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Role of Morphological Awareness in Language and Literacy in Children with and without Developmental Language Disorder

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ROLE OF MORPHOLOGICAL AWARENESS IN LANGUAGE AND LITERACY IN CHILDREN WITH AND WITHOUT DEVELOPMENTAL LANGUAGE DISORDER

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Past research has shown phonological awareness is highly correlated with language and literacy success in children with and without Developmental Language Disorder (DLD), but a less examined area of language and literacy is morphological awareness. Delayed morphology in children with DLD has been studied extensively in spoken language, but relatively little in written language in the DLD population. This study explored two research questions: 1) Is morphological awareness related to language and literacy success in children with and without DLD, and 2) Is morphological awareness impaired for those children with DLD and dyslexia similarly to that of phonological awareness. A classroom-based language and literacy screener was administered to all kindergarten students in the public schools of Missoula, Montana and Worcester, Massachusetts. Children who scored in the bottom 33% of their class were invited to complete additional standardized assessment to evaluate their language and literacy skills. Data for this study was collected from 40 kindergarten children (20 female, 20 male with an average age of 5;11) who completed all testing. After data collection, Pearson correlational analyses were run to examine the relationships between each of the five language and literacy measures. Morphological awareness was found to be significantly correlated ($p < .01$) with all five measures of language and literacy. Phonological awareness was not found to be as related to language and literacy skills as morphological awareness, with only two similarly significant ($p < .01$) relationships and one less significant ($p < .05$) relationship. These results suggest impaired morphological awareness in written language may be another hallmark of DLD. As such, morphological awareness could potentially increase sensitivity of screening measures for more accurate early identification of children with language and literacy deficits, possibly preventing literacy failure. Future research should aim to increase participant numbers to allow for division of participants into various subgroups (e.g., based on nonverbal intelligence, word reading status) to determine if these significant correlations extend to all children or only specific subgroups.

Keywords: morphological awareness, developmental language disorder, literacy, language impairment

Role of Morphological Awareness in Language and Literacy in Children with and without Developmental Language Disorder

Developmental Language Disorder (DLD), a language disorder defined by difficulties with understanding and using spoken language in the absence of other medical conditions, negatively impacts approximately 7% to 9% of children (Norbury et al., 2016; Tomblin et al., 1997) and is associated with increased risk of social difficulties, unemployment, reading difficulties, and decreased educational attainment (Conti-Ramsden, 2003; Conti-Ramsden et al., 2001; Poll et al., 2010; Snowling et al., 2016; Tomblin & Nippold, 2014). Despite its prevalence, DLD often goes undiagnosed and untreated, with fewer than 40% of children with DLD identified to receive services (Norbury et al., 2016; Prelock et al., 2008; Tomblin et al., 1997 Zhang & Tomblin, 2000). Children with DLD are at a high risk of developing reading disorders, and approximately 50% of children with DLD experience word reading difficulties or dyslexia (e.g., Catts et al., 2005; Catts et al., 2002; McArthur et al., 2000; Snowling et al., 2000).

One factor in these reading difficulties is children with DLD and/or dyslexia's impaired awareness of the sound system of a language, or phonological awareness (e.g., Adlof, 2020). Early phonological processing underpins acquisition of the alphabetic principle (i.e., letter-sound correspondence; Ehri & Robbins, 1992; Seidenberg, 2005; Share, 1995) and thus is highly correlated with children's language and literacy success (e.g., Bird et al., 1995; Ehri et al., 2001; Goswami & Bryant, 1990; Stanovich et al., 1984; Torgesen et al., 1994). Given the relationship of phonological awareness and language and literacy success, it is not surprising that many children with DLD experience reading difficulties. Children who struggle with language and literacy may rely on other language systems to support their reading skills. Although less examined than phonological awareness, the awareness of the language meaning system,

morphological awareness, is also significantly related to children's language and literacy success (Apel & Lawrence, 2011; Deacon, 2012; Kirby et al., 2012; Wolter et al., 2009). The relationship between morphological awareness and language and literacy in children with DLD could provide further insights into identifying and helping to prevent literacy failure.

If additional research can confirm that morphological awareness is indeed a unique contributor and/or significantly correlated with literacy success in children with and without DLD, then there are clinical implications for screening, intervention, and possibly an explanatory factor for why children with DLD may or may not go on to develop the word-reading deficit of dyslexia. This study's purpose is to examine the relationship between morphological awareness and key areas of language and literacy (e.g., spelling, expressive vocabulary) to determine if there is a relationship between the level of morphological awareness and language and literacy abilities in kindergarten children with and without DLD in order to potentially increase screening sensitivity and prevent literacy failure. Given the prevalence, under identification, lack of treatment, and negative outcomes associated with DLD, increasing early screening sensitivity and treatment efficacy could have significant positive benefits for children with DLD.

Literature Review

Language Correlates

Language can be segmented into a variety of component parts, with awareness of each part essential to language and literacy development. Awareness of the overall sound system in a language is referred to as phonological awareness, and the more specific skill of understanding the discrete sounds and the ability to manipulate them is known as phonemic awareness. Phonemes are the smallest units of sound (e.g., *dog* has three sounds, /*d*, *a*, *g*/) and can be manipulated consciously by the speaker (e.g., /*dag/* with the first sound /d/ removed is /*ag/*).

Similarly, morphemes are the smallest units of meaning in a language (e.g., *dogs* has two morphemes or units of meaning: the base word *dog* and plural -*s*). Morphological awareness refers to a person's awareness of morphemes and their ability to manipulate them (e.g., a person with morphological awareness knows *dogs* has two units of meaning whereas *Mars* has one).

When these two systems of phonology and morphology are associated with letters and written words, then the orthography system is engaged. Orthographic awareness refers to awareness of the spelling system of a language, or how oral words are translated to written words. A grapheme is the written correspondent of a phoneme and can be made of one or more letters (e.g., the sound /*d*/ is represented by the letter *d* whereas the sound /*tʃ*/ is represented by letters *ch*). Each of these metalinguistic skills—phonological awareness, morphological awareness, and orthographic awareness—play key roles in literacy development.

Reading is a complex task that requires the interplay of these skills and systems, with multiple opportunities for breakdowns. Some children may present with typical receptive and expressive oral language, but have difficulty with written language (e.g., children with dyslexia). Other children present with delayed or disordered receptive or expressive language (e.g., children with DLD), with about half of these children going on to struggle with reading. It is the aim of this study to investigate one of the potential factors in this discrepancy: morphological awareness.

Dyslexia and Language; The Simple View of Reading

The simple view of reading, first put forth by Gough and Tunmer (1986) and expanded on by Hoover and Gough (1990), states that reading is the product of decoding and comprehension. Decoding, as defined by Hoover and Gough (1990), is essentially efficient word recognition—i.e., the ability to recognize printed words quickly, accurately, and silently.

Comprehension is the ability to understand what one is reading. The simple view states that reading results from the combination of decoding and comprehension, with deficiencies in either area negatively impacting a person's reading ability. Therefore, there are three types of reading disability: difficulty with only decoding (i.e., dyslexia), only comprehension (i.e., hyperlexia), or both (i.e., mixed reading disability).

Dyslexia, as defined by Gough and Tunmer (1986), is characterized by normal achievement in areas other than reading (e.g., typical intelligence and sensory function without a physical disability) with a "seemingly inexplicable deficiency" in reading (p. 7). Gough and Tunmer (1986) attribute this difficulty with reading to poor decoding skills resulting from a lack of phonological awareness. Children with dyslexia are likely to have no difficulty understanding and using spoken language and may have typical comprehension when information is read to them, only struggling when asked to decode written language. However, dyslexia can co-occur with other language disorders, such as DLD, and result in a wide array of difficulties.

Impacts of DLD

DLD is defined by the CATALISE consortium of researchers as a neurodevelopmental, persistent language disorder that is not associated with any known biomedical condition and significantly impacts a person's social or educational functioning (Bishop et al., 2016; Bishop et al., 2017). DLD can be present with or without an intellectual disability—it is not caused by a lack of intelligence or cognition of any sort. DLD specifically impairs spoken language and can co-occur with a variety of other conditions, including impairments to cognitive (e.g., attention, memory), sensorimotor, or behavioral functioning. Additionally, DLD can co-occur with other language, literacy, or speech disorders. Specific to literacy, some researchers have found that children with DLD have delayed morphological awareness abilities (Deacon et al., 2014). In fact,

lack of grammatical morphology (e.g., *-ed*, *-ing*) is one of the hallmarks of the diagnosis of *Specific Language Impairment* (SLI; the language diagnosis term that predates DLD), as children with SLI almost always present with delayed or impaired grammatical morphology (Rice et al., 1995). Delayed or impaired grammatical morphology has been studied in spoken language, but relatively little in written language in children with DLD.

In addition to delayed or impaired morphological awareness, children with DLD present with delayed phonological awareness (Adlof, 2020) and are at significant risk for developing reading disabilities such as dyslexia (e.g., Catts et al., 2005; Catts et al., 2003; Snowling et al., 2000) and poor reading comprehension (Nation et al., 2004). Phonological awareness is known to be a key component of literacy development and delayed phonological awareness in children with DLD can negatively impact their literacy success.

Phonological and Orthographic Awareness and Early Literacy Success

Phonological awareness plays a significant role in early literacy success, specifically contributing to reading and spelling abilities (e.g., Bird et al., 1995; Ehri et al., 2001; Goswami & Bryant, 1990; Stanovich et al., 1984; Torgesen et al., 1994). According to the National Reading Panel report (2000), phonological awareness is necessary to use letter-sound information and thus is necessary for early literacy success. In other words, phonological awareness allows children to blend sounds to decode written language and to break spoken words into individual sounds to write.

A meta-analysis of 56 studies conducted by Ehri et al. (2001) found that instruction in phonemic awareness had a significant effect on helping children acquire phonemic awareness and, in turn, a significant impact on word reading, reading comprehension, and spelling. Additionally, instruction in phonemic awareness impacts the reading skills of a wide variety of

children, from typically developing children to those at-risk for or diagnosed with a reading disability. Ehri and colleagues (2001) found this relationship between phonological awareness and early literacy success was still present after being controlled for a variety of possible confounding factors (e.g., socioeconomic status, intelligence, and age). On measures of word-level reading and spelling, research has shown phonological awareness explains 28 to 43% of variance in children's performance (e.g., Cunningham et al., 2001; Manis et al., 2000; Swanson et al., 2003).

Similar to phonological awareness, orthographic awareness has also been found to significantly impact oral vocabulary acquisition in children with and without dyslexia (Baron et al., 2018; Ricketts et al., 2009). Children with dyslexia are known to have phonological processing difficulties, so they may rely on other systems, such as orthography or morphology, to facilitate their reading skills. Although orthography (letter knowledge) is not a significant focus of this study and the remainder of this paper will focus on morphology, there is certainly a relationship between letter awareness and phonological awareness, which in turn can be related to children's literacy deficits. For example, Baron et al. (2018) found that *all* children were more accurate when producing pseudo-words learned with orthography present, but children with dyslexia showed significant orthographic facilitation initially followed by a plateau. Baron and colleagues suggest this increase, followed by plateau, may occur because orthography could only improve phonology up to a certain point in children with dyslexia. Thus, it is important to focus on linguistic awareness beyond just that of phonological and related orthographic awareness and consider how word meaning or morphological awareness might provide that link.

Morphological Awareness and Early Literacy Success

Development of Morphological Awareness

Morphology begins to develop quite young, with children beginning to experiment with morphemes as young as two or three years old (Carlisle, 2010). As children develop, morphology continues to play an integral role in language acquisition and is typically acquired without conscious effort or instruction. Children typically learn morphemes as they learn spoken language, gradually discovering what morphemes mean and how to use them. Conscious awareness of morphemes in language, or morphological awareness, is a gradual process, with significant increases coming as children learn to read and spell (Carlisle, 2010). Research has shown children experience significant growth in morphological awareness between first and third grade (e.g., Apel et al., 2013; Berninger et al, 2010). Children as young as first grade demonstrate morphological awareness without instruction, with children as young as preschool capable of acquiring morphological awareness given instruction (Lyster et al., 2016; Wolter et al., 2009).

Due to the early presence of morphological awareness, it is unsurprising that morphological awareness contributes to early literacy development in decoding, word meaning, and reading comprehension, among other literacy skills (e.g., Apel et al., 2012; Carlisle, 2010; Good et al. 2015; Kirby et al., 2012; Lyster et al., 2016). In an integrative review of 16 studies, Carlisle (2010) found a significant effect of instruction in morphological awareness on measures of literacy in all but one study. However, even the findings of the one study without significant effects approached significance. Carlisle found that morphological awareness could be taught to children as young as kindergarten, who do and do not speak English, and those with and without reading disabilities such as dyslexia. Moreover, for *all* these populations of children,

morphological instruction had positive impacts on early literacy skills (e.g., word reading, spelling, morphological analysis of unfamiliar words).

Influence of Morphological Awareness on Early Reading, Decoding, and Spelling

Morphological awareness has a significant impact on early word-level reading and spelling (e.g., Apel & Lawrence, 2011; Deacon, 2012; Deacon & Kirby; 2004; Kirby et al., 2012; Wolter et al., 2009). Morphological awareness can influence early reading and decoding by helping children break words into smaller, more manageable parts (i.e., morphemes) that are easier to decode (e.g., *goldfish* could be broken into *gold* and *fish*). Additionally, a reader with morphological awareness can decode following morphological rules, which helps the reader decode correctly. For example, the word *hothouse* contains two morphemes, *hot* and *house*, so the /*t*/ and /*h*/ are pronounced separately instead of blending into /*θ*/ because they fall on either side of a morphemic boundary. A child with morphological awareness would be able to recognize this morpheme boundary and adjust their decoding accordingly.

Similarly, there is a significant link between morphological awareness and spelling success (e.g., Apel et al., 2012; Kirby et al., 2012; Wolter et al., 2009; Wolter & Dilworth, 2013). Morphological awareness can influence spelling by helping children spell unfamiliar words that are morphologically related to words they already know (e.g., *just*, *justice*, *justify*, *unjust*), as well as identify silent letters or exceptions to sound-letter correspondence. Additionally, the spelling of individual morphemes stays the same across words despite any sound change that may happen—as in *sign* and *signature* (Nagy et al., 2006). A child with morphological awareness would be able to draw on these skills to facilitate spelling success.

Influence of Morphological Awareness on Vocabulary and Reading Comprehension

Morphological awareness also contributes uniquely to vocabulary (Bowers et al., 2010; Carlisle, 2000; Carlisle & Nomanbhoy, 1993; Nagy et al., 2003; Schwiebert et al., 2002), and can facilitate vocabulary acquisition by helping readers recognize familiar morphemes in unfamiliar words. This allows readers to guess the meaning of unfamiliar words fairly accurately, thus expanding their vocabulary. For example, *international* could be deciphered by its component morphemes if a child knew what *inter-* and *nation* meant. Morphological awareness gives a person access to a much greater vocabulary network, allowing them to decode and make sense of unfamiliar words almost immediately.

Morphological awareness also contributes uniquely to reading comprehension (Apel et al., 2012; Carlisle, 2000; Deacon & Kirby; 2004; Kirby et al., 2012; Lyster et al., 2016; McCutchen et al., 2008; Nagy et al., 2006; Schwiebert et al., 2002) and can facilitate reading comprehension by helping readers create an accurate model of what is occurring in the text. In other words, even if readers encounter unfamiliar words in a text that may otherwise impede comprehension, a reader with morphological awareness could decipher unfamiliar words based on familiar morphemes and maintain a high level of comprehension. A longitudinal study of 103 children by Kirby and colleagues (2012) found morphological awareness to be a significant predictor of reading comprehension, reading speed, and reading accuracy, with morphological awareness explaining variance in reading comprehension abilities. Similarly, Lyster et al. (2016) evaluated the effect of preschool morphological awareness training on 233 children and found that the students who received morphological awareness training had significantly higher reading scores than controls. Taken together, these findings indicate that training children in

morphological awareness as early as preschool has positive long-term impacts on reading comprehension, with morphological awareness significantly predicting reading abilities.

Impact of Morphological Awareness for Students with and without DLD

Morphological awareness significantly impacts literacy success for not only typically developing children, but also those at-risk for or diagnosed with language disorders such as DLD. Several studies have demonstrated these impacts apply to typically developing children (Goodwin & Ahn, 2013) and children at-risk for, or diagnosed with, other language or literacy disorders, such as DLD and dyslexia (Bowers et al., 2010; Goodwin & Ahn, 2010; Wolter & Dilworth, 2014). A meta-analysis by Goodwin and Ahn (2010) examined 17 studies on morphological awareness interventions. The researchers found positive significant effects on phonological awareness, morphological awareness, vocabulary, reading comprehension, and spelling following morphological instruction. Goodwin and Ahn found morphological awareness instruction was particularly effective for children with reading or language difficulties, suggesting that morphological instruction could remediate the phonological processing challenges often present in children with language and literacy difficulties. Similarly, a systematic review by Bowers et al. (2010) examined 22 studies on morphological awareness instruction and found that morphological awareness interventions can significantly increase literacy success, particularly for less able readers.

Morphological awareness also has an impact on reading, spelling, and vocabulary skills in children with language impairments (Good et al., 2010). In a 2010 study by Good and colleagues, 16 children with language impairments, such as DLD, were randomly assigned to one of two treatment groups—the experimental group received instruction in morphological awareness and the control group received the same treatment stimuli without instruction in

morphology. Good and colleagues found that participants in the experimental group made significantly greater gains than the control group in measures of both vocabulary and spelling skills. In addition to the large effect sizes noted on the experimental measures, those in the experimental group demonstrated generalization in their ability to apply learned morphological awareness skills to untaught words. These results suggest that morphological awareness instruction improves language and literacy skills in children with DLD.

Summary and Research Questions

Morphological awareness, which is present at a young age (e.g., Carlisle, 2010; Lyster et al., 2016; Wolter et al., 2009), plays a key role in early literacy development (e.g., Bowers et al., 2010; Carlisle, 2010; Good et al., 2015; Goodwin & Ahn, 2010; Kirby et al., 2012). It specifically impacts early reading and decoding (e.g., Apel & Lawrence, 2011; Deacon, 2012; Deacon & Kirby; 2004; Kirby et al., 2012; Wolter et al., 2009), spelling (e.g., Kirby et al., 2012; Wolter et al., 2009; Wolter & Dilworth, 2013), vocabulary (Bowers et al., 2010; Carlisle, 2000; Carlisle & Nomanbhoy, 1993; Nagy et al., 2003; Schwiebert et al., 2002), and reading comprehension (Carlisle, 2000; McCutchen et al., 2008; Nagy et al., 2006; Schwiebert et al., 2002). Children who struggle with language and literacy (e.g., children with DLD) have deficits in areas such as phonological processing, and thus may rely on other systems, such as morphology, to support their reading skills. There is evidence of phonological awareness significantly impacting literacy skills (e.g., Bird et al., 1995; Ehri et al., 2001; Goswami & Bryant, 1990; Stanovich et al., 1984; Torgesen et al., 1994) and evidence of orthography providing a facilitative effect on vocabulary acquisition for children with and without language and literacy disorders (Baron et al., 2018; Ricketts et al., 2009). Therefore, it may be possible

that a child's level of morphological awareness is also significantly related to language and literacy success in typically developing children and those with language and literacy disorders.

Conversely, children with DLD may experience challenges of morphological awareness like that of phonological awareness, and this may negatively impact their literacy success. Lack of grammatical morphology is one of the hallmarks of the diagnosis of SLI/DLD (Rice et al., 1995). This delayed morphological acquisition has been studied extensively in spoken language, but minimally in written language in children with DLD. However, given the prevalence of impaired spoken language morphology, we may expect that morphology in written language may be impaired as well.

This study will examine the relationship between morphological awareness and key areas of language and literacy (e.g., spelling, expressive vocabulary) to determine if there is any significant correlation between level of morphological awareness and language and literacy abilities. If we find morphological awareness to be significantly correlated with areas of language and literacy, then there could be significant clinical implications for screening, intervention, and perhaps an explanatory factor for why some children with language and literacy deficits may or may not develop further language and literacy deficits (e.g., dyslexia).

The goal of this study is to investigate the following questions:

1. Is morphological awareness related to language and literacy success in children with and without DLD?
2. Is morphological awareness impaired for those children with DLD and dyslexia similarly to that of phonological awareness?

Methods

Participants

The data for this study was collected from a subset of students participating in a larger longitudinal study funded by a National Institute of Health (NIH) grant (see Acknowledgements section for further grant details). Data was collected from 40 kindergarten students (20 female, 20 male) from Missoula, Montana and Worcester, Massachusetts. Children were identified for this study via a classroom-based language and literacy screener, followed by a battery of standardized, norm-referenced assessments. After completing the initial assessment battery, participants who met the inclusionary criteria were invited to participate in a series of additional assessments, including an assessment of morphological awareness.

The participants were between the ages of 5;0 (years; months) and 6;9, with an average age of 5;11. Tables 1 and 2 delineate the participating children's race and ethnicity, respectively, within our sample.

Table 1.

Participants' Race

Child's Race	Percentage of Sample
White	72.5%
Mixed race	15.0%
Not reported	7.5%
American Indian/Alaska Native	5.0%

Table 2.

Participants' Ethnicity

Child's Ethnicity	Percentage of Sample
Not Hispanic/Latino	80.0%
Hispanic/Latino	17.5%
Not reported	2.5%

When parents and caregivers were asked about their child's history of receiving speech services, 59% reported their child had never received speech, language, reading, or other special education services and 41% reported their child had received services. Researchers also asked about parent or caregiver education levels. Table 3 delineates the highest level of education for each caregiver. Finally, caregivers were asked to select their household income level according to U.S. Census Bureau categories. Table 4 delineates household income levels in our sample.

Table 3.

Parent/Caregiver Highest Level of Education

Level of Education	Parent/Caregiver 1	Parent/Caregiver 2
Less than high school	2.8%	3.0%
High school diploma or GED	11.1%	24.2%
Some college	13.9%	15.2%
Associate's degree/Technical certification	13.9%	15.2%
Bachelor's degree	33.3%	27.3%
Master's degree or higher	25.0%	15.2%

Table 4.

Participants' Household Income Level

Household Income Level	Percentage of Sample
Less than $20,000	19.4%
$20,000 – $44,999	13.9%
$45,000 – $139,999	47.2%
$140,000 – $149,999	2.8%
$150,000 – $199,999	5.6%
$200,000+	11.1%

Of note, the COVID-19 pandemic significantly reduced participant numbers in the second year of data collection (school year 2019-2020). As a result, 32 of the 40 children who participated in additional testing were from cohort one (school year 2018-2019) of the larger longitudinal study.

Inclusionary Criteria

After completing a battery of assessments to determine study eligibility, the participants were divided into two groups: one group with DLD and one group with typically developing (TD) language skills. All children were required to 1) display typical nonverbal intelligence via a nonverbal index score of 75 or above on the *Primary Test of Nonverbal Intelligence* (PTONI) (Ehrler & McGhee, 2007), 2) be screened with hearing abilities within normal limits, 3) have no identifiable speech sound disorder, and 4) speak English as their primary language. Children in the DLD group qualified as DLD based on a percentile rank of 25% or below on the *Clinical Evaluation of Language Fundamentals – Fifth Edition* (CELF-5) *Core Language Score* (CLS) (Semel et al., 2013). Children in the TD group qualified as TD based on a CELF-5 CLS percentile rank of 40% to 85%. Children with percentile ranks between 25% and 40%, or those

above 85%, did not qualify for the study as they displayed slightly delayed or significantly above average language skills and thus were respectively neither DLD nor TD. Of the participating sample, 18 children were identified with DLD (mean age 5;10) and 22 as TD (mean age 5;9).

Measures

Classroom-based Language and Literacy Screener

Prior to qualifying to be part of the study, all students in all participating school kindergarten classrooms were invited to complete a general language and literacy screener developed by the researchers (see Beall et al., 2020 for initial screening development details). The language and literacy screener consisted of approximately twenty items assessing participants' receptive language and literacy skills. The language portion of the screener involved a sentence-picture matching task, where children were given four black-and-white picture options and asked to choose the one that matched the sentence read aloud by the assessor and color the bubble beneath their choice. The literacy portion of the screener required students to complete a variety of literacy tasks (e.g., choosing the option that could be a word and choosing a written word that matches the spoken word said by the assessor). Initially, this screener was given to an entire kindergarten class at once, with one assessor reading each item's sentence or prompt twice. After the COVID-19 pandemic, the paper, in-person screener was adapted to a digital screener to accommodate remote learning. In the remote version, students listened to a prerecorded voice synchronized with each item, then clicked on their picture choice.

Parent Questionnaire

The parent/caregiver questionnaire included in consent paperwork addressed basic case history information for each participant. It included demographic information (e.g., name, age, gender, address), history of speech or language difficulty, other medical diagnoses, and parental

education level. Eligibility criteria pulled from the parent/caregiver questionnaire included primary language of the child (this study required English be the child's primary language) and presence of any co-occurring conditions that would disqualify them from the present study (e.g., autism spectrum disorder). Parent/caregivers completing the consent packets could provide information for one or two parents or caregivers, including details about the parent or caregiver's socioeconomic status and highest education completed. Additionally, parents/caregivers were asked to indicate whether they had concerns about their child's development in a variety of areas via a checklist of potential concerns. These areas of concern included expressive and receptive language (e.g., understanding teachers at school, expressing his/her thoughts while speaking), literacy (e.g., spelling, reading individual words), speech production (e.g., saying words correctly), and attention and memory (e.g., remembering his/her personal belongings, paying attention in school or at home).

Nonverbal Intelligence

To assess the kindergarten participants' nonverbal cognitive abilities, researchers administered the PTONI (Ehrler & McGhee, 2007). The PTONI requires minimal oral directions and a pointing-response format ideal for children with even minimal verbal language or motoric abilities. During administration, children look at a series of pictures and are instructed to point to the picture that is different and does not belong. Test items measure visual and spatial perception, analogical thinking, sequential reasoning, and categorical formation. Scoring was completed according to standardized scoring procedures.

Language Ability

To determine presence or absence of DLD, researchers administered the four core subtests of the CELF-5 (Semel et al., 2013) for ages five to eight: Sentence Comprehension,

Word Structure, Formulated Sentences, and Recalling Sentences. The Sentence Comprehension subtest assessed participants' receptive language skills, asking them to point to the picture that best corresponded to each sentence read aloud by the examiner. The Word Structure subtest assessed participants' grammar and morphological awareness by assessing their knowledge of common grammar (e.g., past tense *-ed*) and common irregular grammatical changes (e.g., singular *mouse* changes to plural *mice*) when completing sentences presented verbally by the examiner. The Formulated Sentences subtest evaluated participants' ability to generate sentences given semantic and syntactic constraints (i.e., students must make their sentence about a given picture and must use given target words in their sentence). The Recalling Sentences subtest evaluated participants' ability to recall and reproduce sentences read aloud by the examiner of increasing length and complexity. Scoring was completed according to standardized scoring procedures. Altogether, scores on these four subtests determined a participant's Core Language Score (CLS) which indicated their overall language skills.

Morphological Awareness

To assess morphological awareness, researchers administered an experimental morphological awareness relatives task borrowed from the work of Apel et al. (2013). For this task, the assessor gave the child a word, said an incomplete sentence aloud, and asked the child to finish the sentence using the given word. For example, if the examiner said the word to use was *sock* and the sentence was "please put on your shoes and _____," the child would finish the sentence with *socks*. Test items included sentences requiring children use either inflected morphemes (grammatical affixes, e.g., *sock* to *socks*) or derived morphemes (affixes that can change the meaning of the word, e.g., *like* to *dislike*). Scoring was conducted to determine whether or not the targeted word was produced with the correct inflection. If the targeted word

was not correctly provided, then scorers determined via discussion whether a produced substitute word made sense, and, if so, then was scored correct if the targeted affix was produced.

Expressive Vocabulary

To assess expressive vocabulary and word retrieval, researchers administered the *Expressive Vocabulary Test* (EVT-3) (Williams, 2019). The EVT-3 measured participants' ability to label items and knowledge of synonyms. During this task, children were shown a series of pictures and asked to name some part of each picture (e.g., in a picture of a girl singing, the child is asked "what is the girl doing?" to elicit "singing"). Scoring was completed according to standardized scoring procedures.

Phonological Working Memory

To assess phonological working memory and speech perception, researchers administered a nonword repetition task (Dollaghan & Campbell, 1998). During this task, children repeated increasingly complex nonwords aloud (i.e., words increasing in length and/or complexity of sound combinations). There is specific benefit to including nonword repetition tasks in the assessment battery as nonword repetition tasks tend to be less linguistically and culturally biased than other standardized assessments. Nonword repetition tasks do not require prior linguistic knowledge (as many standardized assessments do) and thus reduce bias against children who have not had the same instruction or acculturation as others. Scorers transcribed each response using the International Phonetic Alphabet (IPA) to determine the total number of correctly produced consonants and vowels, as well as respective percentages of correct consonants, vowels, and total phonemes.

Word Reading

To assess decoding skills, researchers administered the *Woodcock Johnson IV Tests of Achievement* (WJ-IV) *Letter-Word Identification* subtest (Mather & Wendling, 2014). This subtest required participants to identify and read isolated letters and words aloud. Letters and words were presented in isolation (i.e., without context), so participants were unable to use contextual clues to aid in their decoding. Based on participants' percentile rank scores, they were classified as having high (percentile rank of 40% to 85%), mid (percentile rank of 25% to 39%), or low (percentile rank of < 25%) word recognition skills. Scoring was completed according to standardized scoring procedures.

Spelling

To assess spelling, researchers administered a 15-word spelling dictation test (Byrne and Fielding-Barnsley, 1993; Treiman, Hulsander et al., 2019; Treiman, Kessler et al., 2019) which was adapted for U.S. kindergartners. Children were asked to spell words provided in a spoken context, followed by a short, spoken sentence, and then the single word spoken again. This spelling dictation task had a few sentences adapted to be more applicable for the U.S. participants. Responses were scored with an adaptation of Levenshtein's distance (1966), which captured the difference, or 'distance,' between the targeted spelling and the child's spelling. Students were given full credit for producing all letters in a word in the correct order and partial credit that accounted for letter position such that more points were given for the correct letter and position within a word than for producing the correct letter but not in the correct position in the word.

Articulation

To determine the presence or absence of a speech sound disorder, the POWER speech screener developed in Gray and colleagues' NIH R01 grant (2018-2023) was administered. In total, 21 phonemes were assessed in the initial and/or final positions of words. When provided with pictures of objects, children were asked to name various parts of the picture (e.g., "what is the pig standing in?" for target word *mud* with target phonemes /*m*, *d*/). Children were required to correctly produce at least 19 of the 21 targeted phonemes to pass the screening, with each target phoneme substitution or misarticulation counting as one error (e.g., producing *mut* instead of *mud* would count as one error).

Procedure

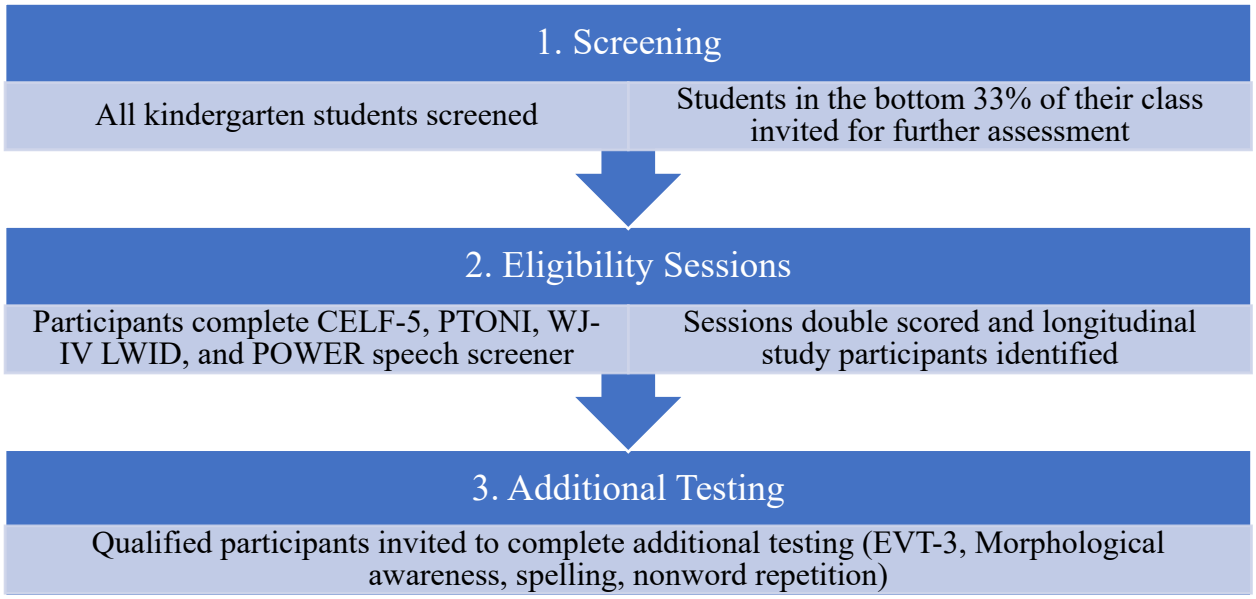
Researchers administered a classroom-based language and literacy screener to all kindergarten students who attended on the day of scheduled screenings in the Missoula County Public School District and Worcester Public School District to determine initial eligibility. All children who scored in the bottom 33% of their respective kindergarten class were determined as having failed the initial screening. These children were invited to participate in the larger longitudinal study. Additionally, a subset of children who passed the screening were invited to participate as a TD control group. After identifying children for study participation, researchers distributed recruitment packets to the parents or guardians of eligible participants including consent forms.

After receiving consent forms, trained research assistants administered an initial battery of assessments to determine eligibility for the longitudinal study. The assessment battery had two purposes: 1) to establish the presence or absence of a language disorder and 2) to rule out co-occurring conditions (e.g., autism-spectrum disorder, speech sound disorder, hearing loss, or

intellectual disability). Participants completed the following assessments: the CELF-5 (Semel et al., 2013) core subtests, the WJ-IV Letter-Word Identification subtest (Mather & Wendling, 2014), the PTONI (Ehrler & McGhee, 2007), an articulation screening, and a hearing screening. Then, participants who met the inclusionary criteria (e.g., typical nonverbal intelligence denoted by PTONI nonverbal index score of >75) were invited to complete additional language and literacy testing in the areas of morphological awareness, spelling, nonword repetition, and expressive vocabulary. Figure 1 illustrates each step of the study for further clarity.

Figure 1.

Experimental Design



Training for each research assistant included watching standardized videos of proper and improper administration of each subtest, quizzes on each subtest with a required score of 100% to continue, and practice administering each subtest to a certified speech-language pathologist before administering to any study participant. Additional training was required to administer assessments via Zoom, with a similar training process (watching standardized videos of remote administration, quizzes on each subtest, and practice administering remotely to a certified

speech-language pathologist). The whole battery of assessments was administered over a series of approximately one-hour-long individual sessions with participants, with each session audio and video recorded for double-scoring of assessments.

The testing sessions were conducted face-to-face as well as over Zoom, as the COVID-19 pandemic prevented some testing from occurring in-person. As such, modifications were made to the assessment presentation to allow for virtual administration. For example, for tests which require participants to point to their desired answer, brightly colored dots were added to each possible answer and participants were instead instructed to say the color that matched their answer. Before beginning any formal testing, participants were trained on the color name of each dot (e.g., pink, blue, green, black) so they could accurately name the color that matched their answer. If participants named a color that was not an option during assessment (e.g., naming "blue" when the options were green, pink, black, and orange), assessors would name the color of each dot on the screen and ask participants to state the color of their answer again.

After assessors administered the initial assessment battery, research assistants reviewed the audio and video recordings of each assessment, scored each subtest, calculated standard scores and percentile ranks, and entered item-level data as well as standard scores and percentile ranks into Microsoft Excel and REDCap. The initial assessment battery (CELF-5, WJ-IV, PTONI, and articulation screener) was double scored by two research assistants in addition to the original assessor for increased reliability of results.

After compiling data from the initial assessment battery, participants who met the eligibility criteria were invited to participate in further language and literacy testing including tasks assessing morphological awareness, spelling, expressive vocabulary, and phonological awareness (via the nonword repetition task). The additional testing sessions were conducted

entirely via Zoom for ease of scheduling. Participants who agreed to participate in additional testing were provided with a Chromebook (which they kept as payment for their participation) to ensure consistent audio and video quality across participants and assessment sessions.

Results

Descriptive statistics and correlational analyses were calculated in SPSS Version 26. Descriptive statistics for all measures are presented for the whole sample in Table 5. In addition to whole-group statistics, descriptive statistics for all measures were calculated for the DLD and typically developing subgroups, as shown in Table 6.

Table 5.

Descriptive Statistics – Whole Sample (n = 40)

Measure	*M*	*SD*
PTONI*	98.25	17.39
Nonword repetition**	35.22	10.46
Morphological awareness**	9.50	4.86
CELF-5 CLS*	93.28	17.01
EVT-3*	94.57	10.88
Spelling total accuracy**	3.18	3.25
WJ-IV LWID*	93.73	11.73

Note. Scores are *standard scores or **raw scores. Nonword repetition raw score is out of 56 possible consonants correct. Morphological awareness raw score is out of 26 items. Spelling total accuracy score is out of 15 items. PTONI = Primary Test of Nonverbal Intelligence (Ehrler & McGhee, 2007); Nonword repetition = Nonword repetition task (Dollaghan & Campbell, 1998); Morphological awareness = morphological awareness relatives task (Apel et al., 2013); CELF-5 CLS = Clinical Evaluation of Language Fundamentals – Fifth Edition, Core Language Score (Semel et al., 2013); EVT-3 = Expressive Vocabulary Test (Williams, 2019); WJ-IV LWID = Woodcock Johnson IV Tests of Achievement Letter-Word Identification subtest (Mather & Wendling, 2014).

Table 6.

Descriptive Statistics – Sample Subgroups

Subgroup	Measure	*M*	*SD*	Range
Children with typical language (*n* = 18)	PTONI*	104.50	18.23	63
	Nonword repetition**	40.06	7.39	27
	Morphological awareness**	12.44	3.42	13
	CELF-5 CLS*	109	9.36	43
	EVT-3*	100.78	8.07	34
	Spelling total accuracy**	4.94	3.23	14
	WJ-IV LWID*	101.56	6.56	22
Children at risk for language (DLD) (*n* = 22)	PTONI*	93.14	15.22	63
	Nonword repetition**	30.89	11.06	39
	Morphological awareness**	7.09	4.57	15
	CELF-5 CLS*	80.41	9.01	37
	EVT-3*	88.68	10.01	39
	Spelling total accuracy**	1.73	2.51	9
	WJ-IV LWID*	87.32	11.19	41

Note. Scores are *standard scores or **raw scores. Nonword repetition raw score is out of 56 possible consonants correct. Morphological awareness raw score is out of 26 items. Spelling total accuracy score is out of 15 items. PTONI = Primary Test of Nonverbal Intelligence (Ehrler & McGhee, 2007); Nonword repetition = Nonword repetition task (Dollaghan & Campbell, 1998); Morphological awareness = morphological awareness relatives task (Apel et al., 2013); CELF-5 CLS = Clinical Evaluation of Language Fundamentals – Fifth Edition, Core Language Score (Semel et al., 2013); EVT-3 = Expressive Vocabulary Test (Williams, 2019); WJ-IV LWID = Woodcock Johnson IV Tests of Achievement Letter-Word Identification subtest (Mather & Wendling, 2014).

When examining nonverbal intelligence via the PTONI nonverbal index scores, there was a significant difference between the DLD and typically developing groups, $t(1,38) = 2.15$, $p < .05$. Children in the typically developing group had a higher standard score on the PTONI ($M =$

104.50, *SD* = 18.23) compared to the DLD group (*M* = 93.14, *SD* = 15.22). However, all participants had a nonverbal index score of 75 or above, indicating nonverbal intelligence within the typical range. Language abilities are known to influence nonverbal intelligence scores (e.g., Botting, 2020), but this significant difference between groups could be a limitation. For this reason, subsequent comparison t-tests were not run, and correlational analysis included cognition in addition to that of the experimental measures of language and literacy skills.

In order to examine the relationship between morphological awareness and language and literacy abilities, a Pearson correlational analysis was conducted on the whole sample (Table 7) and on the DLD and TD subgroups (Table 8). For both groups of children, morphological awareness was expected to have a strong relationship with early language and literacy skills in addition to phonological awareness and language scores. Overall, morphological awareness had the strongest relationship with language (.64) ($p < .01$), followed by that of phonological awareness (.63), vocabulary (.46), spelling (.46), and reading (.40) ($p < .01$). Interestingly, phonological awareness was not significantly related to children's reading scores and only moderately related to language (.45), followed by vocabulary (.38) and spelling (.33) ($p < .01$).

Further correlational analyses were conducted for the TD and DLD child subgroups. For the TD group, neither phonological awareness nor morphological awareness appeared to have a significant relationship with language or literacy (i.e., spelling, reading), and only the language score had a significant and moderate relationship (.51) ($p < .05$) with reading. Neither morphological awareness nor phonological awareness were related to the TD children's language or literacy scores. For children with DLD, only language was moderately and significantly related to reading (.43) and spelling (.43*)* ($p < .05$). However, phonological awareness was

significantly and moderately related to morphological awareness (.52) ($p < .05$), which in turn was significantly related to language (.51).

Table 7.

Correlations for Language and Literacy Battery – Whole Sample (n = 40)

Measure	1	2	3	4	5	6	7
1. Nonverbal IQ	1						
2. PA	.308	1					
3. MA	.341*	.625**	1				
4. Language	.454**	.446**	.638**	1			
5. Vocabulary	.408*	.375*	.458**	.606**	1		
6. Spelling	.308	.332*	.456**	.488**	.280	1	
7. Reading	.351*	.287	.401**	.703**	.320	.566**	1

*$p < .05$. **$p < .01$

Note. All scores are standard scores except for Phonological Awareness (PA; measured by nonword repetition), Morphological Awareness (MA), and Spelling, which are raw scores. Phonological awareness raw score is out of 56 possible consonants correct. Morphological awareness raw score is out of 26 items. Spelling raw score is out of 15 items. Nonverbal IQ = Primary Test of Nonverbal Intelligence (Ehrler & McGhee, 2007); PA = Nonword repetition task (Dollaghan & Campbell, 1998); Morphological awareness = morphological awareness relatives task (Apel et al., 2013); Language = Clinical Evaluation of Language Fundamentals – Fifth Edition, Core Language Score (Semel et al., 2013); Vocabulary = Expressive Vocabulary Test (Williams, 2019); Reading = Woodcock Johnson IV Tests of Achievement Letter-Word Identification subtest (Mather & Wendling, 2014).

Table 8.

Correlations for Language and Literacy Battery – Sample Subgroups

Subgroup	Measure	1	2	3	4	5	6	7
Children with typical language (n = 18)	1. Nonverbal IQ	1						
	2. PA	-.312	1					
	3. MA	-.141	.454	1				
	4. Language	.225	.314	.188	1			
	5. Vocabulary	.169	-.080	-.188	.348	1		
	6. Spelling	-.078	.016	.285	-.117	-.066	1	
	7. Reading	-.024	.114	.219	.514*	.379	.252	1
Children at risk for language (n = 22)	1. Nonverbal IQ	1						
	2. PA	.513*	1					
	3. MA	.460*	.521*	1				
	4. Language	.476*	.055	.507*	1			
	5. Vocabulary	.437	.340	.421	.264	1		
	6. Spelling	.492*	.284	.235	.424*	.119	1	
	7. Reading	.347	-.004	.067	.427*	-.203	.505*	1

*$p < .05$

Note. All scores are standard scores except for Phonological Awareness (PA; measured by nonword repetition), Morphological Awareness (MA), and Spelling, which are raw scores. Phonological awareness raw score is out of 56 possible consonants correct. Morphological awareness raw score is out of 26 items. Spelling raw score is out of 15 items. Nonverbal IQ = Primary Test of Nonverbal Intelligence (Ehrler & McGhee, 2007); PA = Nonword repetition task (Dollaghan & Campbell, 1998); MA = morphological awareness relatives task (Apel et al., 2013); Language = Clinical Evaluation of Language Fundamentals – Fifth Edition, Core Language Score (Semel et al., 2013); Vocabulary = Expressive Vocabulary Test (Williams, 2019); Reading = Woodcock Johnson IV Tests of Achievement Letter-Word Identification subtest (Mather & Wendling, 2014).

Based on this data, it appears that for DLD children there is a significant relationship between morphological awareness and language and indirectly literacy skills above and beyond

that of phonological awareness. However, more data is needed to determine whether this significance applies to both TD and children with DLD once separated into subgroups with sufficient participant numbers for rigorous analyses. These findings may be significant for screening, identifying children at risk for language, and intervention, among other clinical applications. Despite having limited participant numbers, nonverbal intelligence scores via the PTONI were also somewhat significantly related (.51) ($p < .05$) with most measures of language and literacy for the DLD subgroup only.

To further understand children's morphological awareness, phonological awareness, and orthographic awareness as they relate across each other within students with DLD and/or dyslexia, a subsequent descriptive analysis was run to examine patterns of linguistic knowledge. The means of morphological awareness, phonological awareness (nonword repetition), and orthographic awareness (spelling) were calculated for each subgroup of children with and without DLD, according to whether the children scored low ($\leq 25^{th}$ percentile) or mid/high ($> 25^{th}$ percentile) on the WJ-IV Letter-Word Identification subtest. These descriptive statistics are presented in Table 9.

The results of the descriptive analysis by subgroup show the mean scores in all three areas of morphological awareness, phonological awareness (nonword repetition), and orthographic awareness (spelling) were, as expected, depressed for children at-risk for DLD. Interestingly, even those children at-risk for DLD with high/mid word reading had lower average scores in all three areas than their typically developing peers who also had high/mid word reading abilities. Additionally, the standard deviations and score ranges for morphological and phonological awareness measures were higher for both DLD subgroups than the typically

developing subgroup, suggesting a wider range of abilities in children at-risk for DLD compared to their typically developing peers.

Table 9.

Descriptive Statistics – Linguistic Knowledge by Subgroup

Subgroup	Measure	*M*	*SD*	Range
DLD & High/Mid Word Reading (*n* = 8)	Morphological awareness	9.50	3.67	11
	Nonword repetition	35.29	11.90	34
	Spelling total accuracy	3.25	3.15	9
DLD & Low Word Reading (*n* = 14)	Morphological awareness	5.71	4.67	15
	Nonword repetition	28.33	10.17	39
	Spelling total accuracy	.86	1.61	5
TD & High/Mid Word Reading (*n* = 17)	Morphological awareness	12.88	2.95	13
	Nonword repetition	40.25	7.59	27
	Spelling total accuracy	5.18	3.17	13
TD & Low Word Reading (*n* = 1)	Morphological awareness	5	N/A	0
	Nonword repetition	37	N/A	0
	Spelling total accuracy	1	N/A	0

Note. All scores are raw scores. Nonword repetition raw score is out of 56 possible consonants correct. Morphological awareness raw score is out of 26 items. Spelling total accuracy raw score is out of 15 items.

Discussion

Past research has shown phonological awareness is highly correlated with language and literacy success in children, but a less examined area of language and literacy is morphological awareness. This study examined the relationship between morphological awareness and key areas of language and literacy (e.g., spelling, expressive vocabulary) to determine whether there is any significant correlation between level of morphological awareness and language and

literacy abilities. If this study found morphological awareness to be significantly correlated with areas of language and literacy, then there could potentially be clinical implications for including morphological awareness in early literacy screenings, assessments, and intervention. Moreover, new insights into morphological awareness as it relates to literacy performance in children with DLD may help in understanding why some children with DLD and literacy deficits do and do not go on to develop further literacy deficits (e.g., dyslexia).

When examining morphological awareness as it relates to language and literacy across all participating children, we indeed found a moderate and significant correlation ($p < .01$) between morphological awareness and language and literacy, indicating that morphological awareness is related to both spoken and written language skill performance. When comparing the relationship between phonological awareness and measures of language and literacy, we found fewer and less significant relationships. This suggests that morphological awareness may be uniquely contributing to language and literacy success differently than that of the well-established phonological awareness.

Lack of spoken grammar, specifically grammatical morphology (e.g., *-ed*, *-ing*) is one of the hallmarks of children who have DLD and as such the specific relationship between morphological awareness and written language was examined. Given the prevalence of impaired spoken language morphology, it was expected that morphology in written language may be impaired as well. After conducting a Pearson correlational analysis for children with and without DLD, it was found that morphological awareness was only significantly, moderately, and directly related to the language scores. However, these language scores were moderately, significantly, and directly related to reading and spelling. Thus, morphological awareness appears to be indirectly related to literacy skills in this population. Interestingly, phonological

awareness was not related to literacy skills in children with DLD, however, phonological awareness was significantly and moderately related to morphological awareness. Which again suggests that sound awareness is related to children's development of word meaning, that is related to spoken language and ultimately written language or spelling and reading development.

Our results, in which there were differing findings in how directly morphological awareness appeared to be related to language succuss in all children compared to a nonsignificant or indirect relationship for the sub-grouped children, could be explained in multiple ways. First, the small sample size could contribute to the decreased power in our sub-grouped analyses which appeared to dampen the overall strength and significance of the results found in the larger combined group analysis. In addition, the significant difference in nonverbal intelligence, that was further evidenced by significant relationships between nonverbal intelligence all areas of language and literacy could have accounted for the significant correlations between morphological awareness and language and literacy for the full group. Future studies may increase sample size and control for nonverbal intelligence for further replication.

The descriptive statistics in Table 9 regarding linguistic knowledge of each subgroup provide additional insight despite very limited participants. Even within the high/mid word reading group as a whole (i.e., TD high/mid plus DLD high/mid), the DLD high/mid group had lower scores than the TD high/mid group. Of course, as would be expected, there is a greater difference in scores between the high/mid group as a whole and the low group than the DLD high/mid and TD high/mid scores, but it is interesting to have such a noticeable difference between DLD and TD group scores even when the groups are controlled for word reading status. Given the significant correlation of morphological awareness to word reading, among other

language and literacy skills, it is possible that some children with DLD are using morphological awareness to bolster their word reading and thus achieve high/mid word reading despite their language difficulties. Orthographic awareness (measured by spelling in this study), which had an even stronger correlation to word reading than morphological awareness, could also be used by children with DLD to bolster their word reading skills. It is possible that, as seen by Baron et al. (2009), children with DLD are only able to rely on other systems (e.g., morphology, orthography) up to a certain point, after which their scores plateau, which would match the score trends in Table 9.

Limitations

Some limitations of this study include the aforementioned relatively small sample size, which prevented us from conducting deep statistical analysis to further compare the DLD and TD groups. Since we had limited samples, we were unable to statistically compare differences between the groups nor conduct respective regression predictive analyses, and thus it remains unclear whether these significant correlations are present in both typically developing children and children with DLD or just one subgroup. Further analyses such as this could allow researchers to determine whether morphological awareness is a uniquely sensitive linguistic variable to be included in early literacy screening or interventions for children with DLD. Another previously mentioned limitation is when examining the nonverbal intelligence scores (via the PTONI), we found a significant difference between the typically developing and DLD subgroups. Although we know that language difficulties often result in depressed intelligence scores, possibly due to the language processing required to complete intelligence tests, intelligence differences could be a variable contributing to the uniquely significant relationships

between our variables in this study. Future research may more readily control for equal variance between DLD and TD groups.

Clinical Implications & Future Research

Despite this being a small study, we found a significant relationship between morphological awareness and language and literacy skills not just specific to spoken language, but to literacy (written language) as well. This significant relationship suggests impaired morphological awareness in written language may be another hallmark of DLD. If indeed subsequent replications find this to be the case, then morphological awareness may prove to be another area for screening, or minimally an area to pay close attention to as we work clinically with individuals with DLD. Since we found morphological awareness to be significantly correlated with a variety of language and literacy measures, it is possible screening for morphological awareness abilities could be added to early language-literacy screeners to potentially increase the sensitivity of those who may be at risk for language and literacy failure.

Regardless, this study suggests the trends we anticipated are indeed supported by the data—that is, delayed morphology in spoken language appears to be linked to delayed morphological awareness in written language. Despite spoken language morphology being seen as a key indicator of DLD, there is limited research in the area of written morphology in individuals with DLD. Given the limited existing research, the findings of this study contribute importantly to the existing body of research. The results of this study highlight the necessity of delving deeper into more metalinguistic and written challenges that individuals with DLD experience, with morphological awareness as one possible key to these challenges. To further examine these metalinguistic and written challenges, future research should explore additional methods of assessing morphological awareness (e.g., dynamic assessment) (Wolter & Pike,

2015; Wolter et al., 2020). Since morphological awareness is a difficult skill for children with DLD, it may be more useful to use dynamic assessments to measure the progression of this skill as opposed to a simple static assessment. New measures for dynamic assessment of morphological awareness have been developed recently. The inclusion of these new measures may increase sensitivity and provide additional insights into how typically developing children and those at risk for DLD use and learn morphological awareness skills.

Future research should also increase participant numbers so more specific analyses can be conducted on the DLD subgroup as compared with typically developing children. Increased participant numbers, as well as longitudinal data, would allow exploration of whether or not morphology has a predictive relationship with language and literacy success above and beyond a correlational relationship. Additionally, future research with increased participant numbers would allow analyses to be conducted across nonverbal intelligence groups, which could illuminate the role of nonverbal intelligence in these correlations.

Conclusion

This study extends previous research by showing that morphological awareness is significantly correlated with multiple measures of both spoken *and* written language in typically developing children and children at-risk for DLD. Although impaired morphology in spoken language is a known hallmark of SLI/DLD, little research has been conducted on morphological awareness and literacy outcomes in the DLD population. As expected, this study showed decreased morphological awareness in children with literacy deficits and/or DLD, with significant relationships between morphological awareness and all measures of language and literacy. Morphological awareness appeared to be more significantly related to language and literacy than both phonological and orthographic awareness for our participants. Clinically, this

significant relationship suggests impaired morphological awareness in written language may be another hallmark of DLD. If it is another hallmark, morphological awareness could be another area clinicians could screen for, potentially increasing the sensitivity of screening and ultimately preventing literacy failure. Thus, future work should further explore the metalinguistic and written language challenges individuals with DLD experience, as morphology may be the key to these challenges.

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