



Home literacy environment and existing knowledge mediate the link between socioeconomic status and language learning skills in dual language learners

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ABSTRACT

Children learning two languages (Dual Language Learners; DLLs) represent a rapidly growing population in the United States. DLLs are disproportionately more likely to live in families of low socioeconomic status (SES), which places many of them at risk for poor dual-language outcomes. To date, most studies on SES and dual language development have relied on static measures of vocabulary and syntactic skills, without examining the language learning processes – children's ability to acquire new language items. The current study used a newly developed language measure, the Quick Interactive Language Screener: English and Spanish (QUILS:ES), to assess 3- through 5-year-old Spanish-English DLLs' language learning processes. We also examined the association between SES (as measured by primary caregivers' education) and language learning processes, and further explored mechanisms underlying the association. DLLs from higher-SES families showed better language learning skills than those from lower-SES families. The size of the gap did not vary by child age. Home literacy environment (i.e., access to books, book-reading frequency) and children's existing knowledge (i.e., vocabulary and syntactic knowledge) mediated the SES effect. Together, these findings highlight the need to better prepare DLLs from low-SES families for learning from a dual-language environment. Supporting DLLs' language environment and knowledge through learning materials and language and literacy activities in both languages is crucial for ameliorating the SES gap in language learning processes.

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1. Introduction

Dual Language Learners (DLLs) – children exposed to a language other than English at home – represent 32% of the U.S. population under age 8; and the majority of them are from Spanish-speaking families (McCabe et al., 2013; Park, O'Toole, & Katsiaficas, 2017). Experiences and abilities in both languages are foundational for DLLs' future success (Hammer, Lawrence, & Miccio, 2008; Iglesias & Rojas, 2012; Tamis-LeMonda et al., 2014). While early English skills predict DLLs' academic trajectory throughout the

school years (Kieffer, 2008; Halle, Hair, Wandner, McNamara, & Chien, 2012), strong home language development benefits English learning and promotes positive family relationships and socioemotional adjustment (Hammer et al., 2014; Oh & Fuligni, 2010). Despite the importance of early dual language skills, contextual factors such as poverty or low socioeconomic status (SES) place many DLLs at disproportionate risk for poor language outcomes. Indeed, approximately 28% of DLLs from Spanish-speaking households are living below the federal poverty rate, compared to an overall childhood poverty rate of 19% in the United States (Child Trends, 2018; Koball & Jiang, 2018). Childhood poverty relates to increased risk for a range of negative developmental outcomes, including language delays and poor academic achievement (Hair, Hanson, Wolfe, & Pollak, 2015). There is a need to understand how SES relates to dual-language development, and how the effect of

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SES changes over preschool years, a critical time for DLLs to gain school readiness skills.

To date, studies on SES and dual-language acquisition have almost exclusively focused on language *product* – what children know about the two languages (Calvo & Bialystok, 2014; Gathercole, Kennedy, & Thomas, 2016). However, little is known about whether SES relates to DLLs' language learning *processes* – their ability to gain new words and grammatical structures in one language or both of their languages. Do children from different SES backgrounds vary in their ability to learn from their language environment? If so, why? These are important questions, because language learning processes are a prerequisite for language acquisition, which in turn is foundational for long-term language and academic growth (Maguire et al., 2018). Answers to these questions will reveal new opportunities to narrow the language gap. If SES differences in DLLs' language learning processes do exist, language interventions may be more effective if language learning skills are targeted in addition to the quantity and quality of children's language environment (Maguire et al., 2018). Additionally, understanding the contextual contributors to children's language learning processes will help reduce bias in the diagnosis of language disorders in DLL and low-income populations (Peña, Iglesias, & Lidz, 2001; Weismer & Evans, 2002).

The current study examined the association between SES and Spanish-English DLLs' language learning processes. We assessed 3- through 5-year-old children's language knowledge (i.e., vocabulary and syntax) and language learning processes in both languages using a new language measure, the Quick Interactive Language Screener: English and Spanish (QUILS:ES; Iglesias, de Villiers, Golinkoff, Hirsh-Pasek & Wilson, *in press*). In particular, we investigated whether SES related to language learning processes; and if so, how the strength of the SES effect changed over preschool years and what factors mediated the SES effect.

1.1. Developmental mechanisms of language learning processes

Language learning processes refer to children's ability to gain the meaning of new language items from language environment. In the current study, we examined children's language learning processes using two well-studied approaches: Fast mapping and syntactic bootstrapping. Fast mapping is the process in which children learn and extend new words with minimal exposure (Carey & Bartlett, 1978). For instance, when presented with an unfamiliar, previously unnamed object and a familiar one (e.g., an apple), a young child can rapidly match a novel word (e.g., "dax") with the unfamiliar object. Syntactic bootstrapping allows children use syntactic structures to infer the meaning of words (Gleitman, 1990; Naigles, 1990). An example would be when hearing the sentence "he is praving something", a child can understand that the novel word "praving" refers to an action rather than an object. Both fast-mapping and syntactic bootstrapping are important mechanisms that support efficient language acquisition.

Language learning processes are thought to involve both experience-independent and experience-dependent mechanisms. Unlike vocabulary and syntactic knowledge that are highly associated with language input, language learning processes might be less dependent on prior experiences. Some researchers have proposed that language learning processes such as those utilized during fast mapping may be relatively "experience-independent" (Campbell, Dollaghan, Needleman, & Janosky, 1997). However, recent evidence has shown that language learning processes are not fully static, but rather are malleable and influenced by experience-dependent factors, such as children's existing language skills and language environment (e.g., Aravind et al., 2018; Bion, Borovsky, & Fernald, 2013; Byers-Heinlein & Werker, 2009).

The notion of "language begets language" emphasizes the role of existing language knowledge and skills in language learning (Hemphill & Tivnan, 2008). Evidence suggests that children's existing vocabulary and grammatical knowledge relates to their fast mapping skills (Aravind et al., 2018; Bion et al., 2013; Gray, 2004; Wilkinson & Mazzitelli, 2003), and their ability to learn nouns and verbs through reading and instruction (Hill, Wagovich, & Manfra, 2017; Kelley, 2017). Knowing more words and grammatical structures allows children to better target the referent of a new word in ambiguous situation, form a more nuanced and deeper understanding of words and grammatical structures, access and retrieve their linguistic knowledge more efficiently, and integrate semantic information more successfully (Bion et al., 2013; Cain, Oakhill, & Elbro, 2003; Hill et al., 2017; Huang, Leech, & Rowe, 2017; Maguire et al., 2018; Weisleder & Fernald, 2013), all of which are critical for language learning processes (Bion et al., 2013; Hurtado, Marchman, & Fernald, 2008; Jackson, Leita, & Claessen, 2016; Kan, Sadagopan, Janich, & Andrade, 2014). For instance, strengthening the phonological representations of novel words through speech practice has been found to successfully improve fast mapping performance (Kan et al., 2014). Notably, the association between existing language skills and language learning processes is likely bidirectional. Children with better language learning skills early on show better language outcomes years later (Bion et al., 2013; Venker, Kover, & Weismer, 2016). As such, language learning processes and existing language skills may influence each other reciprocally as an integrated language learning system.

Environmental input can also support the development of language learning processes. Language environment with high quantity and quality, characterized by diverse, complex, and contingent language input, question use, inferential talk, and rich literacy experiences (e.g., books and book-reading activities), promotes children's vocabulary and grammatical knowledge (Farver, Xu, Lonigan, & Eppe, 2013; Hirsh-Pasek et al., 2015; Hoff, 2003; Rowe, 2012; Rowe, Leech, & Cabrera, 2017; Tompkins, Bengochea, Nicol, & Justice, 2017), which may in turn support successful language learning processes. Alternatively, home language environment may directly facilitate language learning processes by offering children the opportunities to hone skills that are essential to language learning. For instance, the quantity, lexicon diversity, and syntactic complexity of language input have been found to predict word recognition speed (Hurtado et al., 2008). An experimental study suggested that asking questions about new words during book-sharing enhanced children's ability to form word-referent associations (Blewitt, Rump, Shealy, & Cook, 2009). Repeated and varied exposures to words in multiple ways increased children's ability to detect recurring linguistic structures (Schwab & Lew-Williams, 2016) and allowed them to gain more refined and deeper word knowledge (Coyne, McCoach, Loftus, Zipoli, & Kapp, 2009).

Language learning processes are supported by existing language skills and the language environment, both of which are experience-dependent and therefore subject to contextual influences. The current study focused on SES as a critical contextual factor that can shape children's language skills and experiences, and potentially language learning processes.

1.2. SES and language products

In both monolingual and DLL samples, SES, often indicated by parental education and/or household income, predicts children's English vocabulary, syntactic knowledge, and language processing skills (Buac, Gross, & Kaushanskaya, 2016; Calvo & Bialystok, 2014; Fernald, Marchman, & Weisleder, 2013; Gathercole et al., 2016; Gonzalez et al., 2017; Huttenlocher, Waterfall, Vasilyeva, Vevea, & Hedges, 2010; Pace, Luo, Hirsh-Pasek, & Golinkoff, 2017). The SES-related gaps in language product can be partially explained by

differences in the home learning environment, including the quality of parent-child language interactions, the availability of literacy resources, and the frequency of language learning activities (Farver et al., 2013; Gonzalez et al., 2017; Hoff, 2003; Huttenlocher et al., 2010; Pace et al., 2017).

Fewer studies have examined the link between SES and DLLs' Spanish outcomes, which tends to be language-specific. That is, mothers' highest education achieved in Spanish predicts children's Spanish vocabulary, whereas their highest education achieved in English relates to children's English vocabulary (Hoff, Burridge, Ribot, & Giguere, 2018). Some studies with Spanish-dominant families in the United States found no association between maternal education and DLLs' Spanish vocabulary (Deanda, Arias-Trejo, Poulin-Dubois, Zesiger, & Friend, 2016; Hammer et al., 2012; Place & Hoff, 2016). Yet, there is also evidence that an association between parental education and DLLs' Spanish vocabulary exists in families where parents use both English and Spanish (Stadthagen-González, Gathercole, Pérez-Tattam, & Yavas, 2013). Perhaps it takes effort to maintain a bilingual home environment. Parents who use both languages tend to highly value bilingualism, and those with higher-SES may have more resources to achieve their goal to support children's bilingual development (Stadthagen-González et al., 2013). However, some (not all) Spanish-dominant parents may value English learning but predominantly use Spanish due to their low English proficiency.

1.3. SES and language learning processes

Building on previous work on the relation between SES and language knowledge, the current study examined SES differences in language learning processes. Despite the considerable individual variation in children's performance on language learning tasks (Kelley, 2017), little is known about the extent to which contextual factors such as SES contribute to the development of language learning processes, especially in DLL populations. The few studies on this topic have yielded mixed findings.

1.3.1. Evidence of the lack of SES differences

A few studies have found that, even though children from low-SES families tend to receive less rich language input and have less developed vocabulary and grammar, they might be as successful as children from higher-SES families in acquiring language when learning opportunities are presented. A study showed that African American toddlers from low-SES and mid-SES families performed similarly on a task of fast mapping nouns, despite the robust SES differences in their existing knowledge of vocabulary (Horton-Ikard & Weismer, 2007). However, this study only included a small sample ($n = 30$) with a restricted age range (30–40 months). Evidence suggests that the SES-related gap in vocabulary widens during infancy (Fernald et al., 2013). It is plausible that SES differences in language learning processes start to emerge in preschool years when the gap in language knowledge becomes large.

Similarly, another study used a dynamic assessment to measure African American kindergarten children's ability to learn novel nouns through story reading, and did not find any SES differences, although this might be due to the low performance across the two SES groups (Burton & Watkins, 2007). Additionally, children were classified into low-risk (i.e., relatively higher SES) or high-risk (i.e., relatively lower SES) groups based on whether they received free lunch, whether their mothers attended at least some college, and whether their school had a concentration of children from low-income families. The relatively low variability in SES, in combination with the small sample size ($n = 24$), could result in limited power to detect the SES effect.

Another study did not find SES differences in Spanish-English DLLs' ability to learn novel English nouns (Buac et al., 2016). Chil-

dren heard a list of novel words paired with referents and then selected pictures corresponding to the novel words in a recognition task. Notably, the study tested children's memory of word-referent associations rather than their ability to *infer* the meaning of words. Additionally, the study only examined English word learning and did not control for children's relative language exposure at home (e.g., English only, Spanish only, or both English and Spanish), a potential confounder of the SES effect.

1.3.2. Evidence of SES differences

The Eco-Bio-Developmental Model posits that environmental factors such as SES can alter brain architecture, which in turn impacts basic learning and cognitive functioning traditionally thought to be independent from experiences (American Academy of Pediatrics, 2014). Indeed, children from different SES backgrounds vary in brain structure and brain activation associated with language and literacy (Farah, 2017; Hackman & Farah, 2009; Kuhl, 2011) and their ability to process vocabulary and syntactic input during real-time comprehension (language processing efficiency; Fernald et al., 2013; Huang et al., 2017). Likewise, there are SES differences in other processing-based tasks, such as non-word repetition and sentence repetition (Buac et al., 2016; Chiat & Polišenská, 2016; Meir & Armon-Lotem, 2017). Given that the ability to process language input is foundational for language acquisition, SES might also play a role in language learning processes. Additionally, compared to other processing skills, the language learning processes examined in the current study might more closely depend on children's existing language knowledge.

Only two studies to our knowledge have documented the association between SES and language learning processes. One study assessed 3- through 5-year-old, monolingual children's learning of nouns, verbs, and adjectives using the English monolingual version of the Quick Interactive Language Screener (Levine et al., 2020). Results revealed an SES gap throughout preschool years, the magnitude of which did not vary by child age. Another study tested school-age children's ability to learn novel English nouns through reading sentences. Children from low-SES households learned fewer novel words than their more affluent peers (Maguire et al., 2018). The SES effects on English word learning did not vary by children's DLL status. Nonetheless, the findings were limited to English learning processes and were based on a mixture of children who are English-speaking monolingual and DLLs from diverse linguistic backgrounds.

The inconsistent findings reviewed above might be due to differences in the age groups studied and tasks used, the limited variability in SES, as well as the lack of control of DLLs' relative language experiences. Previous work with toddlers did not find significant SES differences (Horton-Ikard & Weismer, 2007), yet some studies found SES differences in preschooler and school-age children (Levine et al., 2020; Maguire et al., 2018). The SES effect in language learning processes is likely to emerge in preschool years when SES differences in children's language experiences and skills become large. Thus, the current study focused on 3- through 5-year-old preschoolers from a wide range of SES backgrounds (i.e., parental education ranging from lower than high school to graduate degree), while controlling for children's dual-language home experiences. We also explored developmental changes in the strength of SES effect over the preschool years. Based on previous work, we expected the SES effect to be stable over time. Additionally, the few studies of children who are DLLs exclusively focused on the learning of English nouns, without examining children's ability to learn other word categories (e.g., verbs, adjectives) and their learning processes in the home language. Thus, the current study examined SES differences in DLLs' learning of nouns, verbs, and adjectives in both English and Spanish.

1.4. Mediators of SES effect in language learning processes

Another aim of the study was to explore the underlying mechanisms of the likely association between SES and language learning processes. Here we examined two potential mediators: Existing language knowledge and home literacy environment.

The substantial SES gap in children's existing vocabulary and syntactic knowledge can place children from low-SES families at a disadvantage in language learning. As reviewed above, the notion of "language begets language" highlights the role of existing language skills in language learning. Vocabulary and syntactic knowledge are essential components of language ability and are related to other language skills, such as language processing efficiency (Hurtado et al., 2008). Indeed, a study found that children's existing vocabulary mediated the association between SES and word learning skills (Maguire et al., 2018), although these findings were primarily based on school-age monolingual children. However, the few studies examining language knowledge and language learning processes with DLLs have yielded mixed findings. A study with Hmong-English DLLs found no significant correlation between receptive vocabulary and fast-mapping ability within each language (Kan & Kohnert, 2008), whereas other studies with Spanish-English DLLs found an association between English vocabulary and English novel word learning (Buac et al., 2016). Additionally, typically developing DLLs outperformed those with primary language impairment in a word learning task (Kapantzoglou, Restrepo, & Thompson, 2012). Thus, more evidence is needed to understand the role of existing knowledge in the link between SES and language learning processes in DLL populations.

SES might also exert its impact through home literacy environment. Here we focused on home literacy environment (e.g., the availability of books and the frequency of book reading activity) as a proxy of high-quality language experiences, because book-related experiences expose children to rich, diverse, and complex language input and questions (Peterson & McCabe, 1994; Soderstrom & Wittebolle, 2013; Tamis-LeMonda, Custode, Kuchirko, Escobar, & Lo, 2018), which have been found to be important for language learning. According to the parental investment model, parents from low-SES background have limited financial resources and human capital to invest in their children's development (Becker & Tomes, 1986; Haveman & Wolfe, 1994). Consequently, children from lower-SES families tend to have fewer books and less frequent book-reading experiences than their peers from higher-SES families, which may further lead to disadvantages in vocabulary, oral language, and emergent literacy skills (Farver et al., 2013; Froiland, Powell, Diamond, & Son, 2013; Mol & Bus, 2011). Notably, children can also actively shape their home literacy environment, such that children with stronger language skills may seek out more literacy experiences and elicit higher-quality language input from their parents (Harste, Woodward, & Burke, 1984; Park, Tsai, Liu, & Lau, 2012; Sy, Gottfried, & Gottfried, 2013). However, there is some evidence that the influences from parents to children tend to be more robust than those from children to parents (Leigh, Nievar, & Nathans, 2011). Therefore, the current study focused on the influence of home environment on language knowledge and learning processes rather than vice versa.

Few studies have examined whether the home literacy environment affects children's language learning processes though it might relate either directly or indirectly through the mediation of existing knowledge (i.e., home literacy environment → language knowledge → language learning processes). Recently, a growing body of work reveals the impact of the home literacy environment on children's language processing skills (Hutton et al., 2015, 2017). For instance, when listening to a story, preschool children who had richer literacy materials and more frequent book-reading at home showed greater activation in brain areas related to semantic language processing

(Hutton et al., 2015). Thus, children with richer home literacy environments might be better prepared to learn from their linguistic environment. Again, most studies were based on monolingual samples. Whether these findings apply to DLL populations in one or both languages is still unknown.

1.5. Current study

The ability to learn language is fundamental for language growth and academic success. Understanding the nature and mechanisms of SES differences in language learning processes is critical for addressing the language gap and improving the development of children living in adverse contexts. This is especially important for DLLs, who are disproportionately likely to live in poverty and are at risk for having academic delays (Hoff, 2013; Park et al., 2017). The current study examined SES differences in Spanish-English DLLs' language learning processes by asking three questions.

- 1) Does SES relate to DLLs' English and Spanish learning processes? We expected SES to be related to DLLs' language learning skills in both English and Spanish.
- 2) Does the strength of the SES effect vary based on child age in a cross-sectional design? Based on prior findings with monolingual children (Levine et al., 2020), we expected the SES effect to be stable over the preschool years.
- 3) Which pathways explain the effect of SES on language learning processes? We tested home literacy environment and existing language knowledge as two sequential mediators of the association between SES and language learning processes. Specifically, there might be three potential pathways: (1) SES → home literacy environment → language learning processes; (2) SES → language knowledge → language learning processes; and (3) SES → home literacy environment → language knowledge → language learning processes (see Fig. 1).

Notably, the relationship between language knowledge and language learning processes can be bidirectional, such that early language learning processes may support children's language knowledge later (Bion et al., 2013; Venker et al., 2016). Although the cross-sectional nature of the study precludes a test of the directionality of the relationship, in supplementary analyses we explored two additional pathways: (1) SES → language learning processes → language knowledge, which is an alternative to the second pathway described in the previous paragraph; and (2) SES → home literacy environment → language learning processes → language knowledge, which is an alternative to the third pathway described above.

2. Methods

2.1. Participants

Participants were 108 3- through 5-year-old dual-language learners (age $M = 53.99$ mon, $SD = 8.64$, $range = 39.23$ – 71.42 ; 55 females), recruited from preschools, daycares, and Head Start centers in Florida, Delaware, Pennsylvania, and Massachusetts. The participants were drawn from a larger, standardization sample ($N = 363$) for the QUILES project. Inclusion criteria included children who were typically developing and who were exposed to at least some Spanish at home, and parents who reported on demographic information and children's home literacy environment.

2.2. Procedure

Caregivers (93% mothers) completed a questionnaire in which they reported primary caregivers' educational level, children's date

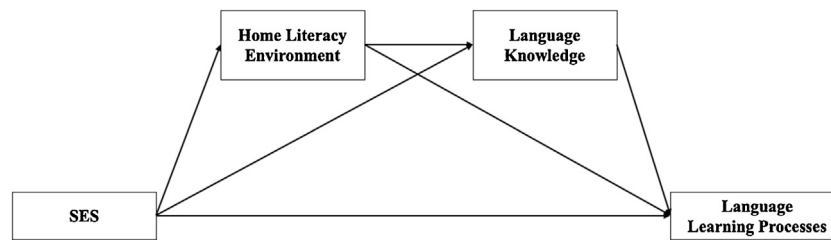


Fig. 1. Hypothetical sequential mediation model for the association between SES and language learning processes. Three pathways are possible: (1) SES → home literacy environment → language learning processes; (2) SES → language knowledge → language learning processes; (3) SES → home literacy environment → language knowledge → language learning processes.

of birth, relative language experiences, and home literacy environment. Children's English and Spanish knowledge and learning processes were assessed using QUILES:ES (Iglesias et al., in press).

2.3. Measurements

2.3.1. Socioeconomic status

Socioeconomic status was measured by primary caregivers' educational level (i.e., 1-lower than high school, 2-high school, 3-trade school, 4-Associate's degree, 5-Bachelor's degree, 6-graduate degree), one of the most commonly used indicators of SES in developmental research (Ensminger & Fothergill, 2003; Hoff, 2013). We chose to use caregivers' education because it is highly correlated with other SES indicators such as income and occupation (Bornstein, Hahn, Suwalsky, & Haynes, 2003), and has more predictive power for SES composite score than other SES indicators (Mistry, Biesanz, Chien, Howes, & Benner, 2008). SES was analyzed as a continuous variable, because prior work has suggested that treating ordinal education variable as continuous results in a minimal loss of information and little bias (MacCallum, Zhang, Preacher, & Rucker, 2002; Pasta, 2009).¹

2.3.2. Children's dual-language home experiences

Caregivers reported children's use of English and Spanish with their primary caregivers, secondary caregivers, siblings, and friends (i.e., 1-Only English, 2-Mostly English, 3-English and Spanish equally, 4-Mostly Spanish, 5-Only Spanish; 4 items, one for each type of social partner), and their exposure to the two languages from primary caregivers, secondary caregivers, and siblings (i.e., 1-Only English, 2-Mostly English, 3-English and Spanish equally, 4-Mostly Spanish, 5-Only Spanish; 3 items, one for each type of social partner). Factor analysis revealed a single-factor solution, which explained 78.23% of the total variance (Eigenvalue = 5.48). Therefore, a composite score was calculated by averaging all the items to indicate children's dual-language experiences outside of school. Children's experiences ranged from mostly English to only Spanish (range = 1.29–5.00). On average, children experienced slightly more Spanish than English ($M = 3.45$; $SD = 1.03$). Children's dual-language home experiences across SES were presented in Table 1. Bivariate correlation suggested that SES was not related to children's dual-language home experiences ($r = .14$, $p = .151$).

2.3.3. Home literacy environment

Caregivers reported on the frequency of book-reading activities at home ("How many times per week is the child read to?"; 1-Zero time, 2-One to three times, 3-Four to seven times, 4-More than seven times) and the number of children's books at home (1-Zero to five books, 2-Six to ten books, 3-Eleven to twenty books,

4-Twenty-one to thirty books; 5-More than thirty books). Because book-reading frequency and number of books were measured by different scales, a composite score was calculated based on the average of standardized z scores to ensure equal weight of the two measurements.

2.3.4. The Quick Interactive Language Screener: English-Spanish version (QUILES:ES)

The QUILES:ES is a computerized interactive assessment designed to examine DLL preschoolers' English and Spanish comprehension separately. To ensure that children's knowledge in one language would not influence their performance in the other language, the English and Spanish tests did not include any overlapping items or cognates (e.g., "fruit" in English and "fruta" in Spanish; Gollan & Acenas, 2004). Native Spanish-speaking and native English-speaking researchers carefully selected the test items to ensure that they were age-appropriate for all preschool-aged children and dialect-free. The same set of items was used to assess preschool children of different ages. The voiceovers for the English and Spanish tests were recorded by a native English-speaking male and a native Spanish-speaking male with a neutral accent, respectively.

The QUILES:ES measures both language products (i.e., Vocabulary and Syntax) and Language Learning Process in English and Spanish (see Table 2 for number of items and example items).

2.3.5. Language products

The Vocabulary component (16 English items, 16 Spanish items) assesses children's understanding of open-class (i.e., Nouns, 4 English and 4 Spanish items; Verbs, 4 English and 4 Spanish items; e.g., "Show me the furniture" in English test; "Encuentra, el recojedor/Find, the dustpan" in Spanish test) and closed-class (i.e., Prepositions, 4 English and 4 Spanish items; Conjunctions, 4 English and 4 Spanish items) words.

The Syntax component (15 English items, 14 Spanish items) assesses children's comprehension of wh-questions (3 English and 3 Spanish items), sentences containing multiple modifiers such as prepositional phrases (4 English and 3 Spanish items), and sentences with past tense (4 English and 4 Spanish items) and embedded clauses (4 English and 4 Spanish items). For instance, in the English Embedded Clauses subtest, children hear the following sentence with corresponding animation, "Grandma asked Grandpa where Mia was and Grandpa said that Mia was getting mail from the mailbox. But look! Mia is playing in the pool instead." Children then respond to the question "Where did Grandpa tell Grandma that Mia was?" by selecting one of the four pictured options: pool (foil), mailbox (target), garden (foil), and stairs (foil).

2.3.6. Language learning processes

The Language Learning Process component (14 English items, 15 Spanish items) tests children's ability to learn new words. The items were designed based on the well-studied paradigms of

¹ Analyses using dichotomous SES variable (high school or lower vs. higher than high school) yielded similar findings.

Table 1

Descriptive statistics for demographic characteristics, children's language learning processes, existing language knowledge, and home literacy environment.

	Total	Primary caregivers' education					
		Some high school or lower	High school	Trade school	Associate's degree	Bachelor's degree	Graduate degree
	% or M(SD)	n = 29	n = 33	n = 7	n = 17	n = 20	n = 2
Test locations							
Northern Delaware, DE	n = 24	54.2% ¹	25.0%	4.2%	0.0%	16.7%	0.0%
Philadelphia metro area, PA	n = 26	30.8%	42.3%	15.4%	0.0%	7.7%	3.8%
Northampton, MA	n = 22	36.4%	45.5%	9.1%	0.0%	4.5%	4.5%
Miami, FL	n = 36	0.0%	16.7%	0.0%	47.2%	36.1%	0.0%
Child characteristics							
Female	50.9%	44.8%	48.5%	85.7%	47.1%	55.0%	50.0%
Age (mon)	53.99 (8.64)	55.42 (8.54)	54.15 (9.54)	53.95 (5.95)	52.96 (10.28)	52.69 (6.80)	52.36 (11.44)
Dual-language home experiences ²	3.45(1.03)	3.55(.89)	3.00(.90)	2.92(1.48)	4.33(.58)	3.67(.96)	1.90(.14)
Book-reading frequency							
1-Zero time	12%	13.8%	15.2%	14.3%	0.0%	15.0%	0.0%
2-One to three times	35.2%	44.8%	33.3%	14.3%	23.5%	40.0%	50.0%
3-Four to seven times	45.4%	41.4%	48.5%	42.9%	58.8%	40.0%	0.0%
4-More than 7 times	7.4%	0.0%	3.0%	28.6%	17.6%	5.0%	50.0%
Number of children's books							
1-Zero to five books	9.3%	10.3%	18.2%	0.0%	0.0%	5.0%	0.0%
2-Six to ten books	26.9%	41.4%	30.3%	14.3%	5.9%	20.0%	50.0%
3-Eleven to twenty books	15.7%	27.6%	9.1%	42.9%	5.9%	10.0%	0.0%
4-Twenty-one to thirty books	14.8%	13.8%	15.2%	42.9%	0.0%	20.0%	0.0%
5-More than thirty books	33.3%	6.9%	27.3%	0.0%	88.2%	45.0%	50.0%
English skills³							
Vocabulary	.43 (.19)	.42 (.18)	.43 (.19)	.45 (.22)	.40 (.17)	.45 (.20)	.66 (.13)
Syntax	.46 (.24)	.42 (.24)	.49 (.22)	.47 (.29)	.47 (.28)	.46 (.24)	.43 (.24)
Process	.48 (.27)	.44 (.24)	.44 (.31)	.41 (.25)	.55 (.26)	.50 (.27)	.89 (.05)
Spanish skills³							
Vocabulary	.51 (.21)	.50 (.21)	.44 (.19)	.44 (.18)	.55 (.25)	.62 (.18)	.53 (.13)
Syntax	.38 (.21)	.35 (.21)	.34 (.19)	.35 (.20)	.47 (.24)	.43 (.21)	.54 (.15)
Process	.42 (.20)	.37 (.18)	.36 (.22)	.46 (.14)	.51 (.20)	.47 (.20)	.53 (.09)

Note. ¹ Percentages of SES subgroups within each test location. ² Dual-language home experience was assessed via a 5-point Likert scale (1-English only, 3-English and Spanish equally, 5-Spanish only). ³ English and Spanish skills were indicated by proportion correct rate of each subtest.

fast mapping and syntactic bootstrapping (e.g., Carey & Bartlett, 1978; Gertner & Fisher, 2012; Golinkoff, Hirsh-Pasek, Bailey, & Wenger, 1992; Golinkoff, Jacquet, Hirsh-Pasek, & Nandakumar, 1996; Johnson & de Villiers, 2009). The Noun Learning (4 English and 4 Spanish items) and Adjective Learning (4 English and 4 Spanish items) subtests examine children's ability to fast map novel nouns or adjectives to novel objects or features, and to further extend the newly learned words to unfamiliar exemplars. The Verb Learning (4 English and 4 Spanish items) subtest examines children's ability to learn and extend novel verbs using syntactic information. The Converting Active to Passive (2 English and 3 Spanish items) subtest examines children's ability to apply syntactic rules to newly learned verbs by converting active voice into passive voice.

Novel words used in the Process component were either selected from prior studies of word learning (Janse & Newman, 2013) or created based on the phonotactics of English and Spanish. Additionally, the novel words did not rhyme with any of the other novel or familiar words within or across trials and did not have the same initial phonemes as any of the foils in the same item. The familiar objects and known words were selected based on prior work to ensure that they are understood and produced by most children by the age of 30 and 36 months, respectively (e.g., Cross Linguistic Lexical Norm; Dale & Fenson, 1996; Gilhooly & Logie, 1980; Stadthagen-Gonzalez & Davis, 2006).

2.3.7. Procedure

The QUILS:ES English and Spanish tests each took about 15 min to administer and were conducted on two separate days with balanced order, within a 2-week period. The test was given individ-

ually by an administrator in a quiet room at school. The audio was played via computer speakers. All participating children completed the same testing items. Children first viewed three training items on a touch screen computer to get familiar with the test format. Then children viewed and responded to the test items by touching one of the options on the screen. Children could only respond after the auditory prompt of a test item was completed. The prompt would be repeated if a child did not respond in 20 s; and the test would move on to the next item if a child did not respond to the repeated prompt in 15 s. Intermittently, short animated videos were presented as transitions between subtests.

2.3.8. Correct rates and composite scores

The correct rates of Vocabulary, Syntax, and Language Learning Process subtests were calculated for English and Spanish separately to account for different number of items across subtests.² A composite score for children's existing English knowledge was calculated by averaging the z scores of English Vocabulary and English Syntax. Likewise, the composite score for Spanish knowledge was created by averaging the z scores for Spanish Vocabulary and Spanish Syntax. Given that the average correct rate varied across different subscales (range = .38–.51), we used average z scores to ensure equal weight of each subtest.

² Although separate scores for English and Spanish were used in this study, the Best Score across the two languages should be used to determine DLLs' risk for language delay.

Table 2
Number of items and example items of the vocabulary, syntax, and language learning processes tests.

Components	Subtests	# of English Items	Example	# of Spanish Items	Example
Vocabulary Product	Nouns	4	Show me the hinge.	4	Encuentra el recogedor.
	Verbs	4	Who is lugging something?	4	¿Quién está saludando?
	Prepositions	4	Find “the firefighters are between the chairs”	4	Encuentra “la sombrilla está debajo del columpio”
	Conjunctions	4	Who picked up the cake because the baby ate it?	4	¿Quién pintó mientras que el bebé lloraba?
Syntax Product	Wh-Questions	3	How is the baker roasting marshmallows?	3	¿Quién está besando al bebé?
	Prepositional Phrases	4	Find the dog behind a black table.	3	Encuentra la niña detrás de un carro en un garaje blanco.
	Past Tense	4	Look at this wheel. Uh-oh! It broke! Where was the wheel?	4	Mira este sombrero. ¡Ay no! ¡El sombrero se voló! ¿Dónde estaba el sombrero?
	Embedded Clauses	4	Cowboy Bob told Mia to go to the toolshed and bring him a hammer. But instead, Mia is outside riding her skateboard. What did Cowboy Bob tell Mia to do?	4	La abuelita le dijo a Javier que fuera a su cuarto a hacer la tarea. Pero en realidad, Javier está en la sala comiéndose una manzana. ¿A dónde le dijo la abuelita a Javier que fuera?
Process	Noun Learning	4	A dax is a kind of clothing. Show me the dax (testing trial 1; fast mapping). Can you show me another dax (testing trial 2; extending the novel word to an unfamiliar exemplar)?	4	El mepe tiene un sombrero. Enséñame el mepe con el sombrero. ¿Me puedes enseñar otro mepe?
	Adjective Learning	4	Look at this bird. This bird is mezzish. What else is mezzish (testing trial 1; fast mapping)? Show me what else is mezzish (testing trial 2; extending the novel word to an unfamiliar exemplar).	4	Mira esta mesa. Esta es una mesa petosa. ¿Qué otra cosa es petosa? Enséñame otra cosa que es petosa.
	Verb Learning	4	Look, someone is praving something! Hey, someone is praving something. Can you find another one? Find “someone is praving something”	4	Oye, la niña está braliando al niño. Mira, la niña está braliando al niño. ¿Quién fue braliado?
	Converting Active to Passive	2	Hey, the woman is lumming the man. Look, the woman is lumming the man. Which one got lummed?	3	Oye, el hombre está letando la pelota. Mira, el hombre está letando la pelota. ¿Qué fue letado?

2.3.9. Reliability and validity

The QUILES:ES has high internal consistency reliability (English: Cronbach's alpha = .895, $n = 361$; Spanish: Cronbach's alpha = .858, $n = 361$) and good test-retest reliability (English: $r(25) = .782$, $p < .001$; Spanish: $r(25) = .640$, $p < .001$). Additionally, the average correct rate of the three QUILES:ES components was correlated with Auditory Comprehension portion of the bilingual Preschool Language Scales-5 (PLS-5; Zimmerman, Steiner, & Pond, 2011; Zimmerman, Steiner, & Pond, 2012; English: $r(61) = .618$, $p < .001$; Spanish: $r(63) = .474$, $p < .001$), indicating moderate convergent validity.

3. Results

Table 1 presents descriptive statistics for demographics, measures of learning processes, and existing knowledge (i.e., vocabulary, grammar) in English and Spanish, and children's home literacy environment (i.e., the number of children's books, book-reading frequency) within and across SES groups. Table 3 presents bivariate correlations among demographic and key variables. Within English and Spanish, the three subtests (i.e. vocabulary, grammar, and learning process) were significantly associated with one another (English: r 's = .64–.75 p 's < .01; Spanish: r 's = .47–.61, p 's < .01).

We conducted hierarchical linear regressions to examine the effects of SES on English and Spanish learning processes (Research Question 1) and whether the strength of SES effects varied by child age (Research Question 2). Step 1 included child age and dual-

language home experiences as control variables. Step 2 included SES, measured by primary caregivers' educational level. Step 3 included an interaction term between SES and age. Moreover, mediation analysis was conducted using the PROCESS Macro (version 3.0) in SPSS (Hayes, 2013) to examine the extent to which language knowledge and home literacy environment explained the association between SES and language learning processes (Research Question 3). Bootstrapping with 5000 replications was used to estimate the indirect, direct, and total effects, with confidence intervals not covering zero indicating significant effects (Preacher & Hayes, 2004). Notably, the mediation analysis could not test the directionality of the associations, due to the cross-sectional nature of the data. Therefore, in supplementary analyses, we also tested two alternative pathways (i.e., SES → language learning processes → language knowledge; SES → home literacy environment → language learning processes → language knowledge) to address the potential bidirectional relationship between existing language knowledge and language learning processes.

3.1. SES predicting language learning processes

In line with our hypothesis, SES uniquely contributed to children's English learning processes ($b = .05$, $S.E. = .01$, $\beta = .27$, $p = .001$), explaining 7% of the total variance (see Models 1 and 2 in Table 4). Similarly, SES related to children's Spanish learning processes ($b = .04$, $S.E. = .01$, $\beta = .30$, $p = .001$, Models 4 and 5), explaining 9% of the

Table 3

Bivariate correlations among demographic variables, English and Spanish learning processes, knowledge, and home learning environment.

	1	2	3	4	5	6	7	8	9	10
1. Primary caregivers' education	1.00	-.12	.14	.18	.07	.03	.27**	.23*	.22*	.32**
2. Child age		1.00	.05	.52**	.54**	.49**	.39**	.33**	.37**	-.09
3. Dual-language home experiences			1.00	-.12	-.27**	-.18	.15	.41**	.12	.07
4 English learning process				1.00	.75**	.64**	.57**	.25**	.49**	.14
5 English vocabulary					1.00	.72**	.38**	.19*	.48**	.06
6 English grammar						1.00	.36**	.17	.55**	.16
7 Spanish learning process							1.00	.61**	.60**	.31**
8 Spanish vocabulary								1.00	.47**	.16
9 Spanish grammar									1.00	.23*
10 Home literacy environments										1.00

Note. ** $p < .01$, * $p < .05$.**Table 4**

Hierarchical regression models predicting English and Spanish learning processes from age, dual-language home experiences, SES, and the interaction between SES and age.

	English learning process								
	Model 1			Model 2			Model 3		
	b	S.E.	beta	b	S.E.	beta	b	S.E.	beta
Age	.02	.003	.52***	.02	.003	.56***	.02	.003	.56***
Dual-language home experiences	-.04	.02	-.14	-.05	.02	-.18*	-.05	.02	-.18*
SES				.05	.01	.27**	.05	.01	.27**
SES \times age							-.002	.002	-.001
R2	.29***			.36***			.36***		
R2 change				.07**			.00		

	Spanish learning process								
	Model 4			Model 5			Model 6		
	b	S.E.	beta	b	S.E.	beta	b	S.E.	beta
Age	.01	.002	.38***	.01	.002	.42***	.01	.002	.42***
Dual-language home experiences	.03	.02	.13	.02	.02	.09	.02	.02	.09
SES				.04	.01	.30**	.04	.01	.30**
SES \times age							-.001	.002	-.07
R2	.17***			.26***			.26***		
R2 change				.09**			.004		

Note. *** $p < .001$, ** $p < .01$, * $p < .05$.

total variance.³ These SES differences were stable from age 3 to age 5, indicated by non-significant interactions between SES and child age (see Models 3 and 6 in Table 4).

3.2. Mediation role of existing knowledge and home literacy environment

We further examined three potential pathways through which SES related to English and Spanish language learning processes (see Fig. 1). Child age and dual-language home experiences were controlled for in all following analyses.

Before examining the mediation model, we tested SES differences in home literacy environment and children's language knowledge in English and Spanish, respectively. Consistent with prior work, SES uniquely predicted home literacy environments ($b = .17$, $S.E. = .05$, $\beta = .31$, $p = .001$, R^2 change = .09). SES also predicted children's English ($b = .10$, $S.E. = .05$, $\beta = .17$, $p = .032$, R^2 change = .03) and Spanish knowledge ($b = .16$, $S.E. = .05$, $\beta = .28$, $p = .001$, R^2 change = .08).

Fig. 2a illustrates the mediation model for the association between SES and English learning processes. There was a significant indirect effect through the sequential pathway of home literacy

environment and English knowledge ($b = .01$, $S.E. = .003$, 95%CI = [.0001, .0131]), which accounted for 12% of the total SES effect. SES predicted home literacy environments, which related to English knowledge, and which in turn linked to English learning processes. The indirect effects through home literacy environment ($b = .001$, $S.E. = .004$, 95% CI = [-.0071, .0104]) and through English knowledge ($b = .01$, $S.E. = .01$, 95%CI = [-.0045, .0354]) were not significant. The direct effect of SES remains significant ($b = .03$, $S.E. = .01$, 95%CI = [.0034, .0507]), suggesting that the two sequential mediators partially explained the SES effect.

Like the English model, the indirect effect of SES through home literacy environment and Spanish knowledge was significant ($b = .004$, $S.E. = .003$, 95% CI = [.0005, .0104]; 11% of total effect), suggesting a sequential mediation role of home literacy environment and Spanish knowledge. Additionally, there was a significant indirect effect through Spanish knowledge ($b = .02$, $S.E. = .01$, 95% CI = [.0053, .0295]; 43% of total effect), showing that the effect of SES could bypass home literacy environment. Higher SES was directly associated with better Spanish knowledge, which further predicted better Spanish learning processes. Even though home literacy environment was also directly associated with Spanish learning processes ($b = .04$, $S.E. = .02$, $p = .022$), the indirect effect of SES through home literacy environment was not statistically significant ($b = .01$, $S.E. = .004$, 95% CI = [.0000, .0147]). The direct effect of SES was not significant, suggesting a full mediation ($b = .01$, $S.E. = .01$, 95%CI = [-.0078, .0302]).

In order to understand the potential bidirectional relationship between existing language knowledge and language learning processes, we tested two alternative pathways (i.e., SES \rightarrow language

³ Age ($b = .02$, $S.E. = .00$, $\beta = .55$, $p < .001$) and dual-language home experiences ($b = -.04$, $S.E. = .02$, $\beta = -.14$, $p = .015$) together accounted for 29% of the total variance in children's English learning processes. Age ($b = .01$, $S.E. = .00$, $\beta = .42$, $p < .001$; explaining 15% of the total variance), but not dual-language home experiences, predicted children's Spanish learning processes.

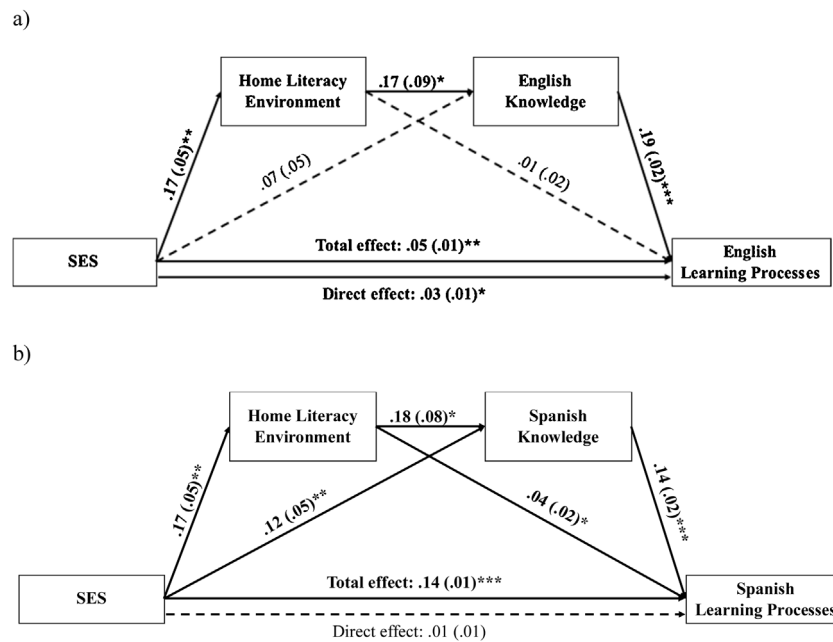


Fig. 2. Sequential mediation models for a) English and b) Spanish learning processes. Age and dual-language home experiences were included as control variables. Solid and dashed lines indicate significant and non-significant associations, respectively. *** $p < .001$, ** $p < .01$, * $p < .05$.

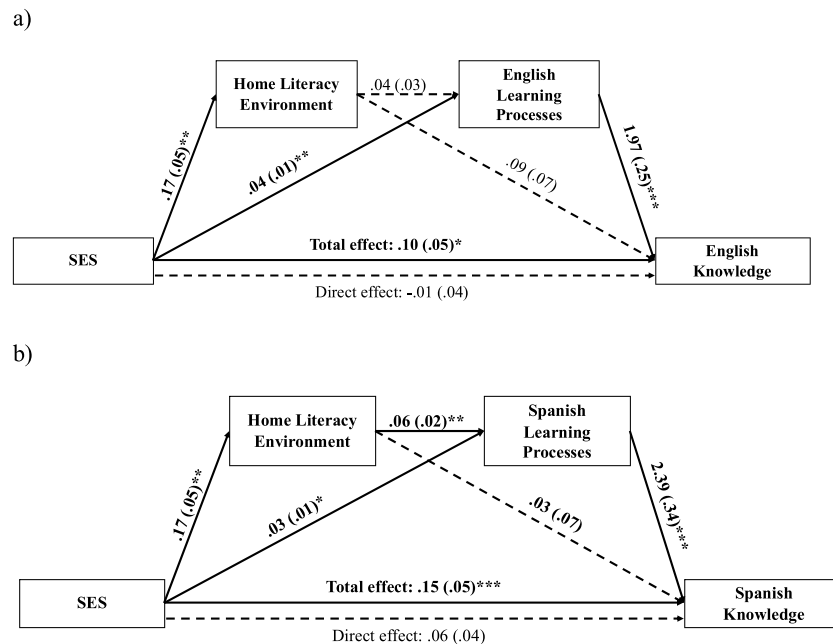


Fig. 3. Sequential mediation models for a) English and b) Spanish, which examined two alternative pathways: SES → language learning processes → language knowledge; SES → home literacy environment → language learning processes → language knowledge. Age and dual-language home experiences were included as control variables. Solid and dashed lines indicate significant and non-significant associations, respectively. *** $p < .001$, ** $p < .01$, * $p < .05$.

learning processes → language knowledge; SES → home literacy environment → language learning processes → language knowledge) in supplementary analyses (see Fig. 3). For English, only the pathway SES → English learning processes → English knowledge was significant ($b = .08$, $S.E. = .034$, 95% CI = [.0172, .1509]; 80% of total effect), suggesting that SES predicted English learning processes, which in turn predicted English knowledge. For Spanish, both pathways were significant: SES → Spanish learning processes → Spanish knowledge ($b = .07$, $S.E. = .028$, 95% CI = [.0164, .1254]; 47% of total effect), SES → home literacy environment → Spanish

learning processes → Spanish knowledge: $b = .03$, $S.E. = .012$, 95% CI = [.0062, .0562]; 20% of total effect), revealing the possibility that SES might impact children's Spanish knowledge through Spanish learning processes and home literacy environment.

4. Discussion

The current study examined the association between SES and DLLs' language learning processes and the extent to which home literacy environment and existing language knowledge mediated

the association. We found that children from higher-SES families (as indicated by primary caregivers' education) performed better on learning new language items than those from lower-SES families. The SES gap existed in both English and Spanish learning processes, emerged as early as 3 years of age, and persisted throughout preschool. Home literacy environment and existing knowledge served as two sequential mediators of the SES effect, suggesting that improving DLLs' language environment and knowledge through learning materials and language and literacy activities may be crucial for ameliorating the SES gap in language learning processes.

4.1. SES differences in English and Spanish learning processes

A major contribution of the study is the focus on the language learning processes of children who are DLLs. Prior work has consistently documented SES differences in children's existing vocabulary and syntactic skills (Buac et al., 2016; Gathercole et al., 2016; Gonzalez et al., 2017; Huttenlocher et al., 2010), the ability to process known language (e.g., language processing efficiency; Fernald et al., 2013; Huang et al., 2017), and the activation of language-related brain areas (Farah, 2017; Kuhl, 2011). Our work further showed that SES was related to DLLs' ability to use existing knowledge to learn new language items. When given minimal exposure to novel language items in the current study, DLLs from lower-SES families were less able to infer the meaning of novel words, compared with those from higher-SES families. These findings challenge the notion that language learning processes are "experience-independent" (Campbell et al., 1997). If DLLs from low-SES families fall short of the ability to learn from their dual-language environment, the SES-related language gap can persist over time and continue after school entry (Hoff, 2013; Mancilla-Martinez & Lesaux, 2011).

Our findings further suggest how SES-based language gaps might evolve over developmental time. Consistent with prior work with monolingual preschoolers (Levine et al., 2020), the current study also found that by age 3, children from low-SES families already lagged behind their more affluent peers. Studies with school-age children also revealed SES differences in word learning (Maguire et al., 2018). Work with younger children, however, has revealed no SES difference in toddlers' fast mapping skills (Horton-Ikard & Weismer, 2007). Thus, the SES gap in language learning processes might emerge between ages 2 and 3 years, which might result from the cumulative SES differences in language learning environment and existing language knowledge over the first three years of life.

4.2. The mediation role of home literacy environment and existing language knowledge

We identified a sequential mediation pathway from SES to language learning processes: Higher SES related to richer home literacy environment, which further predicted better vocabulary and syntactic knowledge, and in turn predicted children's skill at learning new language items. These findings align with prior work showing the importance of the home literacy environment in supporting language outcomes, particularly children's access to books and engagement in book-reading activities (Farver et al., 2013; Gonzalez et al., 2017; Hoff, 2003; Pace et al., 2017). Our work further suggests that a higher-quality home literacy environment not only provides more language learning opportunities, but also sharpens children's *ability to learn* by equipping them with more advanced vocabulary and syntactic skills. Nonetheless, the direction of the association is still unclear. Children with greater language knowledge and better language learning skills might also actively engage in reading activities more frequently and seek

out more book resources. Future research should tease apart the influence of the child's own motivation and knowledge-seeking behaviors.

The mediating role of existing knowledge supports the notion of "language begets language" and is in line with other studies showing the link between vocabulary and novel word learning in children who are monolingual and DLLs (Buac et al., 2016; Maguire et al., 2018). Notably, simply increasing children's vocabulary size and syntactic complexity might not be enough for improving their ability to learn language, because the language used in the Language Learning Process test was selected based on norms and should all fall within children's comprehension ability. We speculate that the mediation role of existing knowledge might be due to the association between existing knowledge and children's ability to access and apply the knowledge. Children with greater vocabulary size and syntactic complexity gain a deeper understanding of word meanings and syntactic structures, access their knowledge more efficiently during real-time comprehension, and are more capable of integrating semantic information (Cain et al., 2003; Hill et al., 2017; Huang et al., 2017; Maguire et al., 2018; Weisleder & Fernald, 2013), all of which help children infer the meaning of new language items in the processes of language learning.

Notably, the association between existing knowledge and language learning processes might be bidirectional, such that strong language learning skills may also enable children to gain greater knowledge of vocabulary and syntax. Indeed, our supplementary analyses confirmed the possibility of the alternative pathways: the effect of SES on language knowledge could be explained by differences in language learning processes. However, longitudinal and experimental studies are needed to further explore the direction of the association. It is likely that SES supports both language knowledge and language learning processes, which influence each other reciprocally and operate synergistically as a unified language learning system.

The mediation patterns varied slightly between English and Spanish, such that the two mediators fully explained the SES differences in Spanish learning processes, but only partially explained that for English learning processes. Given that many DLLs gain a great deal of English experience at school, school-level factors, such as the proportion of students living in poverty and teachers' language use, might also contribute to SES differences in learning new English language items. Additionally, the SES effect on Spanish learning processes (but not that on English learning processes) bypassed home literacy environment (i.e., SES → Spanish knowledge → Spanish learning processes). While book-related activities might be the primary way for DLLs to learn English at home, they might learn Spanish through book-reading and other language activities (e.g., shared narrative, oral storytelling) that are culturally-valued in Spanish-speaking families (Luo & Tamis-LeMonda, 2019). For instance, evidence suggests that SES is associated with the frequency of oral storytelling in Latino families (Luo & Tamis-LeMonda, 2019). It is also possible that the quantity and quality of language input play a role in the association between SES and language learning processes. Parents with higher SES on average have been found to provide richer, more diverse and complex language input, ask more questions, and engage in more contingent conversations with children, although there is variability within SES strata (Hoff, 2003; Huttenlocher et al., 2010; Pace et al., 2017). These SES differences might be larger in parents' home language (e.g., Spanish) and might further relate to differences in children's language learning skills. Additionally, we did not assess the language(s) of the books available at home. Spanish-speaking families may have limited access to books in their home language, which might result in the insignificant pathway through home literacy environment.

4.3. Practical implications

The substantial SES differences in English and Spanish learning processes underscore the need to enhance the language learning skills of DLLs from low-SES families in the first few years of life and prepare children for learning from their environment in not only one, but two languages. The wide SES gap in Spanish learning processes calls for special attention, as home language acquisition may contribute to school readiness through supporting English growth (Hammer et al., 2014). The early onset of process gaps urges caregivers and educators to closely monitor DLLs' language learning ability in the first three years and identify those who need support early on. The QUILS:ES, along with other attempts to develop assessments for language learning skills in DLL populations, are critical for this purpose.

Our findings further unveil new avenues to support children's dual-language development in low-SES families. Enhancing home literacy environment through book materials and language and literacy activities is of vital importance. However, only when a high-quality learning environment is combined with strong language learning skills can children engage in a productive cycle of language growth. To achieve this goal, caregivers, educators, and researchers must move beyond the focus on language product and attend to children's language learning skills, the depth of language knowledge, and children's ability to access and apply their knowledge during real-time language comprehension. For instance, fostering children's metalinguistic awareness by emphasizing linguistic units such as phonemes and morphemes (Eviatar, Taha, Cohen, & Schwartz, 2018), introducing metacognitive learning strategies such as how to use context clues to infer the meaning of words (Harmon, Buckelew-Martin, & Wood, 2010), teaching children vocabularies in conceptually related categories and in diverse contexts (Hadley, Dickinson, Hirsh-Pasek, & Golinkoff, 2019; Hills, Maouene, Riordan, & Smith, 2010), providing rich language input and explicit information about the meaning of words (Bolger, Balass, Landen, & Perfetti, 2008; Hurtado et al., 2008), and asking question about the target words (Blewitt et al., 2009), are useful strategies to promote language learning processes. Notably, these strategies may not be effective for all DLLs and need to be adapted for children from different linguistic, cultural, and socioeconomic backgrounds. Recognizing the diversity of children's home literacy environments is also important. Encouraging book-reading at home is far from the only solution to the SES gap – it is imperative to consider other culturally valued activities (e.g., oral storytelling) and contributing factors outside the home context.

4.4. Limitations

The study has several limitations. First, the cross-sectional nature of the study precludes causal inferences. Although many studies have assumed directional relationships from existing knowledge to language learning processes (Hill et al., 2017; Maguire et al., 2018), and from home literacy environment to child language outcomes (Farver et al., 2013), the relationships are likely to be bidirectional. Children with better language learning skills might learn language more efficiently from their environment, thereby having better vocabulary and syntactic skills; children with strong dual-language skills might seek out more literacy materials and read books more frequently at home. Intervention and longitudinal studies are needed to further disentangle the causal relationships among these constructs, and to examine whether improving home literacy environment and language learning skills effectively narrows the SES gap in language outcomes. In addition, we did not follow the developmental trajectories of

individual children, a project that should also be undertaken in future.

A second set of limitations relates to the measurement of SES, home literacy environment, and dual-language experiences. We only assessed primary caregivers' education as a proxy for SES. Although this is a common approach particularly in the field of developmental language science, examining other indicators (e.g., educational level of other family members, occupation, household income) will provide a more accurate estimate of SES. The effect of SES can also be confounded by factors such as the quality of school/center and the availability of educational resources in the neighborhood. Future work should take children's school and neighborhood experiences into account. Additionally, we only assessed book-reading frequency and the availability of children's books. DLLs engage in many other language and literacy activities in their daily lives and tend to learn English and Spanish through different activities, with different social partners (e.g., parents, siblings, grandparents), and using learning materials in different languages (e.g., English, Spanish, or bilingual books). Future work must pay attention to DLLs' language-specific experiences and explore how those experiences relate to language learning skills within and across the two languages. Moreover, we only examined children's dual-language experiences at home. Children's usage of and exposure to the two languages at school can also impact their dual language development and are worth examining in future research.

A third limitation is associated with the fact that the QUILS:ES is a newly developed assessment. Although QUILS:ES shows high internal consistency reliability and good test-retest reliability and is moderately correlated with a standardized measure of bilingual development (i.e., PLS-5 English/Spanish), more work is still needed to test its psychometric properties, such as specificity and sensitivity. Additionally, it is important for future research to replicate the findings from the current study using other standardized measures and a variety of language learning tasks. Nonetheless, this tool is among the first attempts to develop standardized assessments for language learning skills in the DLL population, and can provide valuable information on individual children's strengths and weaknesses in both English and Spanish. Notably, the language learning processes measured by QUILS:ES require children to use existing knowledge to learn new language items, and should not be mistaken for other related skills, such as language processing skills, which tend to have neurobiological basis and might be more susceptible to factors such as nutrition or stress.

5. Conclusion

The rapid growth and disproportionately high poverty rate in DLL populations in the United States calls for a better understanding of how SES impacts dual-language development. The current study suggests that the effects of SES can go beyond *what* DLLs know about the two languages (i.e., language product) to *how* they learn (i.e., language processes). By age 3, DLLs from families across socioeconomic strata have developed valuable knowledge and critical language learning skills, which serve as the springboard for future language growth. A multipronged approach that targets home literacy environment, in-depth language knowledge, and language learning processes simultaneously is needed to strengthen DLLs' language learning skills and enable them to take full advantage of their dual-language environment.

CRedit authorship contribution statement

Rufan Luo: Conceptualization, Methodology, Formal analysis, Writing - original draft, Visualization. **Amy Pace:** Investigation,

Writing - review & editing, Project administration. **Dani Levine:** Investigation, Writing - review & editing. **Aquiles Iglesias:** Writing - review & editing, Supervision, Funding acquisition. **Jill de Villiers:** Writing - review & editing, Supervision, Funding acquisition. **Roberta Michnick Golinkoff:** Writing - review & editing, Supervision, Funding acquisition. **Mary Sweig Wilson:** Software, Writing - review & editing, Supervision, Funding acquisition. **Kathy Hirsh-Pasek:** Writing - review & editing, Supervision, Funding acquisition.

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