interestingly, this misanalysis of liaison does not have a counterpart in verbal contexts. Buerkin-Salgado (2011) analyzed the data of three children in the Lyon corpus, age 1-3, taking care in distinguishing true liaison errors from other superficially similar errors. She found that the three children produced an average of 10% of liaison errors in the nominal domain. In the verbal domain (S-V agreement) their production of liaison was nearly perfect, as the three children produced 97.4% (1058/1086) of clitic-verb liaison sequences correctly. Of the total 28 errors observed, there were 2 errors with /z/ (both omissions) and 26 errors with /l/ (a mix of omission and replacements).

Finally, Babineau & Shi (2011) tested young Québec French-learning children on their ability to segment liaison consonants, using a preferential looking task. Children were familiarized with

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[16] Most, if not all, theories of word recognition and lexical access rely on matching word boundaries with units of speech processing (e.g. Content, Dumay, & Frauenfelder, 2000); it has therefore been a challenge to explain the ease of processing French despite its sandhi phenomena. For liaison, it has come down to making the argument that liaison consonants are phonetically different from their non-liaison (e.g. word-initial) counterparts (Spinelli et al., 2003). The experimental evidence across liaison consonants /n, t, z, r/, however, is mixed. Some studies have found differences in durational cues (Dejean de la Bâtie, 1993; Wauquiers-Gravelines, 1996 for /t/ only), others have not (Bannert, 1998). Yersin-Besson & Grosjean (1996) report that liaison /z/ is on average 10% shorter than its word-initial counterpart, contra Bannert (1998). If it is shorter, why should /z/ liaison be easy to perceive? We pursue below the idea that the distribution of /z/, namely its extreme rarity as a word-initial consonant combined with its semantic transparency, makes it special.

novel nouns like *onche* /õʃ/ in a variety of obligatory /z, n, t, r/ liaison contexts and tested on either familiarized /õʃ/ vs. non-familiarized /ɛk/, or familiarized /zõʃ/ vs. non-familiarized /zɛk/. When presented with the vowel-initial targets, 20-month-olds showed no difference in looking times between the two conditions, however they had a clear novelty preference for the non-familiarized consonant-initial stimuli. The authors hypothesized that 20-month-olds misperceive vowel-initial words as being consonant-initial due to a general syllable alignment bias, despite statistical cues supporting vowel-initial parsing. At 24 months, however, children succeeded in using sub-syllabic statistical cues to segment vowel-initial words in liaison contexts, as attested by a preference for the familiarized vowel-initial stimuli. Their overall conclusion was that French-hearing children require a significant amount of learning in order to counter the general syllable alignment bias and successfully segment sub-syllabic word units in liaison contexts. What is most relevant to comprehension in our studies is their demonstration that French-learning children can undo /z/ liaison at a very young age—24 months.

Having provided converging evidence that liaison does not pose a particular challenge to learners, we now argue for two *advantages* of /z/ liaison compared to markers in English and Spanish, which we hypothesize to be the main source of relatively early comprehension of the S-V agreement subsystem tested. First, there are reasons to believe that on general perceptual grounds, French /z/ may be more salient than Spanish /–n/, which in turn may be more salient than English post-consonantal /–z/~[–s]. According to Redford and Diehl (1999) and Benki (2003), for example, most properties of consonants are better perceived inter- or pre-vocalically (V_V or _V, as in French) than post-vocalically (V_#, as in Spanish, or V_C), and worse again if not adjacent to any vowel (in this case C_#, as is the case for most English verbs tested), although evidence of more difficult consonant processing in coda than onset position is mixed (Swingley, 2005, Zamuner, 2006, contra Nazzi & Bertoncini, 2009; Swingley, 2009). Because strident fricatives like /s, z/ are in general more acoustically salient than other consonants however, further evidence would be needed to confirm that these positional differences in fact lead to such a perceptual difference between French and English.[17]

The second, and we believe most critical, factor underlying the asymmetry in comprehension between English and Spanish on the one hand and French on the other is cue reliability. Cue reliability has been hypothesized by a number of researchers to explain asymmetries in the order of acquisition of morphosyntax patterns both across and within

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[17] These sounds are characterized by intense high frequency noise, which means their presence and properties can be quite well cued even when they are not adjacent to vowels (see Steriade, 2009). So it is not completely clear that [s]/[z] in the context C_# is less well cued than [n] in V_# –i.e., do the perceptual advantages of stridency offset the disadvantages of not being adjacent to a vowel or not? Voiceless [s] is probably more salient than voiced [z] in most respects, but it is doubtful whether that difference would offset the advantage of being in intervocalic position (French /z/) vs. non-adjacent to a vowel (post-consonantal English [–s]/[–z]). The English /–z/ suffix is voiced [z] after voiced consonants, so if the difference in perceptibility of [s] vs. [z] is significant, we might expect children to acquire the suffix more easily after voiceless consonants (*wraps* vs. *hangs*). We definitely expect the suffix to be more salient after vowel-final words (*ties* vs. *hangs*). We thank Edward Fleming and Colin Wilson for discussion of the relevance of these phonetic factors.

languages (e.g. Brown, 1973; Slobin, 1973; MacWhinney, Bates & Kliegl, 1984). The *–s* marker in English is undoubtedly opaque (as noted by Brown, 1973; de Villiers & Johnson, 2007; and others) as it marks not only the singular on verbs, but the plural as well as the possessive on nouns, resulting in ambiguity like *the cat's litter* vs. *the cats' litter*.[18] The fact that *–s* is plural in the nominal domain but singular in the verb domain may pose particular trouble for learners. A survey of the 1000 most frequent singular nouns in the Corpus of Contemporary American English (Davies, 2008) also reveals that approximately 10% of these singular nouns end in 'plural-sounding' sounds (e.g. *pass, fizz, nose, place*). Beyer & Hudson Kam (2009) explicitly compare children's comprehension of English past tense *–ed* and *–s,* which differ in cue reliability. They show that in a picture matching task, 6-year-olds process *–ed* but not *–s* in sentence comprehension. (Interestingly, they also report eye-tracking evidence suggesting that 6-year-olds are sensitive to the *presence* of *–s* even though they do not appear to integrate it into the meaning of the sentence.) These observations underscore the interpretive challenge that young English-learning children may face when hearing /s/.

In terms of ambiguity, the Spanish *–n* is not as opaque as the English *–s*, as it certainly does not have a conflicting singular *and* plural interpretation. However, critically, in addition to marking 3rd person plural in all verb classes, as mentioned above it does serve as the 2nd person plural verb marker in all Spanish dialects save Castilian. Abstracting away from any contribution of the theme vowel to the marker, the coda consonant /n/ also shows up frequently in nouns, like *buzón* 'mailbox', and adjectives, like *marrón* 'brown'. It is worth noting that the nucleus of the syllable with coda /n/ in a noun is often the locus of the word's main stress in Spanish, e.g. in deverbal nouns such as *información* 'information', *canción* 'song', etc.. A word ending in an unstressed syllable with coda /n/ (although less salient by virtue of the lack of stress) is thus highly likely to be a plural verb, while a word ending in a stressed syllable with coda /n/ is probably a singular noun or adjective. Whether young children track these probabilities is unknown. Taken together this distribution suggests some level of ambiguity is likely present for children; Spanish *–n* does reliably mark (non-1st person) plural verbs, but it does not uniquely pick out the 3rd person plural, and occurrences of the *–n* consonant in word-final position of some nouns and adjectives may influence its strength as a cue. Note that the singular cue in Spanish (*–a*,) is comparatively more opaque in that it also constitutes a nominal ending; this may contribute to better plural performance in Spanish.

The cue reliability of /z/ as a marker of the plural in French contrasts starkly with that of *–s* in English and *–n* in Spanish. In particular, the distribution of /–z/ in French encourages its early and preferential segmentation as a liaison consonant and, we argue, its early analysis as a reliable marker of plural. First, only about 32 nouns and 6 verbs, including some very infrequent ones of both types, begin with /z/ in French.[19] The only /z/-initial words young children are likely to know are *zèbre* 'zebra', *zoo* 'zoo', and possibly *zéro* 'zero' (although not likely at 30 months). As a result, /z/ is among the word-initial consonants with the lowest frequency in the language

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[18] There is also a derivational suffix –s, used to generate abstract nominals, e.g. *linguistics*, etc. (Stahlke, Cheng, & Sung, 2007).

[19] These numbers reflect the number of *z*-initial words in the first author's active lexicon. A few more scientific nouns and related adjectives can be found in any dictionary. In all the French CHILDES corpora combined there are 11 /z/-initial words (including proper names).

(in the Lyon corpus, Demuth & Tremblay, 2008, /z/ is the least frequent initial consonant, with a total occurrence of only 140 out of approximately 560,000 tokens), making it unlikely to be confused with a liaison segment during segmentation. Furthermore, /z/ liaison obligatorily marks plurality in *both* verbal *and* nominal domains. This means that /z/ has very high semantic transparency or *cue reliability* (95% for /z/, including both verbal and nominal contexts in a corpus study of the input reported in Barrière et al., in revision).[20] We hypothesize that native French speakers (past age 2, given the results of Babineau & Shi, 2011) have a strong preference to process /z/ as a liaison consonant rather than a word-initial consonant; they in turn can immediately undo the resyllabification to recover the root and its meaning. Because /z/ is also the most frequent liaison consonant in corpora of natural speech (50.5 % vs. 30.4% for /t/ and 18.9% for /n/, according to Boë & Tubach (1992), based on 20 hours of adult speech), native speakers necessarily receive a lot of practice processing it starting at a very early age.

5.3 Overall conclusion

Convincing evidence suggests that French-speaking children have mastered liaison-based S-V agreement by the age of 30 months, as revealed by their ability to discriminate singular from plural agreement with both known and novel verbs, in both preferential looking and pointing tasks (Legendre et al., 2010b; Barrière et al., 2011). By contrast, at a slightly older age (approximately 35 months) we found *no* evidence of comprehension in English children, and comprehension of the plural only in Spanish. These results were found using the same visual stimuli and comparable methods and procedures. While our findings for English and Spanish children confirm the comprehension delay identified previously in Johnson et al. (2005) and Pérez-Leroux (2005), the asymmetry found for French children clearly suggests that late comprehension is *not* the result of universal properties of agreement. A number of additional possible explanations for delays in S-V agreement comprehension (compared to production) also fail to account for the full range of results surveyed here, although the overt vs. null morpho-phonological status of the relevant person/number features, suggested by Pérez-Leroux (2005), may contribute to the differences found. An alternative working hypothesis we have put forward ties earlier comprehension in French to the high perceptual saliency and cue reliability of the /z/ liaison consonant—which unambiguously signals plural morphology. This is in contrast to English –s which is particularly opaque and likely serves as a relatively poor cue for children. The Spanish –n, while not as ambiguous as English –s, nevertheless does not offer the same level of reliability as a marker of plurality (or person) as the French.

As mentioned in section 1 and exemplified in (1), French has another subsystem of (suffixal) S-V agreement, which, at a superficial level, resembles the Spanish system (it is likewise inherited from the conjugation class system of Latin, though it results in high phonological variation of the plural inflection). It remains to be seen through further studies planned for the near future whether comprehension performance on 'irregular' S-V agreement aligns with late

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[20] /z/ liaison does not mark plurality 100% of the time. Contexts like *mais il* /me.zil/ 'but he' may undergo /z/ liaison. The main difference is that /z/ liaison marking plurality is obligatory in all contexts while non-plurality /z/ liaison is merely optional, and tied to register level. In the spoken register, speakers avoid optional liaisons, which are characteristic of a more formal register.

success in Spanish/English, or whether early success on liaison-based agreement might 'prime' French-speaking children and ensure early mastery of S-V agreement across the board.

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