Word Recognition in Spanish-English Learning Toddlers with and without Language Delay

by

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THESIS ABSTRACT

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Although there are long-term impacts of developmental language delay on children's academic and life-long outcomes, there is limited understanding of language delay (LD) in the context of dual language learners (DLLs). The ability to recognize and process words is an important early language skill that is diminished in LD contexts. Early word recognition abilities, including speed of word recognition, may be crucial in identifying DLLs who are at high likelihood of persistent challenges and for developing effective interventions. The purpose of this thesis is to examine how speed of word recognition may differ in young children learning Spanish and English and present with or without LD and how these differences may appear across a critical year of language development. This study made use of an existing database of Spanish-speaking children who are ages 24 months, 30 months, and 36 months at the time of data collection. Children had varying levels of exposure to and proficiency in English and Spanish and a subgroup was identified as experiencing LD. To measure speed of word processing as a dependent variable, children's reaction times were captured with eye gaze behavior using the Looking-While-Listening (LWL) task in Spanish and English. A two-way interaction was found between language and LD status revealing that language effects due to greater exposure were most pronounced in those DLLs without LD compared to those with LD. These findings indicate that Spanish-English language exposure and likelihood of LD are associated with DLL's speed of word recognition in each language. This may support future clinicians working with young DLL with LD, some of

whom are at higher likelihood for persistent language and academic challenges that differ from their typically developing DLL counterparts. Overall, these findings stress the importance of understanding language proficiency and delay in the context of multilingualism and diversity.

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Introduction

Language Delay in the Context of Dual Language Learners

Young dual language learners (DLLs) are children who are learning English in addition to their home language and comprise approximately 21 percent of all school-age children (Federal Interagency Forum on Child and Family Statistics, 2023). Spanish and English learners are the largest group of DLLs, and some of these children may experience early challenges in the fundamental aspects of language comprehension that cannot be explained by language differences between Spanish and English or single vs. dual language learners. Rather, some DLLs may actually have a language delay (LD) in early toddlerhood and the preschool years that appears in both languages (e.g., Spanish and English) they are learning in the first few years of life. There are well documented long-term impacts of LD on children's academic and life-long outcomes (American Speech-Language-Hearing Association [ASHA], 2026), yet there is limited understanding on Spanish-English DLLs with LD. To be clear, it is well established that exposure to multiple languages does not cause or worsen LD or developmental language disorder (DLD) or any language or cognitive developmental disorder. However, early differences in fundamental aspects of language comprehension must be examined to tailor interventions to the unique needs of Spanish-English DLLs with LD. This study seeks to evaluate word recognition skills in Spanish-English DLLs with and without LD.

Long-Term Impacts of Developmental Language Disorder (DLD)

Understanding LD is especially important because some toddlers may have persistent challenges and later be diagnosed with developmental language disorder (DLD). For many children with LD, they will eventually reach language ability expected for their age. However, a portion of children with LD will continue to have difficulties with language well into their

school-age years and beyond, resulting in a diagnosis of DLD. This means that while LD is observed typically in toddlerhood and the preschool period, a diagnosis of DLD is typically given at school age if language challenges persist.

DLD is a common neurodevelopmental disorder that impacts more children than autism spectrum disorder (ASD) and permanent hearing impairment (McGregor, 2020). While not all children with LD will later be diagnosed with DLD, a portion will. These children with DLD may experience significant difficulties in learning, understanding and utilizing language, which consequently greatly impacts their academic success in the classroom. Children identified with language impairments have a higher likelihood of having reading disabilities and difficulties with spelling and math into young adulthood, with a greater likelihood of experiencing challenges in all three of these areas as compared to neurotypical counterparts (Young et al., 2002). Challenges in reading, writing, and math may continue well beyond school-age and into adulthood, thus impacting access to higher education and employment, leading to some adults with DLD being more likely to go longer than a year without employment (Law et al., 2009). Additionally, individuals with DLD are more likely to experience clinical anxiety and depression (Conti-Ramsden & Botting, 2008). Despite the impact that DLD has on children and their later life outcomes, DLD and its links to early LD are still under researched (Bishop, 2010; McGregor, 2020). Understanding LD in DLLs is necessary in order to support early identification of those children at greatest likelihood of DLD diagnosis in later years and to support healthy communication development in toddlerhood and the preschool years across both languages. The overall goal of this study is to better understand a fundamental component of early word comprehension among DLLs with LD who are at greater likelihood of DLD diagnosis and those without LD.

Speed of Word Recognition Measured via Looking While Listening Task

Speed of word recognition is one measure of early language comprehension ability that predicts later language and other cognitive skills. In one study, Marchman and Fernald (2008) showed that speed of word recognition and vocabulary size in toddlers (25 months of age) accounted for 41 percent of the variance in expressive language and 58 percent of the variance in working memory at 8 years of age. This illustrates the importance of speed of word recognition in predicting later outcomes. Speed of word recognition describes how quickly children can identify the meaning of a spoken word and can be measured by the looking-while-listening (LWL) task among toddlers (Swingley, 2012). The LWL is an effective measure of early comprehension because it can be used with very young children (i.e. infants and toddlers) due to the use of relatively passive eye gaze behavior as compared to explicit button pressing that many other comprehension tasks may require. For example, in a typical LWL task the child is presented with pictures of two items, such as a dog and a shoe, and then audio stimuli are presented directing the child to look at one of the items. In this example, the child promptly looking at the image of the dog when it is named would be showing evidence of word comprehension (Swingley, 2012). This study will focus on speed of word recognition which measures how quickly children shift their gaze to the correct target object as a measure of reaction time. Given that speed of word recognition is an early skill that predicts later development, this measure of reaction time offers insight into the early challenges among children with LD that may lead to later DLD diagnosis. The purpose of this study is to describe speed of word recognition in young toddler DLLs that present with or without LD and examine how these differences may appear across a critical year of language development across Spanish and English for children in the US.

Research on DLLs without LD

Prior research on speed of word recognition that has used the LWL task with children who are DLLs has primarily focused on North American children, with the overwhelming focus on U.S. and Canadian contexts and emerging research in other continents (1 study in UK). Within this body of literature, most of this research is focused on English being the language learned in addition to Spanish or French. These studies are exclusively focused on children without LD, resulting in a gap in our understanding of speed of word recognition abilities among children with early communication challenges.

Prior studies have evaluated various factors and their association with children's word recognition abilities using the LWL task among DLLs as outlined below.

Age

Within studies evaluating speed of word recognition among DLLs, age has been shown to be significantly associated with word recognition both in toddlerhood (López Pérez et al., 2024; Sander-Montant et al., 2023) and early preschool age (Marchman et al., 2020) such that U.S. children process words faster with development. Other studies like the one led by Potter et al. (2019) found that age does not significantly predict speed of word recognition in Spanish-English learning U.S. toddlers. Potter et al. (2019) may have not found a significant effect due to their relatively smaller sample size (20 participants) compared to other studies that did find this effect. Additionally, Potter and colleagues utilized the LWL task with switched language trials (i.e. sentence frame and target noun differ in language), in which the additional cognitive demands on the LWL task may not be ideal for showing developmental effects. Overall, the pattern of findings across studies shows that developmental effects are likely as word recognition gets faster across infancy through early preschool age.

Proficiency

For studies of toddlers, proficiency is commonly determined by the child's size of vocabulary, both expressive and receptive, and is often reported by parents via checklists. Larger vocabulary size has been found to be associated with faster speed of word recognition (Hurtado et al., 2013; López Pérez et al., 2024), including when considering language outcomes at preschool-age (Marchman et al., 2009). Similar associations can be seen with Spanish-learning children with larger vocabulary sizes being faster at using gender-marked articles to identify referents during word recognition tasks like the LWL (Lew-Williams & Fernald, 2007). Although these studies show that proficiency as measured by vocabulary size is associated with speed of word recognition, it is unclear how a small vocabulary caused by an underlying language delay or disability may affect speed of word recognition among DLL children as prior work has not included clinical populations.

Exposure and Experience

A child's amount of exposure to language has also been studied in relation to speed of word recognition. Hurtado et al. (2013) found that greater exposure to Spanish led to faster processing in Spanish among 18-month-old Spanish-dominant learners and greater exposure to English resulting in shorter processing time in English for English-dominant learners. Similar findings in toddlers and preschoolers (14-48 months) from Sander-Montant et al.'s (2023) study showed that increased experience with a language led to faster processing in both younger and older toddlers, independent from age. Lastly, Potter et al. (2019) found dominance effects impacted toddler's (18-30 months) costs in switching between languages. This means that for toddlers with more exposure to one language (e.g., Spanish), they had increased processing time when switching to another language they had less exposure to (e.g., English) as compared to

those with more equal exposure to both languages. It is important to remember that LD occurs despite ample exposure and experience with a language and in monolingual and multilingual contexts alike.

In summary, the research on DLLs evaluating speed of word recognition shows that word recognition gets faster with age, experience, and proficiency and is used differently than monolinguals during word learning. Despite a growing body of literature on DLLs with respect to speed of word recognition, none of these studies focused on DLLs with LD, further motivating the current study.

Research on Monolinguals with LD

Due to the lack of LD representation in DLL literature, we can look to monolingual literature about children with LD for some insight. Just as with DLLs, various factors have been shown to be associated with children's speed of word recognition.

Age

Just as maturation effects were seen in DLLs, Fernald and Marchman (2012) found that 60 percent of 18-month-old late-talkers (those with LD) improved in speed of word recognition over the course of the year, with some experiencing faster and more accelerated vocabulary growth compared to typically-developing (TD) children in the US. Peter et al. (2019) found similar findings as Fernald & Marchman (2012) with toddlers in England who had a family history of language challenges making them at high likelihood of DLD, in that toddlers became faster processors a year after testing. Based on these studies, developmental effects may similarly be expected among DLLs with LD.

Proficiency

As seen with DLLs, Marchman et al. (2015) noted that for monolingual children born preterm, who are at greater risk of LD, their early language processing efficiency can predict their later receptive vocabulary outcomes. Fernald & Marchman (2012) found that processing efficiency at 18 months predicts vocabulary growth over the following year for monolinguals with LD, with more accelerated rates of vocab growth as compared to TD children. Van Alphen et al. (2021) showed that for toddlers with DLD, speed of word recognition is associated with offline expressive language. As evidenced by these studies, monolingual children who are more likely to have LD or have already been categorized as "late talkers" or diagnosed with DLD do show effects of proficiency on speed of word recognition.

Word Learning Strategies

A variety of studies have also shown differences in children with and without LD or DLD in speed of word recognition during learning. Specifically, LaTourette et al. (2023) found that children with LD can recognize and learn nouns and verbs with similar success, but those with LD are slower. Among children ages 4 to 5 years with DLD, Deevy & Leonard (2018) showed that children with LD did not show "anticipatory looking" based on the provided numerical information in the same way that younger TD children did. For example, when presented with a pair of drawings and auxiliary starting prompt of "is" verse "are" (e.g., "|are the |dogs running. |"), children with DLD did not look at the drawing with two dogs running when presented with the auxiliary prompt. This suggests marked differences among those with and without language learning challenges. However, Curtis et al. (2023) show no group differences between TD and late talkers in tasks of encoding semantic relationships to predict similar referents. Curtis et al. (2023) stated that not finding group differences may be due to limited sample size (46 participants) and the LT group being younger than the TD group. Overall, these studies show

that children with LD do differ from TD children during some word learning tasks, but how this extends to DLLs learning two languages simultaneously is unknown.

The pattern of findings across monolingual and DLL literature shows that there remain gaps in our understanding of speed of word recognition in toddlers with LD. Specifically, there may be differences in speed of word recognition between languages, such as Spanish and English, and that these differences in speed of word recognition may look different for young DLLs who have a LD compared to those who do not. Additionally, mixed results can be seen with studies that investigate age associations to speed of word recognition for DLLs and word learning strategies for monolingual children with LD. Differences in speed of word recognition between languages, between LD status, and how age plays a role in word recognition are major gaps across both DLL and monolingual literature. These gaps indicate further need to investigate how these factors associate with speed of word recognition to help guide future clinical practice.

This Study

Based on the literature about DLLs and monolinguals with LD and the noted gaps in knowledge, for this study we ask three questions: 1) Regarding LD status, are there differences in speed of word recognition between young DLL children with LD compared to those without LD? 2) When considering language, is there a difference between Spanish and English word recognition? If so, does this difference vary for DLL children with and without LD? 3) Finally, what differences in speed of word recognition can be observed in DLL children with and without LD at 24 months, 30 months, and 36 months?

Hypotheses

Based on the monolingual literature with TD and LD children and the DLL literature, we expect that the LD group will have slower speed of word recognition compared to those without

LD in both Spanish and English and that the group with LD will have greater difference between Spanish and English speed of word processing compared to those without LD. Lastly, based on the age associations seen both in DLL and monolingual literature, we predict that all DLL children will get faster with development (from 24 to 36 months), but those with LD will have slower development of speed of word recognition compared to those without LD.

Methods

Participants

The children from this study form part of a larger longitudinal study looking at language development of young toddlers learning Spanish and English. Requirements for the children to be a part of this larger study were that they had to have at least 20 percent exposure to Spanish at home since birth and the mother identified as Hispanic or Latina/x. An additional criterion for participation in the larger longitudinal study excluded children who had developmental concerns where communication difficulties were secondary to the primary disorder or if additional developmental concerns outside of language and communication were reported (i.e. Autistic children or those who are Deaf or Hard of Hearing).

Forty-two children were selected to be a part of this current study. Children participated at 24, 30, and 36 months of age, or at 30 and 36 months of age. The demographics of these children and their families were collected via The Center for Early Care and Education Research-Dual Language Learners (CECER-DLL) Child and Family Questionnaire (Hammer et al., 2020). Details of the children and their family's demographic data shown in Table 1. All participants of this study had more exposure to Spanish than English based on the Language Exposure Assessment Tool (De Anda et al., 2016). Due to some participants not attending data collection at all three waves, with some attending at 30 and 36 months, this study is a cross-sectional study. Participants who missed an appointment at 24, 30, or 36 months of age were still included if they had complete data for at least one visit.

LD Groups

The children were divided into groups based on their LD status (with LD or without LD) at their first data collection visit to answer the research questions of interest, with 20 participants

included in the LD group. This LD status definition was based on potential likelihood of LD defined by the child meeting at least one of the following criteria: (a) the child was currently receiving services for a communication delay or disorder, (b) parental concerns for communication, (c) family history of language disorders, and (d) an English-Spanish Vocabulary Inventory (ESVI, De Anda et al., 2022) standard score below the 20th percentile in both languages. The ESVI is a measure developed by combining inventory measures created for monolinguals from the MacArthur-Bates Communicative Inventory (CDI, Fenson et al., 2007). The ESVI was developed for English and Spanish monolingual and DLLs in the U.S. and showed content validity, criterion validity, construct validity, and social validity for assessing these populations, with or without LD (De Anda et al., 2022).

Measures

Looking While Listening (LWL) Task

The primary dependent measure of interest is speed of word recognition assessed using the LWL task. Previous studies have used LWL task to assess speed of word recognition with young monolinguals and DLLs both at singular time points (Marchman et al., 2010; López Pérez, 2024; Deevy & Leonard, 2018) and longitudinally as participants age (Fernald et al., 2008; Fernald & Marchman, 2012; Peter et al., 2019).

Stimuli. Two images were presented on a computer screen while an audio stimulus (e.g., "do you like the balloon") was simultaneously presented in child-directed speech, as shown by Figure 1. Eight words that are commonly known by children of this age were presented in English (e.g., balloon, cookie, doggie, door, foot, kitty, milk, mouth) and Spanish (e.g., globo, galleta, perro, puerta, pie, gato, leche, boca). For visual stimuli, four pairs of pictures were utilized for each trial with each pair always being shown together (e.g., doggie and cookie were

always paired), and one image acted as the distractor while the other the target. These paired images would switch between distractor and target for an equal number of trials. The total number of yoked paired images was four, with eight total trials in each language.

Setting. For this study, data was collected over Zoom. Parents were coached on how to set up their child in front of their home computer screen and camera to ensure that the child's eyes were in view for recording. Audio levels were checked and parents were coached on minimizing distractions and interference with the task. Before starting the trials and at the end of the trials, synchronization of the video and audio was checked to mitigate any potential lag in video and audio that may occur during Zoom.

Coding. Coders were trained to annotate the children's looking behavior using Eudico Linguistic Annotator (ELAN, 2026). The coders coded when the target word was presented, and when the child's eyes were on the central fixation point and whether they looked left, right, or away from the screen. The analysis window began at the start of the target word and ended approximately 2000 milliseconds after the target word was stated. Consistent with established practice, speed of word recognition was extracted by measuring reaction times. Reaction times are computed only for trials where the child's first look is to the distractor image. For this subset of trials, we code how long it took the child (in milliseconds) to shift from the distractor to the target to arrive at a reaction time for speed of word recognition. The child's ability to quickly recognize that the word they just heard does not match what they are seeing measures the child's speed of word recognition.

Procedures

Participants were screened through a phone call. Once it was determined they met eligibility criteria, they were scheduled for a data collection appointment. At the appointment,

parents reviewed consent documents with the research assistant in their preferred language. Following consent, parents were instructed on how to set up the zoom screen and their child's position and how to set up the environment for data collection. Within one week of the initial data collection appointment, parents were given the ESVI form to determine child vocabulary size in Spanish and English. After completion of the data collection, parents received an incentive for participation and were informed the study staff would reach out in approximately six months to schedule the next data collection time if they were eligible to return.

Analysis Plan

In order to evaluate the role of Age (24, 30, 36 months of age), Language (English, Spanish) and Language Delay (LD) status (with LD, without LD), these factors were entered as independent variables into a mixed-effect Analysis of Variance (ANOVA) model with speed of word processing as the dependent variable. Main effects, two-way and three-way interactions were evaluated.

Results

Table 2 provides the results of the ANOVA with Age, LD Status, and Language as variables. Results show a marginal main effect of Language ($F(1) = 3.493$; $p = .066$), but no significant main effects of Age and LD status. For 2-way interactions, the Language x Age interaction and LD Status x Age interaction were not significant. However, the Language x LD Status interaction was significant ($F(1) = 6.000$; $p = .017$). There was no significant 3-way interaction observed between Language x Age x LD Status.

As shown in Figure 2, the 2-way significant interaction (Language x LD Status) reflects that for TD participants, they significantly were faster at recognizing (shorter reaction times) Spanish than English. Conversely, for LD participants the standard error margins overlap, suggesting no significant difference in processing speed across languages.

When referring to the study's first research question regarding differences in speed of word recognition for DLLs with and without LD, results showed no significant main effect of LD status. However, question two asks if there are differences in speed of word recognition between languages and if this difference varies for DLLs with and without LD. The significant 2-way interaction between Language and LD status indicates that both factors have a combined association with speed of word recognition. Lastly, research question three asks if differences in speed of word recognition can be found at different ages. The lack of a significant main effect or interaction with Age suggests we did not detect differences from 24 to 36 months of age.

Discussion

The goal of this study was to determine if speed of word recognition differed for children with and without likelihood of language delay among DLL toddlers, and how this may change with age and between Spanish and English. Data were collected via the LWL task to assess speed of word recognition across languages among DLL children. The LWL task combines visual and auditory stimuli and captures the participants' speed of word recognition as they look at the distractor image and switch to the target image paired with the target word. Overall, results showed that speed of word recognition differed based on an interaction between Language (English vs. Spanish) and LD Status (TD vs. LD), but there was no effect of Age. an interaction between Language (English vs. Spanish) and LD Status (TD vs. LD), but there was no effect of Age.

The results of this study showed a significant two-way interaction between LD and language such that participants with LD show no significant difference across Spanish and English processing whereas those with TD status are slower in English than in Spanish. For participants with TD status, the results of this study extend prior DLL literature by showing differences in speed of processing across languages. The participants in this study predominantly had higher language exposure in Spanish as compared to English, which likely explains why TD toddlers in this study were faster at processing words in Spanish over English. This is consistent with existing DLL literature with TD children: studies have found that greater exposure to one language led to faster processing (Hurtado et al., 2013). This faster processing speed can be found to be independent of age (Sander-Montant et al., 2023).

For participants with LD status, when considering existing literature, there are no studies in which both DLLs and LD status are evaluated for speed of word recognition, so these early

findings should be interpreted cautiously. Specifically, findings in this study showed no language effect on speed of word recognition in the LD status group. There are two potential reasons as to why a language effect on speed of word recognition is not seen. First, this effect may be better seen when children have more variance in their language skills. Specifically, it is known that monolingual children with LD know fewer words than their TD peers, and the words they do know can be shallow in understanding (LaTourette et al., 2023; Deevy & Leonard, 2018). When considering DLLs, this could mean that language effects as a possible result of increased exposure and differences between Spanish and English may be more notable at later ages for LD groups once they develop more depth and breadth in vocabulary. The second reason why our study may have not found a language effect on speed of word recognition in the LD group is due to study limitations. It is possible that there may be differences in speed of word recognition between English and Spanish for the LD group, but we could be underpowered to detect the effect. While our sample size was comparable to many existing studies, it could be that the effect is small and not detectable with this sample size.

A post hoc T test was considered to evaluate if language exposure may have played a role in the language effects on speed of word recognition as shown in the TD but not the LD group. Results showed that the LD group had more exposure to Spanish than the TD group, likely due to more participants of the TD group having exposure to a third language. This indicates that language exposure alone does not explain our unexpected findings, as the TD group had a language effect on speed of word recognition and the LD group did not. Therefore, we can only partially confirm our initial hypothesis. We hypothesized that there would be significant differences English and Spanish with greater differences seen for LD participants than TD.

Findings revealed that although language and LD status indeed interact, the direction of the effect on speed of word recognition is more nuanced than what we hypothesized.

Lastly, we were interested in evaluating age effects on speed of word recognition in toddlers between ages 24 months and 36 months, a time when many children experience significant language growth. We did not find a significant effect of age on speed of word recognition in the present study unlike we hypothesized. It may be that differences in speed of word processing between a 24-month-old and 36-month-old are small enough that even eye tracking is not sensitive enough to note a significant difference, especially in a group that may have smaller margins of individual difference with emerging word knowledge. When considering DLL literature, there are mixed findings on the association of age on speed of word recognition. Some studies found significant effects on speed of word recognition in toddlers across multiple months (López Pérez et al., 2024; Sander-Montant et al., 2023). However, Potter et al. (2019) did not find significant effect with some limitations as noted in the literature review. Similarly in monolinguals with LD literature, mixed findings were reported. Fernald & Marchman (2012) and Peter et al. (2019) reported significant effects related to age (testing a year apart) for participants with LD status or high likelihood of DLD. However, Gerbrand et al. (2025) found mixed results, with greater correlation in performance between 10- and 18-month-olds, but not at age 11.5 months. When considering our findings across the body of work, it remains unclear exactly how age plays a role in speed of word recognition when evaluating a range of time at or below 12 months. In general, it is well established that word processing gets faster from early childhood to adolescence and into adulthood.

Clinical Implications

Given the findings of this study, the most noteworthy clinical implication is that the language used (Spanish versus English) and the possibility of LD status have some association with DLL toddler's speed of word recognition. DLLs with LD have nuanced patterns of speed of word recognition that differ from their TD counterparts. This study provides further information about the factors that may be associated with word recognition, especially in DLLs and those with higher likelihood of LD. In addition, findings show that the factors that impact LD DLL are different from TD DLL. However, there may be more factors that were not explored in the scope of this study.

In addition, this study shows that researchers and clinicians alike should be cautious when extending monolingual LD literature for DLLs with LD. Our findings showed that nuance exists in explaining the interaction between LD status and dual language learning. Lastly, this study reminds clinicians to consider both overall word knowledge (vocabulary size) in addition to speed of word processing, even at early ages such as in the participants in this study. Future research is needed to determine the utility of speed of word recognition as a clinical marker and a target of intervention.

Limitations and Future Directions

As noted above, our study may have not found a significant language effect in the LD group due to study limitations. Our sample size may have been underpowered to detect a significant effect on speed of word recognition.

Another limitation but also benefit to research as a whole is the study design incorporating the LWL task into a virtual format (e.g., Zoom). This method of collecting eye tracking data differs from the lab-based methodology that much of the prior literature utilized. However, the eye tracking data gathered in the current study was consistent with LWL studies

conducted in the lab. For example, Hurtado et al. (2013) reported for 30-month-olds a range of reaction time from 617 –1458 milliseconds in Spanish and 540-1291 milliseconds in English. They also reported at 36 months, participants reaction time to Spanish was 542-1130 milliseconds and 546-1020 milliseconds to English. The mean reaction times for participants in our study fall within these ranges reported by Hurtado et al. (2013) suggesting consistent data across remote and lab LWL formats. The data used for this study was collected largely during the COVID-19 pandemic, requiring alternative data collection methods to be developed and implemented. This alternative data collection does mean that our data differ from most LWL studies, though recent methodological advancements are increasing the use of remote data collection approaches (Bacon et al., 2021; Tenenbaum et al., 2025). Although remote data collection poses same challenges, this may allow for larger access to participants across multiple areas, thus reducing regional demographic bias. There certainly are downsides to a study design such as ours. Technology is not perfect and may yield user errors both on the participant's and researcher's end, even with set protocols implemented. Several trials had to be thrown out due to technical challenges involved with the remote setting, which may have been minimized in the lab.

A future direction of this study is based on the exclusionary criteria for potential participants, as this study explicitly did not include Autistic children. In the literature, there is a large body of autism spectrum disorder (ASD) research and how they process language, including the speed with which they process words. This exclusionary criterion was utilized because among the related disciplines, literature for ASD is often considered separate from LD as the underlying challenge with language differs. An argument can be made such that different disciplines and the research within and between these disciplines should not always be siloed,

but rather shared in collective thought. Alternatively, not all autistic children have language delays and they should not be presumed to have one. Additionally, a large portion of ASD research focuses on language challenges that are secondary to other behaviors (e.g., pragmatics). Despite there being similarities between ASD and LD, their challenges are often different with potentially different impacts on the child's life.

Additionally, since speed of word recognition is a fundamental aspect of language comprehension, this research can be applied to many other clinical populations, including adults with aphasia. Future research should explore if speed of word recognition differs in bilingual and multilingual adults in both typical and clinical populations and if these differences are parallel with the findings of this study.

Conclusion

As a whole, DLLs with LD status are a largely under-researched group in the U.S. This study is only one perspective, one piece of the large gap in literature between DLLs and LD. Results showed a differential pattern of results in speed of word recognition based on those with and without LD and across languages, with language effects due to exposure being more pronounced in TD vs. LD toddlers. Future research should continue to evaluate and describe basic language comprehension skills like word recognition and the deficits associated with LD among DLLs. The findings of this study underscore the need to focus on these underrepresented, marginalized groups.

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Figures and Tables

Figure 1

Example of visual stimulus with timing of audio stimulus.

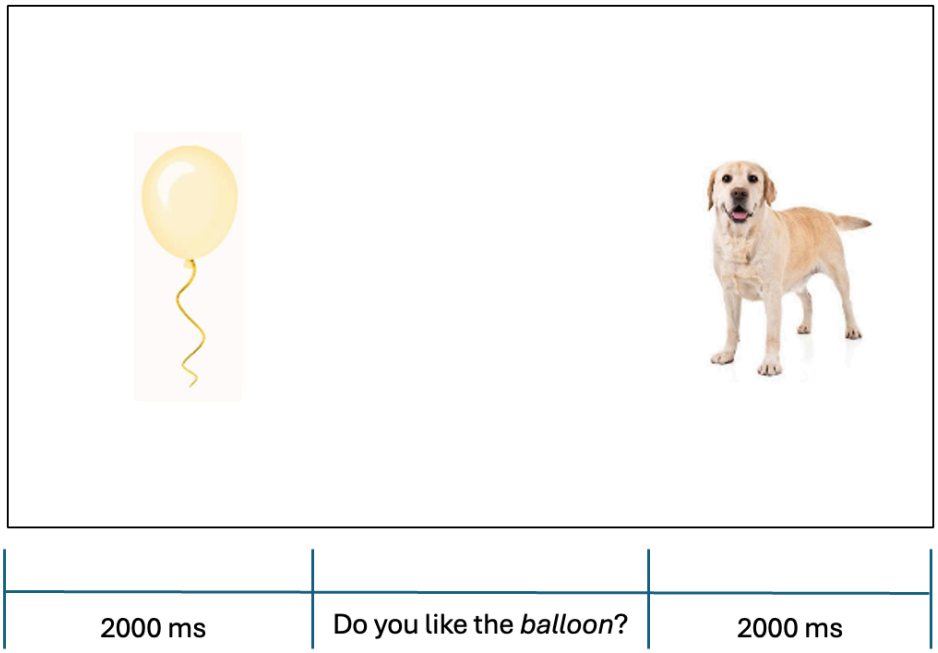


Figure 2

Significant two-way Language x LD Status interaction.

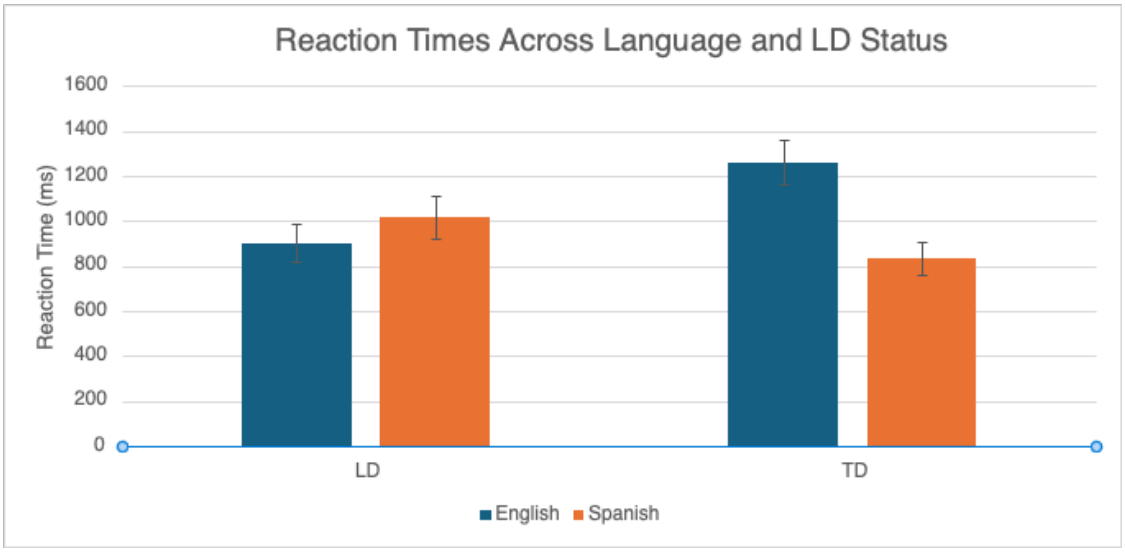


Table 1

Child (N= 42) and family characteristics.

	N(%)	*M*(*SD*)
Child Characteristics		
Age in Months		
Wave 1 (23-25 months)		25.71(1.37)
Wave 2 (29-31 months)		30.32(1.67)
Wave 3 (35-37 months)		36.19(1.26)
Gender		
Boy	20(48%)	
Girl	22(52%)	
Born in the US	42(100%)	
Developmental Concerns[1]	20(48%)	
Child Language Exposure[2]		
% exposure to Spanish		67.90(29.31)
% exposure to English		28.46(25.38)
% exposure Other Language		7.00(7.94)
Maternal Characteristics		
Age in Years		33.47(1.68)
Ethnicity		
Mexican, Mexican American, Chicano	38(90%)	
Guatemalan	1(2.3%)	

Peruvian	1(2.3%)
Cuban	1(2.3%)
Venezuelan	1(2.3%)
Chilean	1(2.3%)
Education	
Less than high school	5(12%)
High school diploma or GED	10(24%)
Vocational training or some college	5(12%)
Associate's degree	4(10%)
Bachelor's degree	10(24%)
Some graduate, no degree	2(5%)
Master's or higher	2(5%)
Prefer to not answer	4(10%)
Born in the US	16(38%)
Annual Family Income	
<$10k	2(5%)
$10,001-20,000	5(12%)
$20,001-30,000	3(7%)
$30,001-40,000	2(5%)
$40,001-50-000	1(2.4%)
$50,001-60,000	5(12%)
$60,001-70,000	2(5%)

$70,001-80,000	2(5%)
>$80,001	6(14%)
Prefer to not answer	14(33%)

Note. [1]Refers to parent-reported concerns and/or participation in early intervention or early childhood special education. [2]Cumulative exposure from birth as measured by the Language Exposure Assessment Tool.

Table 2

ANOVA results of the main effects (age, LD status, language), two-way interactions (age and LD status, age and language, LD status and language), and three-way interaction.

Variable	Df	Sum Sq	Mean Sq	F value	p value
Age	2	84008	42004	0.191	0.826
LD status	1	172978	172978	0.786	0.378
Language	1	768712	768712	3.493	0.066
Age x LD status	2	334083	167041	0.759	0.472
Age x Language	2	513747	256874	1.167	0.317
LD status x Language	1	1320516	1320516	6.000	0.017*
Age x LD status x Language	2	47631	23815	0.108	0.897

Note. *$p < .05$