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Agarra, agarran: Evidence of Early Comprehension of Subject-Verb Agreement in Spanish

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Abstract

Studies across many languages (e.g., Dutch, English, Farsi, Spanish, Xhosa) have failed to show early acquisition of subject-verb agreement, while recent studies on French reveal acquisition by 30 months of age. Using a similar procedure as in previous French studies, the present study evaluated whether earlier comprehension of subject-verb agreement in (Mexican) Spanish can be revealed when task demands are lowered. Two experiments using a touch-screen pointing task tested comprehension of SV agreement by monolingual Spanish-speaking children growing up in Mexico City, between about 3 and 5 years of age. In Experiment 1, the auditory stimuli consisted of a transitive verb + pseudonoun object (e.g. *agarra el micho* 'he throws the micho' vs. *agarran el duco* 'they throw the duco'); results failed to show early comprehension of SV agreement, replicating previous findings. In Experiment 2, the same stimuli were used, with the crucial difference that the word *objeto* 'object' replaced all pseudonouns; results revealed SV agreement comprehension as early as 41 to 50 months. Taken together, our findings show that comprehension at this age is facilitated when task demands are lowered, here by not requiring children to process pseudowords (even when these were not critical to the task). These findings hence underscore the importance of task-/stimulus-specific features when testing early morphosyntactic development, and suggest that previous results may have underestimated Spanish-speaking children's competence.

Introduction

For nearly half a century research in language acquisition has investigated asymmetries between children's ability to *comprehend* certain forms and their ability to *produce* those same forms. As noted in an early review of studies on the relationship between young children's developing ability to comprehend and produce language, there is a cogent argument to be made that comprehension must logically precede production (Clark & Hecht, 1983). But the appearance of production in the absence of comprehension is not impossible: children may have partial but not full comprehension of certain forms, even while they produce them in what seems to be fully adult-like contexts (e.g. Childers, Fernandez, Echols, & Tomasello, 2000; Clark & Hecht, 1983; Rispoli, Hadley & Holt, 2012). On the other hand, it is also possible that failures in establishing children's comprehension are not related to lack of knowledge of the relevant linguistic structures, but are instead due to processing issues, if the tasks used to assess comprehension were excessively challenging for probing children's emerging linguistic knowledge (cf. the discussion in Arias-Trejo, Cantrell, Smith, & Alva-Canto, 2014; Crain & Fodor, 1989). Hence, a challenge in studying comprehension lies in determining the cues that children use in order to interpret specific structures (Weiss, 2009). The acquisition of subject-verb (SV) agreement is one of the few domains in which much research has suggested a reversal of the typical precedence of comprehension relative to production (cf. Legendre et al., 2014). Yet many methodological factors may have obscured children's grammatical competence in these studies, giving the impression that children have acquired less abstract linguistic knowledge than they actually possess (Naigles, 2002). The present study reevaluates SV agreement comprehension in monolingual Spanish-speaking children, in two experiments manipulating task demands.

In recent years, research on SV agreement has painted an increasingly more nuanced picture of its acquisition in a variety of languages. Studies on children acquiring English have failed to provide evidence of comprehension of number agreement in the 3rd person until surprisingly late, around 60 months (Childers et al., 2000; Johnson, de Villiers, & Seymour, 2005; Legendre et al., 2014). This result may not be unanticipated given the impoverished nature of English morphosyntax, the relative infrequency of the use of the simple present in modern English (i.e., speakers use the present progressive, "Sam is running", at least twice as often as the simple present, "Sam runs", in the presence of children, Barrière et al., 2016a), as well as findings suggesting that it is not until around 40 months that English-speaking children reliably produce SV agreement (e.g., Brown, 1973; de Villiers & De Villiers, 1973). Similar late emergence of SV agreement comprehension (i.e., at 60 months) was also reported in Spanish (Legendre et al., 2014; Pérez-Leroux, 2005), a morphologically rich language in which children are claimed to reliably *produce* SV agreement by age 30 months (Clahsen, Aveledo & Roca, 2002; Montrul, 2004; Mueller Gathercole, Sebastián, & Soto, 1999; cf. Table 1 for examples of SV agreement in English, French and Spanish). Similar asymmetries between production and comprehension abilities have been observed in other languages that also exhibit rich verbal morphology including Farsi/Persian (Rastegar, Shirazi, & Sadighi, 2012), German (Brandt-Kobele & Höhle, 2010), Xhosa (Smouse, Gxilishe, de Villiers, & de Villiers, 2012). and, to a lesser extent, Dutch (Verhagen & Blom, 2014).

Table 1. Example of SV agreement in English, French[1] and Spanish (and phonetic transcription).

English	**French**	**Spanish**

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[1] In spoken French (which represents a diachronic change from the written standard), subject clitics have the status of agreement markers rather than pronouns, based on both distributional properties (Legendre et al., 2010b) and experimental evidence (Culbertson, 2010). In the conjugation class of vowel-initial verbs tested in the French studies on comprehension, the ending (singular –e/plural –ent) is silent while the singular/plural distinction is expressed via audible 'liaison' and resyllabification of the final consonant of the preverbal subject clitic with the verb. Note that there is also a second agreement system in French (instantiated on irregular verbs such as 'lire': le/les garçons lit/lisent 'the boy(s) read(s)'), that has been explored for acquisition of phonological form (Nazzi et al.,2011) but not yet for comprehension.

Singular	**He**SG catches**SG** /hikætʃəz/	**Il**SG -attrape_SG /ilatʁap/	**El**SG agarra_SG /el aˈɣa
Plural	They**PL** **catch_PL** /ðeɪ kætʃ/	**Ils**PL -attrapp**ent**PL /izatʁap/	**Ellos**PL agarran**PL** /eʎos aˈɣaran/

Nevertheless, further methodological refinements, and testing the acquisition of SV agreement in a growing range of languages, have shown that such late acquisition may not be universal and, indeed, may depend on language-specific as well as task-specific factors. These include the kind of stimuli used (e.g., auditory alone vs. multimodal; still images vs. dynamic videos), the structure of the linguistic stimulus (e.g., the position of the agreement morpheme in the utterance; the degree of the morpheme's salience), and the structure of the language's agreement paradigm (how reliable a cue to SV agreement the phonological manifestation of the morpheme is).

In fact, a recent study exploring predictive processing in English-learning toddlers has revealed that 28-to-42-month-olds can use agreeing verbs to predict number features of an upcoming noun (Lukyanenko & Fisher, 2016). In this study, children were presented with two pictures (depicting either one or two elements; e.g. one of an apple and the other one of two biscuits) accompanied by a question in which the verb could either be informative as to the number of elements (e.g. Where is the good apple? i.e., via agreement between 'is' and the post-verbal subject) or uninformative (e.g. Can you find the good apple?). Their results showed that children were faster and more likely to shift from distractor to target in the informative condition, showing evidence of early sensitivity to SV agreement. These findings highlight the importance of task-specific factors and their effects on children's ability to demonstrate knowledge of agreement in comprehension.

After reviewing in more detail the research that has identified the roles and effects of these factors, we present a new experimental study that addresses another factor potentially influencing the accuracy of the depiction of young children's SV agreement knowledge gathered from experimental research: the use of pseudowords and how this can influence the child's conception of the task goals, even when those words are not critical to the task (see Naigles, 2002).

Previous results in French and Spanish

The methodological and stimulus details used in recent research on the acquisition of SV agreement (Barrière et al., 2016b; Legendre et al., 2010a, 2014), whose methods we employ here, differ in potentially important ways from earlier research on the comprehension of agreement in first language acquisition (Johnson et al., 2005; Pérez-Leroux, 2005). In this section, we review these differences and discuss how they may have impacted previous findings.

The work of Legendre et al. (2010a) and Barrière et al. (2016b) on French SV number agreement sought to remove several characteristics of earlier studies that may have negatively affected children's ability to succeed in the task, even if the requisite grammatical representations were in place. First, dynamic visual stimuli were used to increase the visual appeal and interpretability of the scenes and potentially increase participant engagement while both Johnson et al. (2005) and Pérez-Leroux (2005) used still pictures. Relatedly, both Johnson et al. (2005) and Pérez-Leroux (2005) had used displays contrasting a single agent with a pair of agents, which could be problematic if children have a general preference for looking at a display with more agents. On the contrary, Legendre et al. (2010a) and Barrière et al. (2016b) only used displays with two actors (contrasting whether the action is performed by only one or both actors), which arguably could have made the task more difficult because the number refers to agents, and not actors present on the scene.

Second, two semantic issues arising from the mapping between such scenes and the utterances that are meant to distinguish them (see Kouider, Halberda, Wood, & Carey, 2006 for additional discussion) were considered in the studies on French. A singular utterance like "the duck swims in the pond" could in principle be interpreted as referring to either the singular display or to *one* of the ducks in the plural display (distributive reading). A plural utterance like "the ducks swim in the pond" could be interpreted as referring to both displays, which together contain swimming ducks (collective reading). These interpretations could lead to apparent errors on both singular and plural trials. Following Kouider et al. (2006), Legendre et al. (2010a) and Barrière et al. (2016b) used two distinct unfamiliar objects for singular and plural visual displays in order to discourage such interpretations. That this design succeeded in guiding children toward the intended interpretations is suggested by the success of French-learning 30-month-olds in the task (cf. Legendre et al., 2010a; Barrière et al., 2016).

Third, pseudonouns were used to designate the unfamiliar objects to provide a neutral formulation, since there were two different objects in the videos. Another advantage of using pseudonoun labels is that it obviates the need to control for children's knowledge of noun vocabulary. Finally, the use of pseudonouns also neutralizes the possible effect of frequent associations between specific nouns and verbs. This could facilitate the task and support the interpretation of children's performance as an actual indication of the comprehension of morphosyntactic markers, as opposed to the assignment of the roles of agents and patients to familiar lexical items (Valian, Prasada, & Scarpa, 2006).

These potentially more engaging visual stimuli and less ambiguous visual and auditory stimuli were used in the context of Intermodal Preferential Looking studies, as well as two pointing studies, to test early comprehension of agreement in French. It was found that children as young as 30 months show successful comprehension in both tasks (Legendre et al., 2010a), even in a more challenging task using nonce verbs (Barrière et al., 2016). This suggests that the alternative distributive or collective interpretations we highlighted above may have been a problem in previous studies. Legendre et al. (2010a) and Barrière et al. (2016) may have overcome this methodological challenge with their use of videos featuring two actors and unfamiliar objects, and their use of pseudonouns. Legendre et al. (2014) then used this methodology to seek evidence of early comprehension in Mexican Spanish-learning children. Despite these methodological improvements, their results were nevertheless in line with Pérez-Leroux (2005): no evidence of successful comprehension was revealed in children ranging from 30 to 47 months. These results strongly suggest that even when holding visual stimuli and other task properties constant, differences remain in the development of SV comprehension across French- and Spanish-speaking children. The primary hypothesis proposed by Legendre et al. (2014) to explain this difference revolves around language- specific properties of the French and Spanish SV agreement systems. These crosslinguistic differences include, for example, the use of overt markers (that applies to the expression of the plural in Spanish, the singular in English, and to both the singular and the plural in French) vs. null markers, and to the relative salience and cue reliability of the overt markers across languages.

Here, we build on these previous findings by examining another factor that may have contributed to the 30-to-47-month-old Spanish-learning children's apparent failure to comprehend SV agreement in Legendre et al. (2014), namely the potential role of the pseudonouns in the stimuli. As explained above, pseudonouns were previously used to provide a neutral formulation (given the two different objects that appeared in the videos), and 30-month-old French-speaking children were able to use SV agreement to map successfully those sentences containing pseudonouns to their target images. However, there are reasons to believe that including pseudowords may introduce an additional source of complexity in this task, in particular as children grow older (see more on this below). The literature provides some evidence for a cost in processing non-words (Berko, 1958; Riches, Faragher, & Conti-Ramsden, 2006; but see Barrière et al., 2016b, for an example of the lack of a lexicality effect). The inclusion of pseudowords may thus have decreased the computational resources available to the Spanish-speaking children to process the SV agreement markers. Going one step further, it could be that the pseudowords actually acted as a distraction to the Spanish-speaking children if these children construed them as being relevant to the task, so that they may have been actively trying to map the pseudonouns onto the unknown objects in the scene. But if so, why were the Spanish-speaking children in Legendre et al. (2014) more affected than the French-speaking children in Legendre et al. (2010a) who succeed when presented with pseudonouns? There are at least two possible explanations for this. First, the Spanish-learning children (30 to 47 months) were older than the French-learning children (28 to 35 months for preferential looking; 28 to 32 months for pointing). Therefore, having larger vocabularies, they might be less used to encountering novel words (so that the distinction between real and pseudowords might have been more relevant to them than to the younger children) and thus they may have been more troubled by the fact that they did not know the words designating the unfamiliar objects. Second, the agreement cue is suffixal in Spanish (e.g., *agarra-n el duco* 'they catch the duco') while it is prefixal (e.g., *ils –z–attrapent le douk* 'they catch the douk') in the phonological liaison-based subsystem of French tested in Legendre et al. (2010a) and Barrière et al. (2016). The closer temporal alignment of the agreement

cue with the following pseudonoun may, therefore, have induced greater interference in processing, and hence might have been more detrimental to comprehension, in Spanish than in French.

In the present study, we tested the hypothesis that pseudonouns might have been detrimental for SV processing in Spanish-speaking children by manipulating the use of pseudonouns in two related experiments. These new experiments were very similar in procedure to the pointing experiment in Legendre et al. (2010a), the main difference being that because we could not make video recordings of the sessions for ethical reasons, children were asked to tap a touch screen that automatically recorded the responses, rather than to point at computer screens while being videotaped. We tested children between 38 and 64 months of age, given previous studies failing to show comprehension of SV agreement in Spanish before 60 months of age (Pérez-Leroux, 2005; Legendre et al., 2014). We compared comprehension of SV agreement when pseudonouns were used to label the unfamiliar objects (Experiment 1) with its comprehension when the familiar generic word *objeto* 'object' wasused instead (Experiment 2). If pseudonouns have indeed been detrimental for SV processing in Spanish-speaking children, better performance would be expected in Experiment 2, even though pseudonouns were not critical to the task. Given the range of ages at which SV agreement has been shown to emerge in comprehension and our hypothesis that Spanish- speaking children should succeed at some point between the ages at which French- and English-speaking children do, participants in both experiments were separated into two age groups: the younger group included children aged 50 months or younger and the older group included children aged 51 months or older.

Experiment 1

Method

Participants. Forty monolingual Mexican Spanish-speaking children were tested (mean age = 50 months, SD = 7; range: 38-64 months; 22 girls, 18 boys). While 100% of participants completed the task, the data of four additional children were not included in the analyses due to a side bias (always responding to the same side of the screen; N = 2) or to an object bias (repeatedly stating, "I do not know which the 'pseudonoun' is"; N = 2, see more on this issue below). Grouping children by age around the 50-month cut-off resulted in a younger groupthat included children aged 50 months or younger (N = 19; mean age = 43 months, SD = 4; range: 38-50 months; 12 girls, 7 boys), and an older group included children aged 51 months or older (N = 21; mean age = 56 months, SD = 3; range: 51-64 months; 10 girls, 11 boys).

Stimuli.

Visual Stimuli. The visual stimuli were sixteen videos of eight different actions borrowed from Legendre et al. (2010a); a sample still image is shown in Figure 1. In each video two boys appear, and for each action, either one boy performs the action alone while the other boy stands still beside him (singular video), or the two boys perform the action jointly (plural video). Different unfamiliar objects were used in the singular and plural conditions of each action (hence, a total of sixteen unfamiliar objects were used). Thus, the same action was performed on different objects by a single boy (singular video) versus two boys (plural video). All video sequences lasted 6 seconds.
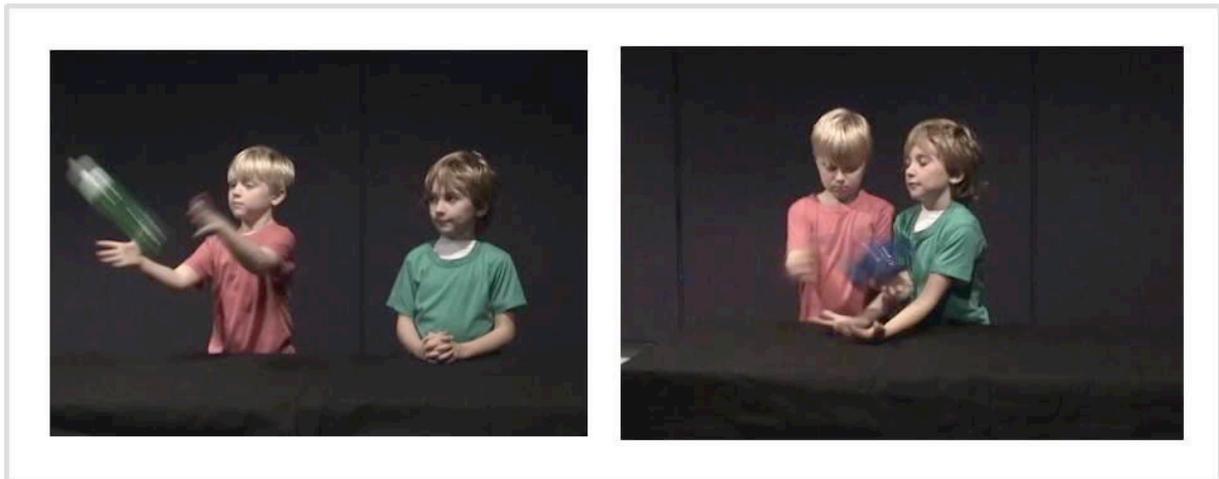
Figure 1. Still image extracted from one video pair (left: singular action; right: plural action).

Auditory Stimuli. Auditory stimuli consisted of short null subject sentences having a transitive verb + determiner + pseudonoun structure (e.g. *agarra el miso* '(he) catches the miso' vs. *agarran el miso* '(they) catch the miso'). Null subject sentences, the predominant pattern for 3rd person referents in Spanish (Cameron, 1992), were used in order to provide only a single cue to number from the verb (as was done in the French study by Legendre et al., 2010a). Eight verbs, referring to the eight actions in the videos, were used: *amarrar* 'tie', *agarrar* 'catch', *besar* 'kiss', *quitar* 'remove', *limpiar* 'wipe', *parar* 'stop', *llevar* 'carry', *sacar* 'take out'. These verbs were chosen because they are known by many children according to the Mexican Spanish adaptation (Jackson-Maldonado, Marchman, Thal, Bates, & Gutierrez-Clellen, 1993) of the MacArthur CDI "Words and phrases" (Fenson et al., 1993), they follow the most regular pattern of Spanish verbal morphology (ending in -*ar*), and they can all be used transitively. Although there were sixteen different objects, only eight pseudonouns were used, given that there were eight trials and only one of the objects was labelled on each trial. The eight pseudonouns used were: *lipe, pliro, napo, duco, leto, miso, trude*, and *jaldo*. They were all disyllabic and, to facilitate naturalness, designed to have high frequency Spanish phonological neighbors. Like real masculine nouns, all novel nouns ended in the two most frequent masculine noun endings –e (N=2) or –o (N=6), matching the relative proportion of e- versus o-ending nouns in Spanish (Clegg, 2011).

Procedure and Apparatus.

Each child was tested individually in a quiet space within their kindergarten. Children were seated in front of a touchscreen LCD 22" monitor (Planar PX2230MW). The touchscreen was connected to a laptop controlling the presentation of the visual stimuli. The experimenter was seated behind the child and next to the laptop. First, the child was told that some images would appear on the screen and that she would be asked to touch one of the images. Each experimental session began with four training trials, consisting of two images of familiar objects (a house, a car, a cat, a dog, a book, a key, an apple or a leaf) presented on each side of the screen. After 12 seconds of visual presentation, the live experimenter said, for example: *Viste la* **casa***?, muéstrame con tu dedo la* **casa***, dónde está la* **casa***?* 'Did you see the house? point to where the house is, where is the house?'. When the child touched the image, the color of the screen background changed from black to purple, indicating that theanswer was registered. After the four training trials, a 3-second-long video of two boys waving was presented (the same boys that appear in the test videos) while the experimenter said: "Now you will see videos of two boys doing different activities and I will ask you to point at one of them, watch them carefully!"

The test phase consisted of eight trials. Each trial started with one video presented in silence twice on the left side of the screen. After the first video disappeared, a second video appeared in silence on the right side of the screen; it was played twice and then disappeared. Both videos depicted the same action, with one video representing the 'singular' form of the action and

the other representing the 'plural' form (see Fig. 1). Then, both videos (plural and singular) were displayed simultaneously while the live experimenter said, for example: *Viste?*
agarran el duco, muéstrame con tu dedo en cuál imagen agarran el duco, dónde agarran el duco
'Did you see? (they) catch the duco, point to where (they) catch the duco, where (do they) catch the duco?' As in the training phase, the color of the screen background changed when the child touched the image. At the end of each test trial, the same eye-catching video used after the training trials (see above) was displayed on the side which played the *matching* video to keep the children interested in the task, following Kouider et al. (2006). Each trial was only presented once. There was no explicit response time limit; however, all children responded rapidly after they were asked to point at the screen.

For half of the test trials, the speech stimulus, produced by the live experimenter, corresponded to the singular video, while it corresponded to the plural video for the other half of the trials. All verbs were presented with equal frequency in the plural and singular conditions across participants. The side on which the matching video was presented was counterbalanced within participants (hence for the singular trials, 2 out of 4 correct responses were on the left side, the other 2 being on the right side; same for plural trials).

Results

Accuracy Analyses. As in Legendre et al. (2010a), the percentage of pointing towards matching videos (accuracy) was calculated for each child, both for the singular and the plural. To explore whether response accuracy was modulated by age and number, a two-way ANOVA was conducted with the between-subject factor of age (younger vs. older) and the within-subject factor of number (singular vs. plural). Neither age ($F(1, 38)= 0.01$, p=.91), number ($F(1, 38)=0.65$, p=.43), nor the age by number interaction ($F(1, 38)=2.24$, p=.14) reached significance. The results failed to show above chance level performance overall ($M_{Total} = 54.37\%$, SD = 15.90%; $t(39) = 1.74$, p = .09). In spite of the lack of main effects and interactions (hence the failure to find that infants perform differently across ages and number conditions), we nevertheless explored whether accuracy for each modality of these factors differed from chance. The results showed overall performance at chance level for both the younger ($M_{Total} = 55.26\%$, SD = 17.34%; $t(18) = 1.32$, p = .20) and the older group ($M_{Total} = 53.57\%$, SD = 14.87%; $t(20) = 1.10$, p = .28), as well as for singular trials ($M_{Singular} = 51.87\%$, SD = 27.96; $t(39) = .43$, p = .67). Performance in plural trials was found to be greater than chance ($M_{Plural} = 56.88\%$, SD = 18.76; $t(39) = 2.32$, p = .03), but only marginally so when corrected for multiple comparisons. Figure 2 displays overall mean performance (left bar), with singular and plural mean performance in the center and right bars, respectively.
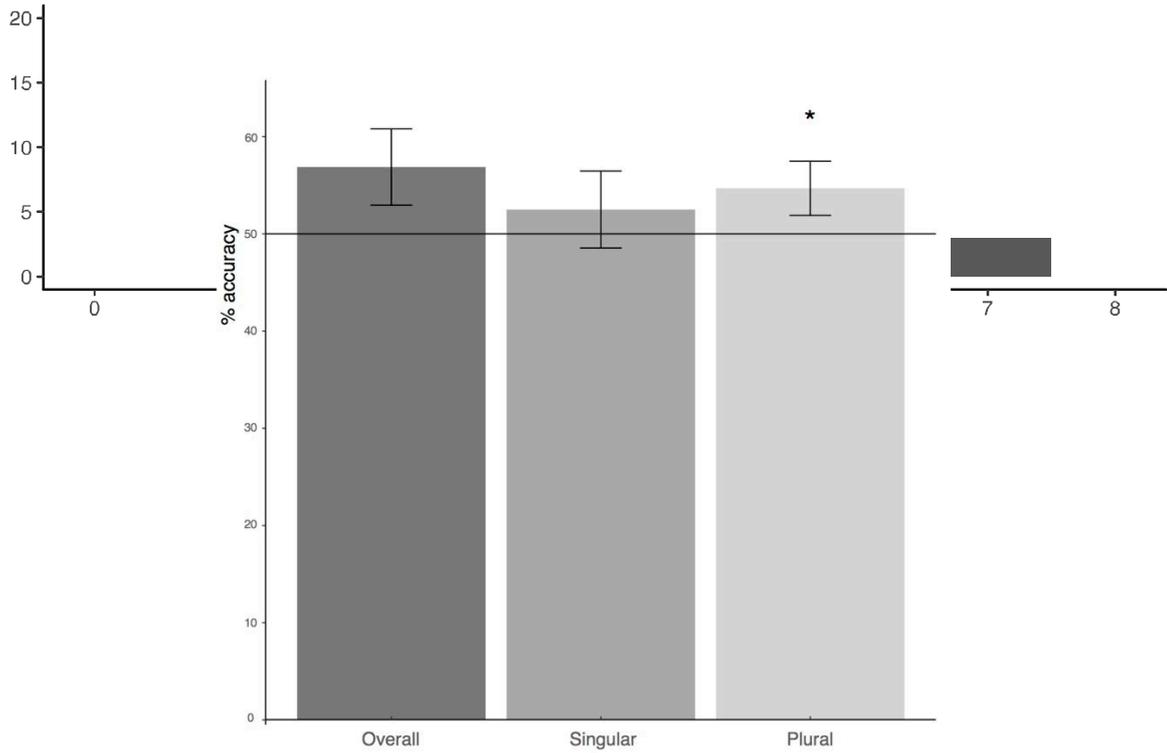
Figure 2. Accuracy Scores: percentage of pointing towards matching videos (and SEs) across all trials, on singular trials only, and on plural trials only.

To permit examination of the distribution of accurate responders across the whole sample, Figure 3 displays histograms of the number of children performing at each level, also broken down by number.
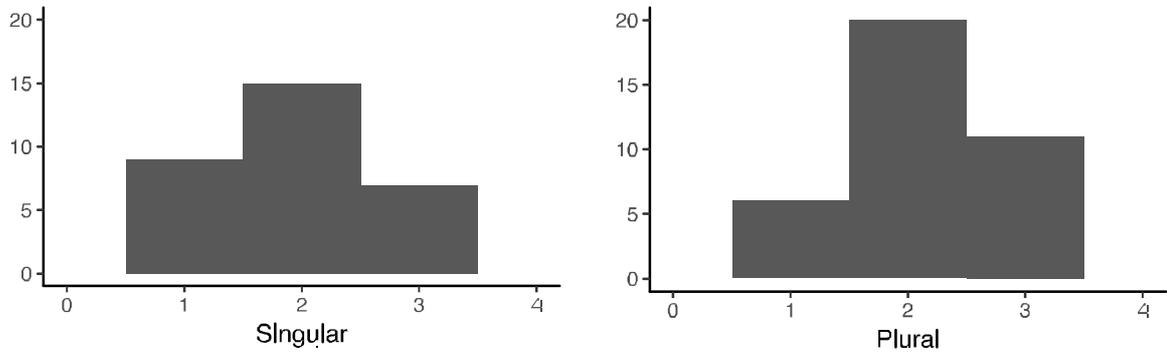

Figure 3. Histograms of the number of children performing at each level (from 0 –all incorrect responses- to 4/8 –all correct responses), overall (top panel) and also broken down by number: singular (left panel) and plural (right panel).

Sensitivity Analyses. Following Johnson et al. (2005) and Barrière et al. (2016b), we also conducted sensitivity analyses that reflect the proportion of a child's points to a given video type (singular or plural) that is linked to hearing that verbal stimulus type. Sensitivity analyses allow to correct for the possibility that the pattern of correct responses in different conditions is biased due to non-linguistic preferences toward one type of visual stimulus (e.g., toward the plural videos because two boys are more attention-getting than one). Therefore, for each participant, we computed two sensitivity scores, one score for the singular and one for the plural videos. Sensitivity scores were computed by dividing the hit rate to one type of videos (e.g., the points to the SG videos when SG auditory stimuli

were presented) by the sum of the hits and the false alarms to the same videos (e.g., all points to the SG videos, whether the auditory stimuli were singular or plural). Accordingly, sensitivity scores were calculated using the following formulas: $\text{Singular Sensitivity}_{(\text{SG videos}' \text{ scores only})} =$

$$\frac{\text{SG hits}}{\text{SG hits} + \text{SG false alarms}} \quad \text{and} \quad \text{Plural Sensitivity}_{(\text{PL videos}' \text{ scores only})} = \frac{\text{PL hits}}{\text{PL hits} + \text{PL false alarms}}.$$

As with accuracy, sensitivity (given in percentages) was analyzed using a two-way ANOVA with age and number. The effect of age (F(1, 38)=0.003, $p = .95$), and the age by number interaction (F(1, 38)=0.07, $p = .79$) failed to reach significance. However, the effect of number was significant (F(1, 38) = 4.68, $p = .037$), establishing that performance was better for the plural than the singular. T-tests against 50% chance-level revealed that sensitivity to singular auditory stimuli did not differ from chance (M = 52.34%; SD = 18.96%; $t(39) = 0.65$ $p = .52$). Sensitivity to plural auditory stimuli was significantly above chance (M = 57.82%; SD = 18.96%; $t(39) = 2.30, p = .03$), although only marginally so if corrected for multiple comparisons, suggesting that the plural verbal stimuli led children to choose the plural videos above chance while this was not the case for the singular condition. The right two panels of Figure 4, below, display the distribution of individual sensitivities to singular vs. plural stimuli, while the left two panels reflect participants' accuracy on those same types of trials, to facilitate comparison between the two measures. The sensitivity measure effectively narrows the dispersion of children's responses, especially in the singular condition, where the accuracy measure appears to be negatively impacted by a bias toward pointing at the plural video.
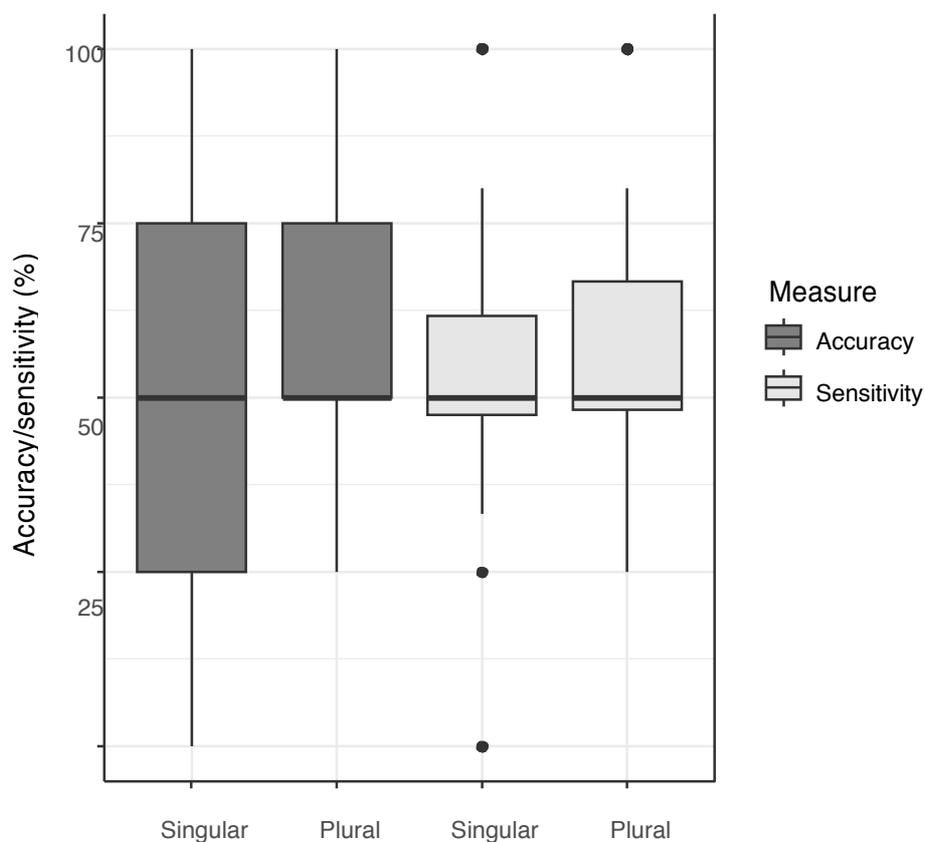
Figure 4. Distribution of accuracy (left) and sensitivity (right) scores (%) towards the target videos on trials in which children pointed towards the singular versus the plural videos. The upper edge of each box represents the 75th percentile and the lower edge of the box represents the 25th percentile. The solid horizontal line in the middle of the plot represents the median (i.e., the 50th percentile). The vertical lines, or "whiskers" are extended to a maximum of 1.5 times the inter-quartile range and the points outside of the whiskers are considered to be outliers.

Discussion

The results of Experiment 1 reveal overall accuracy performance at chance level, although both accuracy and sensitivity measures suggest trends in comprehension of the plural agreement. No effect of age was found in any of our analyses. These findings replicate those of previously-reported studies, which failed to find evidence of early comprehension of SV agreement in Spanish in this age range, while finding better performance for plural agreement (Pérez-Leroux, 2005; Legendre et al., 2014), even when the task was made more interactive and engaging by using a touch screen and live auditory stimuli.

From similar findings, previous work had highlighted differences in the agreement systems of French and Spanish which could explain why child learners of the former succeeded in this task while learners of the latter did not (cf. Legendre et al., 2014). Here, however, our goal was to simplify the task itself in order to potentially reveal comprehension in Spanish as early as possible. To do this, we explored the possibility that children may have had difficulties with the pseudonouns in the test sentences. If these pseudonouns (particularly in the context of known verbs) increased processing difficulty or distracted children from the otherwise unambiguous agreement distinction, this could have negatively impacted their performance. This idea was supported by several children's comments to the experimenter during the task. Two children, in particular, said repeatedly, *No sé cuál es el "miso"* 'I do not know which the "*miso*" is'. This suggests that during

the test phase these children may have been actively trying to discover which object the pseudonoun in the sentence corresponded to, thus reducing attention to the SV agreement. Experiment 2 tested this possibility, replacing the pseudonouns with the word *objeto* 'object,' thus avoiding presenting children with unknown words in the test utterances. Importantly, though, the objects on the two visual scenes remained different, and the generic word *objeto* could refer equally to each of them

Experiment 2

Method

Participants. Forty monolingual Mexican Spanish-speaking children were tested (mean age = 51 months, SD = 7; range: 41-61 months; 16 girls, 24 boys). The data of two additional children were not included in the analyses due to a side bias (children always responded to the same side of the screen; N = 2), although as above all children who began the task completed it. This sample did not differ in age from the sample tested in Experiment 1 ($t(77) = 1.25, p > .2$). As in Experiment 1, we also separated the children into two age groups: the younger group included children age 50 months or younger (N = 20; mean age = 43 months, SD = 3; range: 41-50 months; 9 girls, 11 boys) and the older group included children age 51 months or older (N = 20; mean age = 58 months, SD = 3; range: 51-61 months; 7 girls, 13 boys).

Stimuli.

Visual Stimuli. The visual stimuli were the same as in Experiment 1.

Auditory Stimuli. Auditory stimuli were identical to those in Experiment 1 except, crucially, that the pseudonouns were replaced by the frequent noun *objeto* 'object', a word that is one of the six hundred most frequent words of Spanish according to the CREA corpus (Real Academia Española [REA], 2016, June 2). It is important to highlight that the word *objeto* in Spanish is as frequently used to replace the name of an object as the word "thing" in English and it can be acquired as early as 24 months of age (Spanish AoA corpus, Alonso, Fernandez, & Díez, 2015). Hence this word is likely to be familiar to children of this age, although this word is not included in the Mexican Spanish of the MacArthur CDI 'Words and Phrases' adaptation (Jackson-Maldonado et al., 1993). The auditory stimuli consisted of short null subject sentences having a transitive verb + determiner + "object" structure (e.g. *agarra el objeto* '(he) catches the object' vs. *agarran el objeto* '(they) catch the object'). The eight verbs, referring to the eight actions in the videos, were the same as in Experiment 1.

Procedure and Apparatus

The apparatus and procedure used were identical to those used in Experiment 1.

Results

Accuracy Analyses. Percentage of pointing towards matching videos was calculated for each child, broken down by number. Again, a two-way ANOVA was conducted with the between- subject factor of age (younger vs. older) and the within-subject factor of number (singular vs. plural). The effects of age ($F(1, 38)=0.174, p=.68$), number ($F(1, 38)=0.064, p=.80$), and the age by number interaction ($F(1, 38)=0.580, p=.45$) failed to reach significance. The results revealed above chance performance overall ($M_{Total} = 61.56\%$, SD = 18.64%; $t(39) = 3.92, p < .001$). As before, although performance is not significantly modulated by age or number, we explored whether accuracy for each modality of these factors differed from chance: the results showed overall performance above chance in both age groups (younger: $M_{Total} = 62.50\%$, SD = 19.45%; $t(19)= 2.87, p = .009$; older group: $M_{Total} = 60.62\%$, SD = 18.26%; $t(19) = 2.60, p = .01$), confirming that both younger and older children comprehend SV agreement irrespectively of number markers. Moreover, performance was above chance for both singular ($M_{Singular} = 60.63\%$, SD = 23.94; $t(39) = 2.81, p = .007$) and plural trials ($M_{Plural} =$

62.50%, SD = 24.67; t(39) = 3.20, p = .002). Figures 5 and 6 present mean performance level and the distribution of children across performance levels, broken down by number
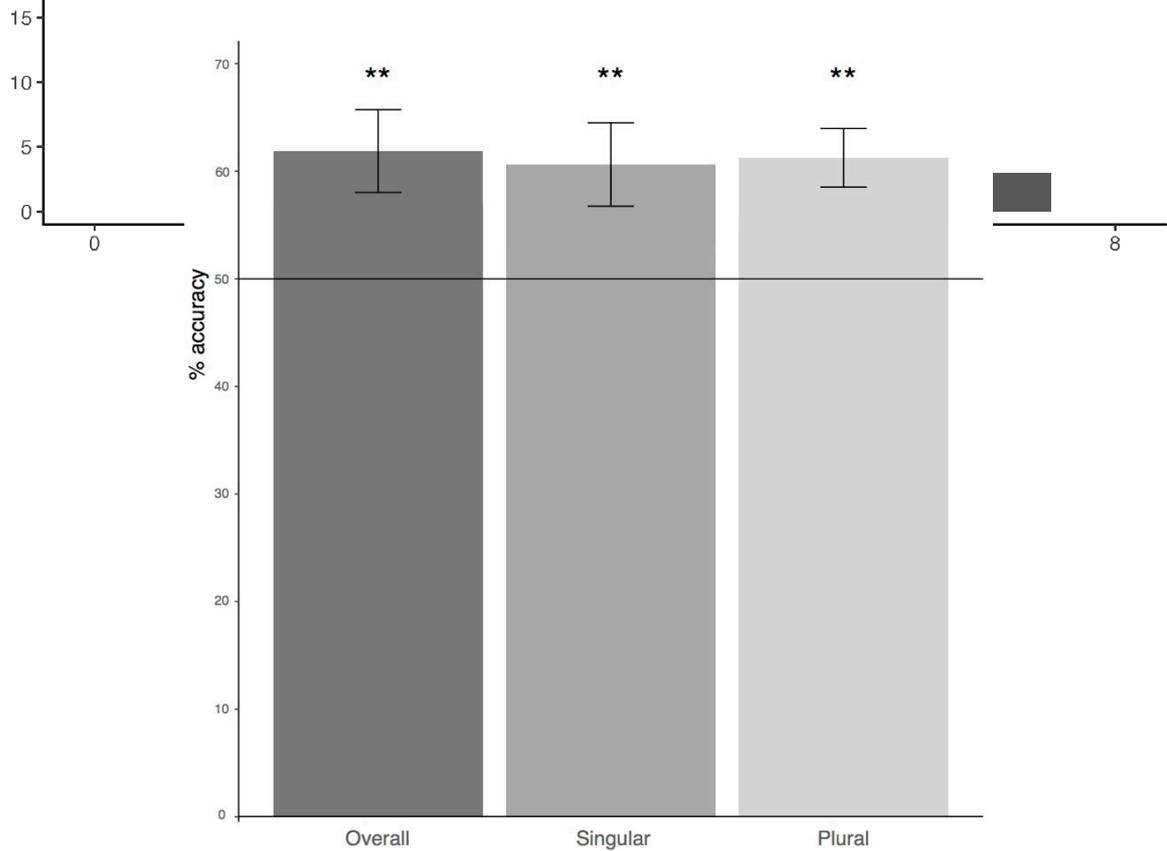

Figure 5. Accuracy scores: percentage of pointing towards matching videos (and SEs) across all trials, on singular trials only, and on plural trials only.
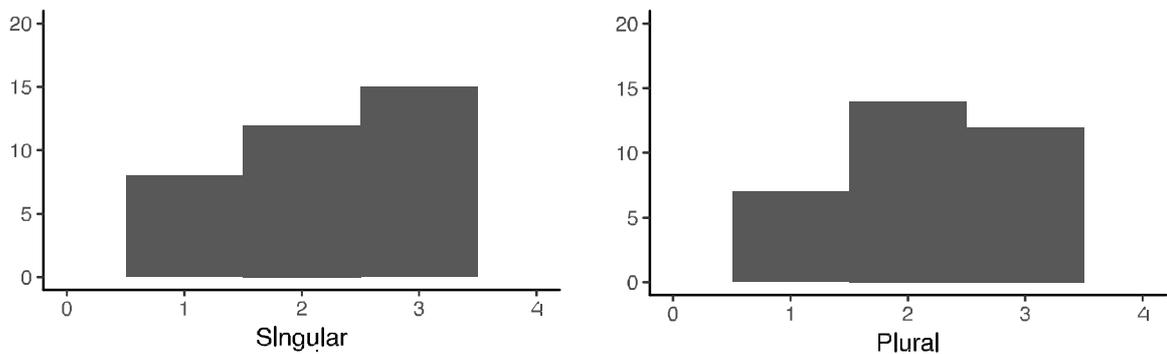

Figure 6. Histograms of the number of children performing at each level (from 0 − all incorrect responses − to 4/8 − all correct responses), overall (top panel) and also broken down by number: singular (left panel) and plural (right panel).

Sensitivity Analyses. As before, effects of age and number on sensitivity were analyzed using a two-way ANOVA. Here, the effects of age (F(1, 38)=0.053, p=.82), number (F(1, 38)=0.119, p=.73), and the age by number interaction (F(1, 38)=0.043, p=.84) failed to reach significance. For comparison with Experiment 1, and in spite of the present lack of an effect of number, t-tests against 50% chance level were conducted, revealing sensitivity to both plural (M = 62.51%; SD = 18.64%; t(39) = 3.82, p < .001) and singular auditory stimuli (M = 63.35%; SD = 25.28%; t(39) = 3.81, p < .001; see Figure 4, right panels).
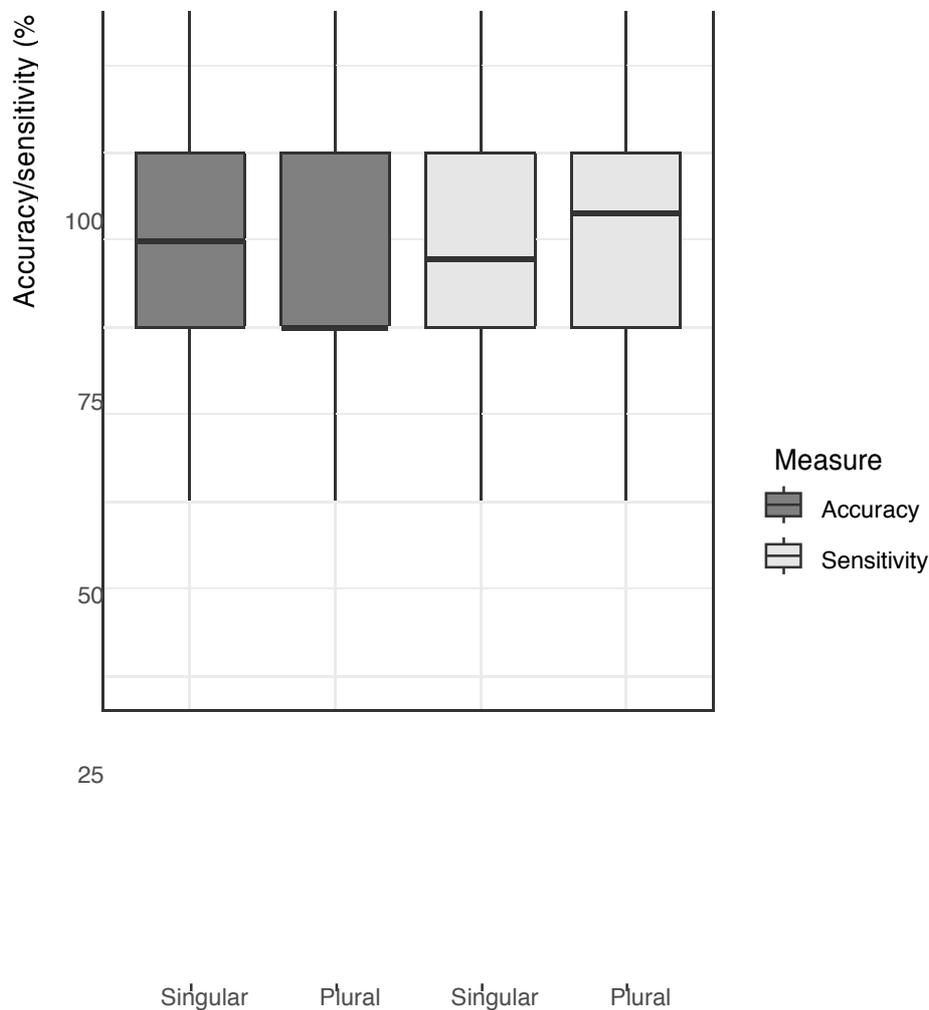
Figure 7. Accuracy (left) and sensitivity (right) scores (%) towards the target videos on trials in which children pointed towards the singular versus the plural videos. (The same plotting conventions are followed as in Figure 4.)

Discussion

The results of Experiment 2 show above-chance performance for both the singular and plural conditions, and for both age groups tested. Our findings, therefore, suggest that when task demands are lowered by removing pseudonouns from the test sentences, Spanish- learning children exhibit clear evidence of SV agreement comprehension as early as 41-to-50 months of age.

General Discussion

The goal of the present study was to explore whether early comprehension of SV agreement can be found in Spanish and how its detection may be modulated by task requirements. Accordingly, we compared comprehension of SV agreement in transitive sentences when pseudonouns were used to label the unfamiliar objects on the videos (Experiment 1) with the use instead of the familiar word objeto 'object' (Experiment 2). The results of Experiment 1 showed overall performance at chance level irrespective of age, although children exhibited performance marginally above chance level for the plural condition. However, the results of Experiment 2 revealed clear evidence of SV number agreement comprehension between 41 and 61 months of age. This was true across both singular and plural trials, and for both the younger and older children tested (that is, before and after 50 months), and whether the outcome measure was accuracy or sensitivity. The findings of Experiment 2 thus establish for the first time that Spanish-learning children's system of SV number agreement is sufficiently in place by 41-to-50 months of age to allow for successful comprehension in an experimental setting.

While comprehension of SV agreement seems to be in place by 41-to-50 months, the results of Experiment 1 are in line with previous findings (Legendre et al., 2014; Pérez- Leroux, 2005) showing better performance for plural agreement in Spanish-speaking children, this time extending it down to the 41-to-64-months age range. Indeed, while these children can reliably map a verb in the

plural form to two agents as opposed to one, they fail to reliably map a verb in the singular form to one agent as opposed to two. Two different explanations might have accounted for the difference in performance between the singular and plural stimuli. The first and simplest possibility would be that children have a general preference for plural actions. However, based on our sensitivity analyses showing that PL verbal stimuli tend to lead children to choose the PL videos more systematically, this possibility seems unlikely. The second possibility would be related to the way SV agreement is marked in Spanish, where there is overt marking of the plural form only (*come* [SG] '(he) eats' vs. *come__n__* [PL] '(they) eat'), increasing its perceptual salience (see Pérez-Leroux, 2005). However, the advantage for plural agreement is not found in Experiment 2, suggesting that these differences only surface under conditions imposing a high cognitive load, and thus that these children do have knowledge of both singular and plural agreement already by 41- to-50 months (since no age effect was found separating the children into median-age-split). To our knowledge, these results represent the earliest evidence of SV agreement comprehension in Spanish.

The difference in performance between Experiment 1 and 2 raises the question of how the presence of pseudowords may have had an effect on performance in our study. We have suggested in general terms that pseudowords may result in a relatively higher processing load for children. However, at least some children in Experiment 1 expressed their confusion with respect to the pseudonouns more concretely, suggesting that they were actively attempting to match the auditory stimuli with the pictures by determining the referent of the pseudonoun rather than by using the SV agreement markers. There are several potential reasons they may have been doing so. First, as in previous studies on this issue (Legendre et al., 2010a; Barrière et al., 2016), our practice trials involved presenting two objects and asking children to match a noun label to one of these objects. This may have led children to expect that objects would be relevant to generating responses to the task (rather than the number of actors). To avoid this possibility, future studies should try having similar types of trials, with similar points of attention, in the practice and in the test phase. Second, the two videos presented for any given test trial were purposefully as similar as possible (the same two boys were present, and the action was necessarily the same) except for the distinct unfamiliar object on each screen (and the number of agents performing the action). This may have made the unfamiliar objects particularly salient to the children. A third possibility is that children wanted to map the new word onto the new object, as a remnant of earlier fast-mapping processes, since their lexicons are still growing. Interestingly, children were not affected by the fact that, in Experiment 2, the same word (i.e. *objeto*) was used to refer to all kinds of unfamiliar objects. This can be explained by the usage that the word *objeto* has in Spanish, where it is frequently used to replace the name of an object just as the word "thing" in English. Since children are accustomed to hearing this word to refer to all kinds of objects, its use in Experiment 2 was not a problem during the task (and did not apparently elicit strong distributive or collective interpretations of the sentences). In fact, instead of being distracting, it might have focused their attention on the SV agreement facilitating the task.

Although the effect of using pseudonouns as opposed to a generic noun like *objeto* has not been evaluated in French, their use did not prevent French-learning children from showing evidence of successful comprehension at an even earlier age, 30 months. We consider possible explanations for this (potential) differential effect: the age difference between the populations tested in French and Spanish; and the differences in agreement marking between both languages, whether in terms of position or in terms of the relative reliability or salience of the agreement markers in both languages.

Regarding age, the Spanish-learning children tested in studies on the acquisition of SV agreement have consistently been older (aged 36 to 60 months) than the French-learning children (aged 28 to 35 months). The age of our Spanish-learning participants in the present study was in keeping with that earlier research, the goal being to establish successful comprehension first at older ages, and then to look at younger children. The age difference between these two populations, though, is highly likely linked to differences in the size of the children's lexicons (Fenson et al., 1993; Jackson-Maldonado et al., 1993). While toddlers very often encounter unknown words, older children have a larger lexicon, and thus are likely to encounter unknown words less frequently. For these older children, it is more likely that the presence of pseudowords might have drawn their attention, obscuring any sensitivity to the morphological SV agreement differences. This explanation is consistent with results obtained on Spanish-speaking children's comprehension of number markers

in the nominal domain, in which 24-month-old Mexican-Spanish-speaking children could rely on the number-marking of determiners and on the nominal suffixing of pseudonouns in order to successfully match auditory stimuli to visual stimuli that displayed different nonce-objects (Arias-Trejo et al., 2014). Future work will further evaluate this possibility by testing younger Spanish learners in an SV agreement task, for which we would predict a lesser impact of using pseudowords. Alternatively, we could also test French learners to evaluate the prediction that the impact of using pseudonouns rather than a familiar word like *jouet* 'toy' would increase with age/lexical development.

Differences in the agreement systems of French and Spanish may also have contributed to children's ability to show successful comprehension in the face of task demands. The Spoken French paradigm that has been tested so far is the system of prefixal agreement (Legendre et al., 2010a, 2010b; Culbertson, 2010), which has distinct overt forms in the 3rd person when followed by vowel-initial verbs: /l/ in the singular (*il-arrive (i.la.riv)* 'he arrives') and /z/ in the plural (*ils-arrivent (i.za.riv)* 'they arrive'). By contrast, Spanish has suffixal marking that is overt on the plural form only (*agarra* '(he) catches' vs. *agarran* '(they) catch'; cf. Table 1). These differences may have facilitated performance in French compared to Spanish for different reasons.

First, differences in the position of the relevant agreement markers (prefixal in French, suffixal in Spanish) with respect to the pseudonouns may have caused the pseudonouns to be more difficult to process in Spanish, given the temporal proximity of the agreement cue and the pseudonoun, which might have caused more interference. Note that French has a second SV agreement paradigm, based on irregular forms that mostly alternate in verb-final position (i.e., *lit/lisent* 'reads/read'; *fait/font* 'does/do'). If position partly explains the larger impact of the use of pseudonouns in our present Spanish study than in previous French prefixal agreement studies, this larger effect should also be found for irregular agreement in French, or for agreement in English (also suffixal).

Second, the paradigm in Spanish might not be as salient to children as the French one. One difficulty in Spanish is that the third-person singular form in Spanish could be taken as a default form to number because it is null (cf. Pratt & Grinstead, 2007). Moreover, there are several ways in which the French system previously tested may be more salient to learners compared to the Spanish system. The first way concerns a process of morphophonological segmentation which learners must acquire along with this agreement system: liaison. Indeed, the coda consonants on the French agreement morphemes *il* and *ils* undergo obligatory resyllabification when they precede a vowel-initial verb. Children must, therefore, undo liaison by removing the /l/ or /z/ in order to retrieve the verbal item. There is empirical evidence that demonstrates that French-learning children can undo liaison by 20 to 24 months of age (Babineau & Shi, 2016). One possibility then is that this process in French serves to bring attention to the morphological status of the marker during early acquisition, asevidenced by French-learning children's tendency to undo liaison in the course of comprehending utterances containing novel phrases *more often* when the liaison consonant was one typically associated with the word-final position (e.g., /z/) than with less reliably position-bound consonants (e.g., /t/: cf. Buerkin-Salgado, Culbertson, Legendre, & Nazzi, 2017). Note also that the realization of the Spanish plural 3rd person agreement is the syllable-final nasal consonant "n". Since there is some evidence that coda consonants are less clearly articulated and less perceptually distinct than onset consonants (Redford & Diehl, 1999), future research will have to explore whether the phonetic realization of the "n" agreement marker in Spanish is weakly realized at the phonetic level.

The difference in perceptual salience between the French and Spanish agreement markers may have been exacerbated by the particular stimuli used in our experiments. The French markers appeared in word-initial and sentence-initial position in the stimuli (i.e. *Il embrasse le naf* 'he kisses the naf'), while the plural Spanish markers appeared word-finally but sentence-medially (i.e. *Agarran el duco* '(they) catch the duco'). Previous studies have shown that children's ability to perceive English SV agreement is influenced by the position of the verb in the sentence: Sundara, Demuth, and Kuhl (2011) showed that 22- and 27- month-olds were only able to detect the presence/absence of the verbal –*s* marker when the verb was in final position (e.g., *now he cries*), but not when it was in medial position (e.g., *he cries now*). Based on these results, it seems reasonable to expect that the positional differences between the French and the Spanish stimuli might have contributed to relatively

poor performance across studies on Spanish compared to studies on French. Future studies should explore this issue further, for example by testing Spanish learners in an SV agreement task using intransitive verbs and manipulating the relative position of the verb in the sentence.

Finally, perhaps the most convincing difference between French and Spanish is the high cue reliability of the French agreement marker /z-/ (Barrière et al., 2016b). Few nouns and verbs begin with /z-/ in French, making the /z-/ a reliable marker of agreement (via liaison) with vowel-initial plural nouns and verbs. Thus, when French-learning children hear /z-/, they can consistently map the noun or verb onto a plural representation. This is not possible with the Spanish second and third person plural suffix /-n/, which is a somewhat common final phoneme in singular nouns and adjectives. In fact, an analysis of the Mexican Spanish Montes corpus (Montes, 1987, 1992) from the CHILDES database (MacWhinney, 2000) shows that 26% of Spanish words ending in /-n/ are nouns, 66% are verbs and the rest are adjectives, articles, adverbs, prepositions or pronouns. Thus, when we ultimately compare French- and Spanish-learning children on identical paradigms and at identical age ranges, there is still reason to predict performance differences. The mapping from /z-/ to 'plural' in French is almost deterministic regardless of any other available cue; the mapping from /-n/ to 'plural' in Spanish needs to take into account the category of the lexical item (verb vs. noun) in order to be correct. The increased complexity of the Spanish mapping relative to the French one may mean that it is both harder to learn and harder to apply in on-line comprehension in Spanish.

In conclusion, we have presented new evidence of early comprehension of SV agreement in Mexican Spanish, pushing the age of earliest comprehension down by nearly a year relative to previous studies. By manipulating properties of the verbal stimuli (use of a known word instead of pseudonouns), we showed that children as young as 41-to-50 months can comprehend the third person SV number agreement paradigm in Spanish, a finding that opens up the possibility of testing even younger children (since these children are still about 12 to 18 months older than the age at which SV agreement comprehension was found in French). We believe that these studies help to shed light on a surprising case in which production has been claimed to precede comprehension. First, by looking at multiple languages while holding methodology and visual stimuli constant, we can narrow the field of possible explanations for apparent late comprehension. Second, the present work points to the importance of task-specific features which might mask evidence of earlier comprehension competence (see also Lukyanenko & Fisher, 2016, for convergent evidence in English). These features include the possible role of perceptual salience in the stimulus materials, the potential for alternative interpretations of visual displays, and finally, the impact of pseudowords on children's task expectations and processing.

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