

Journal of Learning Disabilities

<http://ldx.sagepub.com/>

Assessing Component Language Deficits in the Early Detection of Reading Difficulty Risk

Heather K. J. van der Lely and Chloë R. Marshall

J Learn Disabil 2010 43: 357 originally published online 17 May 2010

DOI: 10.1177/0022219410369078

The online version of this article can be found at:

<http://ldx.sagepub.com/content/43/4/357>

Published by:

Hammill Institute on Disabilities



and



<http://www.sagepublications.com>

Additional services and information for *Journal of Learning Disabilities* can be found at:

Email Alerts: <http://ldx.sagepub.com/cgi/alerts>

Subscriptions: <http://ldx.sagepub.com/subscriptions>

Reprints: <http://www.sagepub.com/journalsReprints.nav>

Permissions: <http://www.sagepub.com/journalsPermissions.nav>

Citations: <http://ldx.sagepub.com/content/43/4/357.refs.html>

Assessing Component Language Deficits in the Early Detection of Reading Difficulty Risk

Journal of Learning Disabilities
43(4) 357–368
© Hammill Institute on Disabilities 2010
Reprints and permission:
sagepub.com/journalsPermissions.nav
DOI: 10.1177/0022219410369078
http://jloflearningdisabilities
.sagepub.com


Heather K. J. van der Lely, PhD¹ and Chloë R. Marshall, PhD^{1,2}

Abstract

This article focuses on some of the linguistic components that underlie letter-sound decoding skills and reading comprehension: specifically phonology, morphology, and syntax. Many children who have reading difficulties had language deficits that were detectable before they began reading. Early identification of language difficulties will therefore help identify children at risk of reading failure. Using a developmental psycholinguistic framework, the authors provide a model of how syntax, morphology, and phonology break down in children with language impairments. The article reports on a screening test of these language abilities for preschool or young school-aged children that identifies those at risk for literacy problems and in need of further assessment.

Keywords

dyslexia, specific language impairment, early detection, grammar and phonology screening test

Dyslexia and specific language impairment (SLI) are disorders of communication that are arguably the most prevalent developmental disorders. They affect an estimated 10% and 7% of the school-aged population, respectively (Snowling, 2000; Tomblin et al., 1997), and severely affect whether children reach their educational and vocational potential. These impairments affect not only the individual but also society through social and economic factors; indeed, a U.K. study found that a large proportion of young offenders (63% or more) had significant literacy and language impairments that prevented them from accessing educational programs to prevent reoffending (Bryan, Freer, & Furlong, 2007). Much more needs to be done to prevent such situations, and early detection of at-risk individuals is an excellent starting point.

Dyslexia is defined as an impairment in learning to read despite otherwise normal intellectual functioning and hearing and an adequate learning environment (Snowling, 2000), whereas SLI is a difficulty in acquiring language alongside similar exclusionary criteria (Leonard, 1998). There is significant heterogeneity in both groups (Bailey, Manis, Pederson, & Seidenberg, 2004; Joanisse, Manis, Keating, & Seidenberg, 2000; Leonard, 1998) and a substantial overlap between the two disorders: Many children diagnosed with dyslexia also have SLI, and vice versa. The underlying causes of these two disorders and the reasons for their overlap

have been the focus of much debate (Bishop & Snowling, 2004; Catts, Adlof, Hogan, & Weismer, 2005; McArthur, Hogben, Edwards, Heath, & Mengler, 2000; Pennington & Bishop, 2009; Messaoud-Galusi & Marshall, 2010).

In this article we discuss the reasons for considering language deficits in the identification of children at risk for reading impairment and suggest how such impairments can be assessed in the early years. In particular, we present a psycholinguistically informed model of language impairment and consequent reading impairment that has been used to create a simple and quick screening test for early identification of at-risk children before they fail to learn to read. There are two reasons for considering language deficits in the identification of children at risk for reading deficits. First, many children with a diagnosis of dyslexia have language deficits that extend beyond phonology to the lexicon, morphology, and syntax. Second, vocabulary knowledge, morphology, and syntax play a critical role in reading comprehension. We discuss both these issues in the next section.

¹Harvard University

²City University London

Corresponding Author:

Heather K. J. van der Lely, Department of Psychology, Harvard University, William James Hall, 33 Kirkland Street, Cambridge, MA 02138
Email: h.vanderlely@ldcn.org

What Factors Underlie Reading Impairment?

The goal of all reading is to understand text. Gough and Tunmer's simple model of reading identifies two subskills necessary for reading comprehension: decoding (i.e., word identification) and language comprehension (Gough & Tunmer, 1986). Evidence for the latter comes from studies showing that spoken language comprehension and written language comprehension are related throughout development; furthermore, reading comprehension relies on knowledge of word meanings, syntactic processing, and inferencing skills (for a review, see Perfetti, Landi, & Oakhill, 2005). In support of the distinction between decoding and comprehension, a recent longitudinal twin study points to common genetic influences on decoding and comprehension but also significant genetic influence on comprehension, independent of that on decoding (Betjemann et al., 2008). In this section we focus on the language skills that underlie decoding and language comprehension and review studies of dyslexic children that have found impairments in these areas.

Phonology

Decoding words in a language that is represented by an alphabetic script, such as English, requires an awareness of phonemes and how these are linked to letters. Successful reading, therefore, requires access to the phonological structure of the word.

There is substantial evidence that children with dyslexia have a triad of phonological deficits (Frith, 1985; Snowling, 2000; Vellutino, 1979). They are poor at phonological awareness tasks such as phoneme manipulation¹ (Bradley & Bryant, 1978, 1983; Catts et al., 2005; Joanisse et al., 2000), have poor verbal short-term memory as measured by tasks such as digit span and nonword repetition (Ramus & Szenkovits, 2008; Snowling, 2000), and are slow at rapid automatic naming tasks, which index speed of access to familiar lexical items and their phonological representations (Denckla & Rudel, 1976; Wolf & Bowers, 1999). Whether such difficulties result from an impairment in phonological representations themselves or from impaired access to or ability to manipulate those representations remains unresolved (Ramus & Szenkovits, 2008), but in either case the phonological deficit is claimed to make the phoneme-grapheme matching process problematic for dyslexic readers, thereby leading to decoding difficulties.

The Lexicon

Words are a mapping between phonology and semantics. However, they also contain a set of mappings between syntax, morphological, and pragmatic features that contribute to

meaning. For a successful reader, decoding the word on the page allows access to the meaning of that word. It is therefore not surprising that the correlation between oral vocabulary and reading comprehension is strong (Biemiller, 2003).

In terms of oral vocabulary, many children with dyslexia have word-finding difficulties, which can be defined as difficulties in retrieving known words from the lexicon (Faust, Dimitrivsky, & Shacht, 2003; German & Newman, 2007). However, word-finding difficulties are most likely related not to poor semantic representations but to poor phonology and specifically to difficulties in accessing the phonological word forms (Faust et al., 2003). For example, multisyllabic words with rare phonological patterns are particularly problematic (German & Newman, 2007). Such word-finding difficulties particularly affect children's accuracy in reading out loud and may be less evident in silent reading (German & Newman, 2007).

Despite the likelihood that word-finding difficulties are a consequence of dyslexic children's poor phonology, sensitive neuroscientific techniques such as event-related potentials (ERPs) have uncovered subtle semantic deficits. For example, Rüsseler and colleagues asked German adults with dyslexia to perform a semantic judgment task: Presented with the written words *house* and *window*, participants had to judge whether these were semantically related. The authors examined a neural correlate of semantic processing, the N400. Although the onset latency and the peak amplitude of the N400 did not differ between the adult with dyslexia and normal readers, it persisted for significantly longer in adults with dyslexia, indicating that semantic integration may take longer (Rüsseler, Becker, Johannes, & Munte, 2007).

Morphology

English spelling is traditionally seen as highly irregular, but spelling doesn't just represent the phonemes of a language: It also represents morphemes. As the smallest units of meaning, morphemes serve as phonological, semantic/syntactic, and orthographic units. Their identification is therefore essential both for decoding and for accessing meaning (Carlisle, 2003; Kessler & Treiman, 2003). English has relatively little inflectional morphology but rich derivational morphology.² Derivational morphology becomes increasingly important for decoding as the child gets older and encounters rare or new words through print (Nagy, Anderson, Schommer, Scott, & Stallman, 1989).

Despite the relationship between reading and morphology, relatively few studies have investigated whether dyslexic readers have impaired morphology. Those that have investigated derivational abilities have tended to use metalinguistic tasks, that is, tasks that tap the reader's ability to make judgments about derived forms, and have found

differences between readers with dyslexia and normal readers (Bentin & Feldman, 1990; Schiff & Ravid, 2007).

There is increasing evidence that children with dyslexia have significant impairments, or at the very least weaknesses, in inflectional morphology, and these difficulties have been shown not only in metalinguistic tasks but also in more implicit tasks. Joanisse and colleagues found that English-speaking children with dyslexia had significant difficulties inflecting verbs for tense (Joanisse et al., 2000). Likewise, we have found in our own work that dyslexic children aged 8 to 12 who do not meet the criteria for SLI nevertheless have weaknesses in past tense morphology (Marshall, Harcourt-Brown, Ramus, & van der Lely, 2009).

Rispens found a similar result for Dutch in her investigations of subject–verb agreement morphology (Rispens, 2004; Rispens & Been, 2007). Dyslexic 8-year-olds made more agreement errors in their spontaneous speech and were poorer at detecting agreement violations in a grammaticality judgment task than were controls matched for chronological and reading age. Furthermore, variation in performance on the judgment task contributed significantly to variance in word decoding skills. However, the agreement impairment was significantly more severe in children with a diagnosis of SLI but no dyslexia.

Also for Dutch, but with a much younger sample of children who were at familial risk of dyslexia, Wilsenach (2006) found that 18- to 23-month-olds did not distinguish sentences containing the correct temporal auxiliary combined with a past participle from an ungrammatical construction of a modal with the past participle.³ This was something that typically developing children of the same age were able to do.

Debate surrounds whether dyslexic readers' morphological deficits are caused by their phonological deficit or are independent. Certainly for typical French readers, morphological abilities have been shown to contribute to both decoding and comprehension independently of phonological abilities (Casalis & Louis-Alexandre, 2000), whereas for typical English readers morphology makes an independent contribution to decoding but not to comprehension (McCutchen, Green, & Abbott, 2008). The precise relationship of morphology to decoding and comprehension will no doubt depend on the measures used and the language being tested. Meanwhile, Joanisse and his colleagues (2000), Rispens (2004), and Wilsenach (2006) all interpret the inflectional deficits in their groups of dyslexic participants as resulting from impairments in phonological processing. As we discuss later in this article, there is compelling evidence that phonological deficits do indeed affect inflection. For older children, however, it is difficult to tease apart cause and effect and to determine whether early phonological deficits were in fact the cause of their subtle morphological impairments. This makes Wilsenach's findings all the more valuable—we would argue that presumably the younger the

age at which morphological difficulties can be detected, the more likely they are to reflect a deficit that is independent of phonology. More studies of young at-risk children, and in other languages, are warranted to gauge whether an independent morphological deficit exists in children with dyslexia.

Syntax

The reader most often has the task of reading sentences rather than isolated words, and therefore understanding sentences is an important part of reading comprehension. Syntactic difficulties in dyslexia have been hard to find, and where they are found, they appear to be related to working memory demands of the tasks used (Shankweiler et al., 1995). For example, Shankweiler and colleagues found that for sentences requiring the assignment of reference to pronouns, 9-year-old children with dyslexia were less accurate at repeating them than their age-matched controls but did not differ in a picture-choice comprehension task, which arguably has lower working memory demands (Shankweiler, Smith, & Mann, 1984). Shankweiler and colleagues have therefore proposed that syntax is unimpaired in children with dyslexia (Shankweiler et al., 1995). Likewise, we have investigated passive sentence comprehension using a picture-choice task and found that dyslexic children aged 8 to 12 who do not meet the criteria for SLI do not have difficulties with this particular aspect of syntax (Marshall et al., 2009).

In summary, the simple view of reading (Gough & Tunmer, 1986) claims that skilled reading is the result of decoding plus comprehension. Phonology is central to decoding, whereas other components of language—the lexicon, morphology and syntax—are central to reading comprehension. This division is not developmentally absolute but rather is dynamic in nature: For example, knowledge of derivational morphology plays an important role in older children's decoding when they encounter new and rare words (Nagy et al., 1989). This link between phonology, language, and reading is in itself motivation for arguing that when testing for risk of early literacy deficits, we should assess language skills alongside phonological skills.

Further motivation comes from work we have discussed in this section showing that although dyslexia is traditionally associated with a phonological deficit, there is evidence for deficits in other components of language as well. Indeed, when we appraise the research literature on dyslexic populations it is challenging to tease apart those language deficits that are due to dyslexia and those that result from SLI. This is because many children with dyslexia also have SLI, whereas many children with SLI have dyslexia, and research studies have rarely made explicit both the language and reading abilities of their participants. The overlap between dyslexia and SLI is the topic of the next section

Overlap Between Dyslexia and SLI

Since the 1970s researchers have recognized that a significant proportion of children with dyslexia also have impairments in oral language and meet the criteria for diagnosis of SLI. In reviewing studies of dyslexic children whose language skills had also been measured, McArthur and her colleagues (2000) noted that between 13% and 63% of children who had taken part in various studies on the basis of their diagnosis of dyslexia could equally well have been classified as having SLI, and the authors themselves found that 55% of their dyslexic sample had SLI. It is clear therefore that dyslexia and SLI are highly comorbid disorders.

Understanding the cognitive underpinnings of this behavioral overlap is not straightforward, and a variety of models have been proposed, which fall under two broad categories. The first category sees dyslexia and SLI as qualitatively similar disorders that originate from an underlying phonological deficit (Kamhi & Catts, 1986; Tallal, 2003). The second category claims that although there are behavioral similarities between dyslexia and SLI, the two are nevertheless distinct disorders, with language deficits that are independent of any phonological deficit (Bishop & Snowling, 2004; Catts et al., 2005; Marshall & van der Lely, 2009). It goes beyond the scope of this article to discuss these models (see Catts et al., 2005, for a review). However, an increasing number of studies are directly comparing the phonological and language deficits in children with dyslexia (or at risk of dyslexia) and children with SLI from a linguistically informed perspective, in order to understand the exact nature of the overlap (See papers in Messaoud-Galusi & Marshall, 2010).

In a longitudinal study comparing the phonological deficits of children with SLI to those of children at familial risk of dyslexia, de Bree and her colleagues have shown that deficits in nonword repetition characterize both groups at around 4 1/2 years of age, before literacy instruction has begun (de Bree, Rispen & Gerrits, 2007). Interestingly, though, the nature of the relationship between nonword repetition and reading accuracy appears to be different in those two groups by the time they reach 8 years of age: There is a significant correlation between nonword repetition and decoding in the SLI group but not the dyslexia group (de Bree, Wijnen & Gerrits, 2010). The authors interpret this finding as evidence that dyslexia and SLI should not be seen as qualitatively similar disorders.

In most studies using nonword repetition methodology, only the number of syllables in nonwords has been manipulated. More detailed work investigating how word position and stress affect the accuracy of cluster repetition in nonwords has revealed that both children with SLI and those with dyslexia are more accurate at repeating a consonant cluster when it is at the beginning of a nonsense word (e.g., *kletafa*) compared with other positions (e.g., *fakleta*)

(Marshall & van der Lely, 2009). Yet the two groups differ with respect to stress: Whereas children with dyslexia are less accurate at repeating unstressed clusters compared with stressed clusters, for children with SLI there is no such effect. Qualitative phonological differences between SLI and dyslexia have hitherto been hard to find, but this result suggests that the phonological deficit in both groups may not be identical.

Turning now to language deficits, Marshall et al. (2009) compared three groups—dyslexia-only, SLI-only and SLI+dyslexia—on various subtests of the Profiling Elements of Prosodic Systems–Child version (PEPS-C; Peppé & McCann, 2003). All three groups were significantly worse than age-matched controls at the comprehension of linguistic structures that are marked by prosody: specifically, syntactic chunking (e.g., choosing whether [red][and black and pink socks], presented auditorily, matched a picture of a pair of red socks and a pair of black and pink socks [correct] or a picture of a pair of red and black socks and a pair of pink socks [incorrect]) and pragmatic focus (the child hears an utterance where two colors are mentioned and has to identify on which color the speaker has placed intonational prominence). In contrast, the ability of all three groups to detect similarities and differences between utterances where only the prosody remained (the segmental content of the utterance having been removed by low-pass filtering) did not differ from the controls, leading Marshall and her colleagues to conclude that the difficulty was syntactic and pragmatic rather than phonological. There was, however, one intriguing difference between the two groups with dyslexia and the SLI-only group, which lay in the repetition of prosodic patterns in sentences: The SLI-only group was age-appropriate in repeating prosodic patterns, whereas the two dyslexic groups were significantly less accurate than the age-matched control group.

Notwithstanding the increasing number of studies showing that dyslexia and SLI are not identical disorders at the cognitive level, their substantial comorbidity and the developmental relationship between language and reading lead us to conclude that assessing language alongside phonological skills can play a valuable role in the detection of reading risk. Furthermore, when we move beyond dyslexia and its associated difficulties with decoding, there is increasing research interest in children who are able to decode but who have poor comprehension of what they are reading and interest in how far the language profile of these “poor comprehenders” resembles that of children with SLI (Nation, Clarke, Marshall, & Durand, 2004). Initial results suggest that the profiles are not identical and that for children with SLI, weaknesses exist in both decoding and reading comprehension (Bishop, MacDonald, Bird & Hayiou-Thomas, 2009).

Given that language deficits have been most thoroughly explored and modeled in SLI populations, we now discuss impairments in the different components of language that

have been shown to exist in SLI and outline a psycholinguistic model of how those components are impaired in that disorder.

Component Language Deficits in SLI

There is considerable heterogeneity in SLI, with evidence from both genetic and cognitive investigations of children with SLI that different components of language may be differentially impaired. For example, Bishop and colleagues' study of a large sample of twins with SLI found distinct genetic influences on performance on a test of nonword repetition and on a test of verb inflection that elicits past tense and third-person singular forms (e.g., *washed, fell, rides, paints*; Bishop, Adams, & Norbury, 2006). Furthermore, behavioral investigations of a group of teenaged children with severe grammatical deficits discovered a bimodal and nonoverlapping distribution for phonological abilities (Ebbels, 2005). Half the children performed within the range expected for their chronological age on a test of nonword repetition, whereas the other half showed severe phonological impairments and performed significantly worse than language-matched control children (Ebbels, van der Lely, & Dockrell, 2003). One promising avenue for making sense of this heterogeneity is to identify subgroups of children who share a relatively homogeneous language profile.

One SLI subgroup that has been extensively investigated is Grammatical (G)-SLI (van der Lely, 2005). Evidence indicates that this subgroup has a primary grammar-specific language impairment that encompasses syntax, inflectional morphology, and phonology, with secondary deficits in other components of language such as vocabulary (Fonteneau & van der Lely, 2008; van der Lely, Rosen, & McClelland, 1998). This subgroup is particularly informative when trying to understand the independent contribution of grammatical component deficits on language processing for production and comprehension and relations between language and other cognitive abilities.

A recent imaging study of teenagers with G-SLI illustrates both normal and impaired language components in the same individual. Using ERP techniques, the investigators found that participants with G-SLI had defective early syntactic processing of structural dependencies as reflected by the neural correlate known as early left anterior negativity (ELAN) yet normal later syntactic processing involving reanalysis, reflected by the P600, and semantic processing, reflected by the N400 (Fonteneau & van der Lely, 2008). In other words, participants were using mechanisms associated with semantic processing to process some aspects of sentences that typically developing children process using mechanisms underlying syntactic processing. This finding suggests that these participants used mechanisms underlying semantic processing to compensate for their syntactic impairment.

Computational Grammatical Complexity Model of Language Impairment: Foundations for Assessment

We now turn to the characteristics of impairments in three components of the grammatical system, phonology, morphology and syntax, and discuss the model we have proposed to account for these impairments, the Computational Grammatical Complexity (CGC) model. This work is based on our studies of the G-SLI subgroup, and it provides the basis for the assessment of these components that we describe later below. Note, however, that the literature reveals consistent characteristics in linguistic deficits in each component, in other groups of children with SLI and also cross-linguistically (Bishop, Bright, James, Bishop, & van der Lely, 2000; Friedmann & Novogrodsky, 2007; Hamann, 2006; O'Hara & Johnston, 1997; Stavrakaki, 2001).

The CGC model claims that the language deficits found in children with G-SLI lie in hierarchical structural knowledge that is core to the computational grammatical system. Our work reveals that many school-aged children with G-SLI lack the computations to consistently form hierarchical, structurally complex forms in one or more components of grammar that normally develop between 3 and 6 years of age. The CGC model emphasizes the notion that impairments in syntax, morphology, and phonology are functionally autonomous but cumulative in their effects (Marshall & van der Lely, 2007a; van der Lely, 2005; van der Lely & Marshall, in press). The precise linguistic nature of these deficits is described below.

Phonology

Phonological constituents such as syllables and prosodic words are grouped into successively higher levels of the prosodic hierarchy (Selkirk, 1978). Certain aspects of this phonological hierarchy cause difficulty for children with SLI. For children with SLI, their phonological deficit manifests as a difficulty with forms that are complex at the syllable and foot levels of the prosodic hierarchy (Gallon, Harris, & van der Lely, 2007). In a nonword repetition task, both children with G-SLI and children falling into a broader definition of SLI were found to simplify consonant clusters in all word positions, whereas unfooted syllables are deleted or cause syllabic simplifications and segmental changes elsewhere in the word (Gallon et al., 2007; Marshall, 2004; Marshall, Ebbels, Harris, & van der Lely, 2002).

The CGC model predicts that children with a phonological deficit will have difficulty decoding words with complex phonological structure. It is interesting to speculate as to whether phonological deficits that cause problems in producing and processing morphological forms with complex phonological structure will also affect reading. We found that increasing the phonological complexity of the inflected

verb end (e.g., *rowed* [with a single final consonant] to *packed* [a consonant cluster] to *jumped* [a cluster of three consonants]) caused increased suffix omission in children with G-SLI (Marshall & van der Lely, 2007b). To our knowledge, there have not been any studies of word reading in which phonological structure has been systematically manipulated in this way, but such studies could further our understanding of reading difficulties.

Morphology

Children with G-SLI have significant impairments in inflectional morphology, as commonly reported for SLI more generally (Leonard, 1998). For English-speaking children, this manifests itself in the omission of suffixes such as past tense *-ed*, resulting in bare stem forms, such as "*Yesterday I jump_ in the puddle*" (van der Lely & Ullman, 2001). The CGC model hypothesizes a hierarchical deficit that affects morphologically complex forms. According to the Rules and Words model of inflection (Marcus, Pinker, Ullman, Hollander, & Rosen, 1992; Pinker, 1999), regular forms are computed from an abstract representation of a verb stem + *ed* suffix and are therefore morphologically complex, whereas irregularly inflected forms are stored whole and are not morphologically decomposed. Our data indicate that children with G-SLI preferentially store regular forms, just like irregular forms.

Consistent with this model, children with G-SLI show frequency effects for regular past tense forms, do not show a regularity advantage in producing such forms, and produce inflected plural forms inside compounds (e.g., **rats-eater*) (van der Lely & Christian, 2000; van der Lely & Ullman, 2001). These children are particularly poor at producing regular forms where the cluster formed at the end of past tense forms is phonotactically "illegal," that is, does not occur in monomorphemically simple forms (Marshall & van der Lely, 2006). Illegal clusters such as those in *loved*, *hugged*, and *bathed* are low in frequency and therefore problematic for children with G-SLI. Thus we predict that for such children these forms might not only be hard to produce but harder to read. Furthermore, whereas illegal phonotactics provide a cue to morphological complexity and can be used by typically developing children to aid parsing, they do not help children with G-SLI (Marshall, Marinis, & van der Lely, 2007). For example, typically developing children are able to use the illegal phonotactics of the past participle in a passive sentence such as "*the tortoise was bathed by the hare*" to interpret who is doing what to whom, but children with G-SLI are unable to use this cue. It is unclear whether these difficulties will affect the comprehension of written language too or whether the orthography would provide a cue to both legal and illegal forms and facilitate understanding in language impaired children. Further investigations of these possibilities are warranted.

Syntax

The CGC model claims that the deficit in hierarchical structure is characterized by an impairment in syntactic dependencies. Specifically, whereas dependencies within the phrase are preserved (e.g., agreement, *he jumps* versus *they jump*), those outside the phrase but within the clause are impaired. Broadly speaking, this can be characterized by what Chomsky terms "movement" (Chomsky, 1998) or in current terminology "internal merge" (Chomsky, 2004). The impairment affects tense marking, resulting in errors such as "*Yesterday I walk to school*" (van der Lely & Ullman, 2001). Such errors have been eloquently described and explored by Wexler, Rice, and colleagues, who have claimed that this "extended optional infinitive" phase is the primary impairment within syntax (Rice, Wexler, & Redmond, 1999). However, investigations within the framework of the CGC model have revealed a broader characterization of syntactic deficits in different groups of children with SLI (Bishop et al., 2000; Ebbels, 2005; Norbury, Bishop, & Briscoe, 2002). Impairments with syntactic dependencies are also found in assignment of thematic roles, particularly when more general pragmatic and world knowledge is not available to facilitate interpretation, such as in reversible passive sentences (*The man was eaten by the fish*) or when assigning reference to pronouns or anaphors within sentences (*Mowgli said Baloo was tickling him/himself*) (van der Lely, 1994, 1996; van der Lely & Stollwerck, 1997), as well as embedded sentences and relative clauses.

The nature of syntactic deficits in children with G-SLI is clearly illustrated in a series of studies of *wh*-questions. Object matrix and embedded questions are particularly problematic in English because the *wh*-word has to move from the end of the sentence to the beginning, and "do support" requires checking of tense and question features. Thus, children with G-SLI produce questions such as "*Who Joe see someone?*" (van der Lely & Battell, 2003) and judge such sentences to be grammatical (van der Lely, Jones, & Marshall, in press). They also make "copying" errors of the *wh*-word in embedded questions (*Who did Joe think who hit the man?*) (Archonti, 2003). This pattern is sometimes found in young children (Thornton, 1995), suggesting that such structures are syntactically simpler and therefore easier.

Furthermore, using a cross-modal priming paradigm, we found that children with G-SLI showed no reactivation at the "gap" (marked by "t") in preposition object questions in scenarios such as the following, in contrast to age and language matched control groups (Marinis & van der Lely, 2007):

Baloo gives a long carrot to the rabbit.

Who_i did Baloo give the long carrot to t_i at the farm?
However, we found reactivation for the G-SLI group at the offset of the verb, where subcategorized arguments might

be activated, suggesting that in contrast to their peers, these children were using semantic-lexical processing rather than syntactic processing (Marinis & van der Lely, 2007), perhaps, as our ERP data suggest, to compensate for their syntactic deficits (Fonteneau & van der Lely, 2008).

Although such syntactic impairments can, surprisingly, go relatively unnoticed, especially when the individual has relatively good pragmatic and social skills (van der Lely et al., 1998), it is clear that such subtle but profound syntactic impairments in oral language would have consequences for reading and writing, causing significant impairments in literacy. The role of syntax and reading in learning new words in older children is well known (Bloom, 2000), and impairments in structural dependencies might be particularly important in learning the more complex and subtle abstract words learned in later life. Indeed, children with G-SLI are significantly impaired in using syntactic cues, such as determiners (*a vip* vs. *some vip*) to learn the meaning of novel count or mass nouns (Froud & van der Lely, 2008). More generally, children with SLI appear to be impaired in using simple active, passive, and dative sentence structures to learn the argument relations associated with a novel verb (O'Hara & Johnston, 1997; van der Lely, 1994).

In sum, we have reviewed research that shows that many children with a diagnosis of dyslexia, as well as those with SLI, are weak or are impaired in core grammatical components of language and that these impairments significantly affect reading as well as oral language abilities. The CGC model has provided a framework to characterize the linguistic nature of deficits in three components: phonology, syntax and morphology. Drawing on these findings we now discuss a screening assessment of grammar and phonology.

Grammar and Phonology Screening Test

The Grammar and Phonology Screening (GAPS) test (Gardner, Froud, McClelland, & van der Lely, 2006; van der Lely, Gardner, McClelland, & Froud, 2007) is a 10-minute screening test that can be administered by professionals and nonprofessionals alike. It is designed to identify children from 3;6 years of age to 6;6 with grammatical or phonological impairments who are deemed at risk for literacy and language problems. Comprising 11 sentences and 8 nonsense words for direct imitation, it assesses whether preschool and early school entry children have the necessary grammar and pre-reading phonological skills needed for school education and can therefore identify prior to literacy instruction children who are in need of further assessment and (potentially) remedial help. Here we report the theoretical background, reliability, and standardization of the GAPS test and an initial evaluation of its validity.

The task comprises two subtests. In the syntax and morphology subtest, the child tells a picture book story (repeating sentences spoken by the tester) about a cat and a

dog to an alien called Bik, whereas in the phonology subtest the child repeats Bik's (nonsense) words. The test items in these two subtests were based on research outlined in the earlier sections and target syntactic, morphological, and phonological structures that are known to be impaired in teenagers with SLI yet are typically acquired by 4 to 5 years of age or younger (Gardner et al., 2006). For example, it screens for reversible passive sentences, wh-object questions, intersentential pronominal (*her*) and anaphoric (*herself*) reference, and tense marking. For example, the child has to repeat the sentence "Who did the cat wash?" Such sentences are trivially easy for a typically developing child but cause significant problems for a child with SLI. The phonology subtest contains nonwords that are one, two, or three syllables long and that differ with respect to syllabic and metrical structure. Stimuli contain a variety of initial, medial, and final clusters, and multisyllabic items contain either trochaic (strong-weak) or iambic (weak-strong) stress patterns, for example, *dremp* and *bademper* (the underlined syllable is stressed).

The GAPS test was standardized on 668 children aged 3;6 to 6;6 across the United Kingdom, taking into account population distribution and socioeconomic status. During the standardization, a range of testers were employed, from professionals (speech and language pathologists, teachers, pediatricians) to parents and other nonprofessionals (e.g., nursery and teaching assistants). Our aim was to ensure that administration was feasible and equally accurate when conducted by the different groups of individuals who are typically involved in the education or care of children. Gardner et al. (2006) found that measures of reliability revealed good/very good internal consistency.

The validity of the GAPS in correctly identifying those children at risk of language or literacy difficulties was initially investigated during the test development through partial correlation of scores with three other standardized assessments of general language functioning: the British Picture Vocabulary Scale 2nd Edition (BPVS-2) (Dunn, Dunn, Whetton, & Burley, 1997), the sentence structure and word structure subtests from the Clinical Evaluation of Language Fundamentals–Preschool (Preschool CELF; Wiig, Secord, & Semel, 2000), and the Children's Test of Nonword Repetition (CNRep; Gathercole & Baddeley, 1996). Both subtests of the GAPS test were significantly correlated with performance in all four language tasks. The strongest correlations were with those assessments tapping similar language skills, specifically the Preschool CELF Sentence Structure ($r = .52$) and CNRep ($r = .67$) tasks (Gardner et al., 2006).

The two subtests of the GAPS grammar and phonology subtest were significantly correlated with one another, with correlations ranging generally between .68 and .41, although this was lower at the 5;0 to 5;11 age band (0.28, $p < .01$) (Gardner et al., 2006). One possible reason for this could be the impact of learning to read and starting formal education.

Of note are the results from children falling into the lowest 5% on one or both subtests. These show that grammar and phonology impairments do not go hand in hand. The chance of having a phonological deficit for children with a grammar deficit (defined at the 5% cutoff point), or vice versa, is only around 0.33, with a similar percentage chance of having either a phonological or grammar deficit alone. This pattern of impairments makes sense in the light of some older children with dyslexia who have normal grammar.

Test validation is important and concerns the accuracy of the results and subsequent implications that arise from those results. Payne (2008) conducted an initial validation of GAPS that revealed very encouraging findings. She first tested whether GAPS identified children correctly with language or literacy difficulties in comparison to longer standardized assessments. Second, she investigated whether the grammar and phonology measures used in GAPS were effective clinical markers in accurately identifying impaired and nonimpaired children as revealed by a characteristic bimodal distribution (Pring, 2005; Rice, 2000). Third, she measured the sensitivity and specificity of GAPS: the extent to which true cases of impairment are identified and normal abilities, respectively, are demonstrated. Conti-Ramsden (2003) found that the CNRep test (Gathercole & Baddeley, 1996) and past tense tasks were highly sensitive in identifying children with SLI (91%-100%) but that measures of specificity were lower (51%-71%). If any screening test were to be used broadly it is important that both measures show high accuracy to avoid false positives and false negatives.

Thirty children in mainstream school who were aged 3:7 to 6:8 and considered to be typically developing constituted a control group and 21 children diagnosed with SLI who attended a language unit attached to the same school participated in the study (Payne, 2008). Participants were assessed using a range of standardized language assessments in addition to the GAPS itself. Measures most closely representing the abilities tested in the GAPS were the Recalling Sentences subtest of the CELF Preschool-2UK (Semel, Wiig, & Secord, 2006) and the CNRep (Gathercole & Baddeley, 1996). Measures of language comprehension such as vocabulary that depend on a number of language components for development were also obtained: the BPVS-2 (Dunn et al., 1997) and the Test for Reception of Grammar, 2nd edition (TROG-2; Bishop, 2003). The Word Reading subtest of the Wechsler Objective Reading Dimensions (WORD; Wechsler, 1992) was also administered to obtain an indication of each participant's literacy level for those within the standardization age band.

The results revealed high and significant correlations with both subtests and other tests of language, with the highest correlations being between the GAPS Grammar subtest and the measure that most closely taps similar language abilities, the Preschool CELF 2UK repetition of sentences ($r = .81$), and between the GAPS phonology and CNRep ($r = .73$). Correlations with the literacy measure (WORD)

were also high and significant (Grammar $r = .59$; Phonology $r = .47$) (Payne, 2008). A bimodal distribution was found for both the grammar and phonology subtests, indicating that these highly specific structures provide good clinical markers for language impairments. Finally, the receiver operating characteristic (ROC) curve used to distinguish between impaired and nonimpaired individuals (McFall & Treat, 1999) for the overall test revealed a highly accurate ROC of 0.98. At the 10th percentile (the measure recommended by the test to warrant further assessment) for children falling within the standardization age range, the overall GAPS showed 91% sensitivity and 100% specificity. Finally, Payne found that ROC scores indicating sensitivity and specificity measures for the GAPS were higher than the other tests used in the sample on the same subjects. For example, the overall ROC for the Preschool CELF 2UK repetition of sentences was also high, 0.88, but those for the other tests were lower: CNRep 0.74, BPVS 0.72, and TROG 0.64. We express some (optimistic) caution with respect to the very high ROC scores that were found for the GAPS. The findings warrant further verification in a different lab, because if they are indeed robust, then the GAPS could prove a very valuable screening tool.

The Next Step: Longitudinal Studies

The results of this initial validation study indicate that further studies validating GAPS with a larger sample of children are warranted. In particular, a larger group of children with SLI or dyslexia, or children who are at risk for language and literacy problems (e.g., familial history of SLI or dyslexia), would increase the accuracy indicator of the sensitivity of the GAPS in identifying language-impaired children of preschool and early school age. A longitudinal study would enable exploration of the predictive validity of the GAPS test, which is a common method for demonstrating the validity of screening tests (Pring, 2005). This is particularly so as the relationship between language and word recognition changes over time. For example, Snowling and colleagues found that although only 8% of language-impaired children had poor word recognition at age 8 years, this rose to 43% at age 15 years (Snowling, Bishop, & Stothard, 2000). The value of longitudinal designs is illustrated by the large Finnish and Dutch studies of children at risk for dyslexia (Lyytinen et al., 2001; van Alphen et al., 2004). Measures of each grammatical and nongrammatical language component in the sort of detail we are advocating could be particularly informative with respect to the relationship between linguistic components and later literacy skills. This is clearly complex but can only be illuminated with detailed investigations of language and literacy abilities in a developmental design across time (Goswami, 2003).

Alongside this work is the validation from cross-linguistic studies. Cross-linguistic studies enable us to abstract away

from the surface properties of one language and consider the underlying principles of the language system. Such research, as exemplified by the COST-A33 project investigating some 25 languages in Europe, allows us to hypothesize and test how such impairments will manifest in each language. Taking multiple different approaches—longitudinal, cross-linguistic, cross-sectional—and using interdisciplinary methods (behavioral, imaging, genetic) can only enhance our understanding of how component language deficits affect language and literacy development.

Conclusion

We have focused on some of the linguistic components that underlie both letter-sound decoding skills (phonology) and reading comprehension (syntax and morphology). Children need these basic core linguistic abilities for literacy to get off the ground and to achieve full access to the educational system. Using a psycholinguistic framework, we have provided details of how grammatical components of syntax, morphology, and phonology can break down in children with dyslexia and children with SLI. Drawing on these data, we showed how, using a quick, simple and accurate screening test, children at risk for literacy problems can be identified. The identification of such children is thus possible in pre-school or early school years, before they develop literacy problems and fail in school. As effective remediation depends on etiological insight, we suggested that remediation based on further detailed language assessment would facilitate children reaching their potential.

Acknowledgments

We thank the children, parents, schools, speech and language therapists, and teachers for their participation in our research, which we greatly value. Special thanks are made to Elisabeth Payne for making available the data on the GAPS evaluation and members of the DLDCN Centre for comments on this study. We thank the editors, Tiffany Hogan and Jenny Thomson, and the anonymous reviewers for their valuable and insightful comments: we very much appreciate their careful reading of our manuscript. We thank the participants of the Biocomp Workshop: Specific language impairment and the language faculty debate, Department of Psychology, Harvard University.

Declaration of Conflicting Interests

The GAPS test is HvdL's personal contribution to the field and children with SLI or at risk for dyslexia, and therefore she declares a personal interest in GAPS. No other investigator has any personal or financial interest in the GAPS test.

Financial Disclosure/Funding

Research contributing to this article was supported by the Wellcome Trust, grant 063713, and the Economic and Social Research Council, grant RES-000-23-0575, to HvdL. The writing of this

article was supported by the EACEA-Leonardo da Vinci Lifelong Learning Programme and Leverhulme Visiting Fellowship to HvdL and a Leverhulme Early Career Fellowship to CM.

Notes

1. Phonemes are the contrastive sounds of language. Tasks that require the manipulation of phonemes ask the child to, for example, delete the first sound in a word: to say "cat" without the "c" or to swap the initial sounds of two words, for example, to make "cad sat" out of "sad cat."
2. Inflectional morphology has a grammatical role, as in the past tense suffix for regular verbs, for example, *jumped*, and the plural suffix for nouns, for example, *cats*. Derivational morphology creates new words, as demonstrated by the suffix in *sadness* and the prefix in *reiterate*.
3. For example, "*De zon heeft helder geschenen*" ("the sun has brightly shone"), where *heeft* is the correct form of the auxiliary, versus "*De zon kan helder geschenen*," where *kan* is a modal ("can") that cannot be used with the past participle *geschenen*.

References

- Archonti, A. (2003). *Wh-Question formation in typically developing children and children with grammatical SLI*. Unpublished manuscript, University College London, London, UK.
- Bailey, C., Manis, F., Pederson, W., & Seidenberg, M. S. (2004). Variation amongst developmental dyslexics: Evidence from a printed-word-learning task. *Journal of Experimental Child Psychology*, 87, 125–154.
- Bentin, S., & Feldman, L. B. (1990). The contribution of morphological and semantic relatedness to repetition priming at short and long lags: Evidence from Hebrew. *Quarterly Journal of Experimental Psychology*, 42A(4), 693–711.
- Bejtemann, R., Willcutt, E., Olson, R., Keenan, J., DeFries, J., & Wadsworth, S. (2008). Word reading and reading comprehension: Stability, overlap and independence. *Reading and Writing: An Interdisciplinary Journal*, 21, 539–558.
- Biemiller, A. (2003). Vocabulary: Needed if more children are to read well. *Reading Psychology*, 24, 323–335.
- Bishop, D. (2003). *The Test for Reception of Grammar, Version 2 (TROG-2)*. London, UK: Psychological Corporation.
- Bishop, D., Adams, C., & Norbury, C. (2006). Distinct genetic influences on grammar and phonological STM deficits: Evidence from 6-year-old twins. *Genes, Brain and Behavior*, 5(2), 158–169.
- Bishop, D., Bright, P., James, C., Bishop, S., & van der Lely, H. (2000). Grammatical SLI: A distinct subtype of developmental language disorder? *Applied Psycholinguistics*, 21, 159–181.
- Bishop, D., McDonald, D., Bird, S., & Hayiou-Thomas, M. Children who read accurately despite language impairments: Who are they and how do they do it? *Child Development* 80, 593–605.
- Bishop, D., & Snowling, M. J. (2004). Developmental dyslexia and specific language impairment. *Psychological Bulletin*, 130, 858–886.

- Bloom, P. (2000). *How children learn the meanings of words*. Cambridge, MA: MIT Press.
- Bradley, L., & Bryant, P. E. (1978). Difficulties in auditory organisation as a possible cause of reading backwardness. *Nature*, 271(5647), 746–747.
- Bradley, L., & Bryant, P. E. (1983). Categorizing sounds and learning to read—A causal connection. *Nature*, 301, 419–421.
- Bryan, K., Freer, J., & Furlong, C. (2007). Language and communication difficulties in juvenile offenders. *International Journal of Language and Communication Disorders*, 42(5), 505–520.
- Carlisle, J. (2003). Morphology matters in learning to read: A commentary. *Reading Psychology*, 24, 291–322.
- Casalis, S., & Louis-Alexandre, M.-F. (2000). Morphological analysis, phonological analysis and learning to read French: A longitudinal study. *Reading and Writing: An Interdisciplinary Journal*, 12, 303–335.
- Catts, H. W., Adlof, S. M., Hogan, T. P., & Weismer, S. E. (2005). Are specific language impairment and dyslexia distinct disorders? *Journal of Speech Language and Hearing Research*, 48(6), 1378–1396.
- Chomsky, N. (1998). *Minimalist inquiries: The framework*. Cambridge, MA: MIT Press.
- Chomsky, N. (2004). Beyond explanatory adequacy. In A. Belletti (Ed.), *Structures and beyond: The cartography of syntactic structures* (Vol. 3, pp. 104–131). Oxford, UK: Oxford University Press.
- Conti-Ramsden, G. (2003). Processing and linguistic markers in young children with specific language impairment (SLI). *Journal of Speech Language and Hearing Research*, 46(5), 1029–1037.
- de Bree, E., Rispens, J., & Gerrits, E. (2007). Non-word repetition in Dutch children with (a risk of) dyslexia and SLI. *Clinical Linguistics & Phonetics*, 21, 935–944.
- de Bree, E., Wijnen, F., & Gerrits, E. (2010). Non-word repetition and literacy in Dutch children at-risk of dyslexia and children with SLI: Results of the follow-up study. *Dyslexia* 16, 36–44.
- Denckla, M. B., & Rudel, R. G. (1976). Rapid “automatized” naming (R.A.N.): Dyslexia differentiated from other learning disabilities. *Neuropsychologia*, 14(4), 471–479.
- Dunn, L., Dunn, L., Whetton, C., & Burley, J. (1997). *The British Picture Vocabulary Scale: Second edition*. Windsor, UK: NFER-Nelson.
- Ebbels, S. (2005). *Argument structure in specific language impairment: From theory to therapy*. Unpublished doctoral dissertation, University College London, London, UK.
- Ebbels, S., van der Lely, H. K. J., & Dockrell, J. (2003, October 31–November 2). *Phonological and morphosyntactic abilities in SLI: Is there a causal relationship?* Paper presented at the Boston University Conference on Language Development, Boston, MA.
- Faust, M., Dimitrivsky, L., & Shacht, T. (2003). Naming difficulties in children with dyslexia: Application of the tip-of-the-tongue paradigm. *Journal of Learning Disabilities*, 36, 203–215.
- Fonteneau, E., & van der Lely, H. K. (2008). Electrical brain responses in language-impaired children reveal grammar-specific deficits. *PLoS ONE*, 3(3), e1832.
- Friedmann, N., & Novogrodsky, R. (2007). Is the movement deficit in syntactic SLI related to traces or to thematic role transfer? *Brain and Language*, 101(1), 50–63.
- Frith, U. (1985). Beneath the surface of developmental dyslexia. In K. E. Patterson, J. C. Marshall, & M. Coltheart (Eds.), *Surface dyslexia* (pp. 301–330). London, UK: Lawrence Erlbaum.
- Froud, K., & van der Lely, H. K. (2008). The count-mass distinction in typically developing and grammatically specifically language impaired children: New evidence on the role of syntax and semantics. *Journal of Communication Disorders*, 41(3), 274–303.
- Gallon, N., Harris, J., & van der Lely, H. K. J. (2007). Non-word repetition: An investigation of phonological complexity in children with grammatical-SLI. *Clinical Linguistics and Phonetics*, 21, 435–455.
- Gardner, H., Froud, K., McClelland, A., & van der Lely, H. K. J. (2006). The development of the Grammar and Phonology Screening (GAPS) test to assess key markers of specific language difficulties in young children. *International Journal of Language and Communication Disorders*, 41, 513–540.
- Gathercole, S., & Baddeley, A. (1996). *The Children's Test of Non-Word Repetition*. London, UK: Psychological Corporation.
- German, D., & Newman, R. (2007). Oral reading skills of children with oral language (word-finding) difficulties. *Reading Psychology*, 28, 397–442.
- Goswami, U. (2003). Why theories about developmental dyslexia require developmental designs. *Trends in Cognitive Sciences*, 7(12), 534–540.
- Gough, P., & Tunmer, W. (1986). Decoding, reading and reading disability. *Remedial and Special Education*, 7, 6–10.
- Hamann, C. (2006). Speculations about early syntax: The production of wh-questions by normally developing French children and French children with SLI. *Catalan Journal of Linguistics*, 5, 143–189.
- Joanisse, M. F., Manis, F. R., Keating, P., & Seidenberg, M. S. (2000). Language deficits in dyslexic children: Speech perception, phonology, and morphology. *Journal of Experimental Child Psychology*, 77(1), 30–60.
- Kamhi, A., & Catts, H. (1986). Toward an understanding of developmental language and reading disorders. *Journal of Speech, Language, and Hearing Research*, 51, 337–347.
- Kessler, B., & Treiman, R. (2003). Is English spelling chaotic? Misconceptions concerning its irregularity. *Reading Psychology*, 24, 267–289.
- Leonard, L. (1998). *Children with specific language impairment*. Cambridge, MA: MIT Press.
- Lyytinen, H., Ahonen, T., Eklund, K., Guttorm, T. K., Laakso, M. L., Leinonen, S., . . . Viholainen, H. (2001). Developmental pathways of children with and without familial risk for dyslexia during the first years of life. *Developmental Neuropsychology*, 20(2), 535–554.
- Marcus, G., Pinker, S., Ullman, M., Hollander, M., & Rosen, J. F. (1992). *Overregularization in language acquisition*. *Monographs of the Society for Research in Child Development*, 57(4, Serial No. 228).

- Marinis, T., & van der Lely, H. K. (2007). On-line processing of wh-questions in children with G-SLI and typically developing children. *International Journal of Language and Communication Disorders*, 42(5), 557–582.
- Marshall, C. (2004). *The morpho-phonological interface in specific language impairment*. Unpublished doctoral dissertation, DLDCN Centre, University College London, London, UK.
- Marshall, C. R., Ebbels, S., Harris, J., & van der Lely, H. K. J. (2002). Investigating the impact of prosodic complexity on the speech of children with specific language impairment. In R. Vermeulen & A. Neeleman (Eds.), *UCL working papers in linguistics* (Vol. 14, pp. 43–68). London, UK: University College London.
- Marshall, C. R., Harcourt-Brown, S., Ramus, F., & van der Lely, H. K. J. (IN PRESS). The link between prosody and language skills in children with SLI and/or dyslexia. *International Journal of Language and Communication Disorders*.
- Marshall, C. R., Marinis, T., & van der Lely, H. K. J. (2007). Passive verb morphology: The effect of phonotactics on passive comprehension in typically developing and grammatical-SLI children. *Lingua*, 117, 1434–1447.
- Marshall, C. R., & van der Lely, H. K. J. (2006). A challenge to current models of past tense inflection: The impact of phonotactics. *Cognition*, 100, 302–320.
- Marshall, C. R., & van der Lely, H. K. J. (2007a). Derivational morphology in children with grammatical-specific language impairment. *Clinical Linguistics and Phonetics*, 21, 71–91.
- Marshall, C. R., & van der Lely, H. K. J. (2007b). The impact of phonological complexity on past tense inflection in children with grammatical-SLI. *Advances in Speech Language Pathology*, 9, 191–203.
- Marshall, C. R., & van der Lely, H. K. J. (2009). Effects of word position and stress on onset cluster production: Data from typical development, SLI and dyslexia. *Language*, 85, 39–57.
- McArthur, G. M., Hogben, J. H., Edwards, V. T., Heath, S. M., & Mengler, E. D. (2000). On the “specifics” of specific reading disability and specific language impairment. *Journal of Child Psychology and Psychiatry*, 41(7), 869–874.
- McCutchen, D., Green, L., & Abbott, R. (2008). Children’s morphological knowledge: Links to literacy. *Reading Psychology*, 29, 289–314.
- McFall, R. M., & Treat, T. A. (1999). Quantifying information value of clinical assessments with signal detection theory. *Annual Review of Clinical Psychology*, 50, 215–241.
- Messaoud-Galusi, S. & Marshall, C. R. (2010) (eds) Explaining the overlap between dyslexia and SLI: The role of phonology. *Special Issue of Scientific Studies of Reading*, 14, 1–110.
- Nagy, W., Anderson, R., Schommer, M., Scott, J., & Stallman, A. (1989). Morphological families and word recognition. *Reading Research Quarterly*, 24, 262–282.
- Nation, K., Clarke, P., Marshall, C. M., & Durand, M. (2004). Hidden language impairments in children: Parallels between poor reading comprehension and specific language impairment? *Journal of Speech, Language, and Hearing Research*, 47, 199–211.
- Norbury, C., Bishop, D., & Briscoe, J. (2002). Does impaired grammatical comprehension provide evidence for an innate grammar module? *Applied Psycholinguistics*, 23, 247–268.
- O’Hara, M., & Johnston, J. (1997). Syntactic bootstrapping in children with specific language impairment. *European Journal of Disorders of Communication*, 2, 189–205.
- Payne, E. (2008). *A validation study of the Grammar and Phonology Screening test*. London, UK: University College London.
- Pennington, B., & Bishop, D. (2009). Relations among speech, language and reading disorders. *Annual Review of Psychology*, 60, 283–306.
- Peppé, S., & McCann, J. (2003). Assessing intonation and prosody in children with atypical language development: The PEPS-C test and the revised version. *Clinical Linguistics and Phonetics*, 17, 345–354.
- Perfetti, C., Landi, N., & Oakhill, J. (2005). The acquisition of reading comprehension skill. In M. Snowling & C. Hulme (Eds.), *The science of reading: A handbook* (pp. 227–247). Malden, MA: Blackwell.
- Pinker, S. (1999). *Words and rules: The ingredients of language*. London, UK: Weidenfeld & Nicolson.
- Pring, T. (2005). *Research methods in communication disorders*. London, UK: Whurr.
- Ramus, F., & Szenkovits, G. (2008). What phonological deficit? *Quarterly Journal of Experimental Psychology*, 61(1), 129–141.
- Rice, M. (2000). Grammatical symptoms of specific language impairment. In D. V. M. Bishop & L. Leonard (Eds.), *Speech and language impairments in children* (pp. 35–52). Hove, East Sussex, UK: Psychological Press.
- Rice, M., Wexler, K., & Redmond, S. (1999). Grammaticality judgments of an extended optional infinitive grammar: Evidence from English-speaking children with specific language impairment. *Journal of Speech, Language and Hearing Research*, 42, 943–961.
- Rispens, J. (2004). Syntactic and phonological processing in developmental dyslexia. *Gronnigen Dissertations in Linguistics*, 48.
- Rispens, J., & Been, P. (2007). Subject-verb agreement and phonological processing in developmental dyslexia and SLI: A closer look. *International Journal of Language and Communication Disorders*, 42, 293–305.
- Rüsseler, J., Becker, P., Johannes, S., & Munte, T. F. (2007). Semantic, syntactic, and phonological processing of written words in adult developmental dyslexic readers: An event-related brain potential study. *BMC Neuroscience*, 8, 52.
- Schiff, R., & Ravid, D. (2007). Morphological analogies in Hebrew-speaking university students with dyslexia compared with typically developing gradeschoolers. *Journal of Psycholinguistic Research*, 36, 237–253.
- Selkirk, E. O. (1978). On prosodic structure and its relation to syntactic structure. In T. Fretheim (Ed.), *Nordic prosody* (Vol. 2, pp. 111–140). Trondheim, Norway: TAPIR.
- Semel, E., Wiig, E. H., & Secord, W. A. (2006). *Child evaluation of language fundamentals—Preschool second UK edition*. Oxford, UK: Pearson Assessment.

- Shankweiler, D., Crain, S., Katz, L., Fowler, A., Liberman, A., Brady, S., . . . Shaywitz, B. A. (1995). Cognitive profiles of reading-disabled children: Comparison of language skills in phonology, morphology, and syntax. *Psychological Science*, 6, 149–156.
- Shankweiler, D., Smith, S. T., & Mann, V. A. (1984). Repetition and comprehension of spoken sentences by reading-disabled children. *Brain and Language*, 23(2), 241–257.
- Snowling, M. (2000). *Dyslexia* (2nd edition). Oxford, UK: Blackwell.
- Snowling, M., Bishop, D. V., & Stothard, S. E. (2000). Is pre-school language impairment a risk factor for dyslexia in adolescence? *Journal of Child Psychology and Psychiatry*, 41(5), 587–600.
- Stavrakaki, S. (2001). Comprehension of reversible relative clauses in specifically language impaired and normally developing Greek children. *Brain and Language*, 77, 419–431.
- Tallal, P. (2003). Language learning disabilities: Integrating research approaches. *Current Directions in Psychological Science*, 12, 206–211.
- Thornton, R. (1995). Referentiality and wh-movement in child English: Juvenile D–Linkuency. *Language Acquisition*, 4(1& 2), 139–175.
- Tomblin, J. B., Records, N. L., Buckwalter, P., Zhang, X., Smith, E., & O'Brien, M. (1997). Prevalence of specific language impairment in kindergarten children. *Journal of Speech Language and Hearing Research*, 40(6), 1245–1260.
- van Alphen, P., de Bree, E., Gerrits, E., de Jong, J., Wilsenach, C., & Wijnen, F. (2004). Early language development in children with a genetic risk of dyslexia. *Dyslexia*, 10(4), 265–288.
- van der Lely, H. (1994). Canonical linking rules: Forward versus reverse linking in normally developing and specifically language-impaired children. *Cognition*, 51(1), 29–72.
- van der Lely, H. (1996). Specifically language impaired and normally developing children: Verbal passive vs. adjectival passive sentence interpretation. *Lingua*, 98, 243–272.
- van der Lely, H. (2005). Domain-specific cognitive systems: Insight from grammatical-specific language impairment. *Trends in Cognitive Sciences*, 9, 53–59.
- van der Lely, H. & Battell, J. (2003). Wh-movement in children with grammatical SLI: A test of the RDDR hypothesis. *Language*, 79, 153–181.
- van der Lely, H. & Christian, V. (2000). Lexical word formation in children with grammatical SLI: A grammar-specific versus an input-processing deficit? *Cognition*, 75(1), 33–63.
- van der Lely, H., Gardner, H., McClelland, A., & Froud, K. (2007). *The Grammar and Phonology Screening test (GAPS)*. London, UK: DLDCN.com.
- van der Lely, H., Jones, M., & Marshall, C. R. (IN PRESS). *Who did Buzz see someone? Grammaticality judgement of wh-questions in typically developing and children and children with Grammatical-SLI. *Lingua*.
- van der Lely, H. & Marshall, C. R. (IN PRESS). Grammatical-specific language impairment: A window onto domain specificity. In J. Guendouzi, F. Loncke, & M. Williams (Eds.), *Handbook of psycholinguistics & cognitive processing: Perspectives in communication disorders*. London, UK: Taylor & Francis.
- van der Lely, H., Rosen, S., & McClelland, A. (1998). Evidence for a grammar-specific deficit in children. *Current Biology*, 8(23), 1253–1258.
- van der Lely, H. & Stollwerck, L. (1997). Binding theory and grammatical specific language impairment in children. *Cognition*, 62, 245–290.
- van der Lely, H. & Ullman, M. (2001). Past tense morphology in specifically language impaired children and normally developing children. *Language and Cognitive Processes*, 16, 113–336.
- Vellutino, F. R. (1979). *Dyslexia: Research and theory*. Cambridge, MA: MIT Press.
- Wechsler, D. (1992). *The Wechsler Intelligence Scale for Children* (3rd ed). London, UK: Psychological Corporation.
- Wiig, E. H., Secord, W., & Semel, E. (2000). *Clinical evaluation of language fundamentals—Preschool*. London, UK: Psychological Corporation.
- Wilsenach, A. C. (2006). *Syntactic processing in developmental dyslexia and in specific language impairment: A study on the acquisition of the past participle construction in Dutch*. Unpublished manuscript, Proefschrift Universiteit Utrecht.
- Wolf, M., & Bowers, P. (1999). The “double-deficit hypothesis” for the developmental dyslexias. *Journal of Educational Psychology*, 91, 1–24.

About the Authors

Heather K. J. van der Lely, PhD is a qualified speech and language therapist and Professor of developmental language disorders and cognitive neuroscience. She is currently an affiliated professor at the Department of Psychology, Harvard University. Her research interests are in the development of fundamental human capacities, particularly language, in order to provide insight into the development of specialised cognitive systems furthering understanding of the underlying biology, structure and function of the brain. She studies typically developing and atypically developing infants, children, teenagers and adults, e.g., those with specific language impairment (SLI), dyslexia, and autism using behavioral and imaging techniques.

Chloë R. Marshall, PhD, is a lecturer in developmental psychology and Levehulme Early Career Fellow at City University London. Her research investigates typical and atypical language acquisition in hearing and deaf children, with a focus on Specific Language Impairment and dyslexia.