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Abstract
Infants across cultures need to identify the characteristics of their native languages in order to become competent speakers. The means by which Spanish-speaking children learn to produce number-gender linguistic markers has not been sufficiently investigated. Thirty-eight three-year-olds were tested in Berko-like production tasks, in which they were asked to pluralize or singularize familiar and novel words, with controls for allomorph, number of syllables, and word familiarity. Children found it easier to pluralize and singularize words with the allomorph /-s/ than those requiring /-es/, independent of their familiarity or syllable length. Children also produced a wide variety of noun phrases in which they tended to mark number information in more than one element. These data suggest that Spanish-speaking children's inflectional abilities are mainly influenced by phonological features such as word-endings and not, as previously reported, by the familiarity of the word or syllable length.

Keywords
Elicitation task, inflectional morphology, language acquisition, number allomorphs, Spanish number morphology

Infants across cultures must learn the linguistic markers for the distinction between one and more than one item. Although there is much evidence demonstrating that infants make this distinction from a very early age (Barner, Wood, Hauser, & Carey, 2008; Li,

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Ogura, Barner, Yang, & Carey, 2009), they must learn to map this distinction to the linguistic cues in their native language, at least in languages with a count/mass distinction.

During the first year of life, infants can use lexical information to understand that there is more than one object in a set. Xu, Cote, and Barker (2005) found that infants as young as 12 months of age can infer that there is more than one object in a box when they hear two different pseudo-words (*fep, zav*); however, they infer that there is only one object if they hear the same word twice (*wug, wug*). In addition, in languages in which plural information is morphologically marked in articles, adjectives, nouns, and verbs (e.g., Spanish and French), children must learn the inflectional system that indicates grammatical number and extend it to their speech.

Children's mapping of set representations with plural morphological marking is a protracted process. There are some conceptual difficulties in understanding the non-linguistic one versus more-than-one difference that affects children's comprehension and production of the plural marker /-s/ in nouns. Zapf and Smith (2008) found that children had more difficulty eliciting the pluralized form of a noun when they were exposed to a set of two objects as opposed to a set of four. This might be because they treat two objects as individuals and not as members of a set (Feigenson, Carey, & Hauser, 2002). Zapf and Smith (2008) also reported that children find it easier to pluralize nouns when the plural set contains identical items (e.g., four identical dogs) than when it contains similar items (e.g., four dogs of different breeds).

Not only do children have conceptual difficulty learning and producing the noun-morphological marker of plurality, but they also encounter linguistic constraints such as learning the variety of allomorphs used in some languages to mark plurality of nouns. Studies have shown that these allomorphs are not acquired all at once, and some are acquired faster than others. For example, English-speaking children have to learn three allomorphs of plurality: /-s/, /-z/ and /-əz/. Kouider, Halberda, Wood, and Carey (2006) reported that English-speaking children have difficulty understanding the meaning of the allomorphs /-z/ and /-əz/, at least until the age of 36 months. Ravid and Farah (1999) found a similar pattern in Palestinian Arabic, where three-year-old children correctly used the feminine plural sound /-a:t/; in contrast, children still had difficulty using the other two plural morphemes, the masculine plural sound /-u:n/ and the broken plural, through age six. In German, children have to learn eight forms to morphologically express plurality (/-n/, /-e/, /-ᵊ/, /umlaut+-e/, /-s/, /umlaut+er/, /-er/ and /umlaut+ ᵊ). Szagun (2001) found that 32-month-old German-speaking children produce more /-e/ and /-s/ than adults, while the plural type production of 44-month-olds is similar to that of adults.

Other linguistic constraints are the phonological features of the noun that children have to pluralize. Polite (2011) reported that typically developing English-speaking children and children with Specific Language Impairment (SLI) with similar mean lengths of utterance experience more difficulty with pluralizing words ending in a consonant (e.g., hat) than with those ending in a vowel (e.g., key). Likewise, Ettlinger and Zapf (2011) found that coda complexity affects not only production but also comprehension of plurality. Twenty-six-month-olds had more difficulty in choosing the appropriate image corresponding to the semantic plural form of a noun ending in a consonant than one for a noun ending in a vowel.

Some authors have found that children can produce 'non-conventional plural forms' to indicate the distinction between one and more than one. For example, Clark and Nikitina (2009) reported that the numeral *two* plus a singular noun ('*two dog*') was used as a plural marker by 24- and 36-month-olds (but see Barner, Lui, & Zapf, 2012, for contrary evidence). Evidence supporting the previous pattern has also been reported in Semitic languages. Aljenaie, Abdalla, and Farghal (2011) showed that four-year-old Kuwaiti Arabic-speaking children used the numeral *two* plus a singular noun in place of the dual plural (-een) and the numeral *five* plus a singular noun in place of the plural for more than two objects.

In contrast to these scenarios, children learning languages with a simpler and reiterative noun-marking system, like Spanish, may show an earlier understanding of plural forms. In Spanish, plurality is marked with two allomorphs, /-s/ and /-es/, in adjectives, modifiers, and nouns. Recent research shows that 24-month-olds are able to identify as plural a set with multiple novel objects of the same category when they hear a novel noun ending in /-s/ (Arias-Trejo, Cantrell, Smith, & Alva Canto, in press). In his seminal work on Spanish-speaking children's morpheme acquisition, Pérez-Pereira (1989) reported that three- to six-year-olds had more difficulty pluralizing words requiring the allomorph /-es/ than those with /-s/; moreover, this difficulty was greater for pseudo-nouns than for real nouns. The author concluded that children's difficulty was caused by the familiarity of words requiring /-es/: children could automatize plural production for real nouns, but this strategy could not be applied to pseudo-words. This explanation is supported by the low frequency of nouns in children's vocabulary that require the allomorph /-es/ as compared with those that require /-s/: approximately 13% of the nouns understood by children use /-es/, while 84% use /-s/ (Jackson-Maldonado et al., 2003). Note that a small number of nouns do not require any plural allomorph in Spanish to have a plural semantic charge (e.g., *el/los paraguas*; the umbrella/s). The difference in the frequency of nouns requiring /-s/ versus /-es/ is likely to facilitate the production of nouns requiring the more common allomorph.

Results from Kouider et al. (2006), however, suggest that, at least in English, frequency is not the main factor in children's learning the allomorphs of plurality; in this study, although the allomorph /-z/ is the most common in English, it was not the one children understood best. An alternative explanation is that phonological factors might play an important role in acquiring number morphemes. In Spanish, nouns requiring the /-es/ allomorph tend to end in a consonant in their singular form, while most of the nouns requiring /-s/ end in a vowel. As previously mentioned, phonological factors such as coda complexity affect children's production of plural morphology (Ettlinger & Zapf, 2011; Polite, 2011); the fact that the nouns that require /-es/ end in consonants might explain children's difficulty with that allomorph in Spanish.

Pluralizing a noun in Spanish with the allomorph /-es/ adds an extra syllable (e.g., /*re-loj*/ to /*re-lo-jes*/), whereas /-s/ does not. One last possibility is that the extra syllable requires an extra effort. Children may find it easier to add the allomorph /-s/ than the extra syllable required by /-es/. The effect of syllable length has been explored in the use of articles: Demuth, Patrolia, Song, and Masapollo (2012) found that the syllable length of the following noun affected two Spanish-speaking children's production of monosyllabic articles (e.g., *un, el, la*) but not disyllabic articles (e.g., *unas, unos*). The effect of syllable length on children's early noun-production of plural morphology remains unexplored.

Since nouns in Spanish are generally preceded by either a definite (e.g., *el*/*la*) or an indefinite article (e.g., *un*/*una*), it is important for children to learn not only how to use the plural morphology in nouns, but also how to use noun phrases that are more complex than bare nouns. To the best of our knowledge, only Marrero and Aguirre (2003) have described children's production of noun phrases regarding number agreement. According to these authors, children go through three stages of number agreement acquisition: (1) a pre-morphological stage, in which no plural form is used; (2) a single marker stage, in which children only mark plurality in the noun or the article; and (3) a markers extension stage, in which children begin to generalize the plural to two or more words in a sentence (e.g., *los perros*; the dogs). However, this study used a sample of only three children. Spanish-speaking children's production of types of noun phrases (NP) thus needs further exploration.

Two main objectives are presented here. The first was to explore three-year-old children's ability to use number morphology. Specifically, we wished to evaluate whether children could produce equally the plural with the allomorphs /-s/ and /-es/ as well as extract such allomorphs when singularizing a noun was required. The second goal was to describe children's production of different types of NP in the context of number agreement. To these ends, we performed two Berko-style production tasks (Berko, 1958) in which children either had to pluralize nouns (singular-to-plural task) or singularize them (plural-to-singular task). The Berko-style experiment aimed to explore the generativity of children's morphosyntactic knowledge. We manipulated the familiarity of the nouns (real nouns vs. pseudo-words), the allomorph required (/-s/ vs. /-es/), and the number of syllables (trisyllabic vs. disyllabic words). Additionally, children's responses were categorized depending on the type of NPs children used.

Our predictions were that if children's ability to produce or extract the correct number forms were influenced mainly by phonological features, they would experience difficulty with words requiring /-es/ regardless of whether they were real nouns or pseudo-words. However, there are two possible alternatives: (1) if children's difficulty with the allomorph /-es/ is caused by the requirement to add an extra syllable, they would have the same difficulty with adding a syllable to disyllabic words to create the plural with /-es/ as with trisyllabic words requiring /-s/; (2) if children's difficulty is caused by the familiarity of words (real nouns vs. pseudo-words) that require the allomorph /-es/ versus those that require /-s/, we would expect an interaction between familiarity of the noun and the allomorph required. That is, they would have more difficulty with the allomorph /-es/ than /-s/, and this difficulty would be greater in their production of pseudo-nouns requiring /-es/ than in that of familiar nouns requiring the same allomorph, as previously reported by Pérez-Pereira (1989). In addition, we expect that children would use number agreement in the NPs they produce, as previously reported in spontaneous speech data (Marrero & Aguirre, 2003).

Method

Participants

Thirty-eight children (22 males) between 35;12 and 37;13 months of age (M = 36;06) participated in this study. Five other children were excluded due to failure to pluralize/

singularize any word ($n = 4$) and possible language delay ($n = 1$). Children were recruited by public advertisements and through childcare centers in Mexico City; they came from homes where Spanish was the primary language, and they had no known hearing or visual problems. Eighteen of the children participated in the plural-to-singular task and 20 in the singular-to-plural task.

Stimuli

Real nouns. Twelve familiar nouns (*flor* [flower], *mano* [hand], *manzana* [apple], *nariz* [nose], *pan* [bread], *pastel* [cake], *pelota* [ball], *perro* [dog], *plátano* [banana], *vaca* [cow], *vaso* [cup], *zapato* [shoe]) were selected from the *MacArthur Inventarios del desarrollo de habilidades comunicativas* (Jackson-Maldonado et al., 2003). The number of syllables varied from one to three. Chosen words followed the two main rules of plural formation in Spanish: adding /-s/ or /-es/. A third rule, when the morpheme is added exclusively in the determiner but not in the noun (e.g., *un tianguis/unos tianguis*), was omitted due to the low frequency of this rule in early children's vocabulary. Word gender was counterbalanced: half of the words were masculine and the other half feminine. Of the 12 nouns selected, four were disyllabic and another four were three-syllable words, all following the first rule of pluralization with /-s/; two were disyllabic words, and two were one-syllable words all following the rule with /-es/. The familiar one-syllable words were included since available disyllabic words following the second rule were not suitable: for example, some were difficult to depict visually (e.g., *señor* for man), and others were mass-nouns (e.g., *arroz* for rice). The analyses presented here deal with this imbalance by taking into account the mean correct responses instead of the total number of correct responses.

Pseudo-words. To avoid any kind of phonotactic constraints, 12 pseudo-words (*bobún, cadope, derón, mapo, megoli, neba, labi, lace, ledibo, pabol, quesiba, tesid*) were formed with syllables taken from the syllable frequency dictionary of Justicia (1995), which contains the most frequent syllables written by Spanish-speaking children. Of the 12 pseudo-words, four disyllabic and four three-syllable words followed the pluralization rule of adding /-s/, and four were disyllabic words adding /-es/.

Visual stimuli. For the real nouns, images depicting real objects were chosen; for the pseudo-words, 10 pseudo-objects were taken from previous studies testing grammatical number comprehension (Arias-Trejo et al., in press; Kouider et al., 2006) and two others were created. Images depicting the singular form of the nouns showed only one object, while images depicting the plural form had four smaller objects identical to the one used in the singular image. Care was taken to place the four objects in an area similar in size to the single object. Four objects were used to represent plurality based on evidence suggesting that children find it easier to interpret plurality with four objects rather than two (Zapf & Smith, 2008).

Two books were created, one for each task (plural-to-singular and singular-to-plural). Each had 48 pages, 24 presenting different single objects and 24 presenting the same objects but in their plural form. Half of the images depicted familiar objects and the other

half novel objects. There were three versions of each book in order to counterbalance presentation order, grammatical gender, number of syllables, allomorph, and word familiarity.

Procedure

An adaptation of the task of Zapf and Smith (2007) was employed. Children were seated on their own in front of the experimenter (E) in a quiet room in the laboratory. The E introduced the children to a toy from *Sesame street* (Elmo) and the book, saying in Spanish: 'This is Elmo, and this is Elmo's book. Elmo's book has pictures from this country and from another country. Can you tell him what is inside the book?' The task started once children agreed to help Elmo.

In the singular-to-plural task, children were asked to pluralize the noun corresponding to the name of the picture. E showed the child an image depicting one object while he said '*Mira, una/un (nombre del objeto), aquí hay una/un (nombre del objeto), ¿puedes decir (nombre del objeto)?*' ('Look, an [object name], here is an [object name], can you say [object name]?'). After the child repeated the object's name, E turned the page and said '*¿Qué ves aquí?*' ('What do you see here?'). This new page had an image depicting four objects identical to the one on the previous page. The plural-to-singular task was identical to the singular-to-plural task, except that children saw the image depicting four objects first and then the image with a single object. An example of a trial of each task is illustrated in Figure 1. Each child took part in only one of the two tasks.

Coding

Children's responses were coded in the following way:

0 = No answer or unrelated words (e.g., saying *nariz* [nose] instead of *vaso* [cup]), or an unintelligible response.
1 = Repeating the same noun as the experimenter (e.g., *zapato – zapato*) or using/extracting the incorrect allomorph (e.g., *flores* to *flore*, instead of *flores* to *flor*).
2 = Extracting or using the correct allomorph (e.g., *flores* to *flor*, or *flor* to *flores*).

Two blind scorers coded children's responses. Agreement between scorers for 20% of the data reached $r = .93$ ($p < .001$).

Children's responses were also classified in one of 21 categories based on the type of NP (bare noun or modifier + noun) produced. In a sample of 20% of the data, two coders reached an agreement of $r = .92$ ($p < .001$). These categories were the product of a taxonomy created after compiling all of the responses.

Results

To investigate the effect of Task Type (singular-to-plural vs. plural-to-singular), Noun Familiarity (real noun vs. pseudo-word), and Allomorph (disyllabic word requiring /-s/, disyllabic word requiring /-es/, trisyllabic word requiring /-s/) on children's use

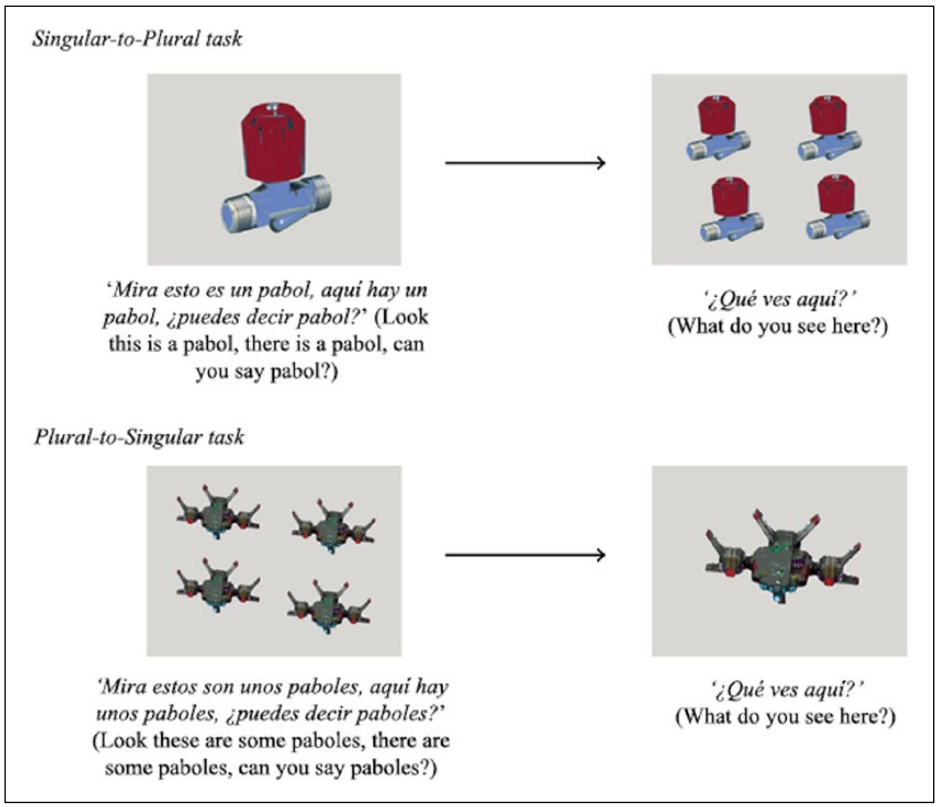

Figure 1. Example of visual and auditory stimuli in both experimental conditions.

of plural morphology, a 2 × 2 × 3 repeated-measures ANOVA was conducted with Familiarity and Allomorph[1] as within-subjects factors, and Task Type as between-subjects factor with children's mean responses. The analysis yielded a main effect of Familiarity, $F(1, 36) = 42.31$, $p < .001$, $\eta^2 = .54$, and Allomorph, $F(2,72) = 36.93$, $p < .001$, $\eta^2 = .50$, as well as a two-way interaction of Familiarity and Task Type, $F(1, 36) = 5.77$, $p < .05$, $\eta^2 = .13$.

The Familiarity effect indicated that children were better at singularizing/pluralizing real nouns ($M = 1.82$; SD = .18) than pseudo-words ($M = 1.60$; SD = .31). To further explore the effect of Allomorph, we used Bonferroni corrected paired-sample *t*-tests. The analyses showed two significant differences: between the disyllabic words requiring /-s/ and those requiring /-es/, $t(36) = .28$, $p < .001$, and the trisyllabic words requiring /-s/ and the disyllabic ones requiring /-es/, $t(36) = .25$, $p < .001$ (see Figure 2). To further explore the interaction between Familiarity and Task Type, we performed a one-way ANOVA with Task Type (singular-to-plural vs. plural-to-singular) for real nouns and pseudo-words, separately. The analyses revealed a significant effect only for Task Type, $F(1, 36) = 10.93$, $p < .01$, $\eta^2 = .23$, for the familiar nouns. Children were better at singularizing ($M = 1.91$; SD = .09) than pluralizing ($M = 1.70$; SD = .25) real nouns (see Figure 3).

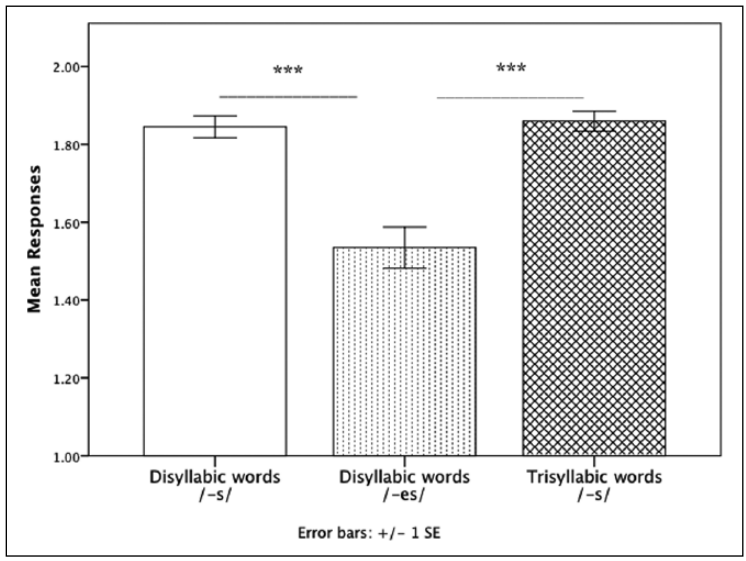

Figure 2. Mean (±SE) children's correct responses by Allomorph.
*** $p < .001$.

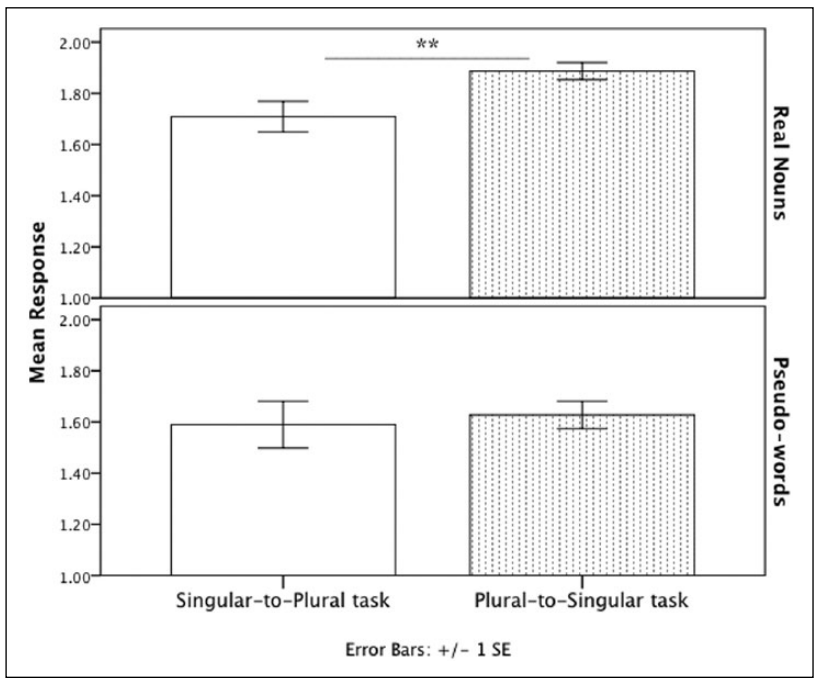

Figure 3. Mean (±SE) children's correct responses by Task Type and Familiarity.
** $p < .01$.

Table 1. Children's responses in singular-to-plural task.

Type of response	Frequency	Percentage
1. Bare plural noun	161	37.3%
2. Bare singular noun	95	22%
3. Singular indefinite article+ singular noun	34	7.9%
4. More than two + plural noun	34	7.9%
5. *Dos* (two) + plural noun	26	6%
6. Plural indefinite article + plural noun	20	4.6%
7. No response	16	3.7%
8. *Más* (more) + plural noun	15	3.5%
9. *Muchas/muchos* (a lot) + plural noun	14	3.2%
10. Singular indefinite article + plural noun	10	2.3%
11. Plural indefinite article + singular noun	2	0.5%
12. *Más* (more) + singular noun	2	0.5%
13. *Dos* (two) + singular noun	1	0.2%
14. *Otro/otra* (other) + singular noun	1	0.2%
15. More than two + singular noun	1	0.2%
Total	432	100%

Finally, children responded with a variety of NPs: 37% of children's responses in the singular-to-plural and 70% in the plural-to-singular tasks had a structure of modifier + noun (e.g., *unas pelotas* and *una pelota*; some balls and a ball). Interestingly, the percentage of responses in which *two* was produced with a bare singular noun (e.g., *dos perro*; two dog) was low (0.2%). See Tables 1 and 2 for a complete description of children's use of NPs.

Discussion

This study evaluated three-year-olds' ability to generate number morphology in a production task in which the number of syllables involved and the allomorph required to pluralize or singularize real nouns and pseudo-words were manipulated. Children's outperformance in adding or subtracting the correct allomorph of familiar words compared with that of pseudo-words is consistent with previous research (Zapf & Smith, 2007). Children had more difficulty in pluralizing or singularizing words requiring the allomorph /-es/ than with words requiring /-s/, regardless of their familiarity or syllable length. We were also interested in exploring the kinds of linguistic strategies employed by children in producing the plural or converting a plural into a singular. We found that three-year-olds produced a wide variety of NPs in which they tended to mark number information in more than one element (e.g., article and noun).

The current study partially replicates the work of Pérez-Pereira (1989), which found that children had more difficulty with the allomorph /-es/ than with /-s/ and that this difficulty increased when children were asked to pluralize pseudo-words. It expands upon the results of that study with new data that allow us to understand the effect of adding or

Table 2. Children's responses in the plural-to-singular task.

Type of response	Frequency	Percentage
1. Singular indefinite article + singular noun	215	44.8%
2. Bare singular noun	83	17.3%
3. *Otro*/*otra* (other) + singular noun	67	14%
4. No response	34	7.1%
5. Bare plural noun	30	6.3%
6. Singular indefinite article + plural noun	17	3.5%
7. *Otro*/*otra* (other) + plural noun	10	2.1%
8. *Uno* (one) + singular noun	6	1.3%
9. *Otros*/*otras* (other) + plural noun	4	0.8%
10. Plural indefinite article + singular noun	3	0.6%
11. Plural indefinite article + plural noun	3	0.6%
12. *Uno* (one) + plural noun	3	0.6%
13. *Este*/*ese* (this/that) + singular noun	3	0.6%
14. *Otros*/*otras* (other) + singular noun	2	0.4%
Total	480	100%

extracting syllables as well as the role of word endings on children's production of grammatical number.

Our examination of children's performance with words requiring a change in the number of syllables with /-es/ and with three-syllable words requiring /-s/ shows that children have more difficulty with the allomorph /-es/ regardless of syllable length. The most plausible explanation for children's difficulty with /-es/ is that words requiring this allomorph end in a consonant in their singular form. Notably, this difficulty with the allomorph /-es/ was exhibited equally in the singular-to-plural and the plural-to-singular tasks, suggesting that it is easier for children to produce a singular form ending in a vowel. In fact, some children extracted only the [-s] from the allomorph /-es/ (e.g., *flore*, instead of the correct form, *flor;* flower). This type of response could be taken as an indication that young children understand that /-s/ is an ending to mark the plural, but do not understand the same for /-es/. This conclusion is consistent with recent studies reporting that in English, a language in which words ending with a consonant are more common than in Spanish, children have more difficulty pluralizing words ending in complex codas (Ettlinger & Zapf, 2011; Polite, 2011). Another study with Spanish-speaking children has similarly reported a relationship between early production of final codas and children's production of plural morphology (Lleó, 2006). Children's better performance at singularizing than pluralizing familiar words should be taken carefully; children might not be using any morphological knowledge to produce the singular, but merely recognizing and naming the images. This hypothesis is plausible since children's performance was similar for plural and singular in the case of novel words.

An interesting question is why we did not encounter differences in children's performance in pluralizing real nouns and pseudo-words requiring /-es/, as reported in previous

studies (Pérez-Pereira, 1989). One reason could be our strict criteria for the formation of pseudo-words. Our pseudo-words not only followed Spanish phonological rules, but were also formed with highly common syllables in order to avoid any effect of syllable frequency. Moreover, unlike Pérez-Pereira (1989), we did not use any pseudo-word ending in /-s/ due to its ambiguity; in some cases these words pluralize as in *autobús-autobuses*, but in others they do not change, as in *paraguas-paraguas*; in any case, this type of word is not significantly represented in children's vocabulary (Jackson-Maldonado et al., 2003). Pérez-Pereira (1989) reported that 86% of three-year-old children left unmodified the pseudo-word *patús*, ending with /-s/ that requires the allomorph /-es/; therefore, the report of children's greater performance with real nouns than with pseudo-words requiring /-es/ could have been driven numerically by children's performance with this particular pseudo-word.

Another important finding of our study concerns the NPs employed by children to express grammatical number. Children produce a large variety of NPs, showing that at three years of age they are capable of marking number morphology in nouns and modifiers such as determiners (e.g., *unos/los/otros vasos*; some/the/other glasses), and to use lexical markers (e.g., quantifiers and numerals) to indicate the plurality/singularity of a set. This finding adds to the previous evidence reported in spontaneous speech data (Marrero & Aguirre, 2003).

Previous studies have proposed that, in some cases, two- and three-year-olds use the numeral *two* as a 'non-conventional plural form' to mark the plurality of a set even though the noun is produced in its singular form (Clark & Nikitina, 2009), but our data do not support this claim. Our study agrees with Barner et al. (2012) that children use *two*, or other numerals, with a correctly pluralized noun but not, in most cases, with a singular noun. In our data children produced the NP *two* or *more than two* + the plural noun 60 times. However, they only produced the NP *two* or *more than two* + the singular noun on two occasions.

Our study has some limitations. Although it contributes to our understanding about children's difficulty with the allomorph /-es/, clarifying the possible role of ending complexity, it does not give a detailed explanation of which endings affect children's use of plural morphology in Spanish. Some endings could make pluralization/singularization more difficult than others. For example, phonological constraints can affect production of grammatical number. Children learning English often show less production of plurals in stop clusters (e.g., t/d) than in other simpler clusters (Kirk & Demuth, 2003). Another consideration for future research is the impact of maternal input on children's production of number morphology. For example, Tare, Shatz, and Gilbertson (2008) showed that maternal speech provides important information for the acquisition of abstract concepts such as number, time, and color words.

In summary, the present research extends our knowledge of children's use of Spanish number morphology. Spanish-learning three-year-olds still have difficulty in pluralizing or singularizing words that require the allomorph /-es/; this difficulty could be due mainly to phonological factors such as ending complexity, and not to the familiarity of the allomorph, as previously suggested. Moreover, children at this age might be moving from a stage of producing number morphology exclusively in nouns to a stage where they start using number morphology in both nouns and modifiers.

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Note

1. For the purposes of this analysis, the term Allomorph is equivalent to syllable length since both aspects involved each other.

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