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The impact of L1 literacy on the production of Spanish verbal passives by school-age Spanish heritage speakers

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Acquiring literacy contributes to monolingual children's language development, especially with the oral production of complex sentences. However, less is known about how written language exposure impacts first language (L1) morphosyntactic growth in Spanish-speaking children in the U.S., who are educated in their second language (L2) and have little opportunities to develop L1 literacy. To investigate this, we evaluated 8–12-year-old Spanish heritage speakers' (HSs) L1 production accuracy of grammatical gender and full verbal passives using picture description and elicited imitation (EI) tasks. One group of HSs attended bilingual (English-Spanish) schools and had developed strong L1 literacy skills; the other group attended English-only schools and had weaker L1 literacy skills, confirmed with standardized literacy tasks. The children receiving literacy instruction and textual exposure in Spanish (the L1) outperformed those attending schools in English only, producing gender agreement more accurately and full passives more accurately. They also outperformed the children in English-only schools in literacy and cognitive measures. These findings indicate that experience with textual input via L1 literacy development is an effective way to aid the acquisition and production of complex linguistic forms in HSs during the school-age period.

KEYWORDS

heritage speakers, elicited imitation (EI), passives, grammatical gender, literacy

Introduction

Although the structural bases of language acquisition are understood to be largely in place by age 4 or 5 (Guasti, 2002), language development continues during the school age period. For example, children learn more abstract and literate vocabulary and gradually exhibit increased morphosyntactic complexity in their spoken language (Ravid and Berman, 2009; Berman, 2004; Friedmann et al., 2021; Tolchinsky and Berman, 2023). They produce prepositional phrases (PPs), heavier noun phrases (NPs), and higher proportions of relative clauses, passives, and constructions with non-finite subordination (Berman, 2008). Previous research indicates that a crucial contribution to this linguistic growth comes from children's experience with complex syntactic structures like passives (Tolchinsky and Rosado, 2005) and conventional relative clauses in the written input they receive after entering school (Guasti and Cardinaletti, 2003). Strong oral language abilities support reading comprehension (Scarborough, 1998), but a bidirectional relationship also exists in that reading experience promotes the oral production of complex syntax as well (Montag and MacDonald, 2015). Although these patterns are well attested in monolingual speakers, less is known about how written text exposure impacts the morphosyntactic growth of the L1 in bilingual children

educated in their L2. We hypothesize that literacy contributes significantly to language development in heritage speakers.

Children in the U.S. who are educated in their L2 have little opportunities to develop L1 literacy which, in our view, impacts their language development. The aim of this study is to investigate how L1 Spanish literacy development, as measured by (a) enrollment in an English-Spanish bilingual school or English-only school and (b) Spanish reading vocabulary score, impacts the oral production of gender agreement and complex sentences in 8–12-year-old Spanish heritage speakers in the United States. We assume literacy to be "the ability to identify, understand, interpret, create, communicate, and compute, using printed and written materials" that exists on a proficiency continuum (UNESCO, 2023). As bilingual native speakers, HSs acquire their home language, which is a minority language in the broader society, from birth in a naturalistic environment through interactions with caregivers, and the societal dominant language outside the home (Montrul, 2016). About 97% of Spanish HSs in the U.S. (Goldenberg and Wagner, 2015) are typically educated in their L2 (English) and do not have an opportunity to develop literacy in their L1 (Spanish). This often interrupts their L1 acquisition and leads to the loss and/or underdevelopment of their morphosyntactic abilities. However, about 3% of HSs develop L1 literacy by attending some sort of bilingual school, including dual immersion programs that provide content instruction in Spanish and English. Information about the heritage language development of HSs and how this is impacted by literacy experience is critical to understand why and how their heritage language proficiency declines so much during the school-age period. Dual immersion may provide an effective method to counteract the inevitable L1 language loss that many HSs educated in English monolingual contexts experience. Therefore, comparing L1 oral production in Spanish HSs attending English-only and bilingual schools allows us to test for the impact of language of schooling on the heritage language development in these children.

To evaluate if L1 literacy development contributes to HSs' L1 morphosyntactic growth, we focus on the children's production of full verbal passives—late acquired syntactically and semantically complex structures, which in Spanish are rare in oral production and more likely to be encountered in written language (Tolchinsky and Rosado, 2005). Thus, verbal passives are ideal to test whether increased exposure to Spanish text will promote their development in school-age HSs. Because Spanish verbal passives mark gender agreement on the passive participle, we also investigated the children's accuracy on gender agreement because the gender morphology on the passive participle provides a potentially informative morphosyntactic cue that could aid in assigning thematic roles. Additionally, we assessed if literacy impacted children's sensitivity to semantic cues by using (im)plausible passives, and whether L1 reading development affected children's ability to use morphosyntactic cues on the passive participle to interpret sentences. Along with school type (English-only vs. English-Spanish), we evaluated participants' reading skills on standardized literacy tasks and measured their working memory via a digit span task. Before presenting the details of our study we discuss how literacy may impact language development.

Linguistic literacy and the literacy enhancement hypothesis

Linguistic Literacy (LL) is a theoretical perspective that considers how experience with text influences language development (Ravid and Tolchinsky, 2002; Tolchinsky, 2022). According to this model, learning to read and write (a) results in a deeper understanding that written and spoken language have different properties, and (b) affects the development of speakers' linguistic competence. The first component describes an individual's ability to effectively produce and comprehend different registers, genres, and modalities of language they encounter through exposure to academic input. The second component stems from children's acquisition of the notational system of written language. In alphabetic languages, letters represent a grapho-phonemic link that establishes mental connections between a language's writing and phonological systems. Morphologically, acquiring LL can aid to disambiguate homophonous words (*il/ils* "he/they" in French) and morphemes (passed/past). The mental representations of morphemes are reinforced in grade school and children who learn to read in languages with different writing systems (consonants only vs. consonants and vowels) segment aural input differently.

Ravid and Tolchinsky (2002) further claimed that the morphophonological knowledge that develops as children acquire LL improves "cognitive control." More literate speakers who have enhanced cognitive control demonstrate improved ability to retrieve a wider range of words and morphosyntactic constructions and exhibit better expressive abilities. In addition, "representational reorganization" strengthens aspects of linguistic knowledge, such as phoneme distinction and morphological production. Finally, the model highlights important correlations between oral language and text-based metrics like literacy skills and school achievement.

Ravid and Tolchinsky also recognize the importance of considering how stronger executive functioning [e.g., working memory (wm)] contributes to LL. It is important to consider working memory because it increases during the school-age period (Gathercole et al., 2004) and appears to improve children's comprehension of complex, non-canonical object initial structures like passives and object relative clauses (Boyle et al., 2013). These components in the LL model highlight how "The changing nature of linguistic awareness is a combined result of development, language experience, and school instruction" (Ravid and Tolchinsky, 2002, p. 432).

The LL model is supported by empirical work. Montag and MacDonald (2015) measured 8- and 12-year-old monolingual English speakers' production of syntactically complex object and passive relative clauses, which their corpus analysis indicated were more common in child directed text than child directed speech. On a picture description task, older children produced more passive relative clauses, and children with increased reading experience produced more passive relative clauses when the target theme was animate. Also, older children with more schooling produced higher rates of *be*-passives, which occur more frequently in written language than *get*-passives, and they included more *by*-phrases in their sentences. These findings indicate that experience with

syntactic structures in written language improves children's ability to access those structures during oral production.

When extended to HS populations, the prediction is that the lack of L1 academic input common among HSs not only deprives these speakers of input quantity, but also of input richness as in different registers, genres, and modalities that include many of the lexical and morphosyntactic features associated with later language development. In fact, for HSs who already experience reduced levels of L1 input overall, experience with written language at school may serve as one critical way to help reinforce morphosyntactic features normally acquired well before school entry.

Recent studies have examined the effect of formal instruction on language development in school-age bilingual children enrolled in different types of educational environments (Fernández-Dobao and Herschensohn, 2020, 2021; Thane, 2024). Some studies conducted in Europe found a small effect of bilingual education on language development of only the majority language and sometimes both languages (Andreou et al., 2020; Dosi and Papadopoulou, 2020; Makrodimitris and Schulz, 2021), while others show clear effects of formal instruction facilitating bilingual children's language development (Bongartz and Torregrossa, 2020; Rodina et al., 2020; Torregrossa et al., 2022). Biliteracy also showed evidence of boosting L2 growth and counterbalancing dominance asymmetries (Dosi et al., 2016). Lastly, and of particular relevance to the current study, Bayram et al. (2019) elicited passive sentences from 10–15-year-old Turkish HSs in Germany in their L1 and L2. Notably, children with higher literacy levels in Turkish also produced more passive sentences in Turkish.

The evidence of formal instruction benefiting linguistic development suggests that strengthening Spanish HSs' L1 morphosyntactic competence by developing reading skills in Spanish will influence how these children process their L1. Therefore, we advance the Literacy Enhancement Hypothesis (LEH), according to which learning to read creates more robust morphosyntactic representations and aids language processing because it strengthens the parser's ability to efficiently monitor and integrate morphosyntactic features in real time (see also Dabrowska, 2020; Dabrowska et al., 2022; Montrul and Armstrong, 2024). It remains unknown, however, the extent to which HSs' L1 processing strategies are affected by learning to read and write in their L2 only, and whether L1 literacy development contributes significantly to their L1 growth. Given research findings that strong L1 development also improves L2 outcomes in bilingual children (Collier and Thomas, 2017; Genesee et al., 2006), it is critical to investigate how HSs' comprehension in their L1 Spanish is affected by their lack of L1 literacy. To test the LEH in Spanish HSs, we focus on the production of full verbal passives (1b below), which previous studies have shown is a late acquired structure that is not fully mastered until mid-late childhood in languages like English and Spanish (Pierce, 1992; Ud Deen, 2011).

Verbal passives

Research on how literacy acquisition affects language development has identified passives as one structure that reveals this relationship (Dabrowska and Street, 2006; Montag and MacDonald, 2015; Street and Dabrowska, 2010), most likely due to the structural and semantic complexity that characterizes these sentences. Despite having the same meaning, the passive sentence in (1b) is structurally more complex than its active form in (1a), which includes the differential object marker (DOM) *a* that appears before specific, animate objects in Spanish.

(1) a.	El	gato	cazó	a	la	rata.	Active
	The$_M$	cat$_M$	hunted	DOM	the$_F$	rat$_F$	
b.	La	rata$_i$	fue	t$_i$	cazada	t$_i$	Passive
	The$_F$	rat$_F$	was		hunted$_F$		
	por	el	gato.				
	by	the$_M$	cat$_M$				

According to the smuggling approach, passive formation involves a two-step movement process in which the syntactic object *la rata* "the rat" first raises to [spec, VP], and then to [spec, TP], where it occupies the position typically assigned to the sentential subject (Collins, 2005). The notional subject of (1b) *el gato* "the cat" appears post-verbally in the *by*-phrase, which merges into the structure as an adjunct attached to VP. In English and Spanish, this syntactic reorganization is semantically complex because unlike canonical SVO structures, the initial NP in subject position is assigned a theme role and the second NP in object position is assigned an agent role. Thus, parsing a passive for subsequent production, or in language processing more generally, requires reassignment of grammatical roles. From this perspective, producing passives with the *by*-phrase is derivationally more complex than producing active forms (Fox and Grodzinsky, 1998). The *by*-phrase introduces structural ambiguity, since various continuations such as locative or temporal information (*by the barn, by three o'clock*) are co-activated, introducing additional processing difficulties. The tense phrase (TP) in Spanish passives is headed by the auxiliary verb *ser* "to be" and agrees with the number feature of the syntactic subject. Passive voice is indicated by the *-da* suffix on the verb *cazar* "to hunt." Derivationally, the verb assigns case to this affix, leaving the object determiner phrase (DP) with an unassigned case feature. This forces *la rata* "the rat" to raise to [spec, TP] where it is assigned nominative case (Zagona, 2002). Recall that *la rata* is assigned its theme role by being base generated as the verb's complement before its movement operation is executed. Like in English, the subject in (1b) is expressed in an optional *by*-phrase.

A crucial aspect of Spanish passives is grammatical gender (and number) agreement. All Spanish nouns carry a lexical gender feature (masculine or feminine), and this feature triggers morphosyntactic agreement between nouns and the other syntactic categories, including passive participles. In Spanish verbal passives, gender feature agreement always occurs between the theme noun and the participle. For example, in (1b) the feminine noun *rata* "rat" triggers agreement expressed in the feminine *-da* suffix on the passive participle. If the theme in (1b) were replaced with a masculine noun like *ratón* "mouse," the participle would express agreement with the masculine *-do* suffix. Note that the participle never agrees with the agent *gato* "cat." When comprehending passives, this makes the participle's gender morpheme a potentially informative cue as to who is acted upon in the passive sentence when the two NPs have contrasting gender features. In fact, monolingual Spanish children in Mexico as young as 3;0 showed improved comprehension of passives when there was a contrast in

TABLE 1 Background characteristics of child participants (in years) based on school type.

Characteristic	English-only School			English-Spanish School		
	M	*SD*	Range	*M*	*SD*	Range
Age	10.5	1.10	9–12	10.6	1.35	8–12
Grade in school	5.4	1.17	4–7	5.4	1.20	4–7
AoE English	3.1	1.91	0–6	2.6	2.07	0–7
Mothers' years of education	11.3	3.52	6–18	14.5	4.04	6–20

TABLE 2 Language richness scores (0–1) based on school type.

School type	Spanish			English		
	M	*SD*	Range	*M*	*SD*	Range
English-only School	0.35	0.09	0.15–0.50	0.79	0.10	0.63–0.94
English-Spanish School	0.71	0.13	0.40–0.90	0.74	0.16	0.31–1

the gender feature of the two predicates (Pierce, 1992). However, school-age Spanish HSs typically have underdeveloped gender representations (Montrul and Potowski, 2007). L1 literacy may be one way to strengthen their grammatical gender knowledge and their ability to use it informatively in verbal participles to comprehend and regenerate verbal passives. The present study assesses the grammatical gender knowledge of HSs.

As mentioned earlier, the main reason we focus on the verbal passive to investigate the role of literacy is the distribution of this structure in the input. In Spanish, verbal passives are infrequent in oral speech and occur more often in written language, as confirmed by corpora studies (Biber et al., 2006; Parodi, 2007). For example, in a 40,000 word corpus of child directed speech, monolingual Spanish daycare instructors only produced one verbal passive (Cychosz and Garrote Salazar, 2016). Full passives including a *by*-phrase are especially characteristic of journalistic text and common in scientific writing (Ciapuscio, 1992; Green, 1975). Therefore, Spanish speakers with weak literacy skills will be exposed to few passive sentences, which may negatively impact how they are acquired and processed. After all, this is likely to be one syntactic structure for which linguistic knowledge is bolstered by input received at school (Guasti and Cardinaletti, 2003).

The study

A limited but growing number of studies have investigated how literacy impacts language development in bilingual children (Andreou et al., 2021; Antonijevic et al., 2017; Dosi et al., 2016; Kaltsa et al., 2020; Makrodimitris and Schulz, 2021) and they provide evidence that language of instruction does affect school-age bilinguals' morphosyntactic production accuracy. Our study contributes additional findings by comparing the L1 production of school-age Spanish HSs who develop literacy in Spanish and English or English only in the United States. Based on the LEH, if Spanish literacy development contributes to the HSs' acquisition of L1 morphosyntactic features, HSs in bilingual schools with more Spanish text experience should outperform their peers in English-only schools on tasks measuring Spanish literacy and oral production of gender agreement and full verbal passives.

TABLE 3 Home language use scores (0–1) based on school type.

	M	*SD*	Range
English-only School	0.61	0.18	0.25–0.88
English-Spanish School	0.38	0.24	0–0.71

Scores > 0.5 indicate a greater use of English at home, whereas scores < 0.5 indicate greater use of Spanish at home.

Method

Participants

The participants were 50 Spanish HSs in in the United States equally divided in two groups based on what type of elementary school they attended: "English-only school" (EOS) and "English-Spanish school" (ESS). All children were exposed to Spanish from birth and had at least one parent who was a native Spanish speaker (i.e., someone who was raised and educated in Spanish while growing up in a Spanish-speaking country before moving to the U.S. as an adult). The groups' Age of Exposure (AoE) to English in years (see Table 1) was not significantly different, $W = 266$, $p = 0.369$, $r = 0.13$. There were no reported cases of reading impairment, learning disabilities, speech-hearing disorders, or developmental delay. Their individual testing sessions took place on Zoom during the COVID-19 pandemic or in-person at local libraries. To try to maintain consistency across sessions, the materials were presented to participants on websites (e.g., Qualtrics) and PowerPoint slides via screensharing on Zoom or a laptop placed in front of the participants for in-person sessions. This meant all participants completed the experimental tasks presented on a computer in a quiet space.

With respect to school type, children in the English-only school group attended schools where the medium of instruction was entirely English. Because this is the most common educational setting for students in the U.S., this group serves as the baseline control. According to parent interviews, children in the English-Spanish school group attended bilingual schools that provided literacy and content instruction (social studies, math, etc.) for part of the day (typically 50%-90%) in Spanish. They were primarily enrolled in two-way, dual immersion programs located in Chicago, IL and San Diego, CA with mixed classrooms of L1 Spanish and L1 English speakers, but a few were enrolled in developmental programs that ultimately transition to English-only instruction (Lindholm-Leary, 2018). Although some participants were engaged in remote learning at the time of testing, bilingual schools had continued to provide content and literacy instruction in Spanish (and English) to their students, and we are not aware of any changes in the amount of instructional time that was dedicated to Spanish and English compared to in-person learning during this challenging time. Thus, the English-only school and English-Spanish school groups were comprised of school-aged Spanish HSs growing up in the U.S. who have used Spanish at home since birth with native speaker caregivers. However, only children in the English-Spanish school group have developed Spanish literacy via consistent and significant exposure to textual material in an academic setting. This creates the crucial difference in Spanish input provided to the two child groups in this study.

The participants' parents completed a language background interview in Spanish based on the Alberta Language Environment Questionnaire (ALEQ) to assess participants' use of Spanish and English in and outside the home (Paradis, 2011). The survey evaluated school input, which languages the children used with their caregivers, siblings, and peers, and how often they completed different activities (e.g., reading, using the computer, watching T.V., extracurricular activities) in each language. The answers were used to calculate the groups' scores for language input. Children in the English-Spanish school group used Spanish at school in academic contexts, which resulted in higher amounts and richness of their Spanish input (Table 2).

This contrast was also reflected in the English-Spanish school group's home language use scores (Table 3). Members of this group appeared more likely to use Spanish outside of school for assignments and general use.

Thus, all the HSs in our study acquired and spoke Spanish in a naturalistic setting, but those in the English-Spanish school group used their L1 Spanish in a greater variety of situations (e.g., home and school), modalities (spoken and written), and topics (colloquial and academic).

It is important to note that there is variable experience within the school groups. For example, the range of home language use scores indicated that some children in the English-only school group used predominantly Spanish at home, and many had indeed developed high levels of Spanish oral and reading proficiency. For this reason, we also evaluated all participants with the same literacy metrics to obtain common measures of L1 Spanish literacy development among these participants beyond school type alone.

Materials and procedure

The experimental tasks belonged to (a) standardized background measures of literacy and working memory and (b) linguistic tasks. The background measures consisted of standardized reading and memory tests to independently establish the participants' literacy and working memory development. There were two linguistic tasks: (1) a grammatical gender production task in which participants described pictures they saw, and (2) an elicited imitation task that elicited verbal passives (and other morphosyntactic structures).

Background measures of literacy and working memory

Literacy was evaluated with five reading subtests from *Batería III Woodcock-Muñoz* (Muñoz-Sandoval et al., 2005) and the rapid automatized naming (RAN) task from the *Comprehensive Test of Phonological Processing* (Wagner et al., 2013). Working memory was assessed with the digit span task from Wechsler's intelligence scales for children (*WISC-V*) (Wechsler, 2014). All test materials were in Spanish, started with easy items appropriate for young children, and gradually became more difficult.

Literacy measures

Reading vocabulary (Vocabulario de lectura)

Participants provided synonyms and antonyms for two separate word lists, respectively, and completed a series of analogies designed to measure knowledge of how words relate to one another.

Passage comprehension (Comprensión de textos)

While silently reading passages, participants used syntactic and semantic cues in the text to provide an appropriate word for a missing lexical item that was represented by a blank space.

Reading fluency (Fluidez en la lectura)

Participants had 3 minutes to read as many sentences as they could (out of 105) that expressed accurate or inaccurate statements while marking each one as true or false.

Word and letter identification (Identificación de letras y palabras)

Participants read a list of real Spanish words aloud, earning a point for each word that was read correctly and fluently.

Word analysis (Análisis de palabras)

Participants read a list of Spanish pseudowords aloud, also earning a point for each word that was read correctly and fluently.

Rapid automatized naming: digits and letters

Participants read aloud as fast as they could a slide with four rows of nine digits (randomly ordered). They followed the same procedure with letters. Reading times for digits and letters were recorded separately.

Working memory measure

Digit span

Participants listened to and repeated recordings (one at a time) of a native Mexican Spanish speaker reading a series of digits. The series began with two digits and gradually increased in length by one digit (there were two separate digit series for each length). The task proceeded until the participant (a) failed to accurately repeat both series of the same length, or (b) reached the end of the test (ten digits). Participants' scores are the sum of the points they received on the task's three subsections: forward, backward, and sequencing.

Analysis

The total raw score on each literacy and working memory measure was calculated for every participant. The normality of the data was evaluated using visual inspection and Shapiro-Wilk tests. If the data for a test did not follow a normal distribution, we applied a Box-Cox transformation. To evaluate the performance of children in the English-only school and English-Spanish school groups, we calculated the mean score of the two groups for each task and compared them using two-sample *t*-tests. With a total of eight comparisons, the Bonferroni adjusted *p* value for measuring significance was lowered to 0.006. Cohen's *d* was calculated for effect size.

Linguistic measures

Grammatical gender production

To understand who is doing what in passives, the gender of the passive participle must be computed. If overall knowledge of gender agreement is unstable or variable in Spanish HSs (Montrul and Potowski, 2007), this may impact their comprehension of passive sentences. For this reason, we evaluated gender agreement proficiency. The experiment required the production of 20 canonical nouns that were common animals: 10 masculine nouns with *-o* word markers (e.g., *perro* "dog") and 10 feminine nouns with *-a* word markers (e.g., *vaca* "cow"). We included familiar nouns that children acquire early (Alonso et al., 2015; Álvarez and Cuetos, 2007; Łuniewska et al., 2016). For each target noun, an artist drew an image of each animal. The images were normed on Mechanical Turk with 23 L1 Spanish-speakers who were raised and currently living in Spanish-speaking countries. The actual gender production experiment in Spanish used colored versions of the images that were *rojo* "red," *negro* "black," *amarillo* "yellow," or *blanco* "white." These color adjectives have *-o*/*-a* word markers that agree overtly with the grammatical gender of the noun they modify (*un perr**o** roj**o*** "a.M dog.M red.M" vs. *una vac**a** roj**a*** "a.F cow.F red.F").

The gender production task was similar to the tasks used in previous studies (Cuza and Pérez-Tattam, 2016; Martinez-Nieto and Restrepo, 2023; Montrul and Potowski, 2007). Each of the 20 target nouns were presented individually as large, colored pictures on a computer screen using PowerPoint. For each animal, participants saw the picture of the target noun on the screen, at which point they were prompted to produce a noun phrase describing what they saw (e.g., *Veo una tortuga amarilla* "I see a yellow turtle") before moving on to the next trial when they were ready. The instructions emphasized the need to include an article, the animal's name, and its color. There were four practice trials (two masculine, two feminine).

Analysis

For every participant, each trial's response was coded as accurate (1) or inaccurate (0) for vocabulary and gender. Responses with correct vocabulary included a noun that accurately labeled the picture regardless of dialectal or regional variation. Gender was scored on responses with full D-N-A picture descriptions (*un gato blanco* "a cat white"). Accurate gender responses included target agreement between the noun, determiner, and adjective. All responses were checked twice.

To compare the groups' performance, we ran logistic generalized linear mixed effects models (GLMM) using the lme4 package (Bates et al., 2015) in R (R Core Team, 2023). A Vocab Model and a Gender Model set vocabulary and gender accuracy as dependent variables (DVs), respectively. The independent variables (IVs) were school type (English-only/English-Spanish) with English-only set as the reference level using dummy coding. We also ran a second Gender Model 2 with Spanish reading vocabulary score as an additional continuous variable of reading development. In all models for the linguistic tasks, there were random effects (intercepts) for participants and items. The bobyqa optimizer was used when the default optimizer did not converge. Effect sizes for all models were expressed with odds ratios (*OR*).

Elicited imitation of verbal passives

Because verbal passives are rarely generated spontaneously by Spanish HSs (Gámez and Shimpi, 2016), we examined their production of this structure using elicited imitation. During an EI task, participants hear and repeat sentences. Several studies have indicated that successfully recalling a sentence goes beyond simple list repetition of words. Instead, doing so requires speakers to regenerate a conceptual representation of what was heard using their linguistic competence (Potter and Lombardi, 1990). Successful sentence repetition involves accessing recently activated lexical items (or items with similar meanings) and independently generating a morphosyntactic structure that expresses their semantic relationship from the original sentence. Thus, participants will only successfully imitate morphosyntactic structures they have already acquired and are capable of parsing and generating autonomously. Otherwise, a different, or ungrammatical, structure will be uttered during recall. This makes EI a useful tool for examining an individual's morphosyntactic development by testing their ability to comprehend and produce sentences with different levels of syntactic complexity. Studies show that sentence repetition abilities develop separately from working memory in Norwegian 4–6-year-olds, indicating its role as a reliable metric of oral language skills (Klem et al., 2015). Furthermore, L1 English and L1 Czech 4–5-year-olds' EI accuracy decreased in sentences with syntactic, semantic, lexical, or prosodic violations, which indicates that sentence repetition draws on several aspects of linguistic knowledge (Polišenská et al., 2015). Because previous studies have

used EI to examine knowledge of morphosyntax in Spanish HSs (Gutiérrez-Clellen et al., 2006; Pérez-Leroux et al., 2011; Pratt et al., 2021), we deemed this methodology appropriate to assess HSs' morphosyntactic development.

The EI task contained 60 Spanish sentences with different syntactic structures produced by a native speaker of Mexican Spanish while being recorded in a sound attenuated booth. The critical test items (see Appendix) were 20 biased, reversible (i.e., with animate agents and patients), full verbal passives (i.e., passives containing a *by*-phrase). Each passive described a different completed event involving one animate NP as the agent and another animate NP as the theme in the format Adv-Aux-Passive Particple-NP1-by-NP2 (e.g., *Ayer fue comida la hormiga por el pájaro*. "Yesterday was eaten the ant by the bird."). To support the children's comprehension of these items, the sentences contained common verbs and early acquired nouns that are typically learned during childhood (Alonso et al., 2015; Álvarez and Cuetos, 2007; Łuniewska et al., 2016). No nouns or verbs were repeated in any of the critical items.

We also controlled for plausibility because this variable has been shown to impact children's EI performance. L1 English 2-year-olds' sentence repetition of SVO sentences was better when the V-O sequence was plausible (*The cat is eating some food)* compared to when it was not (*The cat is eating a sock*) (Valian et al., 2006). From an early age, the conceptual relationship between syntactic constituents plays a role in how comprehenders assign structure and meaning to an utterance. Integrating unexpected or conflicting information adds to the cognitive load required for generating a linguistic representation of the input and degrades recall accuracy as a result. Polišenská et al. (2015) found that 4–5-year-old English and Czech speakers' repetition accuracy decreased for semantically anomalous items. Additionally, English-speaking adults and 6.5-year-old children were better at repeating plausible vs. implausible sentences during immediate and delayed recall (Polišenská et al., 2014; see also Polišenská et al., 2021). According to the LEH, HSs with lower L1 literacy levels may rely more on general-world-knowledge semantic than syntactic cues to comprehend and interpret sentences; their lack of text exposure results in underdeveloped L1 morphosyntactic representations for structures that are frequent in written language.

Therefore, to investigate if L1 text experience impacts HSs' sensitivity to semantic and morphosyntactic cues during elicited imitation that previous research has found, the test sentences were counterbalanced for (a) the plausibility (10 plausible/10 implausible) of the sentence's meaning and (b) the "informativity" (10 informative/10 uninformative) of the gender morpheme on the passive participle, respectively. This resulted in four conditions labeled A–D in Table 4. Plausible sentences were made implausible by switching the syntactic position of the two NPs, which reverses their theta roles and the meaning of the sentence (Condition A vs. Condition C). A separate group of 37 adult native Spanish speakers who did not complete the EI task rated the sentences' plausibility from 1 (implausible) to 4 (plausible) and the difference in ratings between the plausible and implausible sentences was significant, $W = 457$, $p < 0.001$, $r = 0.88$.

Informative sentences have one NP with a masculine gender feature and one NP with a feminine gender feature. Because the passive participle always expresses gender agreement with the theme, a gender contrast between the two NPs results in an "informative" morphological cue on the participle that the listener can use to identify who is acted upon (Condition A vs. Condition B). In other words, the theme is the only NP with the same gender feature expressed on the participle. Conversely, uninformative sentences have two NPs with the same gender, which means both will match the gender feature expressed on the passive participle. This may increase the difficulty of comprehending a passive sentence because the participle's morphological cue becomes uninformative in this context. The informative sentences were counterbalanced so that they had an equal number of masculine and feminine nouns. One critical sentence was removed from the analysis because its structure differed slightly from the rest.

As control items, there were ten active sentences with canonical S-V-O-PP word order and common lexical items. Half of the sentences described plausible events (e.g., *La maestra compró el pez para la clase*. "The teacher bought the fish for the class.") and half described implausible events (e.g., *El gato alimentó al anciano en casa*. "The cat fed the old man at home."). The sentences contained equal numbers of masculine and feminine nouns, and none were repeated from the critical test items.

In addition to the test and control items, the EI task also included 30 additional fillers with different syntactic structures of varying complexity based on items tested by Marinis and Armon-Lotem (2015), Sánchez-Walker (2019), and the *Clinical Evaluation of Language Fundamentals – Fourth Edition, Spanish* (Wiig et al., 2006). In total, the EI task developed for the present study contained 60 sentences representing 12 structures divided into four equal blocks. There was one test item for every two control or filler items. The sentences were presented in a semi randomized order so that each consecutive block contained gradually more complex structures. This was done so participants could become accustomed to the task.

Based on their morphosyntactic complexity, each target structure was categorized as complex or simple. The complex target structures involved syntactic movement plus embedding, full verbal passives containing a *by*-phrase, and morphosyntactic markers and agreement operations that are more complex in Spanish than in English, which Spanish HSs with low L1 literacy levels struggle to produce accurately (differential object marking, gender, and number agreement). According to the LEH, production of these more complex morphosyntactic forms may benefit from increased text exposure.

To complete the EI task, participants listened to one sentence at a time and immediately attempted to repeat it without making any changes to what they heard. All sessions were conducted individually. Before starting, participants were instructed to repeat each sentence exactly as they heard it, and to recall as many words and ideas as possible if they could not remember the entire sentence. To help the children feel relaxed during the session, they were told this activity was not a formal school test, but it was still important to try their best. All participants received encouragement throughout the task regardless of how well they repeated the sentences. It took about 20–25 min to complete, and breaks were taken as needed after each of the four 15-sentence

TABLE 4 Experimental conditions and example test sentences.

Condition	Sentence								Plausibility	Informativity
A	*Ayer*	*fue*	*mordido.M*	*el*	*hombre.M*	*por*	*la*	*ardilla.F*	Plausible	Informative
	Yesterday	was	bitten.M	the	man.M	by	the	squirrel.F		
B	*Ayer*	*fue*	*mordido.M*	*el*	*hombre.M*	*por*	*el*	*perro.M*	Plausible	Uninformative
	Yesterday	was	bitten.M	the	man.M	by	the	dog.M		
C	*Ayer*	*fue*	*mordida.F*	*la*	*ardilla.F*	*por*	*el*	*hombre.M*	Implausible	Informative
	Yesterday	was	bitten.F	the	squirrel.F	by	the	man.M		
D	*Ayer*	*fue*	*mordido.M*	*el*	*perro.M*	*por*	*el*	*hombre.M*	Implausible	Uninformative
	Yesterday	was	bitten.M	the	dog.M	by	the	man.M		

blocks, or whenever a participant wanted to pause. Each task was voice recorded.

Coding

Each repeated sentence received three scores (Marinis and Armon-Lotem, 2015). For "accuracy" (0–1), a sentence received one point for a verbatim repetition and no point if it included any deviation from the original stimulus. For "score" (0–3), a sentence received three points for an exact repetition, two points if the repetition included one change, one point if it included two changes, and zero points if it included three or more changes. For "structure score" (0–1), a sentence received one point if the target syntactic structure (Table 5) was repeated regardless of other changes in the repetition, and no point if the syntactic structure was not preserved. The structure score does not penalize a participant for repetitions that successfully generate the tested structure despite containing synonyms or other unrelated errors that are not central to our research questions. For example, a participant's repetition of the plausible, informative test item *Ayer fue llevado el chico por la mamá* "Yesterday was carried the boy by the mom" as **Ayer fue llevado el niño por el mamá* contains two changes: (a) substitution of *chico* "boy" with the synonym *niño*, (b) switching the gender of the determiner before *mama* from feminine to masculine; and one grammatical error: the gender mismatch between masculine determiner *el* "the" and feminine noun *mamá*. Thus, the repetition would receive an accuracy of 0, a score of 1, and a structure score of 1 for maintaining the target full verbal passive construction.

Because the present study is specifically focused on participants' ability to parse and produce passive sentences, the analysis focuses on structure score as it reflects specific knowledge of the linguistic structure under consideration. Specifically, we coded as structurally correct full verbal passives that included: (a) the auxiliary *ser* "to be" in its preterit form, (b) a passive participle, and (c) a *by*-phrase headed by the preposition *por* "by" that minimally contains a determiner to indicate the participant understands the requirement of an NP in this syntactic position. To augment the structure score, each grammatical error produced during the EI task was also recorded and classified. This allowed us to consider what types of errors led to breakdowns in the participants' production of passives and the other structures targeted in the EI task. Ungrammatical elements were primarily classified as morphological (gender and number agreement errors for different syntactic categories), or lexical (substitutions, additions, omissions).

TABLE 5 Sentence types and syntactic structures targeted in the EI task.

Target sentence structure	Complexity	# of items
Test items		
Verbal passives	Complex	20
Control items		
Actives (S-V-O-PP)	Simple	10
Filler items		
VOS	Simple	2
Finite sentential complement	Simple	2
Non-finite sentential complement	Simple	2
Object question	Simple	2
Subject question	Simple	2
Adjective agreement inflections	Complex	2
Differential Object Marking	Complex	4
Subject relative clause	Complex	6
Object relative clause	Complex	4
Verbal passive (non-test structure)	Complex	4

The participants' responses were scored and classified two times. Additionally, a trained second rater also scored 20% of the data. The raters' structure scores generated a high kappa reliability coefficient ($\kappa = 0.82$), which indicates near perfect agreement that is well above chance when $\kappa = 0$ (Cohen, 1960; Hallgren, 2012). After discussing the small number of trials that received different structure scores, the raters reached 100% agreement.

Analysis

We again fit the data with (generalized) linear mixed effects models [(G)LMM] in R. For an overall perspective of each experimental group's performance on all task items, we ran one LMM with score (0–3) as the DV, and two separate logistic GLMMs with accuracy (1/0) and structure score (1/0) as the DVs, respectively. The IV in all three models was school type [English-only school (EOS)/English-Spanish school (ESS)]. Using dummy coding, EOS was set as the reference level. There were random effects (intercepts) for participants and items.

TABLE 6 Batería III literacy test scores based on school type.

Test (max. score)	English-only School		English-Spanish School		*t*(48)	*p*	Cohen's *d*
	M	*SD*	*M*	*SD*			
Reading vocab. (73)	16.0	9.34	28.4	7.15	5.29	<0.001	1.50
Passage comp. (47)	20.4	6.38	28.2	3.78	5.29	<0.001	1.50
Reading fluency (105)	21.2	9.36	37.3	11.51	5.41	<0.001	1.53
Word and letter ID (76)	34.5	10.30	50.7	9.45	5.79	<0.001	1.64
Word analysis (32)	19.2	4.17	23.4	4.04	3.68	<0.001	1.04

TABLE 7 RAN reading times (transformed) by school type.

Test measure	English-only School		English-Spanish School		*t*(47)	*p*	Cohen's *d*
	M	*SD*	*M*	*SD*			
Digit reading time	0.873	0.012	0.860	0.010	−4.15	<0.001	1.19
Letter reading time	1.367	0.044	1.293	0.034	−6.51	<0.001	1.86

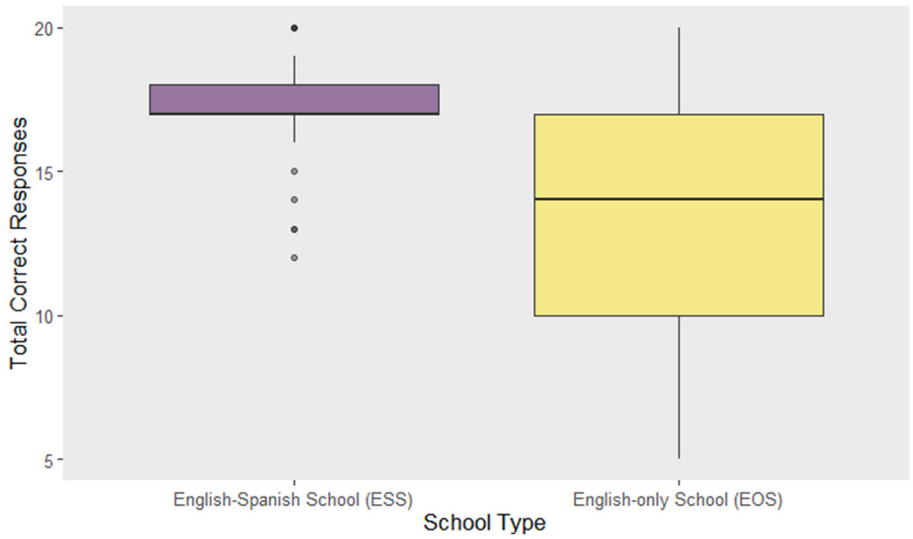

FIGURE 1
Vocabulary score by school type.

For a more detailed inspection of how the EI results could inform our research questions, we ran additional logistic GLMMs with more variables. The DV was structure score (1/0). We used dummy coding for the categorical fixed effect IVs. With reference levels appearing first in the parentheses, the IVs were school group (English-only/English-Spanish), structure (verbal passive/active), plausibility (plausible/implausible), informativity (informative/uninformative), reading vocabulary (continuous), and working memory (continuous). The random effects (intercepts) were participants and items. Including the random effects in all models, we used forward selection beginning with school group only, followed by a school × structure interaction, and then subsequently adding the other fixed effects. The anova() function was used for maximum likelihood estimation to compare how well each model fit the data.

To analyze the results in a broader context with more data, we used the same logistic GLMM and forward selection method and expanded the analysis to include all 12 structures (test, control, fillers) from the EI task in Table 5. The DV was again structure score (1/0). We again used dummy coding, and the fixed effect IVs with reference levels appearing first in parentheses were school group (English-only/English-Spanish), complexity (complex/simple), and reading vocabulary (continuous). We maintained participants and items as random effects (intercepts). Significant interactions were followed up with pairwise comparisons using the emmeans package (Lenth, 2024).

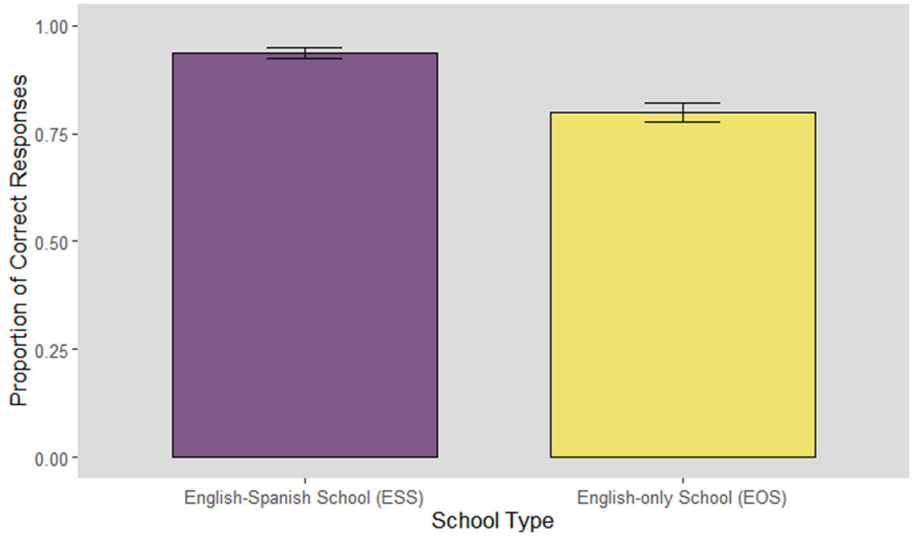

FIGURE 2
Gender accuracy by school type.

TABLE 8 Coefficients and significance tests for gender model 2.

Fixed effect	Estimate	*SE*	95% *CI*		*z* value	*p*	*OR*
			LL	UL			
(Intercept)	−1.06	0.67	−2.38	0.25	−1.58	0.114	0.35
schoolESS	0.02	0.65	−1.25	1.31	0.04	0.968	1.03
Reading vocabulary	0.19	0.04	0.12	0.26	5.14	<0.001	1.21

CI, confidence interval; LL, Lower Limit; UL, Upper Limit; OR, Odds Ratio.

Results

Literacy and working memory

Table 6 summarizes the results that show the English-Spanish school group scored significantly higher than the English-only school group on all five *Batería III* literacy tests.

For the RAN measures, the digit and number reading time data were normally distributed after undergoing a Box-Cox transformation (Table 7). One English-Spanish school participant was removed from the RAN analysis due to a technical error during recording. Overall, the English-Spanish school group had faster reading times for digits (English-Spanish school: $M = 17.1$ s, $SD = 3.77$; English-only school: $M = 29.1$ s, $SD = 17.2$) and letters (English-Spanish school: $M = 20.6$ s, $SD = 5.16$; English-only school: $M = 46.1$ s, $SD = 22.88$). The *t*-test on the transformed data showed these differences were significant.

The mean working memory score for the English-Spanish school group ($M = 25.7$ points, $SD = 6.28$, max. score = 48 points) was higher than that of the English-only school group ($M = 19.6$ points, $SD = 4.58$). One participant was removed for scoring abnormally high on the digit span task (3.6 standard deviations above the mean). The difference between the groups' scores on this task was also significant, $t_{(47)} = 3.91$, $p < 0.001$, $d = 1.12$.

TABLE 9 Mean passive structure score by school type, plausibility, and informativity.

	English-Spanish School		English-only School	
	M	*SD*	*M*	*SD*
Plausibility				
Plausible	86.4	34.35	40.4	49.17
Implausible	81.3	39.05	36.0	48.11
Informativity				
Informative	84.8	35.97	38.0	48.64
Uninformative	83.1	37.55	38.7	48.81

Grammatical gender production

For the vocabulary score, the average number of accurately produced animal words during the task was 17.1 ($SD = 2.24$) out of 20 for the English-Spanish school group compared to 13.3 ($SD = 4.37$) for the English-only school group (Figure 1).

The result of the Vocab logistic GLMM found a significant difference between the groups. English-Spanish school participants were significantly more likely to accurately label the nouns they

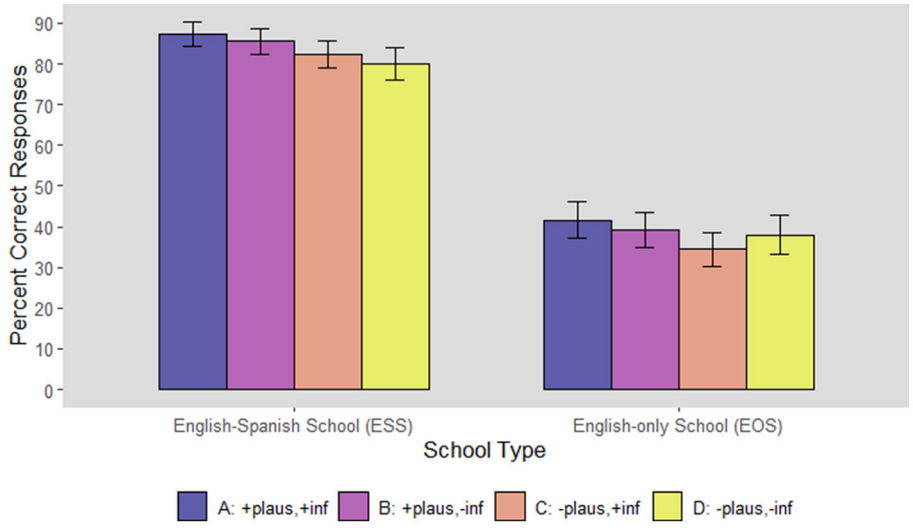

FIGURE 3
EI structure score percentage for verbal passives by condition and school type.

encountered during the gender production task, β = 1.59, 95% *CI* [0.80, 2.38], *SE* = 0.40, *z* = 3.95, *p* < 0.001, *OR* = 4.91.

For the gender accuracy score, the English-Spanish school group accurately produced gender on 93.6% (*SD* = 24.4) of their full DPs (*n* = 440), whereas children in the English-only school group did so on 79.8% (*SD* = 40.2) of their full DPs (*n* = 347) (Figure 2).

The Gender logistic GLMM determined that participants in the English-Spanish school group were significantly more likely to generate DPs with accurate grammatical gender, β = 2.68, 95% *CI* [1.07, 4.29], *SE* = 0.82, *z* = 3.26, *p* = 0.001, *OR* = 14.55. This robust effect indicates that the odds of English-Spanish school participants producing responses with accurate grammatical gender are 14.55 times higher than the English-only school participants. To further explore literacy, we ran an additional Gender logistic GLMM with Spanish reading vocabulary as an additional IV given its status as a reliable predictor of reading comprehension in mono- and bilinguals (Carlisle et al., 1999; Droop and Verhoeven, 2003; Proctor et al., 2010), which we refer to as Gender Model 2:

$$\text{Gender accuracy} \sim \text{school type} + \text{reading vocabulary} + (1|\text{participant}) + (1|\text{item})$$

The output (Table 8) found a significant effect of Spanish reading vocabulary on gender production accuracy. Additionally, when controlling for reading vocabulary, the difference in gender production accuracy based on school type disappears.

The Gender Model 2 results indicate that for every one-point increase in Spanish reading vocabulary, the HSs' odds of producing a DP with accurate grammatical gender assignment and agreement is 1.21 times higher.

Elicited imitation task

On overall EI task performance, the English-Spanish school group repeated sentences more effectively than the English-only school group on all three measures. For accuracy, the English-Spanish school group mean of 59.7% was higher than the English-only school group mean of 24.5%, *β* = 2.55, 95% *CI* [1.71, 3.40], *SE* = 0.43, *z* = 5.93, *p* < 0.001, *OR* = 12.85. For score, the English-Spanish school group averaged 2.3 points whereas the English-only school group averaged 1.2 points, *β* = 1.11, 95% *CI* [0.78, 1.43], *SE* = 0.17, $t_{(48)}$ = 6.57, *p* < 0.001. For structure score, the English-Spanish school group repeated the target structure for 88.1% of the sentences compared to the English-only school group that did so for 56.9% of the sentences, *β* = 2.61, 95% *CI* [1.75, 3.47], *SE* = 0.44, *z* = 5.95, *p* < 0.001, *OR* = 13.61. These results indicate a clear overall advantage on the EI task for HSs in the English-Spanish school group.

A similar pattern emerges between the groups when we focus on the verbal passive critical items. The English-Spanish school group had a higher average structure score (*M* = 84.0%, *SD* = 36.70) than the English-only school group (*M* = 38.3%, *SD* = 48.67).

Examining the impact of plausibility and informativity separately suggested that structural accuracy for the repetition of passives was negatively affected by implausibility, but only minimally. The informativity of the sentences' passive participles appeared to have no influence on repetition (Table 9, Figure 3).

The effects of syntactic complexity and literacy on the children's ability to accurately parse and regenerate passive structures come into stronger relief when we compare their performance on simpler, active items. For active sentences, the English-Spanish school group scored essentially at ceiling (*M* = 97.6%, *SD* = 15.34) and the English-only school group also scored well (*M* = 82.0%, *SD* = 38.50). However, whereas the mean structure score for the English-Spanish school group decreased by 13.6 percentage points to 84% on passive sentences, the English-only school group decreased by roughly three times that amount to 38%.

To determine the significance of these trends, we fit a series of logistic generalized linear mixed effects models using forward selection. After comparing the nested models to their expanded

TABLE 10 Coefficients and significance tests for model 1.

Fixed effect	Estimate	*SE*	95% *CI*		*z* value	*p*	*OR*
			LL	UL			
(Intercept)	−4.03	0.96	−5.91	−2.15	−4.20	<0.001	0.02
schoolESS	1.01	0.52	−0.01	2.02	1.94	0.052	2.73
structureSVO	3.20	0.35	2.51	3.89	9.13	<0.001	24.58
plausibility Implausible	−0.43	0.27	−0.96	0.09	−1.61	0.107	0.65
informativity Uninformative	−0.12	0.27	−0.65	0.40	−0.46	0.649	0.88
Reading vocabulary	0.13	0.03	0.08	0.19	4.67	<0.001	1.14
Working memory	0.08	0.05	−0.02	0.17	1.51	0.130	1.08
schoolESS: structureSVO	−0.58	0.55	−1.65	0.50	−1.05	0.293	0.56

CI, confidence interval; LL, Lower Limit; UL, Upper Limit; OR, Odds Ratio.

form with the addition of each predictor, it was determined that the full model including working memory provided the best fit for the data. We refer to this as Model 1:

$$\text{structure score} \sim \text{school}^{*}\text{structure} + \text{plausibility} + \text{informativity} + \text{reading vocab} + \text{wm} + (1|\text{participant}) + (1|\text{item})$$

The results of Model 1, summarized in Table 10, confirm some of the trends observed in the data and provide some unexpected findings. The output indicated that for passive sentences, the increased log odds of the English-Spanish school group repeating the correct structure very nearly reached significance. Participants in the English-only school group had significantly higher log odds of maintaining the grammatical form of active sentences during recall when compared to passives. Reading vocabulary, the continuous variable we used as a metric for literacy, was also found to significantly predict participants' structure scores in a positive direction. The remaining predictors did not reach significance. Notably, there was no significant school × structure interaction even though producing structurally accurate passives appeared to be more challenging for the English-only school group. It is possible the unequal number of active and passive items included in the EI task contributed to this, and that a model run on more balanced data would detect the difference between groups.

Because Model 1 did not find that working memory significantly predicted participants' structure scores, we also fit a model without this term. This allowed us to include the EI data from the English-Spanish school group participant who had been removed for having an outlier digit span score. We labeled this as Model 2:

$$\text{structure score} \sim \text{school}^{*}\text{structure} + \text{plausibility} + \text{informativity} + \text{reading vocab} + (1|\text{participant}) + (1|\text{item})$$

The output for Model 2 (Table 11) with all participants indicated a simple effect of school type: on passive sentences, the log odds of the English-Spanish school group repeating the correct structure were significantly higher than the those of the English-only school group. For the English-only school group, the odds of repeating a structurally accurate sentence were roughly 25 times higher for active items than passive items ($e^{3.2} = 24.6$). For the Bilingual school group, these same odds were only 14 times higher for actives compared to passives ($e^{3.2-0.56} = 13.9$). An additional model that included the mothers' years of education as an IV indicated this variable did not significantly predict participants' structure scores, $\beta = -0.05$, 95% *CI* [-0.17, 0.06], $SE = 0.06$, $z = -0.91$, $p = 0.363$, $OR = 0.96$.

As part of a *post-hoc* analysis, we fit a logistic GLMM with the DV as passive structure score and three IVs: school type, reading vocabulary, and the sum of participants' structure scores for the active sentences. After including overall accuracy on active sentences as a covariate, the output indicated reading vocabulary predicted participants' passive structure scores, $\beta = 0.19$, 95% *CI* [0.10, 0.27], $SE = 0.04$, $z = 4.23$, $p < 0.001$, $OR = 1.2$, whereas school type approached a marginally significant level ($p = 0.072$). Additionally, we ran Model 2 above after interchanging school type and reading vocabulary. In this case, there was a significant reading vocabulary × structure interaction, $\beta = -0.08$, 95% *CI* [-0.13, −0.03], $SE = 0.02$, $z = -3.33$, $p < 0.001$, $OR = 0.92$, such that reading vocabulary score contributed more to participants' repetition accuracy for passive sentences than active ones.

To understand in more detail what led to the higher error rate for structure score on passive sentences, we grouped all responses with a structure score of 0 and analyzed the participants' changes involving the three main structural components of a full verbal passive: the auxiliary verb, the passive participle, and the *by*-phrase. This resulted in 438 errors for the English-only school group and 86 errors for the English-Spanish school group. Among both groups, the most frequent structural error was the substitution of *por* "by" with *de* "of" in the *by*-phrase.

TABLE 11 Coefficients and significance tests for model 2.

Fixed effect	Estimate	*SE*	95% *CI*		*z* value	*p*	*OR*
			LL	UL			
(Intercept)	−2.81	0.57	−3.93	−1.70	−4.94	<0.001	0.06
schoolESS	1.31	0.53	0.26	2.36	2.45	0.014	3.70
structureSVO	3.20	0.35	2.51	3.89	9.12	<0.001	24.55
plausibility Implausible	−0.43	0.27	−0.96	0.09	−1.61	0.107	0.65
informativity Uninformative	−0.12	0.27	−0.65	0.40	−0.45	0.649	0.89
reading vocabulary	0.15	0.03	0.10	0.20	5.49	<0.001	1.16
schoolESS: structureSVO	−0.56	0.55	−1.64	0.51	−1.03	0.302	0.57

CI, confidence interval; LL, Lower Limit; UL, Upper Limit; OR, Odds Ratio.

(1) Target item: *Ayer fue comida la hormiga por el pájaro.*
'Yesterday was eaten the ant by the bird.'
Repetition: *Ayer fue comida la hormiga* ***de*** *la pájaro.*
'Yesterday was eaten the ant **of** the bird.'
Participant 524, 10 years old

The example above also contains a gender error on the determiner preceding *pájaro* "bird" that did not affect the structure score. (1) demonstrates the most frequent replacement of *por* "by," but it was also substituted by the other prepositions *para* "for," *a* "to/at," *con* "with," *en* "in," the complementizer *porque* "because," and the coordinate conjunction *y* "and." Although this was the most frequent structural change in both groups, it occurred more often in repetitions by English-only school participants (see Table 12). Nevertheless, when considered proportionally, replacement of *por* "by" with one of the words mentioned above accounted for 33% of the structural errors in the English-only school group and 31% in the English-Spanish school group. A different but related *by*-phrase error was its complete omission, which converts the full (long) passive into a short passive.

(2) Target item: *Ayer fue examinado el vaquero por el toro.*
'Yesterday was examined the cowboy by the bull.'
Repetition: *Ayer fue examinado el vaquero [ ].*
'Yesterday was examined the cowboy.'
Participant 540, 11 years old

However, unlike *por* "by" replacement that occurred at similar rates in the two groups, *by*-phrase omission occurred 29 times for the English-only school group but only two times for the English-Spanish school group.

In addition to the *by*-phrase, participants also demonstrated difficulties with the passive participle in the form of participle omissions (3) and non-word forms (4).

(3) Target item: *Ayer fue acariciada la muchacha por el perrito.*
'Yesterday was petted the girl by the little dog.'
Repetition: *Ayer fue [ ] la muchacha por el perro.*
'Yesterday was [ ] the girl by the dog.'
Participant 514, 10 years old

In addition to omitting the participle, the participant response in (3) has potentially changed the interpretation of *fue* to the preterit form of the main verb *ir* "to go," rather than the auxiliary *ser* "to be." We will return to this in the discussion.

(4) Target item: *Ayer fue estudiada la mariposa por la científica.*
'Yesterday was studied the butterfly by the scientist.'
Repetition: *Ayer fue "****estudi****" la mariposa por la científica.*
*'Yesterday was "****studi****" the butterfly by the scientist.'*
Participant 513, 9 years old

In (4), the *-da/-do* participle ending for *-ar* verbs like *estudiar* "to study" was not uttered, which resulted in a word that does not exist in Spanish. Another structural challenge some children demonstrated was an incomplete understanding of the verbal and aspectual requirements of the auxiliary in verbal passive constructions. Upon repetition, several participants converted the auxiliary from its preterit to imperfect form (5). This change in aspect was frequently accompanied by substituting the auxiliary with *estar* "to be," which is typically restricted to adjectival passives that do not describe a completed event or assign nominative case to an agentive NP (6).

(5) Target item: *Ayer fue atacada la víbora por la rana.*
'Yesterday was attacked the snake by the frog.'
Repetition: **Ayer* ***era*** *atacada la víbora por la rana.*
'Yesterday was attacked the snake by the frog.'

TABLE 12 Frequency of verbal passive structural error types (percentage of all errors) by school type.

Error	English-only school	English-Spanish school
***by*-phrase**		
Substitution of *por* "by"		
de "of"	74	19
para "for"	29	0
a "to, at"	25	4
con "with"	5	1
en "in, on"	3	2
y "and"	6	0
porque "because"	3	1
Total *por* substitutions	145 (33%)	27 (31%)
Omission of *por* "by" only	32	4
Omission of *by*-phrase	29	2
Total *by*-phrase errors	**206 (47%)**	**33 (38%)**
Participle		
Non-word	42	13
Omission	51	10
Substitution	2	5
Total participle errors	**95 (22%)**	**28 (33%)**
Auxiliary		
Substitution of *fue* (*ser*)		
está (*estar*)	44	6
Other	3	1
Tense	46	10
Omission	8	0
Total auxiliary errors	**101 (23%)**	**17 (20%)**
Voice		
"Activized"	33	8
Other	3	0
Total voice errors	**36 (8%)**	**8 (9%)**
Total errors	**438**	**86**

(6) Target item: *Esta mañana fue despertada la princesa por el gallo.*
'This morning was awoken the princess by the rooster.'
Repetition: **Esta mañana* ***estaba*** *despertada la princesa por el gallo.*
'This morning was awoken the princess by the rooster.'
Participant 562, 10 years old

Participant 562's repetitions in (5) and (6) resulted in verbal passives containing auxiliaries with imperfect aspect that do not describe a completed event. This renders their presence in constructions with telic verbs and *by*-phrases ungrammatical. However, (5) is grammatical under a reading that intends to describe a progressive or imperfective context (Sánchez-Walker, 2019). The final structural change that we observed was the transformation of passive test sentences into an active form.

(7) Target item: *Al final fue matado el dragón por el héroe.*
'At the end was killed the dragon by the hero.'
Repetition: *Al final el dragón mató al héroe.*
'At the end the dragon killed the hero.'
Participant 517, 9 years old

In addition to being "activized," the repetition in (7) also contains a reversal of the sentence's thematic roles that were assigned to the NPs, but this is not a structural error.

Some deviations from the target sentences during the EI task did not result in a structure score of 0 but are still relevant for our research questions. Namely, these are (a) implausible sentences that participants made plausible during repetition, and (b) morphosyntactic gender agreement errors between the passive participle and the theme. By and large, these errors were quite rare, however. For the passive sentences, the English-only school and the English-Spanish school groups converted 14 and 12 sentences into plausible forms, respectively.

(8) Target item: *Ayer fue cuidada la veterinaria por el pingüino.*
'Yesterday was cared for the veterinarian by the penguin.'
Repetition: *Ayer fue curado el pingüino por la veterinaria.*
'Yesterday was cured the penguin by the veterinarian.'
Participant 536, 12 years old

This repetition error only accounted for 5.8% of implausible sentence repetitions. Changing the plausibility of implausible active sentences occurred at the same rate. There were even fewer gender errors on the passive participles, which occurred nine times in each group. And there were only 40 cases of the theme noun being assigned the incorrect gender and mismatching the passive participle's gender feature. Curiously, this error type was more common on informative items (21 out of 26 items for the English-only school group and all 14 items for the English-Spanish school group).

Before moving on to our analysis of all structures, we also examined the relationship between accuracy on the gender production task and the production of verbal passives on the EI task. For each participant, we calculated the proportion of accurate NPs on the gender production task and included this value as a predictor with school group (English-only/English-Spanish) in a logistic mixed effects model with passive structure score as the DV. There were random effects (intercepts) for items and participants. The model indicated passive structure score was predicted by school type (ESS > EOS, $\beta = 2.39$, $SE = 0.69$, $z = 3.49$, $p < 0.001$) and gender production accuracy score ($\beta = 0.10$, $SE = 0.02$, $z = 4.74$, $p < 0.001$). Spearman correlations also found a positive relationship between production accuracy for grammatical gender

TABLE 13 Coefficients and significance tests for model 3.

Fixed effect	Estimate	*SE*	95% *CI*		*z* value	*p*	*OR*
			LL	UL			
(Intercept)	−2.27	0.43	−3.12	−1.42	−5.24	<0.001	0.10
schoolESS	1.16	0.41	0.36	1.96	2.85	0.004	3.19
complexitySimple	2.81	0.36	2.11	3.51	7.87	<0.001	16.60
Reading vocabulary	0.12	0.02	0.08	0.16	6.03	<0.001	1.13
schoolESS:complexity Simple	−0.70	0.32	−1.32	−0.08	−2.21	0.027	0.50

CI, confidence interval; LL, Lower Limit; UL, Upper Limit; OR, Odds Ratio.

TABLE 14 Pairwise comparison of model 3 school × complexity interaction.

Contrast	Estimate	*SE*	95% *CI*		*z* ratio	*p*	*OR*
			LL	UL			
Simple							
ESS–EOS	0.46	0.49	−0.49	1.41	0.95	0.344	1.59
Complex							
ESS–EOS	1.16	0.41	0.36	1.96	2.85	0.004	3.19

CI, confidence interval; LL, Lower Limit; UL, Upper Limit; OR, Odds Ratio.

and verbal passives for all participants together [$r_{(48)} = 0.67$, $p < 0.001$], and for each school group [EOS: $r_{(23)} = 0.73$, $p < 0.001$; ESS: $r_{(23)} = 0.49$, $p < 0.001$].

Expanding the structure score analysis to include all 12 structures in the EI task revealed a similar pattern to the one with active and passive sentences. For items labeled "simple," the English-Spanish school group scored almost at ceiling ($M = 96.4$, $SD = 18.6$), whereas the English-only school group scored at a lower but still generally accurate level ($M = 82.4$, $SD = 38.1$). However, on the "complex" sentences, the groups' mean structure scores lowered to 83.8% ($SD = 36.9$) and 43.8% ($SD = 49.6$), respectively.

To analyze these results more closely, we ran another series of logistic mixed effects models using forward selection including complexity (complex/simple) as a predictor. This time we began with school type as a single predictor, followed by a school × complexity interaction. The final model we ran, which provided the best fit for the data, included the interaction term and the reading vocabulary scores. We refer to this as Model 3:

$$\text{structure score} \sim \text{school}^{*}\text{complexity} + \text{reading vocabulary} + (1|\text{participant}) + (1|\text{item})$$

The Model 3 output reported several significant effects for the data from all 12 EI structures. There is another simple effect of school type, which indicated that for complex sentences, the log odds of the English-Spanish school group accurately regenerating the target syntactic structure were significantly higher than those of the English-only school group. There was also a simple effect of complexity such that for the English-only school group, the log odds of structurally accurate repetitions were significantly higher for simple sentences. For the English-only school group, the odds of repeating a sentence that was structurally accurate were roughly 17 times higher for simple structures compared to complex ones ($e^{2.81} = 16.6$). In contrast, for the English-Spanish school group, the odds of structural accuracy during sentence repetition were only about 8 times higher for simple structures ($e^{2.81-0.70} = 8.2$). This asymmetry was also indicated by the output's significant school × complexity interaction. The negative impact syntactic complexity had on sentence repetition was greater for HSs in the English-only school group. This is evident when we explore the group differences in a pairwise comparison contrasting the school groups by complexity.

The results of the pairwise comparisons indicated that there was no significant difference in structure score between the English-Spanish school and English-only school groups for sentences with simple structures. However, the difference in structure score between the groups was significant for complex structures. The odds of participants in the English-Spanish school group successfully repeating complex structures during the EI task were about three times higher than odds of participants in the English-only school group. A reviewer points out that object questions could be interpreted as a complex structure. In the present study, the participants produced this structure accurately (above 90%), and rerunning Model 3 with object questions categorized as "complex" did not change the findings of the model or pairwise comparisons reported in Tables 13, 14.

Finally, reading vocabulary score remained a highly significant predictor in Model 3. This is a consistent and robust finding such that HSs with stronger Spanish reading vocabularies regenerated Spanish sentences with greater structural accuracy. Additionally, one final model that included the mothers' years of education as an additional IV found this variable did not predict structure scores on the expanded dataset either, $\beta = -0.03$, 95% *CI* [−0.11, 0.06], $SE = 0.04$, $z = -0.59$, $p = 0.553$, $OR = 0.97$.

Discussion

We examined how L1 literacy development impacted the L1 oral production of Spanish grammatical gender and verbal passives by 8–12-year-old Spanish HSs in the U.S. We tested the Literacy Enhancement Hypothesis (LEH) by assessing language production skills associated with later language development that occurs during the school-age period as children gain exposure to textual input via literacy and content instruction in formal educational settings. The results provide preliminary evidence that L1 literacy contributes to the enrichment of HSs' L1 input, which helps promote the development of stronger representations for grammatical gender, full verbal passives, and other complex structures more generally. Overall, participants in the English-Spanish school group scored significantly higher on the gender production task and produced more accurate sentences on the EI task, including full verbal passives. Higher reading vocabulary also consistently predicted more accurate production on the gender and EI tasks. But despite the school groups' contrast in accuracy for active and passive sentences on the EI task, our analysis did not find a significant school type × structure interaction. However, a follow up analysis found a significant reading vocabulary × structure interaction. Additionally, we also found that after controlling for overall accuracy on active sentences, reading vocabulary scores significantly predicted structural accuracy on passive sentences during the EI task. These findings indicate L1 literacy, as measured by reading vocabulary, makes a unique contribution to the development of full verbal passives in the HSs. This trend was also observed for the extended comparison of simple and complex structures. Although the two school groups scored similarly on simple structures, the HSs in the English-Spanish school group with increased L1 text exposure were significantly more accurate when producing complex structures. As we discuss further below, these findings raise questions about the most effective methods to measure and assess the impact of L1 literacy on HSs' L1 language development (e.g., school type, reading vocabulary, other metrics, etc.) that future research must address. Nevertheless, the present results suggest L1 literacy contributes to HSs' development of complex morphosyntactic structures, providing some initial support for the LEH.

The results of the literacy measures provide clear evidence of differences in literacy development based on participants' school environment. HSs who attended bilingual (English- Spanish) schools scored significantly higher than those who attended English-only schools on all *Batería III* tests designed to measure different Spanish literacy skills. This included accessing and integrating orthographic and phonemic features required for reading nonce words and real words. The advantage in word identification further helped the English-Spanish school group participants read more fluently and comprehend passages with greater lexical and syntactic complexity. One major factor that undoubtedly supported the reading fluency and reading comprehension advantage was the English-Spanish school HSs' improved reading vocabulary scores. In general, HSs from English-only and English-Spanish schools were able to parse some Spanish text, but those attending English-Spanish schools had a stronger ability to integrate the literacy and linguistic knowledge required to read and understand their L1 Spanish in written form. This is further supported by the English-Spanish school group's faster reading times on the RAN task, which relies on the same underlying cognitive skills as reading (Araújo et al., 2015; Kirby et al., 2008). These results are expected, but nevertheless important to demonstrate that the two groups possess different levels of L1 literacy.

Because grammatical gender is a common source of morphosyntactic production errors among HSs, and that the expression of this feature on passive participles provides a potentially useful cue for interpreting verbal passives, we assessed the children's grammatical gender production in DPs. The results provided more evidence that developing L1 literacy may aid the acquisition of gender features in Spanish HSs. Overall, the English-Spanish school group produced DPs with significantly more accurate grammatical gender than their peers in the English-only school group. Montrul and Potowski (2007) found that compared to Spanish monolingual children in Mexico, HSs in the U.S. were significantly less accurate in their production of grammatical gender. The present study adds to our understanding of grammatical gender development by finding that among HSs, L1 literacy appears to contribute to stronger representations of the gender features assigned to the nouns in their lexicons, and to more robust morphosyntactic skills for establishing concord between the different syntactic categories within the DP. These results fit with the findings of previous research that HSs enrolled in two-way schools in Miami had higher accuracy with gender production for non-canonical nouns (Mueller Gathercole, 2002). However, it is important to note that our materials included canonical nouns, which provide an even more fundamental test of grammatical gender knowledge by assessing representations for "inner core" items in Harris (1991)'s theoretical account of how gender is organized in speakers' mental grammars. Among Spanish HSs in the U.S., gender for even inner core canonical nouns is not fully acquired by age 3–4-years-old. For this population, the primary school years serve as a crucial developmental period for continued acquisition of grammatical gender knowledge. And crucially, our results suggest that L1 text exposure and literacy development provide effective sources of input to help school-age HSs acquire the Spanish grammatical gender system to levels that exceed what is typically achieved with L1 oral input at home only.

Our findings on how grammatical gender development is impacted by Spanish HSs' language experience provided important information for discussing the EI experiment. Targeting full verbal passives in the EI task allowed us to study HSs' production of this largely text-based structure, whether they were sensitive to gender information on the passive participle, and whether sensitivity to gender information differs based on L1 literacy. The LEH predicts HSs with stronger L1 literacy skills would be better able to process grammatical gender features on passive participles, and this would improve the accuracy of their production on the EI task, especially when the gender cue can be used to confirm a sentence's implausible meaning before regenerating it. This also suggests HSs with weaker L1 literacy would potentially be more susceptible to repeating implausible sentences as plausible (i.e., inverting the NPs' theta roles) because they are less able to use gender information on the passive participle to confirm a sentence's

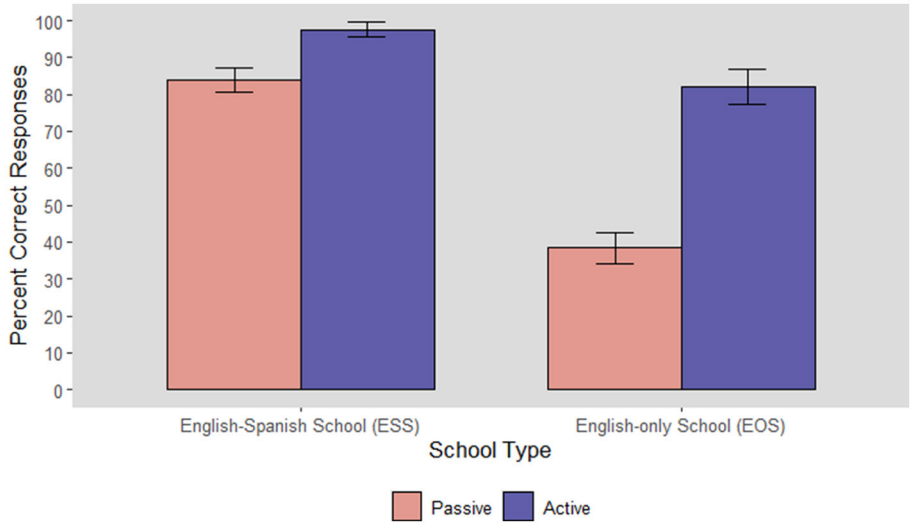

FIGURE 4
EI structure score by school type and structure (passive vs. active).

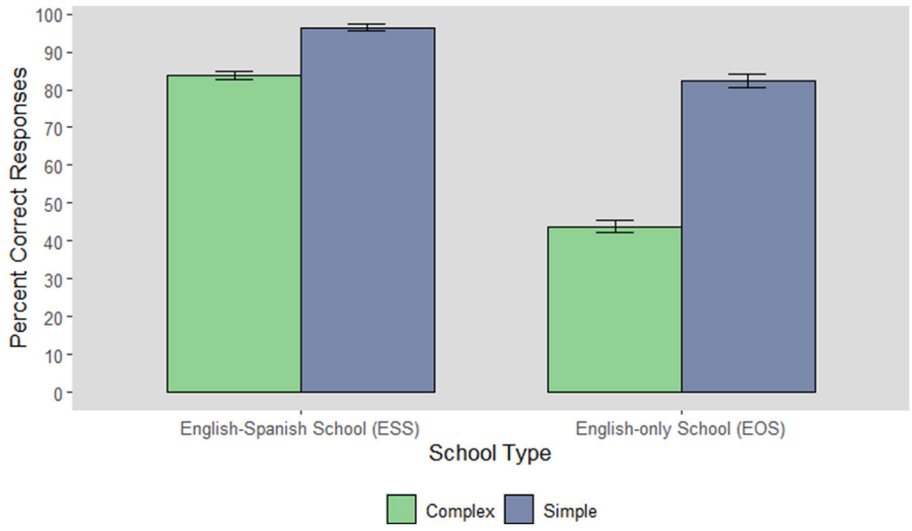

FIGURE 5
Mean structure score by sentence complexity and school type for all EI structures.

implausible reading, and repeat it as such. We also considered the potential impact of working memory on participants' ability to effectively parse, activate, update, and store linguistic information in passive morphosyntactic structures for recall.

Overall, the EI results indicated that for the school-age Spanish HSs in our study, language experience had a notable impact on the development of morphosyntactic knowledge required for producing full verbal passives. The results of the GLMM with structure score as the DV that modeled data from all participants (Model 2) showed that for full verbal passives, HSs in the English-Spanish school group were significantly more likely than the HSs in the English-only school group to repeat structurally accurate sentences. Furthermore, higher scores for Spanish reading vocabulary among the HSs also resulted in higher structure scores on the critical items. These findings provide evidence that developing L1 literacy is a critical language experience factor for Spanish HSs in the U.S. that promotes morphosyntactic growth by exposing them to verbal passives. Recall that as a group, HSs enrolled in bilingual schools had stronger L1 literacy as confirmed by their significantly higher scores on the seven literacy measures they were tested on.

Beyond overall performance, we were interested in how language experience might influence participants' reliance on specific linguistic (morphosyntactic and semantic) cues for comprehending and producing verbal passives on the EI task. The results showed that structure score on the EI task was

not modulated by the passive participle's informativity in either experimental group even though the English-Spanish school participants showed more developed grammatical gender knowledge and stronger L1 literacy. Therefore, contrary to our predictions, neither group demonstrated increased reliance on the participle's gender feature to parse and regenerate full verbal passives. There are several possible reasons for this outcome. First, in half the critical items, the gender feature on the passive participle was *un*informative. As a result, the HSs might have decided not to pay particular attention to this information given that it was useful in only some of the passives they heard. Second, the fact that HSs generally have weaker representations for grammatical gender could have further contributed to the results, but this is less likely because both groups patterned similarly despite showing different levels of grammatical gender knowledge. Third, this finding might reflect a task effect in that the offline repetition of passives in the EI task was unable to detect potential online sensitivity to grammatical gender features. For this reason, future work involving sentence comprehension measured via eye tracking could provide more nuanced data about how efficiently HSs with different language backgrounds integrate this linguistic cue in real time, which would in turn provide valuable information on how L1 literacy affects speakers' strength of and access to grammatical gender representations. Fourth, full verbal passives that express the agent in the *by*-phrase render gender information on the participle less important because the *by*-phrase provides additional, more salient information that comprehenders can use to establish thematic roles, especially if they are less inclined to pay attention to gender features in the first place.

The effect of plausibility on HSs' EI performance was similar to informativity because it did not significantly alter repetition performance of verbal passives either, despite showing larger descriptive effects on recall accuracy for both groups. It is possible that lengthening the time between listening to sentences and repeating them would further strengthen the effect of (im)plausibility. Polišenská et al. (2014) found that 6-year-olds' repetition accuracy on delayed recall decreased more for implausible sentences than plausible ones. Thus, our EI task using immediate repetition could have mitigated the difference we observed between structure scores for plausible and implausible items. Also, compared to our implausible sentences, Polišenská et al.'s (e.g., *The red grass was brave so we spoke to jam*) were less conceivable. This demonstrates how notions of "implausibility" exist on a spectrum from "unlikely but interpretable" to "essentially incomprehensible," and future work on this topic could help refine our understanding of the degree to which "implausibility" impacts young speakers' ability to regenerate different syntactic structures on an EI task and whether language experience plays a role. The limited effects of plausibility in our results were also evident from the small number of implausible sentences that HSs repeated as plausible. Part of this pattern may result from EI's emphasis on production. Future work evaluating language experience on HSs' comprehension of passive sentences is another metric that would help create a more complete understanding of which linguistic processes necessary for using complex syntactic structures rely more on semantic features.

Whereas informativity and plausibility did not appear to exert significant effects on EI structure scores, our error analysis indicated the *by*-phrase was where many HSs struggled while repeating full verbal passives. This was the most frequent point where passive structure broke down when many HSs replaced *por* "by" with a different preposition. The result is a structurally simpler passive that converts the *by*-phrase into regular PPs. According to Fox and Grodzinsky (1998)'s theory, these replacements simplify the full passive construction by obviating the transmission of an external theta role to the agent NP in the *by*-phrase. This finding reflects an overall trend of morphosyntactic simplification typical of heritage grammars that has been observed for other linguistic phenomena such as case, mood, tense/aspect, and differential object marking in languages like Russian, Korean, and Spanish, among several others (Montrul, 2023; Polinsky, 2018). Here it is important to remember that working memory was not a significant predictor of structural accuracy. Consequently, it is unlikely that the HSs who struggled to produce full verbal passives did so because of a reduced ability to temporarily encode, store, and update recently encountered linguistic information (words and structures) before integrating it with their syntactic knowledge of verbal passives activated in long-term memory. Rather, the challenge appears to be linguistic in nature and reflects the difficulty of assigning thematic roles to NPs that occur in infrequent, complex, and morphosyntactically marked constructions.

According to the Regeneration Hypothesis (Potter and Lombardi, 1990), sentence repetition is based on meaning, and the grammatical structure of the recalled sentence is largely restricted to the speaker's syntactic competence. Therefore, HSs who were unable to regenerate full verbal passives in the present experiment appear to lack the grammatical knowledge necessary for assigning thematic roles to NPs in non-canonical morphosyntactic positions. As a result, their repetitions contain simplified sentences that replace the *by*-phrase with non-agentive PPs. Avoidance of the *by*-phrase has been observed in other studies on children's passive production. For this reason, it is an important finding that in our study, which required participants to produce the *by*-phrase, L1 literacy appeared to strengthen the HSs' ability to accurately generate this structure.

The results provide evidence in support of the LEH by indicating that increased experience with L1 text provides input that exposes HSs to full passives and promotes the acquisition of this complex structure during the school-age period. However, the lack of interaction between school type and sentence structure in Models 1 and 2 also suggests that L1 text exposure enriches the input in a way that contributes to overall language growth for structures encountered in oral and written language. Testing additional participants and including more active sentences may identify an interaction that was not detected in the present study despite the apparent contrast in active and passive structure scores based on school type that our investigation has identified. This is an issue that future work aims to address.

Finally, the positive effect of text exposure on the development of morphosyntactic knowledge was also observed when we extended our analysis to include all 12 structures (six simple, six complex) in the EI task. Model 2 indicated HSs in the

English-Spanish school group had significantly higher structure scores for full verbal passives on the EI task, and that the difference in structure scores between active and passive items was numerically larger for the HSs in the English-only school group. This asymmetry also emerged when we compared structure scores for all the simple and complex items (see Figures 4, 5). However, one important result from our analysis of the full dataset was the significant school × complexity interaction in Model 3, which indicated a significant difference between the groups' structure score for complex sentences, but not for simple ones. Thus, we observed that among the HSs who were all raised speaking Spanish at home with their caregiver(s), those who received formal literacy instruction in Spanish had more accurate production of complex morphosyntactic structures. In the same model, higher Spanish reading vocabulary scores resulted in higher structure scores as well. We interpret these results as additional evidence that increasing L1 text exposure to HSs during the school-age period provides a substantial enrichment of the input they receive. The consequence is stronger L1 literacy, but also meaningful linguistic development that significantly improves oral production.

One important aspect of this study's results is a contrast in the relationship between production accuracy and the two literacy metrics (reading vocabulary and school type) included in the analysis. Whereas higher reading vocabulary scores (regardless of school type) were consistently associated with more accurate oral production, school type was less so. As the reviewers have noted, this raises questions about whether improved production of complex sentences was the result of L1 literacy development specifically, or the increased amount of enriched Spanish input some HSs received. We used school type as one metric of L1 literacy based on previous research that has identified bilingual education as a large source of text exposure that positively impacts and predicts school-age HSs' L1 reading skills (Durán et al., 2015; Nakamoto et al., 2012; Proctor et al., 2006). Additionally, cognitive approaches to reading development demonstrate that text comprehension relies on decoding and language comprehension, with increasing reliance on language comprehension during the later stages of primary education for monolinguals and bilinguals (Hoover and Tunmer, 2018; Taboada Barber et al., 2021). This suggests that generally improved L1 language comprehension resulting from bilingual education contributes to improved L1 literacy. However, as the reviewers suggest, it also highlights the challenge of disentangling the close relationship between language and literacy development in school-age HSs, and we agree that bilingual education enriches input in multiple ways that contribute to language development, and that there are other means to accumulate text exposure beyond school type alone (as the impact of reading vocabulary consistently demonstrated). Targeting verbal passives helps address the issue of overall increased oral input because they are exceedingly rare in adults' and children's production. In fact, the same children in the present study produced zero verbal passives (short or long) in a separate oral narrative task not reported here (Armstrong, 2024). Nevertheless, it is important for future work to continue considering how to identify literacy's specific contributions to language development given that HSs' language experience with L1 text is often associated with other factors that also contribute to changes in the input they receive.

Limitations and future directions

The present study has some limitations that can be addressed in future research to further our understanding of how literacy development impacts the acquisition of complex morphosyntactic structures. Methodologically, future versions could present items in counterbalanced lists that distribute the same sentence in its active and passive forms to the participants. This would increase the number of items in the task (which we attempted to limit to a manageable amount for the child participants) but considering this for future studies is important. Future work should also address the comprehension of verbal passives and other complex structures like relative clauses. Cilibrasi et al. (2019) found that stronger reading skills significantly improved the interpretation accuracy of certain object relative clauses (ORCs) in 7–11-year-old monolingual English children. Additionally, increased literacy skills significantly improved L1 Spanish adults' performance on a picture selection task with ORCs (Dabrowska et al., 2022). Finally, it is important to see how instruction in HSs' L1 and L2 affects the development of both languages, since the goal of bilingual education is to promote bilingualism and biliteracy.

Conclusion

The present study aimed to investigate if L1 literacy contributed to Spanish HSs' later language development. We tested this by evaluating their production of grammatical gender and full verbal passives on an EI task. The results indicated that L1 literacy instruction enriched HSs' input and contributed to more accurate production of grammatical gender, passives, and other complex morphosyntactic structures in Spanish. The findings suggest L1 text is a valuable input source that has the potential to make meaningful contributions to L1 morphosyntactic development in school-age HSs. Bilingual education contributes to help develop and maintain the heritage language.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving humans were approved by the Office for Protection of Research Subjects, UIUC. The studies were conducted in accordance with the local legislation and institutional requirements. Written informed consent for participation in this study was provided by the participants' legal guardians/next of kin.

Author contributions

AA: Funding acquisition, Writing – original draft, Writing – review & editing. SM: Funding acquisition, Writing – review & editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/flang.2024.1449315/full#supplementary-material

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