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Research Article

Identifying Children at Risk for Developmental Language Disorder Using a Brief, Whole-Classroom Screen

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Purpose: The aim of this study was to determine whether parents of children with developmental language disorder (DLD) were aware of their children's language difficulties and whether a brief, classroom-based language screen can reliably identify children at risk for DLD, including those with both good and poor word reading skills.
Method: First- and second-grade students (N = 97) completed a language screen and assessments of nonverbal intelligence, word reading, and language designed for linguistically diverse students. Their parents completed a questionnaire.
Results: Few parents of children with DLD reported that their child had ever received speech, language, reading, or other educational services. Parents of children with DLD with average word reading skills reported receiving services approximately half as often as children with DLD with poor word reading. Parents of children with DLD also reported few concerns about their children's speech, language, and academic development. The brief whole-classroom screen showed acceptable classification accuracy for identifying children with DLD overall, although sensitivity was lower for children with DLD with average word reading skills.
Conclusion: Based on reports of prior services and concerns, many parents of children with DLD appear to be unaware of their children's difficulty with oral language. Whole-classroom screens for language show potential for efficient identification of children who may benefit from comprehensive assessments for DLD without relying on their parents or teachers to raise concerns.

Approximately 7%–9% of children present with significant impairment in the ability to understand and produce spoken language, despite otherwise typical development (Norbury et al., 2016; Tomblin et al., 1997). Many labels have been used to describe children meeting these criteria, with the two most common being specific language impairment (SLI; Leonard, 2014; National Institute on Deafness and Other Communication Disorders, 2017; Rice, Wexler, & Hershberger, 1998) and developmental language disorder (DLD; Bishop, Snowling, Thompson, Greenhalgh, & CATALISE-2 Consortium, 2017). The two terms are frequently used interchangeably, but children with SLI must meet stricter criteria for nonverbal IQ (e.g., less 1 *SD* below the mean) than children with DLD (e.g., no more than 2 *SD*s below the mean; Bishop et al., 2017). In the absence of developmental syndromes or sensory impairment, children with DLD are often delayed in their acquisition of first words and multiword utterances, are slower to learn new vocabulary, and show marked difficulty with certain aspects of grammar, such as tense and agreement markers beginning in their preschool years (Bedore & Leonard, 1998; Rice & Wexler, 1996; Tager-Flusberg & Cooper, 1999). For most children with DLD, these spoken language difficulties persist through adolescence into adulthood (Conti-Ramsden, 2003; Conti-Ramsden, Botting, & Faragher, 2001; Poll, Betz, & Miller, 2010; Snowling, Duff, Nash, & Hulme, 2016; Tomblin & Nippold, 2014).

DLD is often associated with reading difficulties (Catts, Fey, Tomblin, & Zhang, 2002), reduced educational attainment, increased risk of social difficulties, and increased risk of unemployment (Conti-Ramsden, Mok, Pickles, & Durkin, 2013; Snowling, Bishop, Stothard, Chipchase, & Kaplan, 2006; Whitehouse, Watt, Line, & Bishop, 2009).

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Although DLD and dyslexia are distinct disorders, many children with DLD experience significant difficulties in learning to read words, consistent with a dyslexia profile (see Adlof, 2017, for a review). Children who meet criteria for both DLD and dyslexia exhibit problems in the phonological domain of language—including difficulties with phonological awareness and phonological working memory—which impede the development of their word reading skills (Bishop, McDonald, Bird, & Hayiou-Thomas, 2009; Catts, Adlof, Hogan, & Weismer, 2005; Ramus, Marshall, Rosen, & van der Lely, 2013).

Many other children with DLD develop strong word reading skills yet still experience considerable difficulty with reading comprehension, related to underlying difficulties with vocabulary, semantics, syntax, and higher level language skills (Bishop et al., 2009; Kelso, Fletcher, & Lee, 2007; Nation, Clarke, Marshall, & Durand, 2004; Ramus et al., 2013). Because the focus of reading instruction in the early grades is on word reading, reading comprehension difficulties for these children with DLD may not be apparent until the later school grades (Catts, Adlof, & Weismer, 2006). Thus, for some children with DLD, it may take several years for negative impacts of spoken language deficits on reading performance to manifest. For example, a study by Catts, Compton, Tomblin, and Bridges (2012) focused on "late-emerging" poor readers, who showed normal reading development until fourth grade, followed by poor reading in later grades (see also Leach, Scarborough, & Rescorla, 2003). Most late-emerging poor readers showed oral language weaknesses from kindergarten to second grade, and many met standard criteria for DLD. If oral language weaknesses had been identified and addressed earlier, it is possible that negative effects on reading development could be prevented or reduced.

Parental Awareness of Children's Language Difficulties

Despite its high prevalence and persistent functional impacts, DLD is largely undetected and underdiagnosed (Prelock, Hutchins, & Glascoe, 2008; Tomblin et al., 1997). Furthermore, the widespread underdiagnosis of DLD means that the majority of children with DLD likely are not receiving language services. A large epidemiological study found that 70% of parents of children who met criteria for DLD in kindergarten were unaware of their child's difficulty with language (Tomblin et al., 1997). In another community-based sample (N = 380), Adlof, Scoggins, Brazendale, Babb, and Petscher (2017) similarly found that the majority of parents of second-grade students who met study criteria for DLD reported no concerns about their child's speech, language, or reading development.

Currently, an evaluation for DLD begins when a teacher, a parent, or another professional (e.g., pediatrician or social worker) raises concern about a student's communication skills or academic performance. Although some pediatricians may inquire about language development as part of regular child wellness visits, many do not, and the screening procedures that have been used by primary care providers for preschool children vary widely in their sensitivity and specificity (Nelson, Nygren, Walker, & Panoscha, 2006; Siu & U.S. Preventive Services Task Force, 2015). There is also considerable variability among pediatricians in what happens following a child's failed screen—many children are not followed up (Radecki, Sand-Loud, O'Connor, Sharp, & Olson, 2011). Despite such screening efforts, studies suggest that most children meeting standard criteria for DLD are not receiving services (Adlof et al., 2017; Tomblin et al., 1997). It has been argued that problems with speech production (i.e., speech articulation) or word reading may be more readily apparent to parents and teachers than problems with understanding and producing oral language (Nation et al., 2004; Silliman & Berninger, 2011), which could, in turn, lead to differential rates of identification and treatment for students with DLD, depending on their speech production and word reading abilities.

Some evidence suggests that parents of children meeting the criteria for both DLD and dyslexia may be more aware of their children's difficulties than parents of children who have DLD in the absence of word reading problems and that children with combined DLD and reading problems are more likely to have received speech, language, or reading services (Adlof et al., 2017; Catts et al., 2005). For example, Adlof et al. (2017) reported that 56.2% of parents of children meeting the criteria for both DLD and dyslexia reported concerns and/or receipt of prior services, whereas only 29% of parents of children with DLD who did not have word reading difficulty reported concerns and/or receipt of prior services. Taken together, these results indicate a need for improved methods for identifying children with DLD.

The Promise of Universal Screening

Universal screening of oral language in the early school years could help to overcome the challenge of underidentification of DLD and help to identify children with hidden oral language impairment before reading and other academic problems manifest. In medicine, screening tests (e.g., blood pressure, cholesterol, insulin levels) are often used to look for diseases (e.g., heart disease, diabetes) before symptoms become apparent. Following a failed screen, further evaluation is conducted to inform the diagnostic decision and determine the appropriate course of treatment, if needed. Similarly, the goal of an oral language screening would be to quickly identify children who may benefit from observation or further assessment. Although it can be difficult to accurately predict language outcomes in very young children, language difficulties that are present after 5 years of age are likely to persist (Stothard, Snowling, Bishop, Chipchase, & Kaplan, 1998). Universal screening of reading abilities in the primary grades has become common practice in schools in the United States that use a response to intervention framework for identifying and providing intervention for struggling readers. However, universal screening of oral language in school-age children is rare, and language

screens tend to be administered to school-age children only in response to a teacher or parent request (Ehren & Nelson, 2005).

For a screening tool to be useful, it should first yield high classification accuracy, such that it reliably distinguishes individuals with strong versus weak language abilities. In practice, clinicians will sometimes tolerate a screen with a higher rate of false positives (i.e., children who fail the screen but do not have a language disorder or learning disability) in order to maximize sensitivity (i.e., to identify as many children with DLD as possible). However, both types of errors (false positives and misses) can be costly because limited resources for continued evaluation will be allocated to the wrong students, and children without language problems may miss class time for unnecessary assessments (Davis, Lindo, & Compton, 2007). In addition to having good classification accuracy, it is important that measures intended for universal screening can be administered and scored quickly, easily, and inexpensively.

Commercially available language screens for students in the elementary grades (e.g., Developmental Indicators for the Assessment of Learning–Fourth Edition, Mardell & Goldenberg, 2010; Diagnostic Evaluation of Language Variation–Screening Test [DELV–Screening Test], Seymour, Roeper, & de Villiers, 2003; Clinical Evaluation of Language Fundamentals–Fifth Edition, Wiig, Secord, & Semel, 2013) are designed to be administered to individual students by speech-language pathologists and require approximately 15–20 min per student. Therefore, using individually administered screens for universal screening for DLD would require substantial time from speech-language pathologists, resulting in less time and resources available for providing intervention and support for students who require it. However, screens that could be administered to all students in a class simultaneously could be useful to increase efficiency, maximize speech-language pathology resources, and minimize interruptions to instructional time.

Adlof et al. (2017) recently explored the utility of group-administered screens for identifying children at risk for DLD and/or dyslexia in second grade. The researchers administered the Listening Comprehension subtest of the Group Reading Assessment and Diagnostic Evaluation (GRADE; Williams, 2001) as a measure of language ability and the Test of Silent Word Reading Fluency (Mather, Hammill, Allen, & Roberts, 2004) as a measure of word reading ability. The screens were given to all students in a classroom at one time. The results were promising and demonstrated the feasibility of administering screens for language and reading ability in whole-classroom settings. The combined screening tasks showed good sensitivity and specificity for identifying children with dyslexia or combined DLD and dyslexia, but they performed less well for identifying children with DLD who had good word reading skills (Adlof et al., 2017).

Study Purpose

Building on the results of Adlof et al. (2017), the purpose of this study was to further examine parent awareness of language difficulties in children with DLD and the utility of classroom-based screens for identifying children with DLD. Our goal was to examine performance among students who meet criteria for DLD but may not be otherwise identified. Thus, the identification of students who meet criteria for DLD but who do not have additional co-occurring disorders, such as dyslexia, was of particular interest. The current study addressed the challenges of the previous research in three ways. First, whereas Adlof et al. (2017) assessed parent awareness of language difficulties with open-ended questions (e.g., "Do you have any concerns about your child's reading or language abilities? If yes, please describe."), the current study asked parents to report concerns about several dimensions of speech production, language, literacy, and attention. Second, whereas the GRADE Listening Comprehension task showed ceiling effects and was not sensitive to DLD in children without comorbid dyslexia in Adlof et al., the current study examined a new screen, involving an adapted set of items from the Test for Reception of Grammar–Second Edition (TROG-2; Bishop, 2003), which was developed specifically for measuring comprehension of English grammatical contrasts marked by inflections, function words, and word order, which are known to be difficult for children with DLD. Third, the current study added screening of first-grade students, which has the potential for improved identification of students at younger ages and thus earlier access to treatment. Our research questions were as follows:

1. To what extent are parents of children meeting criteria for DLD concerned about their children's difficulties? Are parents of children with DLD and poor word reading more likely to report concern than parents of children with DLD and good word reading?
2. Does a brief whole-classroom screen of language ability provide accurate classification of first- and second-grade students with typical language skills (TL) versus DLD, including children who meet criteria for DLD with and without word reading difficulties?

Method

This study was conducted as part of a broader study focused on morphosyntactic skills in children with DLD for which the screening process facilitated participant recruitment (Hendricks & Adlof, in preparation). The institutional review board at the University of South Carolina approved all study procedures. Study procedures involved two parts: (a) classroom screening and (b) individual assessment.

Classroom Screening

Trained research assistants administered language and reading screening measures to 35 first- and second-grade classrooms at four elementary schools in one school district in South Carolina. The focus of this study is on the outcomes of the language screen; thus, data for the reading

screening measures are not reported. Screens were administered to all students in a class at one time (which took approximately 15–20 min), and all students who were present on the day of the screen were administered the screens.

Participants

The screening sample included a total of 690 students, 333 in first grade and 357 in second grade. Demographic information for the screening sample included age and gender, which was provided by the school district. Students were, on average, 7;6 years;months old at the time of the screen (range: 6;2–9;6, *SD* = 0;8). The sample included 348 girls and 339 boys. Demographic information was not available for three participants (< 1%) because the students entered the classroom after the district provided the demographic data.

Screening Measure

The language screen included 16 items selected from the TROG-2, which involved a sentence picture-matching task. Deficits in comprehension and production of morphology and syntax are a hallmark deficit in children with DLD (Leonard, 2014), and the TROG-2 is designed to assess comprehension of English grammatical structures known to be difficult for children with DLD. The TROG-2 items use a restricted vocabulary of simple nouns, verbs, and adjectives that are familiar to young children. Students were given a booklet with four black and white pictures for each item. Below each picture was an open circle. Students were instructed to listen to the sentence spoken by the examiner and fill in the circle below the picture that best matched the examiner's sentence (e.g., *The boy kicks the ball that is big. Neither the cat nor the dog is running.*). The correct picture illustrated the target sentence, and foil pictures illustrated sentences that differed by grammatical or lexical features. The first item was administered as an example to demonstrate how student should complete the scoring booklet. For the remaining items, students were told they could ask for the item to be repeated once, but the item was not repeated if students did not ask for it to be repeated.

We used a systematic approach to select items from the TROG-2 using data from a prior study involving 590 first-grade students who were individually administered the full TROG-2 using standard procedures (Language and Reading Research Consortium; Farquharson & Murphy, 2016). First, we excluded any items that included color contrasts (e.g., *The shirt that is* red *is on the table*) that would not have been distinguishable on black and white test forms. Next, we selected items of a range of difficulty (as measured by the proportion of examinees who answered the item correctly), which maximized discrimination (as measured by the difference between proportion of correct answers from the top 27% of the students in the database versus the bottom 27% of the students in the database). The selected items assessed understanding of negation, relative clauses, complex predicates, and plural marking. The selected items either did not assess features that vary between mainstream American English (MAE) and non–mainstream American English (NMAE) or if the features did vary in production, then the interpretation of the item was not different between MAE and African American English variations. For example, even though copulas are produced variably in African American English, the presence of the copula in MAE sentences does not affect the interpretation of the screening item. The Appendix lists the 16 items that were selected for the screening task; Cronbach's alpha for the items in the screen was $\alpha = .92$.

Scoring of Screens

Participants' response booklets were scanned and recorded using teleform software. Trained research assistants reviewed the teleforms to ensure that each response was recorded correctly. Multiple responses per item (e.g., selecting Pictures A and C) were noted and scored manually as incorrect. Items with no response were marked as incorrect, and research assistants confirmed that nonresponses recorded by the teleform software were true nonresponses (i.e., that they did not have a response that was not detected by the software).

Individual Assessment

Parents of all students were sent study information and invitations to have their children participate in individual testing. All monolingual, English-speaking children whose parents provided written consent were eligible to participate in individual assessments. Parents provided written consent and completed a questionnaire, which included demographic information such as child's race and ethnicity, languages spoken by the child, and maternal level of education. The questionnaire asked parents to report any family history of learning disabilities and their perception of any areas of difficulty for their child.

Signed consent forms were received from 145 students. All participants with returned consent forms whose scores on the language screen fell in the bottom 33% of scores for their grade were tested. The results of the reading screen did not influence participant selection for the individual assessment. Students with returned consent forms whose scores were in the top 67% of scores for their grade were assigned a random number and tested in order of their random number until the study period (the academic year) ended. Participants completed a battery of assessments of reading, language, and cognitive ability in a quiet room at the child's school. Assessments were audio- and video-recorded to allow for offline scoring and reliability.

Participants

The individual assessment sample included 97 participants (65 second-grade students and 32 first-grade students) who completed the language screen and the individual testing session. The participants in the individual assessment sample included 54 girls and 43 boys with a mean age that was similar to the screening sample (*M* = 7;9, range: 6;5–9;4). Race information was provided by 91 families. The individual assessment sample included 54.6% children who were White, 35.1% who were Black/African American, and 4.1%

who were two or more races. Thirty percent of families did not provide ethnicity information, 68% reported that their child was not Hispanic/Latino, and 2.1% reported that their child was Hispanic/Latino. No parents reported any motor disorders, two families reported their child had hearing loss, and one parent reported that his or her child had another nonspecified medical problem.[1] Sixteen parents (16.5%) reported that their child had attention deficit disorder (ADD)/attention-deficit/hyperactivity disorder (ADHD).[2] The sample included students from diverse socioeconomic backgrounds (as measured by mother's highest level of education[3]). Approximately one quarter of families reported that the child's mother graduated high school, held a general education diploma (27%), or had completed some college (23%). Fewer families reported that the child's mother had completed a bachelor's degree (12%) or a master's degree or higher (10%). Maternal education levels were not reported for 11 (11.3%) students.

Individual Assessment Measures

Parent questionnaire. Parents completed a questionnaire that included questions about their child's history of reading and language impairments, their home literacy practices, and concerns regarding language and literacy development. Using a checklist, parents were asked to check "yes" or "no" to indicate whether they had concerns about their child's development in any of the following areas: receptive and expressive language (e.g., understanding what you tell him or her at home, understanding teachers at school, or expressing his or her thoughts when speaking), speech production (e.g., saying words correctly), literacy (e.g., reading individual words, understanding what he or she reads, spelling, or writing sentences or longer texts), and attention (e.g., paying attention). The questionnaire also included space for parents to describe any other areas of concern.

Language ability. The study was conducted in the state of South Carolina, where many students speak NMAE dialects. Thus, the Diagnostic Evaluation of Language Variation–Norm Referenced (DELV–Norm Referenced; Seymour, Roeper, & de Villiers, 2005) was administered as the language outcome measure to ensure that group categorization decisions were not influenced by the use of nonmainstream dialects. The DELV–Norm Referenced is an omnibus measure of language ability that was specifically developed for the assessment of children from diverse language backgrounds, including children who speak mainstream and nonmainstream dialects of American English. The Total Language Score is a composite score derived from three subtests: Syntax, Semantics, and Pragmatics. Importantly, all of these subtests were designed to assess features that do not contrast between MAE and NMAE. The Syntax subtest assesses comprehension and production of syntactic structures, such as article selection and passives. The Semantics subtest includes items such as the interpretation of novel words based on context. The Pragmatics subtest assesses uses of language, including storytelling and communicative role taking. The test manual reports internal consistency between .81 and .92 for the age range of the children in this study (6–9 years old). Students who scored at least 1 *SD* below the mean on the Total Language Score were classified as meeting criteria for DLD, and students scoring above this threshold were classified as having TL. According to the DELV–Norm Referenced manual, this cut-score results in 95% sensitivity and 93% specificity of classification, which is well above the recommended threshold of 80% (cf. Spaulding, Plante, & Farinella, 2006). In practice, diagnosis of DLD would typically involve consideration of additional information beyond a single test score, including an evaluation of functional performance across multiple areas. However, our goal in this study was to determine whether a screen would accurately identify children as good candidates for further evaluation; therefore, the DELV–Norm Referenced score was deemed to be a valid reference standard.

Word reading. Participants completed the Word Identification subtest of the Woodcock Reading Mastery Tests–Third Edition (WRMT-III; Woodcock, 2011). The Word Identification subtest asks students to read real words of increasing difficulty. The test manual reports internal consistency between .94 and .98 for the ages in this study (6–9 years old). Because of scheduling constraints, word reading measures were not administered to six participants. Children who scored at least 1 *SD* below the mean were classified as having poor word reading. This cutoff is comparable to other studies that have used the WRMT-III (or previous versions) for identifying poor word reading (e.g., Catts et al., 2005; Joanisse, Manis, Keating, & Seidenberg, 2000; Siegel, 2008).

Nonverbal intelligence. The Test of Nonverbal Intelligence–Fourth Edition (TONI-4; Brown, Sherbenou, & Johnsen, 2010) was administered as a measure of participants' nonverbal cognitive abilities. The test manual reports .94–.96 reliability for the age group in this sample (6–9 years old). Nonverbal intelligence was assessed for descriptive purposes, and participants were not excluded based on nonverbal intelligence. Because of scheduling constraints, nonverbal intelligence was not assessed in six participants.

Language variation. Participants were administered Part I of the DELV–Screening Test (Seymour et al., 2003),

[1]Although hearing loss and other medical conditions could be considered exclusionary factors for DLD, these children were able to participate in the study tasks without any special accommodations. Both children who reported hearing loss scored below the cut-point for language impairment, whereas the child with the nonspecified other medical problem scored within normal limits. Because they had low language scores, we included the two children with hearing loss in the DLD group, but a more accurate clinical description for them would be "language disorder associated with hearing loss" (cf. Bishop et al., 2017).

[2]Of the 16 students with ADD/ADHD diagnoses, seven were in the TL + good word reading group, three were in the DLD group, four were in the poor word reading group, and two were in the DLD with poor word reading group.

[3]Mothers were listed as one of the primary caregivers for 92% of families who reported maternal education levels.

which is intended to measure the extent to which a child's language varies from unimpaired MAE. Items in Part I assess phoneme production and morphosyntactic structures within sentence structures. This measure was administered for descriptive purposes and did not affect decisions about group membership (DLD vs. TL). Following the procedures of Terry and Connor (2012), we derived a variable for the percentage of NMAE features by dividing the number of NMAE responses by the total number of scoreable responses. Note that, because some items test morphosyntactic structures that are difficult for children with DLD, children with DLD may appear to have higher levels of language variation on this variable, regardless of dialect (cf. Oetting, McDonald, Seidel, & Hegarty, 2016). Children's classifications as DLD or TL were made on the basis of the DELV–Norm Referenced, which is appropriate for children who speak MAE and NMAE dialects.

Scoring Reliability

All scorers were required to pass a scoring test before they were allowed to score assessments independently. A random sample of 20% of assessments were double-scored for reliability. Reliability scoring was completed on blank protocols using the video and audio recordings, and reliability scorers were unaware of the participants' initial scores. Reliability was determined through item-by-item comparisons between the initial score and the reliability score. Scoring reliability was measured by the percentage of items in which the initial scorer and the reliability scorer agreed. Scoring reliability was 95% for Part I of the DELV–Screening Test, 99.6% for the TONI-4, 96.7% for the WRMT-III Word Identification subtest, and 96.1% for the DELV–Norm Referenced.

Results

Descriptive statistics for all measures are presented for each group in Table 1. Within the individual assessment sample, 75 were considered to have TL (DELV–Norm Referenced > 85) and 22 participants met criteria for DLD (DELV–Norm Referenced ≤ 85). All but two of the participants in the DLD group could also be considered to meet criteria for SLI, as they exhibited TONI-4 standard scores of ≥ 85; one participant in the DLD group achieved a TONI-4 standard score of 82, and one was not administered the TONI-4. Similarly, all but five participants in the TL group exhibited TONI-4 standard scores of ≥ 85. One participant in the TL group achieved a TONI-4 standard score of 76, and four were not administered the TONI-4. Recall that the sampling procedures prioritized the identification of children who met criteria for DLD, and therefore, the proportion of children within this study who met criteria for DLD is higher than expected within the population. Within the TL group (DELV–Norm Referenced > 85), 54 students had typical word reading skills (WRMT-III WID > 85; TL + good word reading), 16 had poor word reading skills (WRMT-III WID ≤ 85; TL + poor word reading), and five were missing word reading data. Within the DLD group (DELV ≤ 85), 10 students had typical word reading skills (WRMT-III WID > 85; DLD only), 11 had poor word reading skills (WRMT-III WID ≤ 85; DLD + poor word reading), and one was missing word reading data. To provide an overview of individual differences across both measures and across grades, Figure 1 displays a scatter plot showing participant scores on the language screen and the language ability measure, with markers indicating grade level and word reading status.

Reports of Parental Concerns

Our first research question considered the extent to which parents of children in the DLD group were concerned about their child's abilities through reports of previous services and current reports of concerns. Table 2 displays descriptive statistics for parent report of prior services and current concerns. Slightly less than half (41%) of parents of children in the DLD group reported that their child had received speech, language, reading, or other special education services in the past, as compared to 15% of parents of children with TL with good word reading. Parents were also asked to report if they had concerns in any of the nine areas, corresponding to receptive language (at home and school) and expressive language, speech, reading (words and comprehension), spelling, writing, and paying attention. Overall, parents in both the DLD and TL groups reported few concerns about their children. When the total number of concerns was summed (max = 9), parents of children in the DLD group reported more concerns ($M = 2.68$, $SD = 1.54$) than parents of children in the TL group ($M = 1.57$, $SD = 1.24$); the effect size was relatively large ($d = 0.85$), but the difference was not statistically significant, $t(95) = 0.129$, $p = .055$. The most frequently reported concern from parents of children with TL with good word reading was "paying attention" (37%). Some parents of children with TL reported concerns about their children's ability to understand what they read (24%) and to write sentences or longer texts (22%). Parents of children in the TL group rarely expressed concern in other areas (9%–15%). Less than half of parents of children in the DLD group reported concerns in each area. Similar to the TL group, reading comprehension (45%), writing (41%), and attention (41%) were also the most often reported areas of concern by parents of children in the DLD group, with fewer concerns reported for the other six areas (9%–36%). Taken together, these results suggested that parent concerns alone would not reliably differentiate children with DLD from children with TL.

We also examined whether prior services and/or parental concerns differed by word reading ability. As mentioned previously, word reading measures were not available for six participants (five in the TL group and one in the DLD group) who were therefore excluded from the subgroup analysis of parental concern. As shown in the language/word reading ability subgroups in Table 2, per parent reports, children with DLD who also had poor word reading skills were almost twice as likely to have received prior services (55%) as children in the DLD group who did not have poor

Table 1. Descriptive statistics for children with developmental language disorder (DLD) versus typical language skills (TL) and for subgroups divided according to oral language and word reading ability.

Measure	TL vs. DLD		Language/word reading ability subgroups			
	TL *n* = 75	DLD *n* = 22	TL + good word reading *n* = 54	TL + poor word reading *n* = 16	DLD + good word reading *n* = 10	DLD + poor word reading *n* = 11
Language Screen Accuracy, *M* (*SD*)	0.79 (0.12)	0.61 (0.14)	0.78 (0.12)	0.77 (0.12)	0.61 (0.18)	0.61 (0.11)
DELV–Norm Referenced[a] standard score, *M* (*SD*)	98.57 (9.30)	76.18 (6.27)	99.11 (8.87)	95.25 (9.21)	78.40 (5.15)	73.91 (6.88)
WRMT-III[b] Word Identification standard score, *M* (*SD*)	100.61 (16.54)	84.71 (12.03)	107.17 (11.88)	78.50 (9.14)	94.90 (7.00)	75.45 (6.86)
TONI-4[c] standard score, *M* (*SD*)	103.73 (8.19)	95.90 (7.07)	104.50 (8.18)	100.07 (6.95)	99.80 (5.98)	92.36 (6.23)
DELV–Screening Test[d] % of NMAE use, *M* (*SD*)	27[e] (26)	48 (28)	23 (23)	41 (31)	32 (27)	62 (21)

[a]Diagnostic Evaluation of Language Variation–Norm Referenced. [b]Woodcock Reading Mastery Tests–Third Edition. [c]Test of Nonverbal Intelligence–Fourth Edition. [d]Diagnostic Evaluation of Language Variation–Screening Test. [e]Higher % of non–mainstream American English (NMAE) use reflects use of more features of NMAE dialects.

Figure 1. Scatterplot of Language Screen Accuracy and Total Language Composite on the Diagnostic Evaluation of Language Variation–Norm Referenced (DELV-NR).

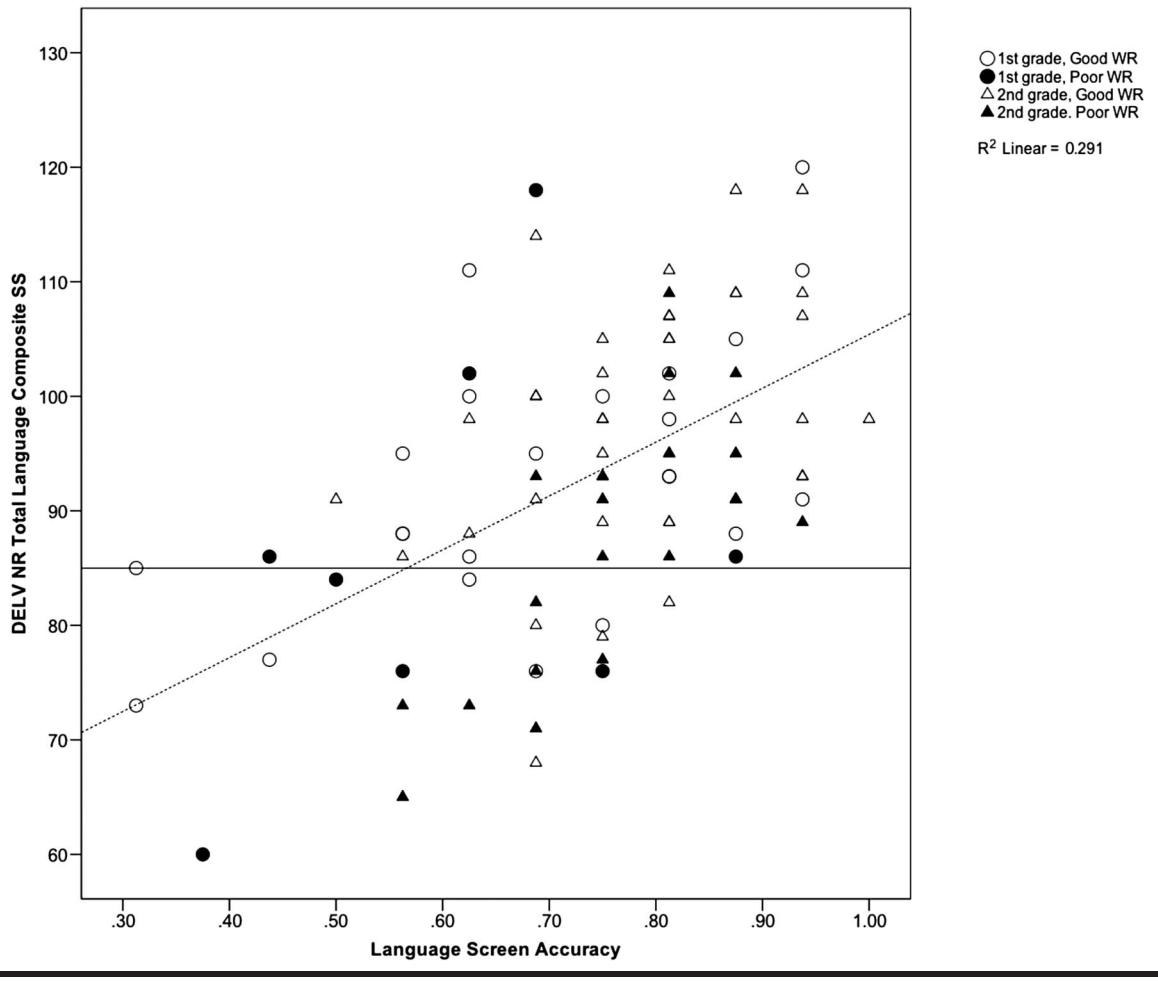

Table 2. Reports of parental concern and services received for children with developmental language disorder (DLD) versus typical language skills (TL) and for subgroups divided according to oral language and word reading ability.

Parent survey responses	TL vs. DLD		Language/word reading ability subgroups			
	TL *n* = 75	DLD *n* = 22	TL + good word reading *n* = 54	TL + poor word reading *n* = 16	DLD + good word reading *n* = 10	DLD + poor word reading *n* = 11
Percentage of parents reporting						
Family history of language or reading disabilities	9	5	7	19	10	0
History of special services	16	41	15	25	30	55
Percentage of parents reporting concerns about						
Understanding what you tell him or her at home	8	9	9	6	10	9
Understanding teachers at school	13	18	11	25	20	18
Expressing his or her thoughts when speaking	9	27	11	6	20	36
Saying words correctly	15	36	15	19	20	55
Reading individual words	15	27	7	44	10	45
Understanding what he or she reads	27	45	24	44	40	55
Spelling	15	23	9	38	20	27
Writing sentences or longer texts	24	41	22	38	50	36
Paying attention	32	41	37	25	40	45
No. of reported concerns (max = 9), *M* (*SD*)	1.57 (1.24)	2.68 (1.54)	1.46 (1.16)	2.44 (1.54)	2.30 (1.20)	3.27 (1.70)

word reading skills (30%). A comparison of the number of concerns across subgroups demonstrated that, on average, parents of children in the DLD group who had poor word reading reported concerns in about 3.27 areas (*SD* = 1.7), compared to an average of 2.3 areas (*SD* = 1.2) for children in the DLD group and good word reading; the effect size of the difference was medium but nonsignificant ($d = 0.69$; $t = 0.913$, $p = .37$). Descriptively, parents of children in the DLD group and poor word reading reported concerns more often than children in the DLD group and good word reading for all areas, except three: understanding what is said at home (9%–10% of parents in each subgroup reported concerns) and school (18%–20% of parents in each subgroup reported concerns) and writing sentences or longer texts (36% of parents in the DLD group with poor word reading subgroup reported concerns, whereas 50% of parents in the DLD group with good word reading reported concerns).

Screening Accuracy

Our second research question was whether a short, whole-classroom screen could accurately identify children meeting criteria for DLD in first and second grades, including those with good and poor word reading abilities. Receiver operating characteristic (ROC) curves were used to evaluate classification accuracy. An ROC curve is a plot of the sensitivity of the screening measure (i.e., the true positive rate) against its false-positive rate (i.e., 1 − specificity) for every possible screening score. The area under the curve (AUC) provides an estimate of the screening accuracy: For all possible pairs of individuals, where one member of the pair is with impairment and the other is without impairment, the AUC indicates the percentage of times the screen will assign a higher risk status to the member of the pair with impairment. A measure with chance-level accuracy will result in a diagonal line and an AUC value of .50. As a rule of thumb, AUC values between .7 and .8 are usually considered acceptable, AUC values between .8 and .9 are considered excellent, and AUC values above .9 are outstanding (Hosmer & Lemeshow, 2000). Table 3 presents the results of the ROC curve analysis for all students and for first- and second-grade students analyzed separately. The AUC for the identification of DLD in first- and second-grade students was excellent overall (AUC = .837, 95% CI [.756, .919]), with similar results when grades were subdivided (first grade: AUC = .816; second grade: AUC = .842).

To examine how well the screen performed for identifying children with DLD with good and poor word reading ability, Table 4 indicates the overall sensitivity, specificity, and the rate of misses for DLD with good versus poor word reading skill for all possible cut-scores. Recall that one child in the DLD group did not complete the word reading measure; that child's data are included in the first three columns of Table 4 but not in the calculation of miss rates for children with DLD with good and poor word reading ability. For diagnostic assessment purposes, it is recommended that cut-scores be selected to maximize both sensitivity and specificity, with a preference for cut-scores that keep both values above .80 (Spaulding et al., 2006). There was no cut-score that met

Table 3. Areas under the curve (AUC) and 95% confidence intervals (CI) for predicting risk of developmental language disorder (DLD).

Group	DLD *n*	TL *n*	AUC	95% CI
All participants	22	75	.837	[.756, .919]
1st grade	11	21	.816	[.665, .967]
2nd grade	11	54	.842	[.736, .948]

Note. TL = typical language skills.

Table 4. Sensitivity and false-positive rate for language screen cut-scores.

Language screen cut-score (% correct)	Overall sensitivity	Overall false-positive rate	Proportion missed DLD only	Proportion missed DLD + poor word reading
50%	.24	.03	.70	.82
56%	.38	.08	.70	.55
63%	.48	.16	.60	.45
69%	**.76**	**.25**	**.30**	**.18**
75%	.95	.41	.10	.00
81%	1.00	.64	.00	.00
88%	1.00	.83	.00	.00
94%	1.00	.99	.00	.00
100%	1.00	1.00	.00	.00

Note. Diagnostic accuracy statistics were computed for students who score at or below each cut-score. DLD = developmental language disorder. The bolded row represents the screening cut score that provided the best balance between sensitivity and false positive rates.

these criteria with the current screening battery, but one cut-score approached it (69% correct, associated with .77 sensitivity and .25 false-positive rate). At this cut-score (and all but one other possible cut-scores), the screen was somewhat less sensitive for identifying children in the DLD group who had good word reading (30% miss rate) than children in the DLD group who had poor word reading (18% miss rate). Overall, results indicated that the screen showed promise for identifying children with DLD, although it was somewhat more accurate for identifying DLD in the children who had poor word reading than good word reading.

Discussion

Our first research question asked whether parents of children with DLD were aware of their child's language difficulties, and we examined parents' reports of concerns and receipt of prior services as indicators of awareness. Overall, parents of children who met criteria for DLD reported few concerns, with an average of less than three concerns out of nine possible areas. Few parents of children with DLD reported concerns in response to specific questions probing receptive and expressive language in the spoken modality (9%–27%). Although parents were somewhat more apt to report concerns about speech production, reading, and writing (27%–41%), it is notable that fewer than half of parents of children in the DLD group reported concerns in any single area. Such results suggest parents may have difficulty in recognizing their child's oral language difficulties. This finding is in line with prior research suggesting that parents of children with DLD may not be aware of their children's difficulty with language (Adlof et al., 2017; Tomblin et al., 1997; see also Silliman & Berninger, 2011).

Similar to the findings of Adlof et al. (2017), parents of children who met criteria for DLD, but who did not have word reading difficulties, were generally less likely than parents of children with DLD and poor word reading to report concerns about their children's language development. Whereas Adlof et al. compared parental concerns between these subgroups with an open-ended question, this study added specific follow-up questions to focus parents' attention on specific characteristics that may be associated with children with DLD. The percentage of parents of children with DLD and poor word reading who reported concerns for each area ranged from 30% to 60%, whereas the percentage of parents of children with DLD and good word reading that reported concerns ranged from 13% to 40%. Although the current study is limited by small sample sizes within the language/reading impairment subgroups, the results converge with past work and add to the growing body of research, showing that language impairments can be "hidden" from parents' view, especially when word reading appears to be developing normally (Adlof et al., 2017; Catts et al., 2005; Nation et al., 2004). One hypothesis is that parents are not familiar with the boundaries of normal oral language development, which leads to lack of awareness of difficulties (Silliman & Berninger, 2011).

These results suggest that an overreliance on parent referrals or parent concerns about language development could contribute to the underidentification of DLD and, in particular, of children with DLD who do not have co-occurring conditions, such as dyslexia. However, we did not query teachers about their awareness of students' reading or language weaknesses. We hypothesize that teachers might have a higher level of awareness than parents, but it remains to be determined whether teachers are aware of language difficulties in young children who display good word reading skills. Furthermore, even if teachers show some awareness of difficulty, overall rates of underidentification would suggest that it is currently insufficient for getting children with DLD access to services.

We were somewhat surprised to note that "paying attention" was one of the most frequently reported areas of concerns for parents in all groups (27%–41%). One hypothesis is that parents are more likely to be aware of the existence of ADD/ADHD than DLD (Redmond, 2016); such heightened awareness may lead parents to report more concerns about attention relative to oral language (see also Redmond, Ash, & Hogan, 2015). Note that 37% of parents of children in the TL + good word reading group (who scored within normal limits on the individually administered language, reading, and nonverbal IQ

assessments) indicated that they were concerned about their child's attention skills, even though only 13% of parents of children in this group reported that their child had previously received a diagnosis of ADD/ADHD. Our data do not allow us to draw strong conclusions about attention, but a review of evidence by Redmond (2016) concluded that assessments of grammatical knowledge, such as those used in this study, are relatively sensitive to DLD and avoid misclassifying children with ADHD.

Our second research question asked whether a short classroom-based language screen that tested complex syntactic structures known to be difficult for children with DLD could reliably identify children with DLD. Accuracy of the language screen was promising for both first- and second-grade students, with AUC levels higher than .8 for both grades. Thus, the current screen extended the previous research (Adlof et al., 2017) to younger children and demonstrated that a whole-classroom screen shows promise for improving the identification of children with DLD as young as first grade. Extending whole-classroom screens for DLD to younger children could lead to earlier access to treatment for children, which could play a role in improving later language outcomes.

Although the obtained sensitivity and specificity values fell below recommendations for acceptable *diagnostic* sensitivity and specificity, the reported levels are promising for a brief, group-administered *screen*. Whereas the goal of a diagnostic measure is to determine whether students meet criteria for DLD, the goal of a screen is to determine whether students would benefit from additional assessment. Thus, the standards for acceptable levels of sensitivity and specificity may differ for screening measures compared to diagnostic assessments. Importantly, a thorough clinical diagnostic evaluation would not rely on a single test score but would also include information from parents and teachers and an evaluation of functional language use at home and in the classroom.

An important strength of this study was its use of a community-based sample, which is representative of how a universal screen would be used within schools. Prior studies evaluating language screening accuracy have often used clinically referred samples, which typically involve children with more severe deficits and may overestimate accuracy when the measure is used to determine whether a child who has not already been flagged should receive intervention or not. Another important strength of this study is that we examined sensitivity and specificity not just for DLD overall but also for children with DLD who had good word reading abilities. The use of a community-based sample also helps to avoid the potential confounds of overrepresentation of comorbid reading and language deficits. In fact, in this sample, 50% of the DLD group displayed word reading scores within normal limits, which is in line with past studies (Bishop et al., 2009; Catts et al., 2005). Our results showed that the screen was able to identify both groups of children with relatively high accuracy, although it showed somewhat better sensitivity for children with co-occurring word reading difficulties than for children with DLD but good word reading. However, given the small sample sizes of the DLD subgroups with and without word reading problems in this study, further research with larger samples is needed to provide greater confidence regarding specific classification accuracy levels for the subgroups.

A third strength of this study was its use of a norm-referenced language assessment that is appropriate for use with speakers of NMAE dialects and mainstream dialects. Our results with a relatively racially and socioeconomically diverse sample of participants showed whole-class screenings can be effective overall. However, more research is needed with larger participant samples to ensure that screens for DLD maintain high levels of classification accuracy across children from different socioeconomic status, race, and ethnicity groups.

In the prior study by Adlof et al. (2017), similar classification accuracy was achieved for second-grade students with DLD (with and without word reading problems), but doing so required combining a word reading fluency screen with an oral language screen, namely, the GRADE Listening Comprehension subtest. Because of ceiling effects with the second-grade students, the GRADE Listening Comprehension was a relatively poor screen for DLD when used independently. In the current study, a promising level of accuracy was achieved with a single screening measure. Moreover, we observed that the screen performed similarly well for children with TL, even when they had poor word reading skills. Thus, the screen was sensitive to oral language weakness, rather than a more general risk for language or literacy problems. Furthermore, it did not show floor or ceiling effects. Future studies could use item response theory to examine the specific types of items that are most discriminating and whether revising the set of items would improve classification accuracy without substantially increasing the time required for screening.

In addition to providing high classification accuracy, a screen must also be feasible to administer both in terms of student participation and teacher support. In our experience, whole-classroom screens are feasible, as evidenced by teacher support and student participation. Teachers appreciated that the screen in this study was administered quickly (approximately 15–20 min per classroom) to all students at once, which limited the amount of disruption to class time. In addition, no special equipment was required to administer the screen, so it could be administered in the regular classroom. Classroom-based screens require that students attend to the task in a large group setting and have the motor skills and attention to be able to track which item they are on and fill in their responses appropriately. The current study confirms the finding from Adlof et al. (2017) that second-grade students were able to attend to a whole-classroom screen and further showed that younger students, first-graders, can complete a whole-classroom screen. Although we used teleforms to score the screens, in our experience, manual scoring requires less than 5 min per student. In summary, the results of this study show that low-tech, whole classroom-based screens of language ability offer much promise for improving the identification of children with DLD in a potentially cost-effective manner.

Summary and Conclusions

In this study, we sought to investigate first whether parents of children with DLD report concern about their children's language difficulty and, second, whether a short classroom-based screen for DLD may be able to accurately identify children with DLD. Our findings lend further evidence to the growing body of research suggesting that parents may be unaware of their children's difficulty with language. These findings suggest that an assessment model that relies on parents to notice language difficulty likely contributes to the underidentification of DLD overall and in particular of children with DLD who do not have co-occurring conditions, such as dyslexia. Future research could consider whether teachers notice these difficulties, and if so, what are the barriers to students with DLD being identified (cf. Wittke & Spaulding, 2018)? Models including universal screening for language ability may reduce the underidentification of DLD. However, yearly universal screening using individual administration may not be feasible for most school districts. The current results suggest that a low-tech, whole-classroom screen is feasible for both first- and second-grade students and can yield acceptable classification accuracy. Future research is needed to refine screens in order to maximize diagnostic accuracy and to create screens for younger and older students so that whole-classroom screens of language ability may be used across development.

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Appendix

Item Numbers for Screening Task Items Adapted From the Test for Reception of Grammar–Second Edition

Language Screen Item No.	TROG-2 Item No.
1 (used as example item)	K1
2	L3
3	N4
4	O2
5	O4
6	P3
7	P4
8	Q1
9	Q3
10	R2
11	R3
12	R4
13	S1
14	S2
15	T1
16	T2

Note. TROG-2 = Test for Reception of Grammar–Second Edition.