Language and Cognition (2024), 1–21
doi:10.1017/langcog.2023.69

ARTICLE

Explicit instruction improves the comprehension of Spanish object relatives by young monolingual children

Miquel Llompart[1,2] and Ewa Dąbrowska[2,3]

[1]Department of Translation and Language Sciences, Universitat Pompeu Fabra, Barcelona, Spain; [2]Department of English and American Studies, Friedrich Alexander University Erlangen-Nuremberg, Erlangen, Germany; [3]Department of English Language and Linguistics, University of Birmingham, Birmingham, UK

Corresponding author: Miquel Llompart; Email: miguel.llompart@upf.edu

(Received 08 August 2022; Revised 08 December 2023; Accepted 12 December 2023)

Abstract

The present study assessed the comprehension of Spanish object relative (OR) clauses by 6- and 7-year-old children before and after a brief training session targeting the structural differences between ORs and subject relatives. In addition, we investigated the potential relationships between OR comprehension on the one hand and vocabulary size and non-verbal intelligence quotient (IQ) on the other. Comprehension of ORs was very poor at the pre-test but improved considerably after training. Further improvement was observed between the immediate post-test and a delayed post-test, suggesting that the knowledge acquired during training had been integrated into the children's developing linguistic systems. Non-verbal IQ and vocabulary were not found to predict comprehension accuracy. We take these results to suggest that children's difficulties with ORs are better explained by their experience with this construction than by maturational factors and that explicit contrast and feedback can bolster grammatical development in L1 acquisition.

Keywords: explicit instruction; first language acquisition; grammatical training; non-verbal intelligence; relative clauses; vocabulary

1. Introduction

There is a vast amount of literature showing that, in languages with postnominal relative clauses, such as English, Hebrew, Spanish, and Italian, object relative (OR) clauses are acquired late by children (e.g., Arosio et al., 2009; Cilibrasi et al., 2019; Kidd & Arciuli, 2016) and are relatively difficult to process even for adults (e.g., del Río et al., 2012; Holmes & O'Regan, 1981). In the present study, we examine whether providing young school-aged Spanish children who have not yet mastered this construction with limited albeit enhanced additional experience will result in an improvement in comprehension. In addition, we investigate the potential relationship between grammatical development and general cognitive ability by assessing whether the comprehension of ORs before and after training is related to the children's vocabulary size and non-verbal intelligence quotient (IQ).

1.1. Why are ORs difficult?

ORs are relative clauses in which the head is the object of the verb in the subordinate clause (e.g., *the man that my friend saw*). In subject relatives (SRs), in contrast, the head is the subject of the verb (e.g., *the man that saw my friend*). The relative difficulty of ORs has been attributed to their structural properties. ORs are thought to be more marked than SRs because objects are lower on the Noun Phrase Accessibility Hierarchy (cf. Keenan & Comrie, 1977) than subjects. They also involve longer dependencies between the filler and the gap,[1] and the subject structurally intervenes between the head noun and the gap. These properties place relatively high demands on working memory, which results in processing difficulties even for adults. They also make the construction more difficult for children to acquire, since children are known to have limited working memory/computational capacity (Adani, 2011; Arosio et al., 2017; Cilibrasi et al., 2019; Contemori & Belletti, 2014; Friedmann et al., 2009).

The late acquisition of ORs could also be attributed to the properties of the input. According to experience-based accounts, including usage-based approaches (e.g., Kidd et al., 2007; Reali, 2014; Reali & Christiansen, 2007), ORs are more difficult to acquire and process because their schematic syntactic structure is less prototypical and frequent than that of SRs, especially when the head is a full Noun Phrase (NP) with an animate referent (Betancort et al., 2009; Reali, 2014; Reali & Christiansen,

[1]In subject relatives, the gap comes immediately after the subordinator, as in (i). In object relatives, the gap comes after the verb, which results in a longer dependency, regardless of whether the subject of the relative clause is preposed, as in (ii), or postposed, as in (iii).

(i) *el niño que __ ayuda al hombre*
↑_________|
the boy that helps to:the man
'the boy that helps the man'

(ii) *el niño al que el hombre ayuda __*
↑_________________________________|
the boy to:the that the man helps
'the boy that the man helps'

(iii) *el niño al que ayuda __ el hombre*
↑____________________|
the boy to:the that helps the man
'the boy that the man helps'

https://doi.org/10.1017/langcog.2023.69 Published online by Cambridge University Press

2007). Although SRs are similar in frequency to ORs and have in fact been found to be slightly less frequent in spoken texts (Reali & Christiansen, 2007; Roland et al., 2007), they have the same word order (SVO) as ordinary transitive sentences in both English and Spanish. Sentences with the canonical SVO structure can be interpreted using a simple processing heuristic, namely, that the first NP corresponds to the agent. This same heuristic works against comprehending ORs and could account for the fact that children sometimes interpret them as if they were SRs (Arosio et al., 2009; Diessel, 2009; Labelle, 1990).

The accounts discussed above make different predictions about the acquisition of ORs. For those based on syntactic structure and processing demands, the late acquisition of ORs is related to maturational and cognitive constraints that are in place until learners reach a particular point in development (Cilibrasi et al., 2019; Contemori & Belletti, 2014; Friedmann et al., 2009). Crucially, according to this position, such constraints stem ultimately from the maturation of the brain and are largely independent of linguistic experience (Borer & Wexler, 1987) – although, of course, proponents of these approaches do acknowledge that some relevant experience is required in order to trigger development. For experience-based accounts (Reali, 2014; Reali & Christiansen, 2007), in contrast, the acquisition of ORs depends on learners' experience with the construction. Therefore, according to the latter view, the acquisition of ORs could be accelerated by providing learners with additional experience. In the present study, we tested this prediction by exposing Spanish children who had not yet acquired ORs to instances of this construction while explicitly contrasting ORs with their corresponding SRs as well as providing explicit feedback on accuracy. If children's difficulties were due to development-related maturational and/or processing constraints, we would not expect their comprehension of the critical structure to improve after a brief training session. By contrast, if what was hindering comprehension was insufficient amount or quality of experience with the construction, training should result in observable improvements.

1.2. Grammatical comprehension, vocabulary, and non-verbal IQ

One fundamental question in the study of language acquisition concerns the mechanisms underlying the acquisition of the grammatical system of the native language. Usage-based models of language acquisition (Bybee, 2010; Goldberg, 2006; Tomasello, 2000) assume that grammar, in the same way as vocabulary, is represented as a set of form–meaning pairings. Partial support for this claim can be found in the existence of robust correlations between grammatical and lexical development in first language acquisition (Bates et al., 1988; Marchman et al., 2004) and in ultimate attainment of grammar and vocabulary in adult L1 speakers (Dąbrowska, 2018; Llompart & Dąbrowska, 2020). Furthermore, usage-based models also argue that the acquisition of both grammar and vocabulary relies on the same domain-general mechanisms (albeit not necessarily to the same extent). Critically, this contrasts with modular models (e.g., Pinker, 1999; Ullman, 2001; Ullman et al., 1997), which assume that grammatical knowledge is stored separately from lexical knowledge and depends on procedural/implicit memory, unlike lexical acquisition, which is thought to rely on declarative/explicit memory.

Still, research to date has not yet been able to provide a clear picture of the learning mechanisms underlying the acquisition of grammar. There is indeed some evidence outlining a close relationship between grammar and implicit learning and memory.

https://doi.org/10.1017/langcog.2023.69 Published online by Cambridge University Press

Several studies have shown correlations between grammatical development in typically developing children and implicit learning abilities (Hamrick et al., 2018; Kidd, 2012; Kidd & Arciuli, 2016; Lum et al., 2012). Furthermore, a number of studies of children with specific language impairment (SLI; now mostly referred to as developmental language disorder [DLD]) have shown persistent deficits in implicit learning in this population (Gabriel et al., 2013; Lum et al., 2012; Ullman & Pierpont, 2005).

However, there are also grounds to argue that explicit learning abilities and problem-solving abilities may play a role in grammatical development. For example, within the usage-based framework, Dąbrowska (2010, 2018) proposes that acquiring a constructional schema effectively requires solving a proportional analogy of the form: MEANING_1: $form_1$:: MEANING_2: $form_2$. In order to do this, learners must be able to encode features, induce abstract relations, and maintain information in working memory. Abilities of this kind are believed to be involved in explicit reasoning, in that they are, for example, routinely targeted by intelligence tests.

In fact, there is also empirical evidence supporting a relationship between IQ and explicit learning abilities, on the one hand, and grammar learning, on the other. First, children with learning impairments consistently perform well below their chronological age on virtually all aspects of language (e.g., van der Schuit et al., 2011). This is also true for individuals with Williams' syndrome: while some researchers claimed that morphosyntactic abilities are selectively preserved in this group (see, e.g., Clahsen & Almazan, 1998), later studies have shown that this is not the case; that is to say, the performance of children and adolescents with Williams' syndrome on language measures is fully in line with their mental age (Stojanovik et al., 2004). Furthermore, in children with cognitive impairments, robust correlations have been reported between non-verbal IQ and grammatical abilities (Facon et al., 2002; van der Schuit et al., 2011). Similar correlations have also been reported in typically developing children (Roth et al., 2002; West et al., 2018), although some studies have failed to find such a relationship (Kidd & Arciuli, 2016; van der Schuit et al., 2011). Finally, correlations between L1 grammatical abilities on the one hand and executive function, language aptitude, and need for cognition (i.e., the extent to which an individual enjoys effortful cognitive activities) on the other hand have been observed in typically developing children (Brooks & Kempe, 2019) as well as in adults (Dąbrowska, 2018; Llompart & Dąbrowska, 2023; Street & Dąbrowska, 2010). In the present study, we contribute to this ongoing discussion by examining the extent to which L1 children's grammatical knowledge, assessed through their comprehension of ORs, is related to (i) their vocabulary size at the time of testing and (ii) their non-verbal IQ.

1.3. Spanish relatives

Both SRs and ORs in Spanish are normally introduced by the subordinating conjunction *que*, although less common variants with the pronouns *cual* 'which' and *quien* 'who' are also possible. SRs share the word order of simple transitive clauses, that is, SVO (1). In ORs, where the NP referring to the patient is the head, the subject of the relative clause can appear either before (2a) or after the verb (2b).

(1)	*El*	*niño*	*que*	*ayuda*	*al*	*hombre*
	the	boy	that	helps	to:the	man
	'the boy that helps the man'					

https://doi.org/10.1017/langcog.2023.69 Published online by Cambridge University Press

(2) a. *El niño que el hombre ayuda*
the boy that the man helps
'the boy that the man helps'

b. *El niño que ayuda el hombre*
the boy that helps the man
'the boy that the man helps'

Spanish is a language with differential object marking (DOM): when the direct object is human and specific, it must be marked with the preposition *a* 'to', as in (1).[2] The preposition *a* can also be used to mark the subordinator in ORs, as in (3).

(3) a. *el niño al que el hombre ayuda*
the boy to:the that the man helps
'the boy that the man helps'

b. *el niño al que ayuda el hombre*
the boy to:the that helps the man
'the boy that the man helps'

Cross-linguistically, the vast majority of ORs modify inanimate heads (see Mitsugi, 2016 and footnote 3). Since *a* only occurs in DOM contexts, it follows that the prepositional variant of the OR, as in (3), is less frequent than the 'plain' variant in (2). This is confirmed by corpus analyses: in a sample of educated spoken Spanish in the Madrid region analyzed by Butler (1992), ORs with *a* accounted for 5.8% of all ORs; in Reali's (2014) corpus, also of spoken Peninsular Spanish, the proportion was even smaller (less than 5%). However, in DOM contexts, the variant *a* is strongly preferred: in fact, the proportion of ORs with the *a* marker is close to the overall frequency of ORs with animate heads attested across a number of corpus studies, suggesting a near-categorical preference for *a* relatives in such contexts.[3]

Furthermore, the *a* variant is arguably easier to process, especially in spoken language, for two reasons. First, it is unambiguously marked as an OR from the onset of the relative clause. This is in opposition to the plain variant, especially when the subject appears in the postverbal position, as in (2b): the latter sentence is identical to the SR in (1) until the final Prepositional Phrase (PP)/NP. Given that there is evidence that sentences like (2b) are initially interpreted as SRs and need to be reanalyzed on reaching the second NP (Betancort et al., 2009), the prepositional variant is expected to reduce processing difficulty. Secondly, in spoken Spanish, sentences like (1) and (2b), both with masculine subjects and objects, differ only in the vowel of an unstressed function word (i.e., [el] vs. [al]), which makes the comprehension of the sentence dependent on hearing this small acoustic difference. With feminine referents, SRs and ORs are often quasi-indistinguishable in perception because, if the preceding

[2]When the preposition *a* is followed by the definite masculine singular article *el*, the two are contracted into *al*. This is not the case with the remaining definite articles (i.e., *a la*, *a los*, *a las*).

[3]We do not have corpus data for the frequency of object relatives with animate heads in spoken Spanish. However, the relevant data are available for English (Montag & MacDonald, 2015), German and Dutch (Mak et al., 2002), Chinese (Pu, 2007), and Japanese (Mitsugi, 2016). The reported frequencies range from 2.5 to 8.3%, with a weighted average of 5.25%.

https://doi.org/10.1017/langcog.2023.69 Published online by Cambridge University Press

word ends in -*a*, the preposition *a* is merged with that vowel: thus, (4a) is almost identical to (4b). As a result, comprehension errors involving the 'plain' variant could be in many cases due to perceptual factors.

(4) a. *la niña que besa a la abuela*
the girl that kisses to the grandma
'the girl that kisses the grandma'

b. *la niña que besa la Abuela*
the girl that kisses the Grandma
'the girl that the grandma kisses'

For these reasons, in the grammatical comprehension task reported here, we used the prepositional variant of the OR with the verb in the final position, that is, the variant corresponding to (3a).

It is important to observe here that ORs such as the ones used in this study and the vast majority of psycholinguistic research on ORs, which have animate heads and full NP subjects, are rare in discourse. As mentioned above, most attested ORs have inanimate heads, and they also tend to have pronominal or, in pro-drop languages, elided subjects (e.g., *el libro que (él) escribió* 'the book that he wrote'). This is because the function of ORs is to anchor the head NP in ongoing discourse by linking it to a previously mentioned animate referent (Fox & Thompson, 1990). Note that such relative clauses can be processed by relying on semantic and/or pragmatic cues: a person can write a book, but a book cannot write a person. Thus, in order to be able to assess whether speakers are able to process ORs by relying on syntactic cues alone, it is necessary to use non-canonical clauses like those in examples (2) and (3).

1.4. The acquisition of relative clauses

Corpus studies of children acquiring Spanish (Barreña, 2000; Hernández Pina, 1984; both cited in Ezeizabarrena, 2012) suggest that both SRs and ORs emerge early in development, at around age 2;6, and Pérez-Leroux (1993) reports that Spanish-speaking children as young as 3 occasionally produce ORs under experimental conditions. However, Pérez-Leroux also notes that young children tend to avoid such structures, and Ezeizabarrena (2012) observed very high error rates in ORs, which persisted even in the oldest children in this study (aged 7).

We are not aware of any experimental studies examining the comprehension of ORs by Spanish-speaking children. However, studies investigating the comprehension of ORs by preschool children acquiring a number of other languages, including English, Greek, Italian, Hebrew, Portuguese, and Catalan, typically report comprehension at around chance (Arosio et al., 2009, 2017; Belletti et al., 2012; Friedmann & Costa, 2010; Gavarró et al., 2012; Guasti et al., 2008; Kidd & Arciuli, 2016). One exception to this is Adani (2011), who found that 6-year-olds chose the target response on 85% of the trials. In Adani's experiment, the subject and object NPs differed in number (one was singular and the other was plural), so it is possible that the children were able to achieve such high levels of performance because they were relying on agreement cues – although the presence of such cues did not help the children tested by Arosio et al. (2009), Gavarró et al. (2012), or Guasti et al. (2008).

https://doi.org/10.1017/langcog.2023.69 Published online by Cambridge University Press

Furthermore, other studies indicate that ORs continue to pose difficulties even for school-aged children. Kidd and Arciuli (2016) report a mean comprehension rate of 55% in English-speaking children aged from 6 to 8, while Cilibrasi et al. (2019), who tested slightly older children (7;5–11;7) found an overall comprehension rate of 68%. Two other studies examined the comprehension of ORs by Italian and Hebrew 7- and 9-year-olds. Arosio et al. (2017) observed accuracy rates of 73% for 7-year-olds and 77% for 9-year-olds for Italian-speaking children. For Hebrew-speaking children, the corresponding figures were 78% and 92%, respectively (Friedmann & Costa, 2010, experiment 5). Importantly, in all of these studies, children performed much better – typically at or close to the ceiling – on SRs. Thus, while there are some differences between studies, it is clear that the acquisition of ORs continues well into the school years.

1.5. The present study

In the present study, we assess school-aged Spanish children's comprehension of ORs using a picture selection task. The children completed the task three times: before they received training (pre-test), immediately after training (post-test 1), and a few days later (post-test 2). Performance on the pre-test was compared to performance on the post-tests in order to assess whether participants had improved after training. Performance on post-test 1 was further compared to performance on post-test 2 to assess whether the improvement (if any) was indeed lasting and to test potential consolidation effects. In addition, we also administered measures of non-verbal intelligence (Raven's Colored Progressive Matrices (CPM); Raven et al., 1990) and receptive vocabulary (the Spanish version of the Peabody Picture Vocabulary Test (PPVT); Dunn et al., 2006) in order to determine the extent to which individual differences in these cognitive abilities modulate grammatical comprehension.

2. Methods

2.1. Participants

Forty children (17 males and 23 females) aged from 5;11 to 7;1 (mean 6;7) took part in this study. All children were native speakers of Spanish and were recruited from a school located in the Seville area (i.e., Colegio San Antonio María Claret). Informed consent was obtained from the parents, and the study was conducted in accordance with the Declaration of Helsinki. Ethics approval was obtained from the Ethics Committee of the Friedrich Alexander University Erlangen-Nuremberg.

2.2. Materials and procedure

Participants were tested individually in a quiet room at the school by an experimenter who was a native speaker of Spanish. There were two experimental sessions of approximately 50 and 30 minutes. The first session included the pre-test, training, and immediate post-test as well as the non-verbal intelligence measure; in the second session, the children completed the delayed post-test and the vocabulary measure. On average, the sessions were 7.3 days apart (SD = 2; range: 1–13). The tasks are described in the following subsections in the order in which they were conducted.

https://doi.org/10.1017/langcog.2023.69 Published online by Cambridge University Press

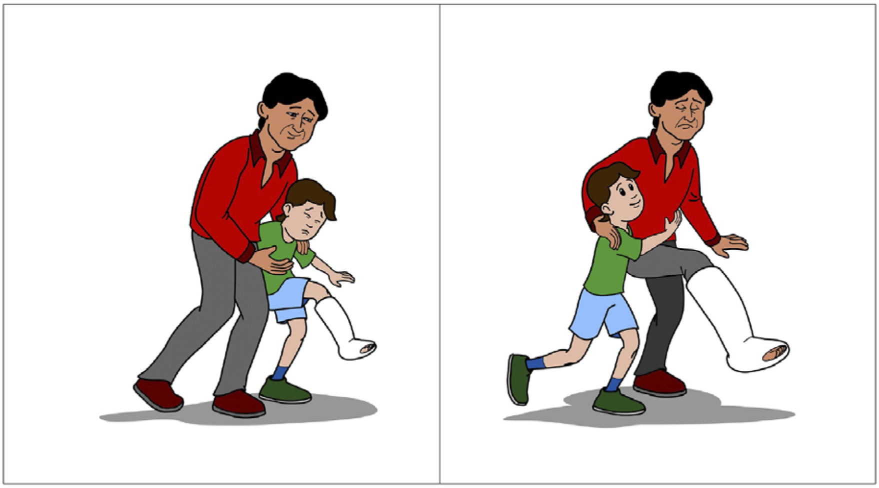

Figure 1. Example of a test item. The corresponding prompt was either *Señala el niño que ayuda al hombre* ('Point to the boy that is helping the man') or *Señala el niño al que el hombre ayuda* ('Point to the boy that the man is helping').

2.2.1. Grammatical comprehension: picture selection task

Materials for this task were 16 pairs of pictures (32 pictures in total) and 64 Spanish sentences. The pairs of pictures depicted transitive actions with two animate participants (e.g., a man and a boy). The pictures in each pair differed in who carried out the action (e.g., a man helping a boy versus a boy helping a man). Corresponding to each picture were two sentences, one containing a SR and the other containing an OR. Both the nouns (e.g., *niño* 'boy', *hombre* 'man', *abuela* 'grandma') and verbs (e.g., *ayudar* 'to help', *besar* 'to kiss', *despertar* 'to wake up') referring to the participants and actions depicted in the pictures were basic Spanish vocabulary and were expected to be known by our participant group. An example of a test item is provided in Figure 1.

The sentences were assigned to two versions of the test, each containing 16 SRs and 16 ORs. This means that, in our example, the two sentences requiring that participants point to the boy (i.e., one SR and one OR) would be included in version 1, while those where the correct response required pointing to the man would be included in version 2. Version 1 was used during pre-test and training, and version 2 was used during post-test 1 and post-test 2. Thus, in the post-tests, the children saw the same picture pairs as in the pre-test and training but heard a different prompt (with the roles reversed): for example, if the pre-test prompt was *Señala el niño al que el hombre ayuda* ('Point to the boy that the man is helping'), the corresponding prompt in the post-tests would be *Señala el hombre al que el niño ayuda* ('Point to the man that the boy is helping'). Note that this feature of the design means that, if participants simply learned to select a particular picture during training, this would result in *decreased* performance in the post-tests, where they were required to choose the *other* picture.

Each part of the picture selection task had a total of 32 trials, 16 with SRs and 16 with ORs. Sentences were presented in a pseudorandom order with the constraint that the SR and OR involving the same action and pair of participants were at least two trials apart.

The procedure was the same for the pre-test, post-test 1, and post-test 2. On each trial, participants were shown a pair of pictures and were orally instructed to point to one specific referent that appeared in one of the pictures (e.g., *Señala el niño al que el hombre ayuda* 'Point to the boy that the man is helping'). As mentioned above, the pictures in each pair shared the same referents but with different roles. Once an answer had been given, the experimenter moved on to the next trial. No feedback was provided during the test stage.

The training part of the task was divided into two blocks. In the first block, which consisted of 16 trials, the child was shown a pair of pictures and the experimenter described each picture in turn using a SR and an OR with the same head noun (*Éste es el niño que ayuda al hombre y éste es el niño al que el hombre ayuda* 'This is the boy that is helping the man, and this is the boy that the man is helping') while pointing to the relevant referent. Immediately afterward, the child was asked to repeat the two sentences while pointing to the matching pictures. Thus, in this phase, the SR and ORs were explicitly contrasted. The experimenter always described the picture on the left first; since the position of the referent of the SR and OR was counterbalanced, this meant that in half of the trials the SR came first, and in the other half, the OR came first.

In the second training block, which also contained 16 trials, the procedure was the same as in the pre-test, except that children were given feedback on their responses. Thus, the child was shown the pictures and asked to point to the correct referent (e.g., *Señala el niño al que el hombre ayuda* 'Point to the boy that the man is helping'). If they selected the matching picture, the experimenter confirmed their choice as correct (e.g., *Sí, éste es el niño al que el hombre ayuda* 'Yes, this is the boy that the man is helping'). If they selected the wrong picture, the experimenter provided negative feedback (e.g., *No, éste es el niño que ayuda al hombre* 'No, this is the boy that is helping the man') and then pointed to the target picture and repeated the correct description (e.g., *Éste de aquí es el niño al que el hombre ayuda* 'This one here is the boy that the man is helping').

2.2.2. Non-verbal IQ test

Raven's CPM test (Raven et al., 1990) was used as a measure of non-verbal IQ. The CPM is designed for children of ages 5 through 12. Each item in the test contains a large colored pattern with a missing part; the participant's task is to choose the missing part from an array of six possible responses. There are 36 items in total.

2.2.3. Vocabulary test

The vocabulary test used in the present study was the Spanish PPVT-III (Dunn et al., 2006). The PPVT-III is a normed test of receptive vocabulary in which participants must identify the visual referents of words from an array of pictures. On each trial, participants were shown a grid containing four pictures and were asked to point toward the picture depicting a specific word (e.g., *lápiz* 'pencil').

3. Results

The dataset analyzed in this article and the code to reproduce the analyses reported are available at https://osf.io/83abx/ (Open Science Framework). Data from one

Table 1. Mean raw scores and percentages of correct responses for subject and object relatives in the pre-test and the two post-tests

	SRs: Raw	SRs: (%)	ORs: Raw	ORs: %
Pre-test	15.7 (0.5)	98.3 (3.2)	4.4 (4)	27.2 (24.9)
Post-test 1	15.5 (0.8)	97 (5.1)	9.6 (3.7)	59.8 (23.4)
Post-test 2	15.6 (1.2)	97.3 (7.4)	10.6 (4.3)	66.3 (26.8)

Note: Standard deviations are in parentheses.

participant for the delayed post-test and the vocabulary task were missing due to that participant not being able to attend the second testing session. Data from this participant for the IQ test and the pre-test and immediate post-test parts of picture selection were retained in all analyses. The age of one of the participants also failed to be recorded. Table 1 shows the descriptive statistics for the picture selection task, with accuracies provided separately for SRs and ORs for all parts. The mean score for PPVT-III was 87 ($SD = 17.9$); the mean for CPM was 22.4 ($SD = 5.8$). Note that the PPVT-III mean of this group is substantially higher than the 50th percentile for children aged 6;7 (a score of 71), which is the mean age of our participants. A total of 33 out of the 39 participants (85%) who completed the vocabulary test were at or above that percentile, and 10 (26%) were above the 75th percentile for that same age (a score of 99). Similar figures are also found for the CPM (Court, Raven et al., 1996). Out of the 40 participants who completed the task, 32 (80%) were above the 50th percentile (a score of 17), and 21 (53%) above the 75th percentile (a score of 22) for children aged 6 to 7 (Raven et al., 1996). The correlation between PPVT-III and CPM scores was not significant ($r(37) = .04$, $p = .79$).

Regarding the picture selection task, as shown in Table 1, the children were extremely accurate with SRs in all three tests. Performance on ORs, in contrast, was very poor in the pre-test (well below chance) but improved substantially after training, with scores on the delayed post-test (i.e., post-test 2) being slightly higher than on the immediate post-test. Figure 2 showcases the distribution of individual

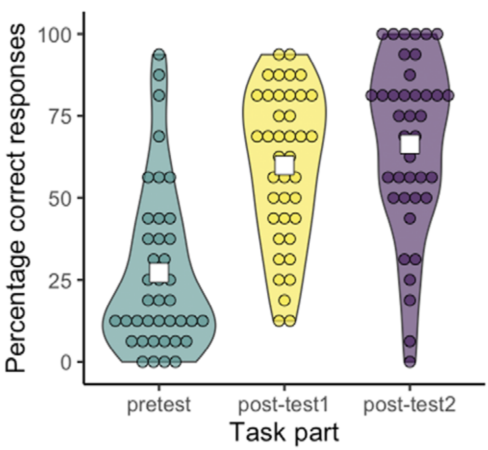

Figure 2. Distribution of individual accuracy scores for ORs by task part. The white squares provide the group mean for each part.

https://doi.org/10.1017/langcog.2023.69 Published online by Cambridge University Press

scores in each part of the task. As observable in this figure, there were only four children (10% of the sample) who were clearly above chance already in the pre-test. This number then rose dramatically for the two test parts after the training.

To systematically examine differences in accuracy as well as the potential effects of participants' non-verbal IQ and vocabulary scores on performance, we fitted a mixed-effects logistic regression model (lme4 package 1.1–31, Bates et al., 2015) in R (Version 4. 2. 2, R Core Team, 2017). The dependent variable was Response in the OR trials (coded 1 for correct and 0 for incorrect). The SR trials were excluded because of the clear ceiling effects in this condition. The independent variables of interest were Task Part (Pre-test/Post-test 1/Post-test 2), IQ, and Vocabulary. Task Part was Helmert-coded as two contrasts to which we will henceforth separately refer as Pre-Post and Post1-Post2, which targeted two different comparisons of interest (see Llompart, 2021, for a similar approach). 'Pre-Post' was coded to capture differences in accuracy between the pre-test (i.e., before training) and the two post-tests (i.e., after the training). Hence, the pre-test was coded as −0.5, and post-test 1 and post-test 2 were both coded as 0.25 (see Brehm & Alday, 2022, for a discussion of the importance of providing the numeric values of contrast-coding procedures in psycholinguistic research). With this coding, a significantly positive regression coefficient would indicate that post-test accuracy was higher than pre-test accuracy. 'Post1-Post2' was coded to quantify differences in accuracy between post-test 1 and post-test 2 (i.e., approximately a week after post-test 1). Post-test 1 was coded as −0.5, post-test 2 was coded as 0.5, and pre-test was left at 0. Therefore, a significantly positive regression coefficient would in this case mean that accuracy in post-test 2 was higher than in post-test 1. IQ scores and Vocabulary scores were entered as centered and scaled numeric predictors. In addition, participants' age was included as a covariate. Age was entered in months and was also centered and scaled.

The Task Part contrasts (i.e., Pre-Post and Post1-Post2), IQ, Vocabulary, and Age, as well as the interactions between the two Task Part contrasts and IQ and those between the two Task Part contrasts and Vocabulary, were included in the model as fixed effects. Regarding random effects, the model included random intercepts for Participants and Items. Given that the items in the pre-test differed from those in the two post-tests in the target sentences but had the same picture pairs, items were re-coded by picture pair before entering the analyses as random factor for Item. The random-effects structure was chosen by a model fitting procedure using log-likelihood ratio tests such that random slopes were only included if they improved the model's fit. This was done because the maximal random-effects structure led to convergence issues.[4] The only random slope that was included was for Pre-Post over participants ($\chi^2(3) = 57.43$, $p < .001$). Random slopes for Post1-Post2 over Participants and for Pre-Post, Post1-Post2, IQ, Vocabulary and Age over Items were not included because they did not improve the fit of the model (all $p > .25$). The model was run using the optimizer 'bobyqa' in the glmer control options to obtain model convergence. Odds ratios and 95% confidence intervals for each predictor, as well as the marginal and conditional R^2 of the model, were estimated using the tab_model

[4]The model with the maximal random-effects structure provided very similar results to the model reported in the main text. A log-likelihood ratio test comparing the maximal model and the one we report did not show significant differences in model fit ($\chi^2(23) = 10.62$, $p = .99$).

https://doi.org/10.1017/langcog.2023.69 Published online by Cambridge University Press

Table 2. Results of the mixed-effects logistic regression model on the effects of Task Part (Pre-Post and Post1-Post2), IQ, Vocabulary, Age, and the relevant interactions on accuracy (correct/incorrect) in picture selection for object relative clauses

Predictor	β	SE	z	p	Odds Ratios (CI)
(Intercept)	0.09	0.18	0.53	.60	1.10 (0.78–1.55)
Pre-Post	2.70	0.35	7.69	<.001	14.92 (7.49–29.73)
Post1-Post2	0.36	0.14	2.65	<.01	1.43 (1.10–1.87)
IQ	0.15	0.18	0.87	.38	1.17 (0.82–1.65)
Vocabulary	0.19	0.17	1.17	.24	1.21 (0.88–1.68)
Age	0.27	0.18	1.52	.13	1.31 (0.92–1.86)
Pre-Post × IQ	0.31	0.36	0.86	.39	1.36 (0.67–2.78)
Post1-Post2 × IQ	0.08	0.14	0.57	.57	1.08 (0.82–1.43)
Pre-Post × Vocabulary	−0.28	0.35	−0.80	.42	0.76 (0.38–1.50)
Post1-Post2 × Vocabulary	−0.12	0.14	−0.85	.40	0.89 (0.68–1.17)
Random effects	**Variance**	**SD**			
Participant	0.84	0.92			
Participant | Pre-Post	3.37	1.84			
Item	0.08	0.28			
Marginal R^2	0.20				
Conditional R^2	0.43				

function from the sjPlot package (version 2.8.14; Lüdecke, 2018). The results are provided in Table 2.

The model revealed significant effects of Pre-Post and Post1-Post2, no effects of IQ, Vocabulary, or Age, and no significant interactions. These results indicate that children chose the correct picture more often after training (i.e., in post-test 1 and post-test 2) than before training (i.e., in the pre-test) and that they were more accurate in the delayed post-test than immediately after training. IQ and Vocabulary were not found to be significant predictors of performance in the comprehension task, and their effects did not significantly interact with Task Part. Coefficients for the correlations between IQ and Vocabulary, on the one hand, and accuracy with ORs in each of the three test parts (all non-significant), on the other hand, are provided in Supplementary Table S1.

Since participants experienced different delays between post-test1 and post-test2, we additionally assessed whether the number of days between sessions had an effect on participants' accuracy with OR in post-test 2. We ran another mixed-effects logistic regression model on the data from post-test 2 only with Response as the dependent variable and Age, IQ, Vocabulary, and Delay (i.e., number of days between sessions), all centered and scaled, as predictors. This analysis showed that the effect of Delay was not significant ($b = 0.33$; $z = 1.36$; $p = .17$), thus indicating that the number of days between the two post-tests did not appear to have an impact on participants' performance in post-test 2.

4. Discussion

In this study, we examined the comprehension of Spanish SRs and ORs by 6- to 7-year-old Spanish-speaking children. In particular, we aimed to assess whether children who had not yet mastered the grammatical structure of Spanish ORs would improve in their comprehension of this grammatical construction if they were

https://doi.org/10.1017/langcog.2023.69 Published online by Cambridge University Press

provided with short but intensive training focusing on the semantic contrast between ORs and SRs. Furthermore, we investigated the extent to which individual differences in the comprehension of sentences containing ORs were related to vocabulary size and non-verbal IQ. In the following subsections, we discuss (i) the effect of training on the comprehension of ORs, (ii) the role of vocabulary size and non-verbal IQ in grammatical development, and (iii) the role of experience in grammatical development.

4.1. The effect of training on the comprehension of ORs

Our results show that a short training session involving the presentation of just 16 ORs resulted in substantial improvement in children's comprehension of this structure. The 6- and 7-year-olds who participated in the study showed very high accuracies in picture selection when faced with SRs in all phases of the task, but their accuracy on ORs in the pre-test was very low and clearly below chance (27% correct). Accuracy improved to 60% correct immediately after training and further improved to 66% correct on the delayed post-test conducted several days afterward.[5]

The fact that children improved so dramatically after training, that is, from pre-test to post-test 1, provides strong evidence against maturational and processing accounts of the late acquisition of ORs. If the difficulties observed during the pre-test were due to excessive syntactic complexity and/or limited processing resources at this specific point in development, then the relatively brief training could not have had such a sizable effect on their ability to comprehend ORs. By contrast, our results are more consistent with experience-based accounts.

In addition to the massive improvement in the comprehension of ORs which occurred between the pre-test and the immediate post-test, we also observed a smaller improvement in performance between the immediate post-test and the delayed post-test. There are two potential explanations for this. First, this improvement could be the result of sleep consolidation effects. A number of studies have shown that performance in learning tasks improves further when learning is reinforced by intervening sleep phases. This is the case for tasks targeting knowledge associated with procedural memory, such as motor sequences (e.g., Barakat et al., 2013), as well as with declarative memory, like, for example, novel word learning (Dumay & Gaskell, 2007). Therefore, in the present scenario, it could be the case that the intervening sleep periods between post-test 1 and post-test 2 reinforced the gains observed for the targeted grammatical structure. Alternatively, the additional improvement observed in post-test 2 could be due to children's additional experience with relatives outside of the laboratory between post-test 1 and post-test 2: in other words, once children became sensitized to the difference between SRs and ORs during the training session, they were able to further entrench the structure through exposure to more ambiguous exemplars in naturalistic settings. Irrespective of the

[5] In principle, it could be possible that (part of) the improvements observed from part to part were due to participants becoming more familiar with the materials and more skilled at performing the task at hand, regardless of their mastery of OR before and after training. This would be particularly likely for post-test 1 versus post-test 2, since the materials were exactly the same. If that were the case, however, one would expect a gradual increase in accuracy as each of the parts progressed (i.e., as a function of trial number within the task). However, our data do not provide evidence of such an increase for pre-test, post-test 1, or post-test 2. This is clearly observable in Supplementary Figure S1.

https://doi.org/10.1017/langcog.2023.69 Published online by Cambridge University Press

reason for this additional improvement, the fact that children were not only not worse in post-test 2 than in post-test 1 – or just as accurate, given that the materials were the same – but actually slightly better, suggests that the knowledge they acquired during training became integrated into their developing linguistic systems.

4.2. The role of vocabulary size and non-verbal IQ in grammatical development

The regression analysis did not reveal any significant effects of children's vocabulary size, as measured by the Spanish PPVT, or non-verbal IQ, which was assessed by means of Raven's CPM, neither on their own nor in interaction with the test part. While this outcome was unexpected to some extent given the findings of previous research (e.g., Bates et al., 1988; Roth et al., 2002; West et al., 2018), we believe that it may have to do with the characteristics of our sample. As discussed in Section 3, the children that we tested were, as a group, well above the expected mean scores for their age for both the vocabulary and the IQ measures. Even though there is variation in the scores for both measures, this may not have been enough for relationships with grammatical proficiency with ORs to arise. Alternatively, it could be that the fact that there were so many participants with high scores and so few scoring below the expected mean obscured the relationship of interest.

In spite of this, it is worth noting that, for accuracy with ORs in the pre-test, the correlation with vocabulary approached significance ($r(37) = .29$, $p = .07$; see Supplementary Table S1) and then the correlation became smaller in the later parts, once participants had undergone the training phase. This suggests that vocabulary may still have played a role in influencing how well children could comprehend the OR sentences before receiving any instruction. This could be because vocabulary size can be considered a proxy for the quantity and quality of the input the learner has received (cf. Hurtado et al., 2008) and children who had been exposed to more input and/or higher quality input may have had more opportunities to acquire both new words (i.e., a larger vocabulary) and new grammatical constructions, including ORs. This explanation is compatible with an experience-based account of children with ORs (e.g., Kidd et al., 2007; Reali, 2014; Reali & Christiansen, 2007) and aligns with the broader usage-driven perspective that additional experience should crucially facilitate the acquisition of the target construction.

4.3. The role of language experience and instruction in grammatical development

Above, we concluded that our results appear to support experience-based accounts of the difficulties that children have with ORs (e.g., Kidd et al., 2007; Reali, 2014; Reali & Christiansen, 2007). However, a key question for these accounts is how exactly one should operationalize language experience. Broadly speaking, relevant experience is usually quantified as the frequency of occurrence of the target construction in the input. Yet, in this case, can frequency alone account for the late acquisition of ORs (vs. SRs)?

Previous research on English (Reali & Christiansen, 2007; Roland et al., 2007) has shown that in spoken language, ORs are actually slightly more frequent than SRs. To obtain similar data for Spanish, we conducted a small-scale corpus study using data from the BecaCESNo corpus (Benedet et al., 2004) in TalkBank. We excerpted 15-minute samples from transcripts of conversations with 20 Spanish children aged

https://doi.org/10.1017/langcog.2023.69 Published online by Cambridge University Press

from 5;9 to 7;5 recorded in a home setting (i.e., 5 hours of speech in total) and automatically extracted all adult utterances containing the subordinating conjunction *que* from this subcorpus. These were then manually coded as SRs, ORs, or 'other'. This procedure yielded 20 ORs and 16 SRs. Extrapolating from these figures, we estimate that Spanish children hear, on average, about 4 ORs and 3.2 SRs per hour. Thus, it is clear that differences in the frequency of these two constructions alone cannot explain the asymmetry between SRs and ORs.

Another apparent problem for an account based on sheer frequency is that, while relative clauses are rather infrequent in comparison with basic structures such as interrogatives or argument structure constructions, they are not *that* rare in absolute terms. If we assume that children are exposed to language for 8 hours per day, which is a rather conservative estimate, this means that between the ages of 2;7, when the development of complex syntax may be said to begin in earnest,[6] and 6;7 (the mean age of our participants), they will have heard about 47000 ORs (4 years × 365 days × 8 hours × 4 tokens) and about 37000 SRs. The number of exemplars that they heard during training, and even during the experiment as a whole, is minuscule compared to these figures. Why, then, had they not acquired ORs earlier? Or to phrase the question differently, what was it about the additional experience during training that triggered learning while preceding exposure did not?

Let us begin with the reasons for the later acquisition of ORs compared to SRs. As mentioned in the introduction, one important difference between SRs and ORs is that the former have the same word order as ordinary transitive sentences. Thus, on a more general level, the match between the SR and the canonical and well-entrenched SVO pattern automatically increases the frequency counts of structures like SRs and likely boosts performance on this construction. Conversely, this advantage for SRs may result in detrimental interference on performance with ORs (Arosio et al., 2009; del Río et al., 2012; Labelle, 1990). Secondly, as discussed in the Introduction, even if ORs were encountered as often, or even more often than SRs, ORs in spoken language tend to be fairly stereotypical in that they usually have inanimate heads and pronominal or null subjects (Reali, 2014; Reali & Christiansen, 2007; Roland et al., 2007). This is likely to facilitate the acquisition of low-level schemas for this specific configuration (e.g., *la INANIMATE (a la) que (PRON) TR.VB* and *el INANIMATE (al) que (PRON) TR.VB*) but, at the same time, may slow down the acquisition of a more general construction that would also subsume sentences of the type we used in our task, which had full NPs designating animate participants in both the subject and the object position.

These observations lead us to an important conclusion for experience-based accounts of OR acquisition, as well as for usage-based models of language acquisition in a more general sense: to explain the order of acquisition, we need to consider not just the frequency of the constructions that we are interested in, but also the frequency of other constructions that may facilitate or interfere with the acquisition of the target construction and the lexical properties of the exemplars of the construction in the input (see Diessel, 2009, or similar observations).

Turning to the second question, namely, what was so special about the experience provided during the training session, three possible explanations come to mind. One possibility is that the experimental input and naturalistic input differ with regard to

[6]This is also a conservative estimate, since relative clauses have been observed in the spontaneous speech of children as young as 2;3 (Aveledo & Gonzalez, 2009).

the distribution of exemplars in time. In the training phase of our experiment, the children heard a number of exemplars during a very short period (about 10 minutes), while in real life, the relevant exemplars are distributed more evenly over longer stretches of time. However, this is unlikely to be the reason for the different outcomes, as the available evidence suggests that, for linguistic and non-linguistic material alike, spaced exposure leads to more efficient learning than massed exposure (cf. Ambridge et al., 2006; Miles, 2014) – in other words, our training is likely to have been even more effective had it been spread out over a number of days.

A more plausible explanation is that, as discussed above, the knowledge that our participants had acquired from naturalistic input was relatively specific: in other words, it comprised a construction or set of constructions which would enable them to process ORs with inanimate heads and pronominal or null subjects, but not a fully general construction which would apply to non-canonical sentences of the kind that they encountered in the experiment. There is considerable evidence that children are conservative learners in the sense that they 'hug the data'; that is to say, they stick closely to patterns that they have heard (Goldberg, 2006; Tomasello, 2000, 2003) and consequently acquire a set of low-level patterns rather than a single construction that captures their commonality. In some cases, such low-level patterns appear to persist into adulthood (cf. Dąbrowska, 2008a, 2008b; Dąbrowska et al., 2009).

A third possibility is that the experimental training was more effective because it explicitly contrasted SRs and ORs and invited children to attend to how the difference in form corresponds to a difference in meaning in its first phase (i.e., when they repeated after the experimenter) and provided feedback on accuracy in its second phase. Explicit instruction and attention to form are known to facilitate the acquisition of grammar in adult L2 learners (Goo et al., 2015; Norris & Ortega, 2001; Spada & Tomita, 2010), but are generally assumed to be irrelevant for language learning in children, which is thought to rely on implicit learning mechanisms. However, there are reasons to consider that attention and explicit reasoning are also relevant for child language learning. As pointed out earlier, correlations have been observed between grammatical proficiency and IQ in both adults and children (Dąbrowska, 2018; Houwen et al., 2016; Roth et al., 2002; West et al., 2018), as well as between L1 grammatical proficiency and (foreign) language aptitude (Dąbrowska, 2018; Llompart & Dąbrowska, 2023; Skehan & Ducroquet, 1988). Furthermore, several artificial language learning studies have shown that the acquisition of *some* (but not all) grammatical patterns appears to be related to conscious awareness (e.g., Kenanidis et al., 2023) and that children in the same age group as our participants benefit from explicit instruction just like adults (Ferman & Karni, 2014; Lichtman, 2016).

Since our training involved increased experience with the more complex and less frequent structure as well as explicit attention to form by means of contrast and explicit feedback, we cannot discriminate between these two explanations on the basis of the data reported here. However, there is some indirect evidence that seems to argue in favor of the second account. First, although the vast majority of the ORs that children have heard in naturalistic contexts are most likely instances of the more specific construction, they are likely to have heard some tokens with less canonical structures, and yet they did not acquire a fully general OR construction. Furthermore, training studies with adult participants critically point toward the idea that explicit attention to the form–function mapping can result in rapid gains in comprehension (e.g., Street & Dąbrowska, 2010), while extensive exposure without such focus can speed up processing but does not necessarily improve comprehension accuracy (Wells et al., 2009).

5. Conclusion

In sum, the present study showed that a brief training session with additional experience including explicit contrast and feedback resulted in a dramatic improvement in the comprehension of Spanish ORs by 6- to 7-year-old Spanish children. This suggests that the difficulties associated with this construction and the late acquisition thereof should be attributed to the quality and quantity of children's experience with it rather than to maturational factors. Thus, our findings are compatible with experience-based accounts of OR acquisition (e.g., Kidd et al., 2007; Reali, 2014; Reali & Christiansen, 2007) and more broadly with usage-based models of language acquisition (Bybee, 2010; Goldberg, 2006; Tomasello, 2000).

Our findings also suggest that learning situations in which children are invited to explicitly attend to details of form and meaning may be particularly beneficial for acquisition, at least for relatively difficult structures such as ORs. The learning that occurs in this kind of setting involves conscious reflection about form and effortful reasoning – processes that one associates with instructed second language learning rather than first language acquisition, which is generally assumed to rely entirely on implicit learning, especially when it comes to grammar. While we do not wish to deny that implicit learning plays a central role in child language acquisition, our results, combined with earlier findings that linked individual differences in grammatical development to IQ, executive functioning, and language aptitude, suggest that explicit learning abilities also play a role. Further research will be necessary to determine exactly how and when such mechanisms are involved.

Supplementary material. The supplementary material for this article can be found at http://doi.org/10.1017/langcog.2023.69.

Data availability statement. The dataset analyzed in this article and the code to reproduce the analyses reported are available at https://osf.io/83abx/ (Open Science Framework).

Acknowledgments. We thank Balma Laseo for her help with participant testing, Colegio San Antonio María Claret for their willingness to collaborate with us, and the participating children and their parents for their interest and for contributing to research in language acquisition.

Funding statement. This project was funded by an Alexander von Humboldt Professorship (ID-1195918) awarded to the second author.

Competing interest. The authors have no competing interests to declare.

References

Adani, F. (2011). Rethinking the acquisition of relative clauses in Italian: Towards a grammatically based account. *Journal of Child Language*, 38(1), 141–165.

Ambridge, B., Theakston, A. L., Lieven, E. V. M., & Tomasello, M. (2006). The distributed learning effect for children's acquisition of an abstract syntactic construction. *Cognitive Development*, 21(2), 174–193. https://doi.org/10.1016/j.cogdev.2005.09.003

Arosio, F., Adani, F., & Guasti, M. T. (2009). Grammatical features in the comprehension of Italian relative clauses by children. In J. M. Brucart, A. Gavarró, & J. Solà (Eds.), *Merging features: Computation, interpretation and acquisition*. Oxford University Press.

Arosio, F., Panzeri, F., Molteni, B., Magazù, S., & Guasti, M. (2017). The comprehension of Italian relative clauses in poor readers and in children with Specific Language Impairment. *Glossa*, 2(1), 9.

Aveledo, F., & Gonzalez, L. (2009). La adquisición de las cláusulas relativas en niños hispanohablantes: un proceso dependiente de múltiples factores. *Lingua Americana*, 23, 9–36.

Barakat, M., Carrier, J., Debas, K., Lungu, O., Fogel, S., Vandewalle, G., Hoge, R. D., Bellec, P., Karni, A., Ungerleider, L. G., Benali, H., & Doyon, J. (2013). Sleep spindles predict neural and behavioral changes in motor sequence consolidation. *Human Brain Mapping*, 34(11), 2918–2928. https://doi.org/10.1002/hbm.22116

Barreña, A. (2000). Estructuras Subordinadas en Niños Monolingues y Bilingues Vasco-Españoles. In R. P. Leow, & C. Sanz (Eds.), *Spanish applied linguistics at the turn of the millennium*. Cascadilla Press.

Bates, D., Mächler, M., Bolker, B., & Walker, S. (2015). Fitting linear mixed-effects models using lme4. *Journal of Statistical Software*, 67(1), 1–48. https://doi.org/10.18637/jss.v067.i01

Bates, E., Bretherton, I., & Snyder, L. (1988). *From first words to grammar: Individual differences and dissociable mechanisms*. Cambridge University Press.

Belletti, A., Friedmann, N., Brunato, D., & Rizzi, L. (2012). Does gender make a difference? Comparing the effect of gender on children's comprehension of relative clauses in Hebrew and Italian. *Lingua*, 122(10), 1053–1069.

Benedet, M., Cruz, C., Carrasco, M., & Snow, C. (2004). *Spanish becaCESNo corpus*. TalkBank.

Betancort, M., Carreiras, M., & Sturt, P. (2009). The processing of subject and object relative clauses in Spanish: An eye-tracking study. *Quarterly Journal of Experimental Psychology*, 62(10), 1915–1929. https://doi.org/10.1080/17470210902866672

Borer, H., & Wexler, K. (1987). The maturation of syntax. In T. Roeper & E. Williams (Eds.), *Parameter-setting and language acquisition* (pp. 123–172). Reidel. https://doi.org/10.1007/978-94-009-3727-7_6

Brehm, L., & Alday, P. M. (2022). Contrast coding choices in a decade of mixed models. *Journal of Memory and Language*, 125, 104334. https://doi.org/10.1016/j.jml.2022.104334

Brooks, P. J., & Kempe, V. (2019). More is more in language learning: Reconsidering the less-is-more hypothesis. *Language Learning*, 69, 13–41. https://doi.org/10.1111/lang.12320

Butler, C. S. (1992). A corpus-based approach to relative clauses in the spoken Spanish of Madrid. *Hispanic Linguistics*, 5(1–2), 1–42.

Bybee, J. (2010). *Language, usage and cognition*. Cambridge University Press. https://doi.org/10.1017/CBO9780511750526

Cilibrasi, L., Adani, F., & Tsimpli, I. (2019). Reading as a predictor of complex syntax. The case of relative clauses. *Frontiers in Psychology*, 10, 1450.

Clahsen, H., & Almazan, M. (1998). Syntax and morphology in Williams syndrome. *Cognition*, 68(3), 167–198.

Contemori, C., & Belletti, A. (2014). Relatives and passive object relatives in Italian-speaking children and adults: Intervention in production and comprehension. *Applied Psycholinguistics*, 35(6), 1021–1053. https://doi.org/10.1017/S0142716412000689

Dąbrowska, E. (2008a). The effects of frequency and neighbourhood density on adult speakers' productivity with Polish case inflections: An empirical test of usage-based approaches to morphology. *Journal of Memory and Language*, 58, 931–951. https://doi.org/10.1016/j.jml.2007.11.005

Dąbrowska, E. (2008b). Questions with "unbounded" dependencies: A usage-based perspective. *Cognitive Linguistics*, 19, 391–425.

Dąbrowska, E. (2010). Productivity, proceduralization and specific language impairment: Commentary on Hsu and Bishop. *Human Development*, 53(5), 278–286. https://www.jstor.org/stable/26764970

Dąbrowska, E. (2018). Experience, aptitude and individual differences in native language ultimate attainment. *Cognition*, 178, 222–235. https://doi.org/10.1016/j.cognition.2018.05.018

Dąbrowska, E., Rowland, C., & Theakston, A. (2009). The acquisition of questions with long-distance dependencies. *Cognitive Linguistics*, 20, 571–596. https://doi.org/10.1515/COGL.2009.025

del Río, D., López-Higes, R., & Martín-Aragoneses, M. (2012). Canonical word order and interference-based integration costs during sentence comprehension: The case of Spanish subject- and object-relative clauses. *Quarterly Journal of Experimental Psychology*, 65(11), 2108–2128. https://doi.org/10.1080/17470218.2012.674951

Diessel, H. (2009). On the role of frequency and similarity in the acquisition of subject and non-subject relative clauses. In T. Givón & M. Shibatani (Eds.), *Syntactic complexity* (pp. 251–276). John Benjamins.

Dumay, N., & Gaskell, M. G. (2007). Sleep-associated changes in the mental representation of spoken words. *Psychological Science*, 18(1), 35–39. https://doi.org/10.1111/j.1467-9280.2007.01845.x

Dunn, L. M., Dunn, L. M., & Arribas, D. (2006). *Peabody, test de vocabulario en imágenes*. TEA Ediciones.

https://doi.org/10.1017/langcog.2023.69 Published online by Cambridge University Press

Ezeizabarrena, M. J. (2012). Children do not substitute object relatives with subject relatives in every Romance language: The case of Spanish. *Revue Roumaine de Linguistique*, LVII(2), 161–181.

Facon, B., Facon-Bollengier, T., & Grubar, J.-C. (2002). Chronological age, receptive vocabulary, and syntax comprehension in children and adolescents with mental retardation. *American Journal on Mental Retardation*, 107(2), 91–98. https://doi.org/10.1352/0895-8017(2002)107<0091:CARVAS>2.0.CO;2

Ferman, S., & Karni, A. (2014). Explicit versus implicit instruction: Which is preferable for learning an artificial morphological rule in children? *Folia Phoniatrica et Logopaedica*, 66, 77–87. https://doi.org/10.1159/000363135

Fox, B. A., & Thompson, S. A. (1990). A discourse explanation of the grammar of relative clauses in English conversation. *Language*, 66, 297–316.

Friedmann, N., Belletti, A., & Rizzi, L. (2009). Relativized relatives: Types of intervention in the acquisition of A-bar dependencies. *Lingua*, 119(1), 67–88. https://doi.org/10.1016/j.lingua.2008.09.002

Friedmann, N., & Costa, J. (2010). The child heard a coordinated sentence and wondered: On children's difficulty in understanding coordination and relative clauses with crossing dependencies. *Lingua*, 120(6), 1502–1515.

Gabriel, A., Maillart, C., Stefaniak, N., Lejeune, C., Desmotte, L., & Meulemans, T. (2013). Procedural learning in specific language impairment: Effects of sequence complexity. *Journal of the International Neuropsychological Society*, 19(3), 264–271. http://doi.org/10.1017/s1355617712001270

Gavarró, A., Cunill, A., Muntané, M., & Reguant, M. (2012). The acquisition of Catalan relatives: Structure and processing. *Revue Roumaine de Linguistique*, LVII(2), 183–201.

Goldberg, A. E. (2006). *Constructions at work: The nature of generalization in language*. Oxford University Press. https://doi.org/10.1093/acprof:oso/9780199268511.001.0001

Goo, J., Granena, G., Yilmaz, Y., & Novella, M. (2015). Implicit and explicit instruction in L2 learning. In P. Rebuschat (Ed.), *Implicit and explicit learning of languages* (pp. 443–482). John Benjamins.

Guasti, M. T., Stavrakaki, S., & Arosio, F. (2008). Number and case in the comprehension of relative clauses: Evidence from Italian and Greek. *Studies in Linguistics*, 2, 102–118.

Hamrick, P., Lum, J. A. G., & Ullman, M. T. (2018). Child first language and adult second language are both tied to general-purpose learning systems. *Proceedings of the National Academy of Sciences*, 115(7), 1487–1492. https://doi.org/10.1073/pnas.1713975115

Hernández Pina, F. (1984). *Teorías psicosociolingüísticas y su aplicación a la adquisición del español como lengua maternal*. Siglo XXI.

Holmes, V. M., & O'Regan, J. K. (1981). Eye fixation patterns during the reading of relative-clause sentences. *Journal of Verbal Learning and Verbal Behavior*, 20(4), 417–430. https://doi.org/10.1016/S0022-5371(81)90533-8

Houwen, S., Visser, L., van der Putten, A., & Vlaskamp, C. (2016). The interrelationships between motor, cognitive, and language development in children with and without intellectual and developmental disabilities. *Research in Developmental Disabilities*, 53–54, 19–31. https://doi.org/10.1016/j.ridd.2016.01.012

Hurtado, N., Marchman, V. A., & Fernald, A. (2008). Does input influence uptake? Links between maternal talk, processing speed and vocabulary size in Spanish-learning children. *Developmental Science*, 11(6), F31–F39. https://doi.org/10.1111/j.1467-7687.2008.00768.x.

Keenan, E. L., & Comrie, B. (1977). Noun phrase accessibility and universal grammar. *Linguistic Inquiry*, 8(1), 63–99.

Kenanidis, P., Dąbrowska, E., Llompart, M., & Pili-Moss, D. (2023). Can adults learn L2 grammar after prolonged exposure under incidental conditions? *PLoS One*, 18(7), e0288989.

Kidd, E. (2012). Implicit statistical learning is directly associated with the acquisition of syntax. *Developmental Psychology*, 48(1), 171–184. http://doi.org/10.1037/a0025405

Kidd, E., & Arciuli, J. (2016). Individual differences in statistical learning predict children's comprehension of syntax. *Child Development*, 87(1), 184–193. https://doi.org/10.1111/cdev.12461

Kidd, E., Brandt, S., Lieven, E., & Tomasello, M. (2007). Object relatives made easy: A cross-linguistic comparison of the constraints influencing young children's processing of relative clauses. *Language and Cognitive Processes*, 22(6), 860–897. https://doi.org/10.1080/01690960601155284

Labelle, M. (1990). Predication, wh-movement, and the development of relative clauses. *Language Acquisition*, 1(1), 95–119. https://doi.org/10.1207/s15327817la0101_4

Lichtman, K. (2016). Age and learning environment: Are children implicit second language learners? *Journal of Child Language*, 43(3), 707–730. https://doi.org/10.1017/S0305000915000598

Llompart, M. (2021). Lexical and phonetic influences on the phonolexical encoding of difficult second-language contrasts: Insights from nonword rejection. *Frontiers in Psychology*, 12, 659852. http://doi.org/10.3389/fpsyg.2021.659852

Llompart, M., & Dąbrowska, E. (2020). Explicit but not implicit memory predicts ultimate attainment in the native language. *Frontiers in Psychology*, 11, 569586. https://doi.org/10.3389/fpsyg.2020.569586

Llompart, M., & Dąbrowska, E. (2023). Foreign language aptitude predicts individual differences in native grammatical proficiency. *Linguistics*, 61(5), 1165–1193. https://doi.org/10.1515/ling-2022-0009

Lüdecke, D. (2018). sjPlot: Data visualization for statistics in social science. *R package version 2*. https://cran.r-project.org/package=sjPlot

Lum, J. A. G., Conti-Ramsden, G., Page, D., & Ullman, M. T. (2012). Working, declarative and procedural memory in specific language impairment. *Cortex*, 48(9), 1138–1154. https://doi.org/10.1016/j.cortex.2011.06.001

Mak, W. M., Vonk, W., & Schriefers, H. (2002). The influence of animacy on relative clause processing. *Journal of Memory and Language*, 47(1), 50–68.

Marchman, V. A., Martínez-Sussmann, C., & Dale, P. S. (2004). The language-specific nature of grammatical development: Evidence from bilingual language learners. *Developmental Science*, 7(2), 212–224. https://doi.org/10.1111/j.1467-7687.2004.00340.x

Miles, S. W. (2014). Spaced vs. massed distribution instruction for L2 grammar learning. *System*, 42, 412–428. https://doi.org/10.1016/j.system.2014.01.014

Mitsugi, S. (2016). A usage-based approach to relativization: An investigation of advanced-learners' written production of relative clauses in Japanese. *Cognitive-Functional Approaches to the Study of Japanese as a Second Language*, 46, 113.

Montag, J. L., & MacDonald, M. C. (2015). Text exposure predicts spoken production of complex sentences in 8-and 12-year-old children and adults. *Journal of Experimental Psychology: General*, 144(2), 447.

Norris, J. M., & Ortega, L. (2001). Does type of instruction make a difference? Substantive findings from a meta-analytic review. *Language Learning*, 51, 157–213. http://doi.org/10.1111/j.1467-1770.2001.tb00017.x

Pérez-Leroux, A. T. (1993). *Empty categories and the acquisition of wh-movement* [Doctoral thesis, University of Massachusetts]. ProQuest Dissertations Publishing.

Pinker, S. (1999). *Words and rules: The ingredients of language*. Harper Perennial.

Pu, M. M. (2007). The distribution of relative clauses in Chinese discourse. *Discourse Processes*, 43(1), 25–53.

R Core Team. (2017). *R: A language and environment for statistical computing*. R Foundation for Statistical Computing. https://www.r-project.org/

Raven, J. C., Court, J. H., & Raven, J. C. (1990). *Manual for Raven's progressive matrices and vocabulary scales - Section 2: Coloured progressive matrices*. Oxford Psychologists Press.

Raven, J. C., Court, J. H., & Raven, J. C. (1996). *Manual Raven matrices progresivas* (2nd ed.). TEA Ediciones.

Reali, F. (2014). Frequency affects object relative clause processing: Some evidence in favor of usage-based accounts. *Language Learning*, 64(3), 685–714. https://doi.org/10.1111/lang.12066

Reali, F., & Christiansen, M. H. (2007). Processing of relative clauses is made easier by frequency of occurrence. *Journal of Memory and Language*, 57(1), 1–23. https://doi.org/10.1016/j.jml.2006.08.014

Roland, D., Dick, F., & Elman, J. L. (2007). Frequency of basic English grammatical structures: A corpus analysis. *Journal of Memory and Language*, 57(3), 348–379. https://doi.org/10.1016/j.jml.2007.03.002

Roth, F. P., Speece, D. L., & Cooper, D. H. (2002). A longitudinal analysis of the connection between oral language and early reading. *The Journal of Educational Research*, 95(5), 259–272. https://doi.org/10.1080/00220670209596600

Skehan, P., & Ducroquet, L. (1988). *A comparison of first and foreign language ability*. ESOL Department, Institute of Education, London University. Working Documents No. 8.

Spada, N., & Tomita, Y. (2010). Interaction between type of instruction and type of language feature: A meta analysis. *Language Learning*, 60, 263–308. https://doi.org/10.1111/j.1467-9922.2010.00562.x

Stojanovik, V., Perkins, M., & Howard, S. (2004). Williams syndrome and specific language impairment do not support claims for developmental double dissociations and innate modularity. *Journal of Neurolinguistics*, 17(6), 403–424. https://doi.org/10.1016/j.jneuroling.2004.01.002

https://doi.org/10.1017/langcog.2023.69 Published online by Cambridge University Press

Street, J. A., & Dąbrowska, E. (2010). More individual differences in language attainment: How much do adult native speakers of English know about passives and quantifiers? *Lingua*, 120(8), 2080–2094. https://doi.org/10.1016/j.lingua.2010.01.004

Tomasello, M. (2000). Do young children have adult syntactic competence? *Cognition*, 74(3), 209–253. https://doi.org/10.1016/S0010-0277(99)00069-4

Tomasello, M. (2003). The key is social cognition. In D. Gentner, & S. Kuczaj (Eds.), *Language and thought* (pp. 47–58). MIT Press.

Ullman, M. T. (2001). The neural basis of lexicon and grammar in first and second language: The declarative/procedural model. *Bilingualism: Language and Cognition*, 4(2), 105–122. https://doi.org/10.1017/S1366728901000220

Ullman, M. T., Corkin, S., Coppola, M., Hickok, G., Growdon, J. H., Koroshetz, W. J., & Pinker, S. (1997). A neural dissociation within language: Evidence that the mental dictionary is part of declarative memory, and that grammatical rules are processed by the procedural system. *Journal of Cognitive Neuroscience*, 9 (2), 266–276. https://doi.org/10.1162/jocn.1997.9.2.266

Ullman, M. T., & Pierpont, E. I. (2005). Specific language impairment is not specific to language: The procedural deficit hypothesis. *Cortex*, 41(3), 399–433. https://doi.org/10.1016/S0010-9452(08)70276-4

van der Schuit, M., Segers, E., van Balkom, H., & Verhoeven, L. (2011). How cognitive factors affect language development in children with intellectual disabilities. *Research in Developmental Disabilities*, 32(5), 1884–1894. https://doi.org/10.1016/j.ridd.2011.03.015

Wells, J. B., Christiansen, M. H., Race, D. S., Acheson, D. J., & MacDonald, M. C. (2009). Experience and sentence processing: Statistical learning and relative clause comprehension. *Cognitive Psychology*, 58(2), 250–271. https://doi.org/10.1016/j.cogpsych.2008.08.002

West, G., Vadillo, M. A., Shanks, D. R., & Hulme, C. (2018). The procedural learning deficit hypothesis of language learning disorders: We see some problems. *Developmental Science*, 21(2), e12552. https://doi.org/10.1111/desc.12552

Cite this article: Llompart, M., & Dąbrowska, E. (2024). Explicit instruction improves the comprehension of Spanish object relatives by young monolingual children, *Language and Cognition*, 1–21. https://doi.org/10.1017/langcog.2023.69