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Exploring the Classification Accuracy of the Early Communication Indicator (ECI) With Dual-Language Learners From Latinx Backgrounds

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Abstract

Few, if any, reliable and valid screening tools exist to identify language delay in young Spanish–English speaking dual-language learners (DLLs). The Early Communication Indicator (ECI) is a brief, naturalistic measure of expressive communication development designed to inform intervention decision-making and progress monitoring for infants and toddlers at-risk for language delays. We assessed the accuracy of the ECI as a language-screening tool for DLLs from Latinx backgrounds by completing classification accuracy analysis on 39 participants who completed the ECI and a widely used standardized reference, the Preschool Language Scales, Fifth Edition–Spanish, (PLS-5 Spanish). Sensitivity of the ECI was high, but the specificity was low, resulting in low classification accuracy overall. Given the limitations of using standalone assessments as a reference for DLLs, a subset of participants ($n = 22$) completed additional parent-report measures related to identification of language delay. Combining the ECI with parent-report data, the specificity of the ECI remained high, and the sensitivity improved. Findings show preliminary support for the ECI as a language-screening tool, especially when combined with other information sources, and highlight the need for validated language assessment for DLLs from Latinx backgrounds.

Keywords

Infant/toddler/preschool, diversity, language, dual-language learners, Latinx

Early communication skills are key indicators of a child's language development and later academic achievement. Children with language-learning difficulties are at significant risk for lasting adverse educational, behavioral, psychosocial, and vocational outcomes (e.g., Johnson et al., 2010; Law et al., 2009; Snowling et al., 2006). Valid and efficient early language-screening tools can support early identification and intervention for children at risk for later language and academic problems (Law et al., 2009) and may help reduce the number of children from minoritized linguistic backgrounds who are under- or over-identified as having special education needs (see Zhang et al., 2014 for a review). However, no validated screening measures are available to quickly identify young Latinx children from Spanish- and Spanish–English–speaking homes (one of the largest and fastest-growing populations in the United States; U.S. Census Bureau, 2013) who may benefit from a thorough evaluation to determine language delay status. This study describes the classification accuracy of the early communication indicator (ECI; Greenwood et al., 2010, 2013, 2020), a brief, naturalistic measure of infant–toddler communication development, as a screening tool for children from Latinx backgrounds who are learning Spanish (and English); hereafter referred to as dual-language learners (DLLs).

The first years of life are a time of rapid communication development often occurring within social and play interactions. Sociocultural theories of language development (e.g., Bruner, 1983; Vygotsky, 1978) emphasize the child's social environment, placing caregiver–child interactions at the nexus of communication development. For example, by the time an infant is about 3 months of age, infants and caregivers engage in protoconversations—reciprocal interactions involving mutual smiles, gazes, and vocalizations (Reed, 2018). These early communicative exchanges with a caregiver lay the foundation for later language development as

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the infant's early vocalizations transition from cooing to babbling to first words (around 12 months of age). Also fundamental to learning and language development is imaginative play. According to Bruner (1983), it is during play that children learn language most rapidly and that adult engagement can scaffold children's learning of new concepts. As play skills advance during the second year of life, children's vocabulary expands, and they begin to combine words into phrases. From there, expressive (oral language) and receptive language (comprehension) grow rapidly. Children produce and understand complete and complex sentences, speech becomes increasingly intelligible and vocabulary size explodes (Reed, 2018).

Although much of the child language research is focused on monolingual children, bilingual children generally achieve developmental language milestones such as babbling (Oller et al., 1997), first words (e.g., Pearson et al., 1993; Petitto et al., 2001) and word combinations (e.g., Hoff et al., 2012; Petitto et al., 2001) within a timeframe comparable to their monolingual peers. Although it is well-established that bilingual language exposure does not hamper language development (e.g., Genesee, 2015; Grosjean, 2010), language abilities in each language can vary greatly across DLLs, given the heterogeneity of the bilingual experience (e.g., children's language exposure and use, the political and social environment, and individual differences in language and cognitive abilities; King et al., 2021; Paradis, 2010). Still, when both languages are measured in bilingual children, vocabulary size is equal or greater than that of monolinguals (Hoff et al., 2012; Pearson et al., 1993).

The Need for Sensitive Language-Screening Measures for Young Dual-Language Learners

Language development is measured in a variety of different ways, including: naturalistic observation, parent report (e.g., vocabulary checklists), standardized norm-referenced assessments, and criterion-referenced assessments. Static measures of language ability attempt to capture abilities at a fixed point and within a structured context naturalistic observations of parent–child communication interactions (drawing from social interactionist theories of language development), attempt to capture the dynamic nature of language within a supported, play-based context. To accurately assess the language development of DLLs, language skills must be measured in all the children's languages (e.g., measuring expressive and receptive vocabulary size across languages to yield a conceptual measure of vocabulary; Bedore et al., 2005). Naturalistic observations of communication skills provide a holistic measure of a child's abilities across their languages yielding key information that can be used to determine the presence or absence of a language impairment and can also inform intervention decision-making if language remediation is deemed necessary.

The prevalence rate for language impairment in the absence of concomitant developmental or genetic disorders or syndromes is approximately 7% in monolingual and bilingual children (Gillam et al., 2013; Tomblin et al., 1997) with persistence rates of 40% to 60% if left untreated (Nelson et al., 2006). Current recommended practices suggest the combined use of various assessment measures (e.g., parent report, vocabulary checklists, and observations) across a child's languages to determine language delay status in young Latinx DLLs (e.g., Bedore & Peña, 2008; De Anda et al., 2020; Kohnert, 2010). However, comprehensive evaluations are not feasible for all children, and although several early language-screening measures are available, most have not been validated for use with children who speak languages other than English, nor have they included children from a variety of racial and ethnic backgrounds (Larson, 2016). Efficient and validated measures are needed to accurately identify Latinx DLLs who may require a comprehensive evaluation to determine the presence of a language delay or impairment.

High-quality screening measures require accurate identification of true positives (i.e., children with delayed or atypical language skills) and true negatives (i.e., children without language delays) by comparing the screening tool against a reference (i.e., "gold") standard. The Preschool Language Scales, Fifth Edition–Spanish (PLS-5 Spanish; Zimmerman et al., 2012) is the only available standardized, diagnostic language assessment instrument for young Spanish–English DLLs that includes children under age 3. The PLS-5 Spanish is grounded in modern theory of language acquisition (i.e., that language development occurs on a continuum and through responsive interactions with caregivers; Vygotsky, 1978) as well as recommended practices to measure the child's abilities across languages. Administration of the PLS-5 Spanish takes 45 to 60 minutes and involves structured play-based tasks yielding a measure of receptive and expressive language abilities across English and Spanish. Although widely used, standardized language assessments such as the PLS-5 Spanish are often criticized for being Euro-centric, overly reliant on the English version, and inappropriate due to issues with content bias, linguistic bias, and limited representation in the normative samples (Bedore & Peña, 2008; Laing & Kamhi, 2003; Restrepo & Silverman, 2001). Naturalistic means of evaluating a child's language development (such as observational methods; Caesar & Kohler, 2007) and parent report (Restrepo, 1998) may be more appropriate for young children from the diversity of cultural and linguistic backgrounds represented across the United States.

One promising naturalistic evaluation format to support early language screening is the ECI, a standardized measure of infant–toddler expressive communication measuring children's use of "four key communication skills"—gestures, vocalizations, single and multiple words—in a 6-minute play-based interaction. The ECI draws from sociocultural theories of language development by leveraging caregiver–child interactions during play to capture the developing child's communication abilities across their languages. The ECI was designed for frequent administration by practitioners to monitor communication growth, identify children who are not progressing at expected levels, assist in planning services and intervention, monitor change in response to an intervention, and to measure program-wide communication outcomes (Greenwood et al., 2020). Although not intended for use as a screener in isolation, the ECI has been used to accurately identify children at risk for language delay and inform diagnostic decisions across children from different racial, ethnic, and linguistic backgrounds (e.g., Buzhardt et al., 2019)—including Spanish–English DLLs (Greenwood et al., 2010, 2020). The classification accuracy of the ECI, however, has not been directly assessed.

We hypothesized that the ECI could be used to identify young Latinx DLLs who may need further evaluation to determine the presence or absence of a language disorder. Given the limitations of the reference standard used in this study (PLS-5 Spanish), we also compared child scores on the ECI against additional indicators (e.g., parent report of concern for language delay, developmental checklists). We refer to this reference as the Language Delay Score (LDS). We asked the following research questions: **RQ1.** What is the concurrent validity of the ECI relative to the PLS-5 Spanish? **RQ2.** What is the classification accuracy of the ECI as a screening measure for young Latinx DLL's compared to the PLS-5 Spanish? and **RQ3.** What is the classification accuracy of the ECI as a screening measure for young Latinx DLLs compared to the LDS?

Method

This study utilized a nonexperimental, correlational design with 39 participants from five states. Parents provided informed consent to meet institutional review board requirements.

Participants

Seventeen participants were recruited from Early Head Start programs in four U.S. Midwestern states, and the remaining participants ($n = 22$) were recruited from an Early Intervention (EI) program and the broader community in Utah. Child participants were between 7 and 36 months of age ($M = 24.9$, $SD = 7.16$), had at least one parent who identified as Hispanic/Latinx, and lived in a home where Spanish (or Spanish and English) was spoken. Thirty-eight children were identified as Hispanic/Latinx (97.43%); three were also identified as White. The remaining child was identified as White and "1/8 Mexicano." Ethnic background was available for 22 children who were further identified as Mexican, Mexicano, or Chicano. Twenty-five (64%) child participants were male and 14 (36%) were female. Thirteen children were receiving EI services at the time of the study. Individualized Family Service Plans (IFSPs) indicated that all children had communication delays (expressive and/or receptive). Four of these children also had motor ($n = 1$), cognitive ($n = 4$), adaptive ($n = 2$), and social-emotional ($n = 3$) delays. Most children lived with two adults ($n = 34$, 87%) who reported being "married or living with partner" ($n = 30$, 77%). Other households included single mothers living on their own ($n = 1$, 3%) or with two ($n = 3$, 8%) or three ($n = 1$, 3%) other adults. Most households had three ($n = 15$, 38%) or four children ($n = 8$, 21%). Six families had one child (15%), five had two children (13%), and the remaining reported having five or more children ($n = 4$, 11%). One participant did not list the number of children in the home. Table 1 includes additional participant information.

Table 1. Participant Demographic Information.

Participant characteristics	*n*	%
Primary language(s) spoken in home		
More Spanish than English or Spanish only	29	74.36
More English than Spanish	6	15.39
Equal quantities of English and Spanish	4	1.02
Maternal education		
Less than high school diploma	6	15.38
High school diploma or GED	15	38.46
Some college	9	23.07
Associate's degree	1	2.56
Bachelor's degree	8	20.51
Monthly household income		
$400 or less	3	7.70
$401 to $1,000	5	9.83
$ 1,001 to $2,000	15	38.46
$ 2,001 to $3,000	5	12.82
$3,001 or more	5	12.82
Unsure/no response	6	15.4

Measures

Demographic survey. Researcher-created demographic surveys were used to gather information on participant gender, age, race and ethnicity, and linguistic background. Questionnaires were used to gather information on the number of children and adults living in the home, household income, marital status, mothers' education level, and whether families received EI services.

Early Communication Indicator. The ECI was used as a screening measure of language abilities, and training and administration procedures were followed according to the ECI administration guidelines (Walker & Buzhardt, 2010). In ECI observations, a familiar adult play partner (i.e., caregiver or assessor) engages with the child for 6 minutes using one of two toy sets: the Fisher Price® Barn or Fisher Price® House. As part of the administration fidelity checklist, play partners are encouraged to follow the child's lead, comment on their words and actions, and minimize questions eliciting one-word responses (e.g., What color is the car?). The ECI was designed for children 6 to 42 months of age. It can be used with children who speak (or are exposed to) any language as long as the play partner and coder are fluent in any language(s) the child might use (to respond to the child during the play-based administration and discriminate between words, multiple words, and nonwords in coding; Walker & Carta, 2010). All communication, regardless of language is scored, and multiword utterances with two languages (e.g., "I want *la vaca*" <I want the cow>) are coded as multiple word utterances regardless of code switching within utterances. Guidelines specific to Spanish speakers include coding article + noun combinations (i.e., "*el perro*") as a multiple word utterance. Interactions during the ECI are coded live or from video recordings, then raw frequencies of the four key communication skills (i.e., child vocalizations, gestures, single words, and multiple words) are entered in an online data system to automatically calculate the ECI-weighted communication rate.

The ECI-weighted communication rate considers the major indicators of language development in the early years and provides more weight for more advanced skills (i.e., single words and multiple words; Buzhardt & Walker, 2010). The age-based benchmarks for the ECI were established with infants and toddlers (n = 5,883) enrolled in Early Head Start who received quarterly ECI assessments as part of their standard services (Greenwood et al., 2010). A rate of more than 1 *SD* below the ECI age-based benchmark is recommended for identifying children at risk for language delay (Carta et al., 2010). The validity of this cut-off score is supported by an intervention study with children (n = 212) who scored at least 1 *SD* below benchmark on the ECI (score < 85) and also had standard scores below the average range on the comprehensive PLS-5 language assessment (M = 84.1; Buzhardt et al., 2020). In addition, an analysis of annual ECI reliability observations by certified staff found high correlations (r = .91–.97) between the primary and reliability observations (Greenwood et al., 2013). Furthermore, an earlier study with trained research staff showed inter-rater reliability estimates of .90 (Luze et al., 2001). Tests of the ECI's criterion validity have identified relations with an earlier version of the PLS (3rd Edition; r = .62) and the Caregiver Communication Measure (Greenwood et al., 2006; r = .51).

PLS-5 Spanish. The PLS-5 Spanish was used as the initial reference standard for this study. It is the only standardized, comprehensive dual-language assessment of receptive and expressive English and Spanish language skills for young children and was normed on 1,150 Spanish–English DLLs living in the United States (Zimmerman et al., 2012). The PLS-5 Spanish includes two subtests (Auditory Comprehension and Expressive Communication) that each yield separate standard scores. The measure also allows for a combined total language score. Items are scored with caregiver report, observation, or through direct elicitation by the examiner. Auditory Comprehension items for very young children consist of items to see if the child can actively search for the person who is talking and go on to assess things like children's ability to identify (by pointing) pictures of familiar objects. Expressive Communication items for the ages of children included in this study range from vocalizing to labeling familiar objects. Although some concerns about its psychometric integrity have been documented (Leaders Project, 2013), the PLS-5 Spanish has adequate internal consistency score reliability (r = .87–.97), and test–retest score reliability (r = .91–92). The PLS-5 Spanish was compared to an earlier version of the assessment (i.e., 4th edition) and the CELF Preschool-2 Spanish (Wiig et al., 2009) for concurrent validity values of r = .81 and .68, respectively. The measure demonstrates fair sensitivity and specificity to identify children with and without language delays with values of .85 and .88, respectively (using a cut score of −1.5 *SD*; Zimmerman et al., 2012).

Parent report. Two parent-report measures were used to gather information on children's development. The first included five yes/no questions, adapted from Restrepo (1998) and Hammer (1998), related to parent perceptions and concerns about their child's language and speech development, as well as family history of language disorders or delays. The second was the Spanish translation of the Centers for Disease Control and Prevention (CDC) Developmental Milestones Checklist (CDC, n.d.), which lists activities typically associated with development between 2 months to 5 years of age. Respondents indicate whether their child has met social–emotional, language, and motor skills typically achieved by same-age children.

Language Delay Score. An LDS was created as an alternative reference measure based on best-practice recommendations for identifying language delays (e.g., Bedore & Peña, 2008; Boerma & Blom, 2017; Kohnert & Medina, 2009). The LDS (ranging from 0 to 5) was determined by assigning and summing a single point for each of the following indicators: (a) standard score in the delay range (≤77) on either the auditory comprehension or expressive communication subtests of the PLS-5 Spanish; (b) two (or more) "yes" responses on the parent concern questions; (c) family history of language or learning disability; (d) fewer than 50% of all possible items checked on the CDC Developmental

Table 2. Descriptive Statistics for the PLS-5 Spanish and the Early Communicator Indicator (ECI).

Measure	Raw score *M* (*SD*)	Range	Standard score *M* (*SD*)	Range
PLS-5 Spanish AC Subtest	23.90 (7.62)	8–37	85.38 (19.09)	50 to 117
PLS-5 Spanish EC Subtest	21.87 (4.70)	10–34	87.15 (15.49)	54 to 117
PLS-5 Spanish Total Language Score	45.77 (11.60)	23–68	85.00 (17.01)	50 to 117
ECI-weighted communication rate	8.45 (7.05)	.83–27.50	−1.6 (2.13)[a]	−4.46 to 4.21

Note. (*N* = 39). AC = Auditory Comprehension; EC = Expressive Communication; PLS-5 Spanish = Preschool Language Scales—Spanish, 5th edition (Zimmerman et al., 2012). Standard scores for the PLS-5 subtests and total language scores are based on a mean of 100 (*SD* = 15). [a]The standard score for the ECI-weighted communication rate is reported as a *z*-score.

Milestones Checklist, and (e) an IFSP. It is not likely that a single indicator is sufficient to diagnose language impairment in bilingual children (Dollaghan & Horner, 2011; Grimm & Schulz, 2014); for example, 50% to 65% of children with a family history of language impairment do not have a language disorder (Bishop, 2000; Grimm & Schulz, 2014). However, diagnosis of a language disorder based on a combination of family history, parent or teacher concern, and direct assessment is common practice in studies of diagnostic accuracy of bilingual language disorder (e.g., Dollaghan & Horner, 2011; Grimm & Schulz, 2014; Paradis, 2010). Although there is little precedence in the literature regarding the specific number of indicators that most accurately predict language delay, we hypothesized a cut point of 2 (child had at least two indicators of language delay to be classified as language impaired) would provide an optimal balance of sensitivity and specificity.

Procedures

All measures were introduced to families using standardized directions in Spanish by bilingual data collectors. All participants completed a demographic survey, the ECI, and the PLS-5 Spanish. Participants from Utah also responded to the parent-report measures. Testing was conducted in the home environment, and most assessments occurred on the same day. No assessments occurred more than a month apart.

Training and reliability. Data collectors included bilingual (Spanish–English) certified speech–language pathologists (SLPs), an SLP master's student, and other early childhood professionals with experience working with young DLLs and their families. Data collectors were trained on the administration and scoring of the PLS-5 Spanish by reading the examiner's manual, observing at least one administration of the PLS-5 Spanish (live or recorded), and role-playing administration items. Each data collector who administrated the PLS-5 Spanish, was observed (live or recorded) to evaluate performance on their administration of the measure across six key skills (i.e., calculating the child's age, initiating the evaluation with the appropriate test item, establishing basal and ceiling, and calculating raw and standard scores). Shadow scoring was also completed to check for agreement in scoring on at least one administration from all data collectors who were not certified SLPs. Reliability for the administration accuracy and scoring agreement on the PLS-5 was 98% for children from Midwestern states (see Buzhardt et al., 2020, for more details) and 100% for researchers who gathered data and scored assessments for participants in Utah.

Training on administration and scoring of the ECI occurred with certified SLPs and SLP master's students at the Utah site and with Early Head Start home visitors in the Midwestern states. Training included a didactic presentation of the measure's purpose, administration protocols, scoring definitions for each of the four key skills, and use of the ECI Online Data System. Trainees participated in group practice sessions identifying key skills through video samples of ECI sessions with trainer-provided feedback. Each trainee then individually coded two videos of full ECI sessions, one with an infant using primarily gestures and vocalizations and another with a toddler using words and multiple words. The trainers reviewed each trainee's scoring and checked their reliability ([agreements/agreements + disagreements] × 100) against a master score (Walker & Carta, 2010). All data collectors achieved at least 85% reliability on the training videos prior to administering and scoring ECI sessions. ECI reliability was maintained through annual re-trainings in the Midwestern sites in which Early Head Start home visitors scored two ECI sessions with at least 85% reliability with master codings by the ECI developers (Buzhardt et al., 2019). Interobserver reliability across 20% of the Utah sample was 85%.

Data analysis. Descriptive statistics for the PLS-5 Spanish and ECI-weighted communication rate are presented in Table 2. Product–moment correlations between the ECI-weighted communication rate and raw scores on the PLS-5 Spanish described the relation between the two measures. To assess classification accuracy, we identified cutoff scores indicative of language delays on the ECI (−1 *SD*) and the PLS-5 Spanish (−1.5 *SD*) as a reference standard. The cutoff of −1 *SD* on the ECI was used per the ECI

Table 3. Pearson Correlation Coefficients (Pearson's *r*) for Scores on PLS-5 Spanish and Early Communication Indicator (ECI).

Variable	1	2	3	4	5	6
1. AC Standard Score	—					
2. EC Standard Score	.682** (<.001)	—				
3. AC Raw Score	.600** (<.001)	.273 (.092)	—			
4. EC Raw Score	.383* (.016)	.582** (<.001)	.762** (<.001)	—		
5. Total Language Standard Score	.936** (<.001)	.892** (<.001)	.505** (.001)	.517** (.001)	—	
6. ECI-weighted communication rate	.272 (.094)	.195 (234)	.565** (<.001)	.503** (.001)	.270 (.097)	—
7. ECI z-score	.457** (.003)	.405* (.011)	.255 (.118)	.208 (.203)	.479** (.002)	.789** (<.001)

Note. PLS-5 Spanish = Preschool Language Scale, Fifth Edition–Spanish; AC = Auditory Comprehension; EC = Expressive Communication.
**indicates correlation is significant at the .01 level (two-tailed); * indicates correlation is significant at the .05 level (two-tailed).

recommendations. The cutoff of −1.5 *SD*s on the PLS-5 Spanish is recommended (Zimmerman et al., 2012). We then determined the number of children whose scores fell into four categories: true positives (below the cutoff on both measures), true negatives (above the cutoff on both measures), false positives (above the cutoff on the PLS-5 Spanish, but below on the ECI), and false negatives (below the cutoff on the PLS-5 Spanish but above on the ECI). Sensitivity (the ability of the ECI to correctly detect children who scored below the cutoff on the PLS-5 Spanish) was calculated by dividing the number of true positives by the sum of true positives and false negatives. Specificity (the ability of the ECI to correctly identify children who scored above the cutoff on the PLS-5 Spanish) was calculated by dividing the number of true negatives by the sum of true negatives and false positives. Although there are no widely agreed-upon sensitivity and specificity standards, values greater than 80% are considered acceptable for tools designed to screen for speech and language delays (Law et al., 2000).

To further explore the relationships between the ECI and the reference standards, we used receiver operating characteristic (ROC) analyses, which allowed us to examine the sensitivity and specificity of multiple cut points on the ECI. To create a standardized test statistic for the ROC analyses, we calculated *z*-scores for the ECI-weighted scores. We then analyzed the ROC graphs to determine the best possible threshold scores for the ECI. We also calculated area under the curve (AUC) values, which summarizes the classification accuracy. The AUC represents the average sensitivity over the range of specificities. An AUC of .5 indicates no predictive value, while an AUC between .8 and .9 indicates that the diagnostic marker has moderately good predictive value (Mandrekar, 2010). Analyses were initially calculated using the PLS-5 Spanish standard score as the reference. To address the final research question, we used the same procedures described above, except using the LDS as the reference standard.

Results

Results of product–moment correlations between ECI-weighted communication rate and raw scores on the PLS-5 Spanish showed significant, moderate correlations with the Auditory Comprehension and Expressive Communication subtests ($r = .565, p < .001$, and $r = .503, p < .001$, respectively). Raw scores on the PLS subtests were used as these scores reflected greater variability than standard scores. ECI *z*-scores and the standardized total language score on the PLS-5 were also significantly correlated ($r = .479, p < .001$). Table 3 includes a bivariate correlation matrix with raw and standardized subtest and total scores on both measures.

Classification Accuracy of the ECI Compared to the PLS-5 Spanish and the LDS

Table S1 in the online supplemental materials includes a table of participants' performance across all measures. An independent-sample *t* test indicated a significant difference between groups of children whose scores that fell above or below the cutoff for language delay (standard score ≤ 77) on the PLS-5 Spanish ($t = .6.88, p < .001$). This suggests that an appropriate cutoff was used to distinguish between group of children considered to be language delayed and those who were not. Similarly, using the hypothesized cut point of 2 on the LDS provided the best balance of sensitivity (93.3%) and specificity (57%), and resulted in an independent-sample *t* test showing a significant difference between those above and below the cutoff ($t = 6.44, p < .001$). A cut point of 1 resulted in lower sensitivity (79%) and specificity (50%), whereas, a cut point of 3 resulted in higher sensitivity (90%) but specificity was even more compromised (33%).

Initially, the recommended −1 *SD* cutoff on the ECI was used to calculate sensitivity and specificity. Using the PLS-5 Spanish as a reference standard, the ECI had 100% sensitivity, meaning that nine out of nine children with scores below the cutoff on the PLS-5 Spanish were also below the −1 *SD* cutoff on the ECI. Of the 30 children who were above the cutoff on the PLS-5 Spanish, 10 were also above the −1 *SD* cutoff on the ECI, resulting in a specificity of 33% (conditional probability Tables S2 and S3 are provided in the online supplemental materials). ROC analysis (see Figure 1) allowed us to explore alternative cut points on the ECI, to determine which cutoff scores provided the

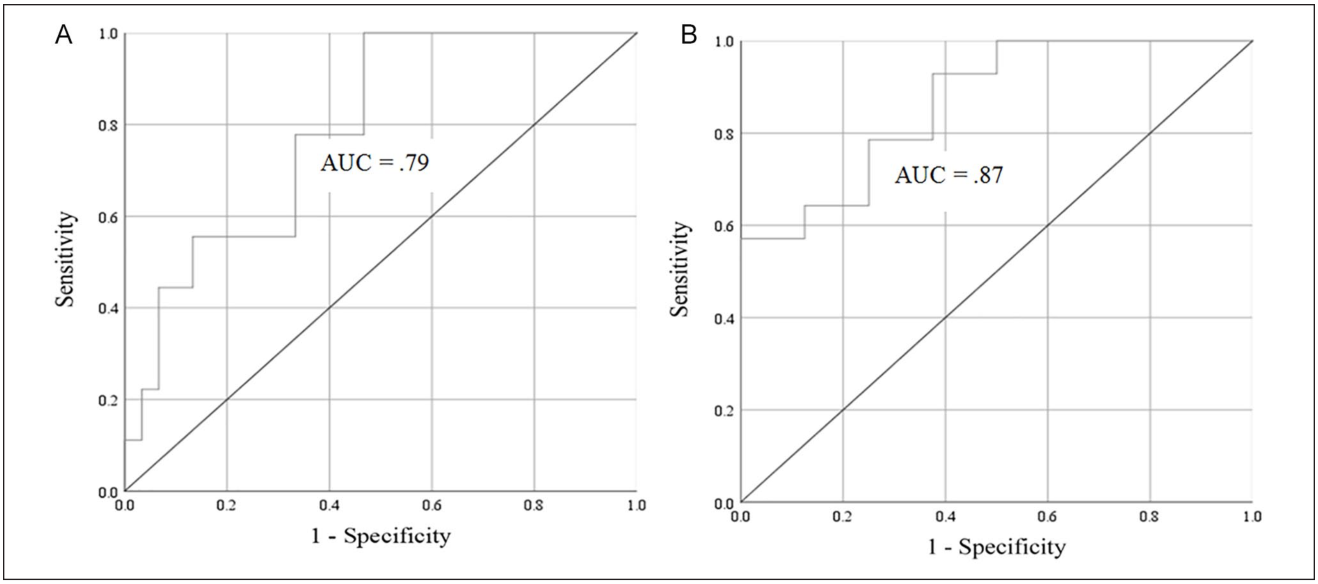

Figure 1. Receiver operating characteristic (ROC) curve and area under the curve (AUC) value for the Early Communication Indicator (ECI) and the Preschool Language Scale, 5th Ed., Spanish (panel A) and the Early Communication Indicator (ECI) and Language Delay Threshold score (panel B): (A) ECI and PLS-5 Spanish and (B) ECI and LDT.

best balance of sensitivity and specificity for the ECI and PLS-5 Spanish. ROC analysis indicated that to achieve near moderate sensitivity, a cut point of −2.07 *SD*s on the ECI yielded a sensitivity of .78 and specificity of .60 (AUC = .79, p = .009). These finding suggested that a more conservative cutoff on the ECI resulted in improved specificity using the PLS-5 Spanish as the reference standard, although neither sensitivity nor specificity values reached the recommended .80 threshold (Law et al., 2000). Using the LDS as a reference standard, and the recommended ECI cut point of −1 *SD*, the sensitivity of the ECI remained high at 93.3% (14 out of 15 children who received an LDS of two or higher were also below the −1 *SD* cutoff on the ECI). Specificity improved substantially using the LDS as the reference standard. Of the seven children identified as unlikely to have a language delay according to their LDS, four also scored above the −1 *SD* cutoff on the ECI, resulting in a specificity of 57% (see supplemental materials). ROC analyses were again used to examine the optimal sensitivity and specificity of the ECI using the LDS as the reference standard (see Figure 1). ROC analyses revealed that a cut point of −1.11 on the ECI yielded an acceptable sensitivity of .86 and a moderate specificity of .63 (AUC = .87, p = .005). These findings indicate that the recommended −1 *SD* cutoff on the ECI was near the optimal cut point to achieve high sensitivity without compromising specificity (although it still fell short of the .80 threshold).

Discussion

This study described the relation between the ECI and the PLS-5 Spanish and assessed the classification accuracy of the ECI for use as a screening tool with young Latinx DLLs. Results indicated moderate concurrent validity between the ECI and PLS-5 Spanish. Sensitivity of the ECI was high using the PLS-5 Spanish and the LDS as reference measures; however, specificity was relatively low across both measures. The ECI accurately identified all children who were likely to have a language delay, but it also identified some children as below benchmark whose PLS-5 Spanish scores were not classified as such. Using the LDS improved specificity relative to using the PLS-5 Spanish only, supporting recommended practices in using multiple methods, and in particular parent report, to identify language delay in young DLLs, and indicating that the ECI has promise as a screening measure for this population.

Our findings revealed a significant positive relationship between the ECI and the PLS-5 Spanish, providing preliminary support for the concurrent validity of the ECI for use with young Latinx DLLs. These findings are in accord with previous research supporting the validity of the ECI with monolingual populations using standardized language measures (Greenwood et al., 2006, 2020). Results of this study also suggest the ECI may be a promising tool for early language screening in young Latinx DLLs.

Utility of the ECI to Support Language Screening

A key function of the ECI is to help identify infants and toddlers at risk of language delay as early as possible and to monitor the effectiveness of early intervention to address those delays through ongoing assessments (Greenwood et al., 2010). Several factors suggest that the ECI is appropriate to inform language-screening decisions for young

DLLs from Latinx backgrounds. First, using the −1 *SD* recommended cut point, the ECI did not miss any children who had scores in the language-delayed group on the PLS-5 Spanish. This supports the initial use of the ECI as an early identification tool to provide timely intervention for children at risk for language delays. When using this cutoff for screening, the ECI is also unlikely to miss children who may be diagnosed with a language delay after a complete evaluation. Second, the ECI has a brief administration time (6 minutes)—a requirement of screening tools to identify potential delays in large groups of children (Bricker et al., 2013). Third, the ECI can be used to assess children's abilities across languages and across time—accounting for all of the children's skills despite any fluctuations in language development that may occur as children's exposure to, or use of, one or more languages shifts in the early years. As such, the ECI is inherently strengths based and grounded in sociocultural language theory, designed to capture the dynamic, reciprocal nature of communication between young children and caregivers in a naturalistic context.

Although specificity estimates for the ECI (when using the PLS-5 Spanish as the reference standard) were below optimal levels, the specificity increased with the use of additional indicators on the LDS. This finding supports prior literature recommending the use of converging evidence in diagnostic decision-making for young DLLs (e.g., Bedore & Peña, 2008; Kohnert & Medina, 2009). For example, the LDS incorporated both standardized and parent–report measures (e.g., developmental milestones checklist, parent-reported concern). Our findings highlight the importance of parent-report measures as a key aspect of a language impairment diagnostic battery. However, accurate diagnosis of Spanish–English speaking DLLs with language impairment remains challenging, given the variability in the population and that there are currently no gold-standard diagnostic assessments. Using brief measures such as parent-reported concerns for language development, family history, and developmental checklists with validated observational measures, such as the ECI, can improve practitioners' accuracy in identifying children with a true language delay and reduce false positives such as children who demonstrate typical bilingual language development. The ECI and similar brief naturalistic assessments that account for the importance of the caregiver–child relationship and assess communication skills across languages may provide a valuable contribution to the assessment toolkit for DLLs so that ultimately, children with true language impairments will receive critical intervention services to improve their language outcomes.

Limitations and Future Directions

A substantial proportion of our sample included children enrolled in Early Head Start or EI services and the small sample size included in this study limits the ability to interpret and generalize findings especially regarding the LDS cutoff score. The participants were not representative of the diverse population of Latinx DLLs in the United States and the power for statistical analyses was limited. Furthermore, only 22 of the 39 participants completed additional parent-report measures (e.g., family history and concern about child language development, developmental milestones checklist) that were used to calculate the LDS. Results of the LDS analysis may have improved sensitivity with the addition of the participants from the Midwest (many of whom did not have an IFSP). Another limitation is that the best-available standardized language assessments for this population are flawed, and although the use of converging evidence for diagnosis is considered best practice, this process is not standardized, and the inclusion of additional assessments may compromise efficiency. Future research should include larger-scale studies examining the classification accuracy of the ECI against comprehensive language evaluations. Larger sample sizes of children with multiple ECI assessments would also allow analysis of DLL children's ECI growth rate to improve specificity. For example, practitioners may be able to more accurately determine risk status for language delay based on whether children's growth rate over multiple assessments exceeds or falls below the benchmark growth rate (i.e., 0.998 communications per minute per month).

The results of this study suggest that the ECI holds promise as a screening tool and is unlikely to miss DLL children who may have language delay. Although the ECI is likely to over-identify children with language delay when used on its own, using the ECI in combination with parent-reported concern, family history of language delay, and other brief measures of child language development may improve classification accuracy. Future research should assess the ecological validity of the ECI to consider whether observations of child language should occur within play or other settings (e.g., mealtime, caregiving routines) where language interactions frequently occur between Latinx caregivers and their children (Cycyk & Hammer, 2020). Additional research is also needed to better understand how standardized procedures related to bilingual language administration may affect the reliability of the ECI. For example, it is possible that children may respond differently in ECI sessions involving partners who they may not perceive as being speakers of the home language due to interlocutor sensitivity (i.e., pragmatic language differentiation; Genesee et al., 1995). As additional early language-screening tools are identified and improved, practitioners are more likely to detect potential language delays in young Latinx DLLs, and those who are determined to have a delay (after thorough evaluation) may be provided with high-quality intervention services.

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The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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Supplemental Material

Supplemental material for this article is available on the *Assessment for Effective Intervention* website with the online version of this article.

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