Processing-Dependent Measures Sensitive to Language Performance Differences in Arabic-Speaking English Language Learners Compared to Children with Developmental Language Disorder

Mesures de traitement de l'information sensibles aux différences de performances langagières des apprenants de langue anglaise arabophones lorsque comparées à celles d'enfants ayant un trouble développemental du langage

Areej M. A. Balilah
Lisa M. D. Archibald

KEYWORDS

ARABIC-SPEAKING CHILDREN

ENGLISH LANGUAGE LEARNERS

DEVELOPMENTAL LANGUAGE DISORDER

PROCESSING-DEPENDENT MEASURES

Areej M. A. Balilah[1] and Lisa M. D. Archibald[2]

[1] Childhood Studies, King Abdulaziz University, Jeddah, SAUDI ARABIA

[2] School of Communication Sciences and Disorders, The University of Western Ontario, London, CANADA

Editor-in-Chief:
David McFarland

Abstract

To address concerns regarding the utility of language measures that depend on linguistic knowledge to distinguish English language learners from those with developmental language disorder, this study compared the performance of Arabic-speaking English language learners with diverse language experiences to the performance of age-matched monolingual children with and without developmental language disorder on processing-dependent measures. The group of 6- to 9-year-old English language learners (*n* = 59) whose first language was Arabic, and who had been learning English as the language of instruction in Canada, and two monolingual groups from Saudi Arabia, typically developing Arabic-speaking children (*n* = 369) and Arabic-speaking children with developmental language disorder (*n* = 52), completed processing-dependent measures of short-term and working memory. No differences were found between the groups of English language learners and typically developing children on the short-term and working memory measures, with the exception of the Arabic nonword repetition task. The performance of the English language learners group was comparable to that of the Arabic-speaking children with developmental language disorder group on the Arabic nonword repetition task and significantly lower than the typically developing group. The English language learners group scored significantly higher than the typically developing and Arabic-speaking children with developmental language disorder groups on only the digit recall subtest. The findings suggest that processing-dependent measures may be valid assessment tools that minimize the role of linguistic knowledge and experiences.

Abrégé

Afin de répondre aux réserves relatives à l'utilité des mesures langagières qui dépendent des connaissances linguistiques pour distinguer les apprenants de langue anglaise ayant un trouble développemental du langage et de ceux qui n'en ont pas, la présente étude a comparé les performances à des mesures reposant sur le traitement de l'information d'apprenants de langue anglaise arabophones ayant différentes expériences linguistiques avec celles d'enfants unilingues appariés sur l'âge avec et sans trouble développemental du langage. Les mémoires à court-terme et de travail d'un groupe d'apprenants de langue anglaise âgés de 6 à 9 ans (n = 59) dont la langue maternelle était l'arabe et dont la langue d'enseignement était l'anglais, ainsi que deux groupes d'enfants arabophones unilingues habitant en Arabie Saoudite (c.-à-d. un groupe de 369 enfants au développement typique et un groupe de 52 enfants ayant un trouble développemental du langage) ont été évaluées. Aucune différence n'a été relevée entre les performances du groupe d'apprenants de langue anglaise et du groupe d'enfants au développement typique aux mesures de mémoires à court terme et de travail, exception faite entre les performances de ces enfants à la tâche répétition de non-mots arabes. La performance du groupe d'apprenants de langue anglaise s'est révélée comparable à celle du groupe d'enfants arabophones ayant un trouble développemental du langage à la tâche de répétition de non-mots arabes et significativement inférieure à celle du groupe d'enfants au développement typique. Uniquement à la tâche de répétition de chiffres, le groupe d'apprenants de langue anglaise a obtenu des scores significativement plus élevés que les groupes d'enfants arabophones au développement typique et ayant un trouble développemental du langage. Les résultats suggèrent que les mesures reposant sur le traitement de l'information pourraient être des outils d'évaluation valides permettant de minimiser l'influence des connaissances linguistiques et des expériences antérieures.

The number of English language learners (ELLs), meaning children whose first language is not English and who attend schools taught in English, is significantly increasing in Canada (Paradis et al., 2010) and the United States (Goldstein, 2004). Identifying children with language disorders in culturally and linguistically diverse communities, such as the United States and Canada, is challenging. On one hand, many studies have found that knowledge-based assessment tools, such as English standardized tests of language, are not accurate in identifying language disorder among ELLs who are in the process of learning English as a second language and have more limited language knowledge than their monolingual peers (e.g., Blom & Boerma, 2017; Chu & Flores, 2011; Sandberg & Reschly, 2011). The reduced language proficiency of ELLs can result in lower reliability and validity of assessments and be a source of measurement error when assessing ELLs (Abedi, 2006). On the other hand, processing-dependent measures, or measures that assess general cognitive abilities, have been hypothesized to contribute to processing and language learning (Park et al., 2021). Such measures probe the abilities supporting language learning and may be less dependent on ELLs' linguistic knowledge (Blom & Boerma, 2017; Park et al., 2021). Studies have investigated the utility of processing-dependent tasks, such as measures of verbal short-term memory, in distinguishing ELLs from children with underlying language impairment (Kohnert et al., 2006; Paradis et al., 2013; Wealer & Engel de Abreu, 2021). The purpose of the current study was to compare Arabic-speaking ELLs with diverse language experiences to children with underlying language impairment, using tests of verbal short-term and working memory.

Children with significant and persistent limitations in their language ability despite average educational and experiential opportunities are referred to as children with developmental language disorder (DLD, also known as specific language impairment; Bishop et al., 2017). The language deficits in children with DLD can affect all areas of language (Stothard et al., 1998), although the profile of language deficits can be unique for each child with DLD. Grammatical deficits in particular have been described as a hallmark deficit in DLD (Leonard et al., 1997). To identify children with DLD, speech-language pathologists (S-LPs) commonly use standardized tests that have been normed with a monolingual population. Children scoring significantly below age expectations on such tests may be identified as having DLD.

Another group of children who may appear to have weak language skills at school is ELLs, that is, those children who are receiving instruction in their second language (English) or in a language other than their minority first language. Research suggests that it can take 4 or 5 years for ELLs to gain English proficiency comparable to their monolingual peers (Hakuta et al., 2000). According to Paradis (2010), there is considerable overlap in the linguistic features of typically developing (TD) ELLs who are in the early stage of developing their second language (within the first two years in particular) and those of monolingual children with DLD, as both groups tend to have errors in vocabulary choice and grammatical morphemes (Tabors, 2008). Receiving instruction in English can also impact ELLs' learning of their first language. Children whose first language is a minority often receive minimal community support in that language, and the opportunities to hear and use it are diminished once they start schooling (Anderson, 2012). As proficiency in ELLs' second language grows, their skills in their first language often do not develop further or even reduce and diminish across time, a phenomenon termed *incomplete acquisition* or *first-language loss* (Anderson, 2012). First-language loss impacts lexical and grammatical systems (Anderson, 2012), two areas of language commonly affected in DLD.

As a result of being in the early stages of English acquisition and potential first-language loss, ELLs may have weak language skills in each of the languages they are learning, which poses challenges when concerns arise regarding language development and language learning. Several studies reported that S-LPs commonly use English norm-referenced standardized tests to assess ELLs' linguistic abilities (Caesar & Kohler, 2007; Gillam et al., 2013). Evidence suggests that administering knowledge-based assessment tools such as English standardized language tests and interpreting scores based on monolingual norms may lead to overdiagnosis of DLD among ELLs (Bedore & Peña, 2008; Klingner & Artiles, 2003).

Even assessment in their first language may underestimate language skills in ELLs. Lexical-semantic knowledge in ELLs is often distributed across languages with, for example, some vocabulary items being experienced mostly at school in English and other vocabulary items experienced mostly at home in the child's first language (Gollan et al., 2008; Pearson et al., 1993; Umbel et al., 1992). The lower frequency of exposure and practice for individual words may result in weaker links between semantic and phonological representations in ELLs (Gollan et al., 2008). As a result, even TD ELLs have been found to score below their monolingual peers on vocabulary measures in both English (e.g., Bialystok et al., 2010) and their first language (Jackson et al., 2014). Indeed, on single language vocabulary measures, TD ELLs often show performance comparable to monolingual children with DLD (Umbel et al., 1992; Windsor

& Kohnert, 2004). Similarly, performance on grammatical language tasks has not been found to distinguish TD ELLs with diverse language backgrounds from monolingual children with DLD (Paradis, 2005; Paradis et al., 2008). Clearly, ELLs' language performance is affected by their limited knowledge and experience with each target language examined (Blom & Boerma, 2017).

Given concerns regarding the utility of any language knowledge measures to discriminate ELLs from those with DLD, attention has turned to the use of processing-dependent measures, especially those found to differentiate monolingual groups with and without DLD, such as processing speed, temporal integration, and immediate memory (Archibald & Gathercole, 2006a; Miller et al., 2001; Windsor & Hwang, 1999; Windsor & Kohnert, 2004). The theory is that processing-dependent measures may be less dependent on ELLs' linguistic knowledge and, therefore, directly tap abilities underlying language learning (Kohnert et al., 2006; Paradis et al., 2013; Park et al., 2021). Recent studies have reported that focusing on processing-dependent measures or supplementing language knowledge measures with processing-dependent measures helped distinguish between ELLs with and without DLD (Park et al., 2021; Wealer & Engel de Abreu, 2021).

Multiple theories have been put forward to explain the disproportionate linguistic deficit found among children with DLD. For example, domain-general theories contend that children with DLD have deficits in the domain-general cognitive processes known to support language learning. When children with DLD present with a limitation in domain-general information processing, it is often connected with reduced space or capacity (Bishop, 1992), or slower speed (Kail, 1994). Working memory, defined as the ability to retain and manipulate information for a short period of time in the current focus of attention, is one domain-general resource that can limit information processing speed or capacity. Nevertheless, none of the DLD theories effectively explain DLD, indicating that DLD is, in fact, a multifactorial disorder (Bishop, 2003). The language features of children with DLD are heterogeneous and the characteristics of the disorder can overlap with other neurodevelopmental disorders (Bishop, 2017).

A number of studies have reported deficits in two aspects of immediate memory in DLD: verbal short-term memory and working memory (Archibald & Gathercole, 2006a; Henry et al., 2012). Short-term memory tasks engage temporary storage; verbal versions require serial recall of words, letters, or digits, whereas visuospatial versions involve recall of visual patterns or sequences of movement (Baddeley, 2000; Conway et al., 2005). Verbal short-term memory has been found to be a key indicator of new-word learning (Majerus et al., 2006; Masoura & Gathercole, 2005) and vocabulary acquisition (Gathercole, 2006; Gathercole et al., 1992) Working memory tasks, on the other hand, impose demands on processing in addition to storage, and are generally assessed by complex memory span paradigms (Engel de Abreu, 2011). Examples of verbal complex span tasks are counting recall and backwards digit recall, in which a participant recalls numbers after counting or reversing the order, respectively. Examples of corresponding visuospatial tasks involve recalling locations or orientations after identifying a different shape or mentally rotating an image, respectively (Alloway et al., 2009). Working memory has been associated with complex cognitive activities, such as language comprehension and word decoding (Cain et al., 2004; Engel de Abreu & Gathercole, 2012). Some researchers have reported comparable performance between monolingual children with DLD and TD peers on visuospatial short-term and working memory measures (e.g., Archibald & Gathercole, 2006b; but see Vugs et al., 2013), suggesting disproportionately smaller DLD deficits in the visuospatial than verbal domain (Archibald & Gathercole, 2006b).

Given that short-term and working memory measures emphasize the storage and processing of new information (Engel de Abreu et al., 2013), the influence of previous knowledge has been considered to be minimal. It has been suggested that processing-dependent measures such as verbal short-term memory and working memory measures may pose similar challenges and be equally familiar (or unfamiliar) to all children, regardless of the language they speak (Engel de Abreu & Gathercole, 2012). It should be noted that the majority of research comparing ELLs with monolingual children with DLD on processing-dependent measures has focused on nonword repetition measures, a task involving the immediate recall of made-up or nonsense words. Although nonword repetition has been argued to be a verbal short-term memory task imposing demands for storage only (Gathercole & Baddeley, 1990), research has identified additional factors influencing nonword repetition and perhaps imposing a load on working memory (Bishop et al., 1996; Graf Estes et al., 2007). Nevertheless, nonword repetition is expected to minimize the role of prior language knowledge and experience given the use of phonological forms novel to all participants.

Accumulated evidence from ELL studies of nonword repetition, however, shows that even previous sublexical phonological knowledge and experience can influence children's performance. For example, Kohnert et al.

(2006) found that the performance of TD ELLs and monolingual English-speakers with DLD did not differ on an English nonword repetition task. Sensitivity and specificity calculations for the English nonword repetition task, however, indicated that such a task was useful for ruling out children with DLD in the ELL group but not for identifying them. In the case of TD children, Engel de Abreu et al. (2013) similarly reported an advantage for monolingual over bilingual children on nonword but not number-based repetition tasks. The researchers suggested that the digits represented highly frequent lexical stimuli of equal familiarity to all school-age children, eliminating any advantage of language familiarity. In summary, although the nonword repetition task is considered a less biased form of assessment than knowledge-based measures (Paradis et al., 2013), nonword repetition does not completely eliminate the effect of children's experience with the target language (Kohnert et al., 2006).

The majority of research comparing ELLs with monolingual children with DLD on processing-dependent measures has focused on nonword repetition measures, and few studies have used different verbal short-term and complex memory measures. For example, Boerma and Blom (2020) and Blom and Boerma (2017) compared the performance of monolingual and bilingual children with DLD to TD peers on verbal short-term and working memory tasks. The results indicated that monolingual and bilingual children with DLD had lower performance on verbal short-term and working memory tasks than their bilingual TD peers. Moreover, Cockcroft (2016) compared 67 English monolingual and 53 bilingual Grade 1 students whose first language was an African language (isiZulu or isiXhosa), and who were educated at English schools, on verbal short-term and verbal working memory tasks. The study reported that there were no group differences on any measures of working memory. Engel de Abreu (2011) compared the performance of 22 simultaneous bilingual children (Luxembourgish and one other European language) and 22 Luxembourgish monolingual peers on verbal short-term and verbal working memory tasks. When controlling for expressive vocabulary, no significant differences were observed between the 6- to 8-year-old monolinguals and bilinguals on verbal short-term and verbal working memory tasks. Similarly, Engel de Abreu et al. (2013) compared 7-year-old Portuguese-speaking language minority children from Luxembourg to majority Portuguese-speaking children from Brazil and multilingual children from Luxembourg. No difference was found between the Portuguese-speaking language minority children and their majority language peers from Brazil and from Luxembourg on three of the four working memory tasks administered.

On the other hand, higher immediate memory scores in bilingual groups have been reported in several studies. Broadly speaking, bilingualism is associated with increased cognitive abilities, including working memory, as reported in a meta-analysis study (Adesope et al., 2010; but see Engel de Abreu, 2011). For instance, Blom et al. (2014) found that when controlling for socioeconomic status and vocabulary, 68 bilingual Turkish–Dutch children showed cognitive advantage in verbal working memory compared to 52 monolingual controls. Moreover, Morales et al. (2013) reported a bilingual advantage on working memory tasks in two studies. The first study found that 27 ELL 5-year-olds from diverse language backgrounds outperformed 29 of their monolingual peers in executive functioning tasks that manipulated different working memory demands. In the second study, 62 ELLs (5- and 7-year-olds) from diverse language backgrounds outperformed 62 of their monolingual peers on visuospatial span tasks that manipulated different executive function components. Nevertheless, findings of equivalent performance by 22 TD ELLs (Spanish–English-speaking) and 28 monolinguals with DLD on a task involving judging the veracity of a sentence while retaining the final word (Kohnert et al., 2006) suggested that some verbal working memory tasks could be influenced by previous language experience (Kohnert, 2010). The present study employed both highly familiar and unfamiliar verbal stimuli as well as verbal and visuospatial stimuli in immediate memory tasks to evaluate group differences associated with a range of processing demands.

In any consideration of bilingual development, the specific languages being learned must be considered. The present study was concerned with the development of Arabic–English learners. Arabic is a Semitic language with a nonconcatenative morphology. The morphology, phonology, and orthography of Semitic languages are distinct from Indo-European languages such as English. Arabic has 28 consonants and six vowels. Arabic is a root and pattern language with complex interaction between syntax, morphology, and phonology. Word roots mostly consist of three consonants that represent the lexical meaning (triliteral root; Beeston, 1970), and the pattern is primarily composed of vowels inserted between the root consonants. The roots carry a semantic meaning shared to various degrees by the derivative words associated with the same root (Bakalla, 1979). Moreover, the verbal inflection system of Arabic is relatively rich. Verbs are morphologically inflected for tense and mood, and the verb agrees with the subject for aspects of person (first, second, and third), number (singular, dual, and plural), and gender (feminine and masculine; Bakalla, 1979). Arabic has many diverse colloquial dialects across Arabic countries, and most countries have their own dialect (Aljenaie, 2001). In general, Arabic colloquial dialects are mutually intelligible, with few being mutually unintelligible (Al-Tamimi, 2011).

Only a few studies have focused on monolingual/bilingual Arabic children, especially in regard to DLD. The epidemiological trends in language and cognitive development in Arabic-speaking children with DLD show many parallels to those reported for other linguistic and cultural groups. For example, Abdalla and Crago (2008) found that Arabic-speaking children with DLD have a specific difficulty with tense and subject-verb agreement forms. Moreover, difficulty in repeating nonsense phonological forms has been reported in Arabic-speaking children with DLD (Shaalan, 2010). Comparing Arabic-speaking ELLs to monolingual Arabic children with DLD is important in order to examine whether there are group differences between these groups on processing-dependent measures.

The present study compared the performance of Arabic-speaking children (ELLs) with diverse language experiences on processing-dependent measures to that of two monolingual peer groups: 1) typically developing Arabic-speaking children (A-TD), and 2) Arabic-speaking children with DLD (A-DLD). Given the shortcomings of knowledge-based measures in differentiating the language performance profiles of children with DLD and ELL, it is important to examine whether there are group differences between ELLs and children with underlying language impairment in verbal short-term and working memory measures. At least equivalent performance by ELL and A-TD groups, and higher scores by the ELL than the A-DLD groups was expected on the processing-dependent immediate memory tasks. However, this prediction was expected to be modified by the verbal demands of the task, such that tasks with higher verbal demands (i.e., nonword repetition) would be less likely to differentiate the three groups than those with low verbal demands (i.e., digit recall) or no verbal demands (i.e., visuospatial short-term or working memory tasks).

Method

Participants

Permission to conduct this study was granted by The University of Western Ontario Research Ethics Board for Non-Medical Research Involving Human Subjects (number: 103912). There were 480 children (M_{age} = 7;9, *SD* = 1.12; 187 males) participating in three groups in this study: (a) 59 unselected ELLs whose first language was Arabic and who were learning English as the language of instruction in Canada (M_{age} = 7;11, *SD* = 1.16; 29 males), (b) 369 typically developing monolingual Arabic-speaking children (A-TD) from Saudi Arabia (M_{age} = 7;11, *SD* = 1.12; 139 males), and (c) 52 monolingual Arabic-speaking children with DLD (A-DLD) from Saudi Arabia (M_{age} = 8;4, *SD* = 1.00; 19 males). The two monolingual Arabic-speaking groups from this study were drawn from a sample of 421 monolingual Arabic-speaking children who participated in other completed studies (Balilah & Archibald, 2018). The language, nonverbal intelligence, and maternal education measures administered in order to characterize the monolingual Arabic participants overlap with previous studies (Balilah & Archibald, 2018). The current study included analysis of new working memory measures as well as comparison to the ELL group who were recruited for this study. All the children who participated in this study ranged from Grade 1 to Grade 4 (i.e., children 6–9 years of age). Children in the ELL group were recruited from a school providing instruction in both English and Arabic (n = 27) and from an extracurricular Arabic instruction class for children receiving regular schooling in English (n = 32). Children in the Arabic-speaking samples were recruited from 10 schools (5 male schools, 2 of which were public; 5 female, all public) in Saudi Arabia (Jeddah) based on a study invitation sent home (600 letters) to all parents of children in the relevant grades. No group differences were found in gender distribution, χ^2 (2) = 2.964, p = .135, or age, F(3, 476) = .608, p = .121. In addition, according to parental reports, none of the children had been diagnosed with any neurological or psychological disorders such as hearing impairment or autism spectrum disorder.

Many research studies employ a clinical cutoff of 1 *SD* to identify children with DLD (e.g., Conti-Ramsden et al., 2001; Wiig et al., 1992). In our study, the following criteria were applied to identify which of the Arabic speaking children to include in the A-DLD group based on the norms from our monolingual Arabic-speaking sample of 421 children (Balilah & Archibald, 2018): (1) Scores of at least 1 SD below the mean on two of four language measures, including the three subtests of the Arabic Language Test (ALT; Shaalan, 2010) and the Arabic Picture Vocabulary Test (APVT; Shaalan, 2010), and (2) a standard score not lower than 86 on the Test of Nonverbal Intelligence (TONI-3; Brown et al., 1997). In the APVT, a measure of receptive vocabulary, participants were shown four pictures and were then asked to indicate which photo corresponded with a specific spoken word, with a maximum possible score of 132. High test–retest reliability has been reported for the APVT, r = .97 (Shaalan, 2017). In the Sentence Comprehension subtest of the ALT, participants were shown three to four pictures and were then asked to indicate which picture corresponded with a specific spoken sentence. In the Expressive Language subtest of ALT, participants were provided with a sentence and then they had to create a phrase or spoken word, while referencing a picture cue. In the Sentence Repetition subtest of ALT, participants listened to an audio recording that played sentences read by a native, adult male Arabic speaker. The participants were then asked to repeat the sentences. The total number of correct responses was counted for each subtest, with a score of 40 being the maximum possible score for the Sentence Comprehension subtest and 68 for the Expressive Language subtest. The 41 items of the Sentence Repetition subtest were scored on a 4-point scale (3 = *correct*; 2 = *1 error*; 1 = *2–3 errors*; 0 = *4 or more errors*, or *no response*), with a score of 123 being the maximum possible score. High test–retest reliability had been reported for the three subtests of the ALT (r = .95–.97; Shaalan, 2017). Raw scores were converted to standard scores based on the normative data available (Balilah & Archibald, 2018). Finally, in the TONI-3, a measure of general nonverbal cognitive abilities, children chose a picture to complete a visual pattern. Raw scores of the TONI-3 were converted to the standard scores based on published test norms.

Descriptive statistics for criterion measures for all groups are displayed in **Figure 1**. Scores were significantly lower for the ELL and A-DLD groups than the A-TD group on both the AREVT and ALST ($p < .001$, all cases), whereas no significant differences were found between the ELL and A-DLD groups (AREVT, p =.112; ALST, p = .158).

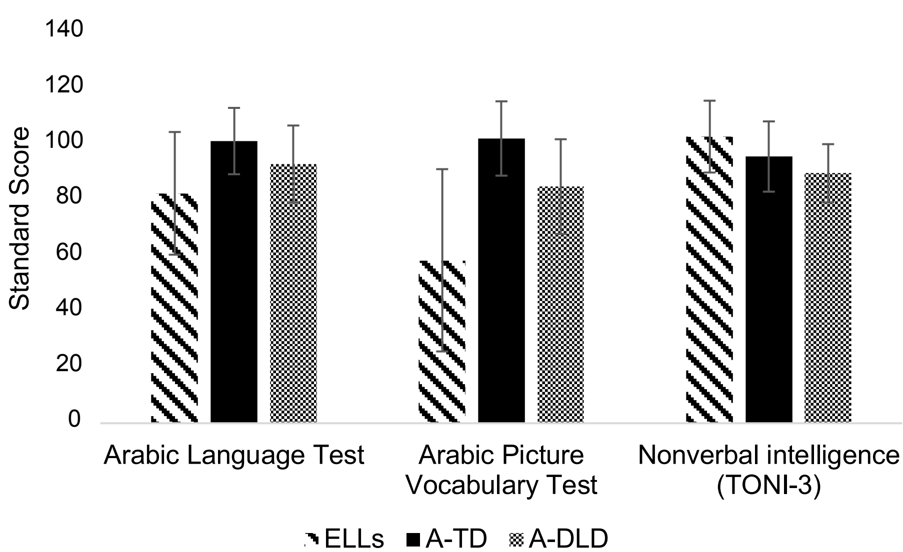
Materials and Procedure

The participants completed a variety of assessment measures individually in a quiet room in their school over 4 weekly sessions of approximately 40 minutes each. The battery included the language and vocabulary measures described above as well as processing-depending measures of verbal short-term and working memory (Arabic Nonword Repetition task [A-NWR], Shaalan, 2010; Automated Working Memory Assessment [AWMA], Alloway, 2007), and nonverbal intelligence (TONI-3, Brown et al., 1997). A fixed order was used to administer the tests so that A-NWR was completed in Session 1, the ALT in Session 2, the APVT and TONI-3 in Session, 3 and the AWMA in Session 4. Other tasks not reported here were additionally completed across sessions. A trained native Arabic speaker tested the children in the battery of assessment measures. Parents completed a questionnaire at the time of completing the study consent form.

Short-Term and Working Memory

Eight subtests from the AWMA (Alloway, 2007) were administered. Measures of verbal short-term memory (Digit Recall; Word Recall) required the immediate repetition of numbers or word forms. Measures of verbal working memory (Counting Recall; Backwards Digit Recall) required the recall of numbers after counting or reversing the

Figure 1



Standard scores for criterion measures for all groups.

Note. ELL = English language learners; A-TD = typically developing Arabic-speaking children; A-DLD = Arabic-speaking children with developmental language disorder. TONI-3 = The Test of Nonverbal Intelligence. Error bars show standard errors, standard score (M = 100, SD = 15).

order, respectively. In addition, four visuospatial short-term and working memory subtests from the AWMA were administered. Measures of visuospatial short-term memory (Dot Matrix; Block Recall) required the recall of locations. Measures of visuospatial working memory (Odd One Out; Spatial Span) required the recall of locations or orientations after identifying a different shape or mentally rotating an image, respectively. For the two monolingual Arabic groups, the AWMA was administered to each child using Arabic. For the ELL group, the AWMA was administered to each child using the child's preferred language (Arabic or English). Of the participants, 70% preferred English and 30% preferred Arabic. In order to ensure that AWMA was accurately transcribed into Arabic, three translations were performed: (1) The task was translated from English to Arabic by a native Arabic-speaker who did not work in the field; (2) The translated Arabic version of the task was then translated back into English by an expert who is a native English-speaker; and (3) The final check of the translation of the task was done through a one-to-one matching of each item of the task by another native Arabic-speaker, and the final version of the translation was written.

One additional verbal short-term memory task was administered, the A-NWR (Shaalan, 2010). In the A-NWR, participants listened to an audio recording that played nonwords read by a native, adult male Arabic speaker. The participants were then asked to repeat the nonwords. Items taken from Shaalan (2010) included 48 nonwords of different lengths (two to three syllables) and cluster type (no cluster, medial cluster, final cluster, and medial and final clusters). Each participant answer was ranked online as either incorrect or correct by a trained research assistant with a maximum possible score of 48. For all the subtests of AWMA and the A-NWR task, raw scores were converted to standard scores based on the normative data (see also, Balilah & Archibald, 2018).

Parent Questionnaire

The parent questionnaire included questions related to maternal level of education. In this study, we used maternal level of education as a proxy for socioeconomic status. Parents were asked to check the highest level of education attained by the child's mother. The descriptors included some high school, completed high school, some college, completed college (2 years), some university, and completed university (4 years or more). Responses were transposed to a 3-point scale with 1 corresponding to *some/completed high school*, 2 to *some/completed college*, and 3 to *some/completed university*. By parent report, approximately 80% of mothers had at least some college or university education in the ELL group. In comparison, approximately 58% of the mothers had at least some college or university education in each of the monolingual groups.

In addition, parents of children in only the ELL group filled out a questionnaire about their child's language background (Kaushanskaya et al., 2010). Parents were asked to provide information about their child's language immersion, history, use, and the parent's rating of their child's current language abilities in each language (on a scale from 0 = *none* to 10 = *perfect*). All parents in the study reported that Arabic was acquired by their children as a first language from birth. Moreover, the parents indicated that their children began to be exposed to English, on average, at the age of 3;3 (*SD* = 2.0, range = 8–96 months). Additionally, in terms of their child's current language abilities—both speaking and understanding—the parents rated their children as very good in Arabic (*M* = 8.00, *SD* = 2.03) and in English (*M* = 8.00; *SD* = 2.11). None of the parents reported that their child's current speaking and understanding abilities were a 3 (*low*) or lower in Arabic and English. Notably, the parents of six participants did not indicate the time when their child was first exposed to English. In addition, complete data were available for all but three children from the ELL group who did not complete all the Arabic language tasks.

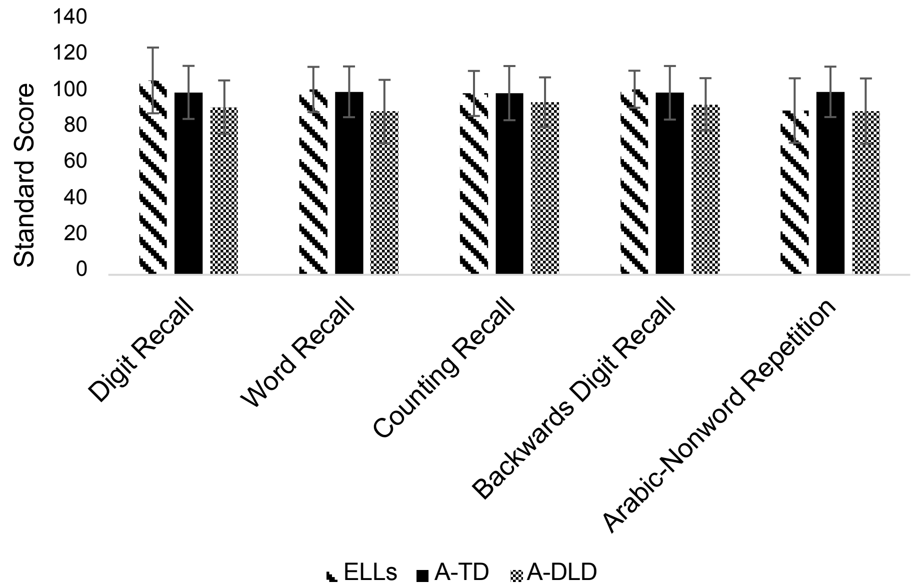
Results

Verbal Short-Term and Working Memory

Figure 2 provides standard scores for the Verbal Short-Term and Working Memory subtests of the AWMA (Digit Recall, Word Recall, Counting Recall, and Backwards Digit Recall) and the A-NWR task for the three groups: ELL, A-TD, and A-DLD. The performance of the A-DLD group was lower than the A-TD and ELL groups on all measures, whereas the performance of the ELL group was similar to, or numerically higher than, the A-TD group (except on the nonword repetition task, A-NWR).

In order to compare the performance of the ELL, A-TD, and A-DLD groups on the verbal short-term and working memory subtests of AWMA, a multivariate analysis of variance was completed on the standard scores of the verbal short-term and working memory measures (A-NWR, Digit Recall, Word Recall, Counting Recall, and Backwards Digit Recall). Between-group analyses indicated that there was a significant group effect: Hotelling's *T*, $F(10, 938) = 8.19$, $p < .001$, $\eta^2_p = .080$. Significant group effects were observed in univariate comparisons for Digit Recall, $F(2,474) = 12.91$, $p < .001$, $\eta^2_p = .052$, Word Recall, $F(2,474) = 13.97$, $p < .001$, $\eta^2_p = .056$, Backwards Digit Recall, $F(2,474) = 5.51$, $p < .001$, $\eta^2_p = .023$, A-NWR, $F(2,474) = 20.67$, $p < .001$, $\eta^2_p = .080$, but not for Counting Recall, $F(2,468) = 2.63$, $p = 0.073$.

Figure 2



Standard scores on the Verbal Short-Term and Working Memory subtests of the Automated Working Memory Assessment (AWMA) and the Arabic Nonword Repetition task (A-NWR).

Note. ELL = English language learners; A-TD = typically developing Arabic-speaking children; A-DLD = Arabic-speaking children with developmental language disorder. Error bars show standard errors, standard score (M = 100, SD = 15).

Pairwise comparisons of the significant AWMA subtests revealed significantly higher scores for the ELL group compared to the A-TD group on the Digit Recall subtest only (p = .007; all remaining cases: p = 1.000). The A-DLD group, on the other hand, had significantly lower scores than either the A-TD groups (in all cases, p < .001; except for Counting Recall, p = .068) and ELL groups (in all cases, p < .001; except for Counting Recall, p = .273). For the A-NWR task, however, the ELL and A-DLD groups had significantly lower scores than the A-TD groups (p = .001), and there was no significant difference between the ELL and A-DLD groups (p = 1.000). It should be noted that in the corresponding analysis of covariance with maternal education as a covariate, the same pattern of results was observed for all the verbal short-term and working memory measures.

Visuospatial Short-Term and Working Memory

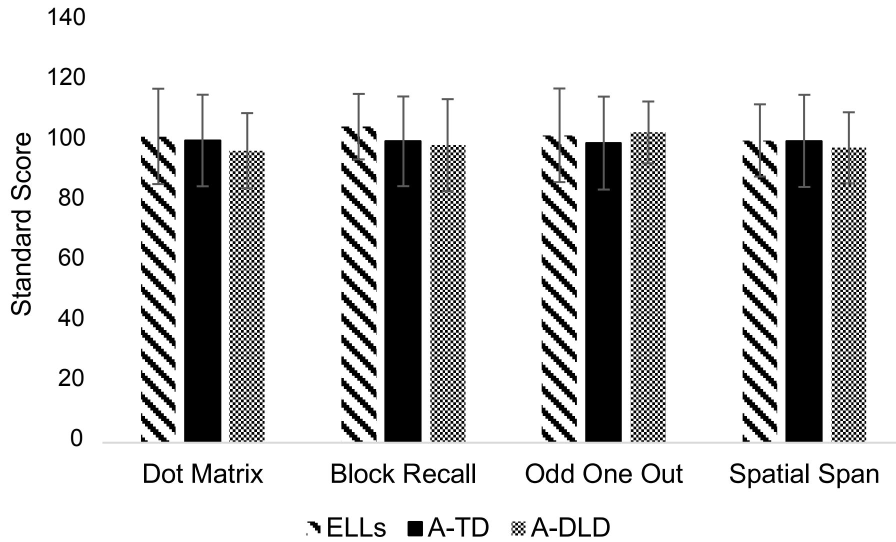
Figure 3 provides standard scores for the visuospatial short-term and working memory subtests of the AWMA (Dot Matrix, Block Recall, Odd One Out, and Spatial Span) for the three groups: ELL, A-TD, and A-DLD. The three groups had almost identical performance on all visuospatial short-term and working memory subtests.

To compare the performance of the ELL, A-TD, and A-DLD groups on the visuospatial short-term and working memory subtests of AWMA, a multivariate analysis of variance was completed on the standard score of the visuospatial short-term and working memory subtests of AWMA (Dot Matrix, Block Recall, Odd One Out, and Spatial Span). The results revealed no significant group effect: Hotelling's T, $F(8, 946) = 1.628$, p = .113. It should be noted that in a corresponding analysis of covariance with maternal education as a covariate the result was unchanged.

Discussion

This study compared the performance of Arabic-speaking ELLs with diverse language experiences on processing-dependent measures to two monolingual peer groups: typically developing A-TD children and A-DLD children. The primary objective of this study was to compare ELLs and monolingual peers with and without DLD on processing-dependent measures (short-term and working memory measures). On the Arabic measures (vocabulary and language), the ELL group scored significantly more poorly than the A-TD group and did not differ from the A-DLD group (see **Figure 1**). On the processing-dependent measures, however, no differences were found between the ELL and A-TD groups on the short-term and working memory measures (see **Figure 2** and **3**), with the exception of the Arabic nonword repetition and counting recall tasks. The performance of the ELL group on the Arabic nonword

Figure 3



Standard scores of the Visuospatial Short-Term and Working Memory subtests of the Automated Working Memory Assessment (AWMA)

Note. ELL = English language learners; A-TD = typically developing Arabic-speaking children; A-DLD = Arabic-speaking children with developmental language disorder. Error bars show standard errors, standard score (*M* = 100, *SD* = 15).

repetition task was comparable to that of the A-DLD group and significantly lower than the A-TD group. Interestingly, the ELL group scored significantly higher than the A-TD and A-DLD groups on only one number-based verbal short-term memory measure (Digit Recall).

On all the verbal memory tasks tapping short-term and working memory (with the exception of Arabic Nonword Repetition), the performance of the ELL group was comparable to the A-TD group, whereas the performance of the A-DLD group was lower than the A-TD and ELL groups on the majority of these measures (with the exception of Counting Recall). These results, on the whole, are consistent with previous evidence suggesting that processing-dependent measures in ELLs are less sensitive to differences in language experience than knowledge-based measures (Blom & Boerma, 2017; Engel de Abreu et al., 2013; Wealer & Engel de Abreu, 2021). The present findings regarding the reduced performance of the A-DLD group but not the ELL group on the majority of the verbal short-term and working memory subtests suggests that processing-dependent rather than knowledge-based measures may hold promise for differentiating between children with DLD and ELLs. A critical finding here is that the current study adds to the literature by showing that one verbal working memory subtest of the AWMA (Backwards Digit Recall), in addition to two verbal short-term subtests of the AWMA (Digit Recall and Word Recall), may be viable options for reducing assessment bias in ELLs.

Importantly, the results of the verbal short-term and working memory measures in this study are consistent with previous evidence suggesting that the nature of the verbal stimuli involved in verbal short-term and working memory tasks possibly account for the considerable difference observed in the ELLs' performance. There were group differences between the ELLs and A-DLD groups on verbal short-term and working memory measures in this study that involved the recall of highly familiar lexical stimuli, such as number words and basic words. These tasks involve familiar lexical stimuli that are generally acquired at an early age by ELLs in both their first and second languages, and that may be equally familiar to all children and less affected by verbal long-term memory (Engel de Abreu et al., 2013; Wealer & Engel de Abreu, 2021). On the other hand, because nonword repetition tasks involve unfamiliar phonological forms, it has been suggested that children's performance on these tasks relies on long-term phonological and lexico-semantic knowledge (Engel de Abreu et al., 2013). Indeed, the findings add to the growing body of evidence indicating that phonological structure and language experience impact ELLs' performance on nonword repetition tasks

(Kohnert et al., 2006; Shaalan, 2010; Windsor et al., 2010). Unlike nonword repetition, therefore, verbal short-term and working memory tasks involving familiar lexical stimuli may be sensitive to the underlying differences between children with DLD and ELLs. Such measures may assist in differentiating language difference from language impairment. Moreover, the results indicated that not all processing-dependent measures are equally effective in reducing the role of prior knowledge or experience in ELLs. Searching for effective assessment measures in ELLs requires careful choice among verbal short-term and working memory measures.

The ELL group in this study scored significantly higher than the A-TD group on only the Digit Recall measure of verbal short-term memory. Although consistent with other studies suggesting a bilingual advantage on working memory tasks (Blom et al., 2014; Morales et al., 2013; but see Engel de Abreu, 2011), the lack of a consistent advantage across a range of measures weakens the finding. In fact, there was no group effect observed for another number-based task involving counting, Counting Recall. Although unexpected based on previous findings (Engel de Abreu, 2011), the consistent group effects over multiple measures in the present study provide stronger evidence of a difference between the ELL and A-DLD groups on these tasks.

Finally, the ELL group in this study did not differ from their monolingual peers (A-TD and A-DLD) on all visuospatial short-term and working memory subtests (see **Figure 3**). Neither, however, did the A-DLD group. As a result, performance on the visuospatial immediate memory groups did not differentiate the ELL and DLD groups in the present study. This finding is in line with evidence suggesting relative visuospatial processing strengths in children with DLD (Archibald & Gathercole, 2006b). As such, these results provide substantial evidence that the immediate memory deficit in Arabic-speaking children with DLD primarily involves the verbal domain, a suggestion consistent with observations for monolingual English DLD speakers (Archibald & Gathercole, 2006a, 2006b).

Study Limitations

The performance of monolingual Arabic children from Saudi Arabia was compared to Arabic-English speakers from Canada in the present study. It must be assumed that significant cultural differences exist across these groups, which could have impacted performance on the study tasks. Importantly, monolingual Arabic-speaking school-age children do not exist in Canada, necessitating the recruitment of a sample from an Arabic-majority country. Arabic, however, has a number of colloquial dialects, which may have differed across the monolingual and ELL groups. Nevertheless, the impact of this variation on the current findings may have been limited. The Arabic language skills of the ELL group were weaker than those of the typically developing monolingual speakers. It is possible that this gap was overestimated in our sample, however, the large effect (8–14 standard score points on average) suggests a true group difference especially in light of the lack of group differences on the majority of processing-dependent measures. Certainly, as Arabic-speaking children use the colloquial dialect in their daily oral communication, language assessment measures should address the acquisition of the colloquial dialect (Al-Tamimi, 2011). Unfortunately, there are no available assessment measures in the majority of Arabic colloquial dialects. In this study, dialectical variations were matched with the participants' spoken output and commonly observed variations were considered correct. Future studies could examine the effects of dialectical variations in greater detail. Another limitation of the study is that the examiners administered the AWMA to each child using the child's preferred language (Arabic or English). Evaluating children's language skills by administering tests in one language can be more convenient. Unfortunately, evidence of parallel forms for the English and Arabic immediate memory measures was unavailable. Future studies should assess the impact of administration processing-dependent measures in two different languages.

Conclusion and Future Directions

In this study, the performance of 6- to 9-year-old ELLs whose first language was Arabic and who had been learning English as the language of instruction in Canada was compared to two monolingual groups: typically developing Arabic-speaking children and Arabic-speaking children with DLD, on processing-dependent measures of short-term and working memory. The primary objective of this study was to compare ELLs with diverse language experiences and monolingual peers with and without DLD on processing-dependent measures (short-term and working memory measures). With the exception of the Arabic nonword repetition task, the performance of the ELL group was comparable to the A-TD group on all the verbal short-term and working memory subtests, whereas the performance of the A-DLD group was lower than the A-TD and ELL groups on these tasks.

The findings of this study suggest that tasks that focusing on the cognitive processes that underlie language learning rather than children's opportunities or experiences with the test language may provide a more accurate representation of ELLs' linguistic abilities. However, it is clear from the verbal short-term and working memory results in this study that not all processing-dependent measures are equally effective in reducing the role of prior knowledge or experience in ELLs' performance. For example, the present study's findings add to the growing body of evidence that indicates that ELLs' performance on nonword repetition is affected by their previous sublexical phonological knowledge and experience in the target language (Kohnert et al., 2006; Thorn & Gathercole, 1999; Windsor et al., 2010). Furthermore, the present study indicates that verbal short-term and working memory tasks involving familiar lexical stimuli may help distinguish ELLs from children with underlying DLD and assist with the identification of children with DLD in culturally and linguistically diverse communities.

Recommendations

S-LPs often use English norm-referenced standardized tests to assess ELLs' linguistic abilities (Caesar & Kohler, 2007; Gillam et al., 2013). However, the evidence suggests that using knowledge-based assessment tools to assist with the diagnosis of ELLs may result in biased assessment and, therefore, using these tools may not be an effective approach. The findings of the present study suggest that S-LPs could also consider administering verbal short-term and working memory tasks involving familiar lexical stimuli, as they may assist in making a diagnosis in linguistically diverse settings. However, it is clear that further investigation on the use of verbal short-term and working memory tasks as assessment tools to recognize children with DLD among ELLs is warranted. More work needs to be done before these tools can be used with ELL populations for screening/diagnosis.

References

Abdalla, F., & Crago, M. (2008). Verb morphology defects in Arabic-speaking children with specific language impairment. *Applied Psycholinguistics, 29*(2), 315–340. https://doi.org/10.1017/S0142716408080156

Abedi, J. (2006). Psychometric issues in the ELL assessment and special education eligibility. *Teachers College Record, 108*(11), 2282–2303. https://journals.sagepub.com/doi/10.1111/j.1467-9620.2006.00782.x

Adesope, O. O., Lavin, T., Thompson, T., & Ungerleider, C. (2010). A systematic review and meta-analysis of the cognitive correlates of bilingualism. *Review of Educational Research, 80*(2), 207–245. https://doi.org/10.3102%2F0034654310368803

Aljenaie, K. (2001). *The emergence of tense and agreement in Kuwaiti Arabic children* [Unpublished doctoral dissertation]. University of Reading.

Alloway, T. P. (2007). *The automated working memory assessment.* Pearson Assessment.

Alloway, T. P., Rajendran, G., & Archibald, L. M. D. (2009). Working memory in children with developmental disorders. *Journal of Learning Disabilities, 42*(4), 372–383. https://doi.org/10.1177/0022219409335214

Al-Tamimi, F. Y. (2011). Assessment of language development in Arabic. In *Encyclopedia of language and literacy development* (pp. 1–9). Canadian Language and Literacy Research Network.

Anderson, R. T. (2012). First language loss in Spanish-speaking children: Patterns of loss and implications for clinical practice. In B. A. Goldstein (Ed.), *Bilingual language development and disorders in Spanish-English speakers* (pp. 193–212.). Brookes. https://brookespublishing.com/wp-content/uploads/2021/06/goldstein-first-language.pdf

Archibald, L. M. D., & Gathercole, S. E. (2006a). Short-term and working memory in specific language impairment. *International Journal of Language & Communication Disorders, 41*(6), 675–693. https://doi.org/10.1080/13682820500442602

Archibald, L. M. D., & Gathercole, S. E. (2006b). Visuospatial immediate memory in specific language impairment. *Journal of Speech, Language, and Hearing Research, 49*(2), 265–277. https://doi.org/10.1044/1092-4388(2006/022)

Baddeley, A. D. (2000). The episodic buffer: A new component of working memory? *Trends in Cognitive Sciences, 4*(11), 417–423. https://doi.org/10.1016/S1364-6613(00)01538-2

Bakalla, M. H. (1979). *The morphological and phonological components of the Arabic verb (Meccan Arabic)*. Longman.

Balilah, A., & Archibald, L. (2018). The measurement of language ability and impairment in Arabic-speaking children. In S. Hidri (Ed.), *Revisiting the assessment of second language abilities: From theory to practice* (pp. 65–84). Springer International.

Bedore, L. M., & Peña, E. (2008). Assessment of bilingual children for identification of language impairment: Current findings and implications for practice. *International Journal of Bilingual Education and Bilingualism, 11*(1), 1–29. https://doi.org/10.2167/beb392.0

Beeston, A. F. L. (1970). *The Arabic language today.* Routledge.

Bialystok, E., Luk, G., Peets, K. F., & Yang, S. (2010). Receptive vocabulary differences in monolingual and bilingual children. *Bilingualism: Language and Cognition, 13*(4), 525–531. https://doi.org/10.1017/S1366728909990423

Bishop, D. V. M. (1992). The underlying nature of specific language impairment. *The Journal of Child Psychology and Psychiatry, 33*(1), 3–66. https://doi.org/10.1111/j.1469-7610.1992.tb00858.x

Bishop, D. V. M., North, T., & Donlan, C. (1996). Nonword repetition as a behavioural marker for inherited language impairment: Evidence from a twin study. *The Journal of Child Psychology and Psychiatry, 37*(4), 391–403. https://doi.org/10.1111/j.1469-7610.1996.tb01420.x

Bishop, D. V. M. (2003). Genetic and environmental risks for specific language impairment in children. *International Journal of Pediatric Otorhynolaryngology, 67*(1), S143–S157. https://doi.org/10.1016/j.ijporl.2003.08.014

Bishop, D. V. M., Snowling, M., Thompson, P. A., & Greenhalgh, T. (2017). Phase 2 of CATALISE: A multinational and multidisciplinary Delphi consensus study of problems with language development: Terminology. *The Journal of Child Psychology and Psychiatry, 58*(10), 1068–1080. https://doi.org/10.1111/jcpp.12721

Bishop, D. V. M. (2017). Why is it so hard to reach agreement on terminology? The case of developmental language disorder (DLD). *International Journal of Language & Communication Disorders, 52*(6), 671–680. https://doi.org/10.1111/1460-6984.12335

Blom, E., Küntay, A. C., Messer, M., Verhagen, J., & Leseman, P. (2014). The benefits of being bilingual: Working memory in bilingual Turkish–Dutch children. *Journal of Experimental Child Psychology, 128*, 105–119. https://doi.org/10.1016/j.jecp.2014.06.007

Blom, E., & Boerma, T. (2017). Effects of language impairment and bilingualism across domains: Vocabulary, morphology and verbal memory. *Linguistic Approaches to Bilingualism, 7*(3–4), 277–300. https://www.jbe-platform.com/content/journals/10.1075/lab.15018.blo

Boerma, T., & Blom, E. (2020). Effects of developmental language disorder and bilingualism on children's executive functioning: A longitudinal study. *Research in Developmental Disabilities, 107*, 103782. https://doi.org/10.1016/j.ridd.2020.103782

Brown, L., Sherbenou, R. J., & Johnsen, S. K. (1997). *Test of nonverbal intelligence-3: A language-free measure of intelligence, aptitude and reasoning*. Pro-Ed.

Caesar, L. G., & Kohler, P. D. (2007). The state of school-based bilingual assessment: Actual practice versus recommended guidelines. *Language, Speech, and Hearing Services in Schools, 38*(3), 190–200. https://doi.org/10.1044/0161-1461(2007/020)

Cain, K., Oakhill, J., & Bryant, P. (2004). Children's reading comprehension ability: Concurrent prediction by working memory, verbal ability, and component skills. *Journal of Educational Psychology, 96*(1), 31–42. https://psycnet.apa.org/doi/10.1037/0022-0663.96.1.31

Chu, S., & Flores, S. (2011). Assessment of English language learners with learning disabilities. *The Clearing House, 84*(6), 244–248. https://doi.org/10.1080/00098655.2011.590550

Cockcroft, K. (2016). A comparison between verbal working memory and vocabulary in bilingual and monolingual South African school beginners: Implications for bilingual language assessment. *International Journal of Bilingual Education and Bilingualism, 19*(1), 74–88. https://doi.org/10.1080/13670050.2014.964172

Conti-Ramsden, G., Botting, N., & Faragher, B. (2001). Psycholinguistic markers for specific language impairment (SLI). *The Journal of Child Psychology and Psychiatry, 42*(6), 741–748. https://doi.org/10.1111/1469-7610.00770

Conway, A. R. A., Kane, M. J., Bunting, M. F., Hambrick, D. Z., Wilhelm, O., & Engle, R. W. (2005). Working memory span tasks: A methodological review and user's guide. *Psychonomic Bulletin & Review, 12*(5), 769–786. https://doi.org/10.3758/BF03196772

Engel de Abreu, P. M. J. (2011). Working memory in multilingual children: Is there a bilingual effect? *Memory, 19*(5), 529–537. https://doi.org/10.1080/09658211.2011.590504

Engel de Abreu, P. M. J., Baldassi, M., Puglisi, M. L., & Befi-Lopes, D. M. (2013). Cross-linguistic and cross-cultural effects on verbal working memory and vocabulary: Testing language-minority children with an immigrant background. *Journal of Speech, Language, and Hearing Research, 56*(2), 630–642. https://doi.org/10.1044/1092-4388(2012/12-0079)

Engel de Abreu, P. M. J., & Gathercole, S. E. (2012). Executive and phonological processes in second-language acquisition. *Journal of Educational Psychology, 104*(4), 974–986. https://psycnet.apa.org/doi/10.1037/a0028390

Gathercole, S. E. (2006). Nonword repetition and word learning: The nature of the relationship. *Applied Psycholinguistics, 27*(4), 513–543. https://doi.org/10.1017/S0142716406060383

Gathercole, S. E., & Baddeley, A. D. (1990). Phonological memory deficits in language disordered children: Is there a causal connection? *Journal of Memory and Language, 29*(3), 336–360. https://doi.org/10.1016/0749-596X(90)90004-J

Gathercole, S. E., Willis, C. S., Emslie, H., & Baddeley, A. D. (1992). Phonological memory and vocabulary development during the early school years: A longitudinal study. *Developmental Psychology, 28*(5), 887–898. https://psycnet.apa.org/doi/10.1037/0012-1649.28.5.887

Gillam, R. B., Peña, E. D., Bedore, L. M., Bohman, T. M., & Mendez-Perez, A. (2013). Identification of specific language impairment in bilingual children: I. Assessment in English. *Journal of Speech, Language, and Hearing Research, 56*(6), 1813–1823. https://doi.org/10.1044/1092-4388(2013/12-0056)

Goldstein, B. (2004). *Bilingual language development and disorders in Spanish-English speakers.* Brookes.

Gollan, T. H., Montoya, R. I., Cera, C., & Sandoval, T. C. (2008). More use almost always means a smaller frequency effect: Aging, bilingualism, and the weaker links hypothesis. *Journal of Memory and Language, 58*(3), 787–814. https://doi.org/10.1016/j.jml.2007.07.001

Graf Estes, K., Evans, J. L., & Else-Quest, N. M. (2007). Differences in the nonword repetition performance of children with and without specific language impairment: A meta-analysis. *Journal of Speech, Language, and Hearing Research, 50*(1), 177–195. https://doi.org/10.1044/1092-4388(2007/015)

Hakuta, K., Butler, Y., & Witt, D. (2000). *How long does it take English learners to attain proficiency?* The University of California Linguistic Minority Research Institute. https://web.stanford.edu/~hakuta/Publications/(2000)%20-%20HOW%20LONG%20DOES%20IT%20TAKE%20ENGLISH%20LEARNERS%20TO%20ATTAIN%20PR.pdf

Henry, L. A., Messer, D. J., & Nash, G. (2012). Executive functioning in children with specific language impairment. *The Journal of Child Psychology and Psychiatry, 53*(1), 37–45. https://doi.org/10.1111/j.1469-7610.2011.02430.x

Jackson, C. W., Schatschneider, C., & Leacox, L. (2014). Longitudinal analysis of receptive vocabulary growth in young Spanish English-speaking children from migrant families. *Language, Speech, and Hearing Services in Schools, 45*(1), 40–51. https://doi.org/10.1044/2013_LSHSS-12-0104

Kail, R. (1994). A method for studying the generalized slowing hypothesis in children with specific language impairment. *Journal of Speech, Language, and Hearing Research, 37*(2), 418–421. https://doi.org/10.1044/jshr.3702.418

Kaushanskaya, M., Gross, M., & Buac, M. (2010). *Parent interview questionnaire* [Unpublished questionnaire]. Language Acquisition and Bilingualism Laboratory, University of Wisconsin-Madison.

Klingner, J., & Artiles, A. (2003). When should bilingual students be in special education? *Educational Leadership, 61*(2), 66–71. https://nepc.colorado.edu/publication/when-should-bilingual-students-be-special-education

Kohnert, K. (2010). Bilingual children with primary language impairment: Issues, evidence and implications for clinical actions. *Journal of Communication Disorders, 43*(6), 456–473. https://doi.org/10.1016/j.jcomdis.2010.02.002

Kohnert, K., Windsor, J., & Yim, D. (2006). Do language-based processing tasks separate children with language impairment from typical bilinguals? *Learning Disabilities Research and Practice, 21*(1), 19–29. https://doi.org/10.1111/j.1540-5826.2006.00204.x

Leonard, L. B., Eyer, J., Bedore, L. M., & Grela, B. (1997). Three accounts of the grammatical morpheme difficulties of English-speaking children with specific language impairment. *Journal of Speech, Language, and Hearing Research, 40*(4), 741–753. https://doi.org/10.1044/jslhr.4004.741

Majerus, S., Poncelet, M., Greffe, C., & van der Linden, M. (2006). Relations between vocabulary development and verbal short-term memory: The relative importance of short-term memory for serial order and item information. *Journal of Experimental Child Psychology, 93*(2), 95–119. https://doi.org/10.1016/j.jecp.2005.07.005

Masoura, E., & Gathercole, S. E. (2005). Contrasting contributions of phonological short-term memory and long-term knowledge to vocabulary learning in a foreign language. *Memory, 13*(3–4), 422–429. https://doi.org/10.1080/09658210344000323

Miller, C., Kail, R., Leonard, L. B., & Tomblin, J. (2001). Speed of processing in children with specific language impairment. *Journal of Speech, Language, and Hearing Research, 44*(2), 416–433. https://doi.org/10.1044/1092-4388(2001/034)

Morales, J., Calvo, A., & Bialystok, E. (2013). Working memory development in monolingual and bilingual children. *Journal of Experimental Child Psychology, 114*(2), 187–202. https://doi.org/10.1016/j.jecp.2012.09.002

Paradis, J. (2005). Grammatical morphology in children learning English as a second language. *Language, Speech, and Hearing Services in Schools, 36*(3), 172–187. https://doi.org/10.1044/0161-1461(2005/019)

Paradis, J. (2010). The interface between bilingual development and specific language impairment. *Applied Psycholinguistics, 31*(2), 227–252. https://doi.org/10.1017/S0142716409990373

Paradis, J., Emmerzael, K., & Sorenson Duncan, T. (2010). Assessment of English language learners: Using parent report on first language development. *Journal of Communication Disorders, 43*(6), 474–497. https://doi.org/10.1016/j.jcomdis.2010.01.002

Paradis, J., Rice, M. L., Crago, M., & Marquis, J. (2008). The acquisition of tense in English: Distinguishing child second language from first language and specific language impairment. *Applied Psycholinguistics, 29*(4), 689–722. https://doi.org/10.1017/S0142716408080296

Paradis, J., Schneider, P., & Sorenson Duncan, T. (2013). Discriminating children with language impairment among English-language learners from diverse first-language backgrounds. *Journal of Speech, Language, and Hearing Research, 56*(3), 971–981. https://doi.org/10.1044/1092-4388(2012/12-0050)

Park, J., Miller, C. A., Sanjeevan, T., Van Hell, J. G., Weiss, D. J., & Mainela-Arnold, E. (2021). Non-linguistic cognitive measures as predictors of functionally defined developmental language disorder in monolingual and bilingual children. *International Journal of Language & Communication Disorders, 56*(4), 858–872. https://doi.org/10.1111/1460-6984.12632

Pearson, B. Z., Fernández, S. C., & Oller, D. K. (1993). Lexical development in bilingual infants and toddlers: Comparison to monolingual norms. *Language Learning, 43*(1), 93–120. https://doi.org/10.1111/j.1467-1770.1993.tb00174.x

Sandberg, K. L., & Reschly, A. L. (2011). English learners: Challenges in assessment and the promise of curriculum-based measurement. *Remedial and Special Education, 32*(2), 144–154. https://doi.org/10.1177/0741932510361260

Shaalan, S. (2010). *Investigating grammatical complexity in Gulf Arabic speaking children with specific language impairment (SLI)* [Unpublished doctoral dissertation]. University College London.

Shaalan, S. (2017). Reliability and validity of four Arabic language tests : A comparison of performance of Qatari school-aged children with and without language impairment. *Arab Journal of Applied Linguistics, 2*(1), 20–48. https://www.arjals.com/index.php/ajal/article/view/101/105

Stothard, S. E., Snowling, M., Bishop, D. V. M., Chipchase, B. B., & Kaplan, C. A. (1998). Language-impaired preschoolers: A follow-up into adolescence. *Journal of Speech, Language, and Hearing Research, 41*(2), 407–418. https://doi.org/10.1044/jslhr.4102.407

Tabors, P. O. (2008). *One child, two languages* (2nd ed.). Paul Brookes.

Thorn, A. S. C., & Gathercole, S. E. (1999). Language-specific knowledge and short-term memory in bilingual and non-bilingual children. *Quarterly Journal of Experimental Psychology, 52*(2), 303–324. https://doi.org/10.1080/713755823

Umbel, V. M., Pearson, B. Z., Fernandez, M. C., & Oller, D. K. (1992). Measuring bilingual children's receptive vocabularies. *Child Development, 63*(4), 1012–1020. https://doi.org/10.1111/j.1467-8624.1992.tb01678.x

Vugs, B., Cuperus, J., Hendriks, M., & Verhoeven, L. (2013). Visuospatial working memory in specific language impairment: A meta-analysis. *Research in Developmental Disabilities, 34*(9), 2586–2597. https://doi.org/10.1016/j.ridd.2013.05.014

Wealer, C., & Engel de Abreu, P. M. J. (2021). Assessments of working memory: A tool for differentiating between language disorder and language difference in multilingual contexts? *Approche Neuropsychologique des Apprentissages chez l'Enfant, 33*(171), 194–204. http://hdl.handle.net/10993/47439

Wiig, E. H., Secord, W. A., & Semel, E. M. (1992). *Clinical evaluation of language fundamentals – Preschool.* Psychological Corporation.

Windsor, J., & Hwang, M. (1999). Children's auditory lexical decisions: A limited processing capacity account of language impairment. *Journal of Speech, Language, and Hearing Research, 42*(4), 990–1002. https://doi.org/10.1044/jslhr.4204.990

Windsor, J., & Kohnert, K. (2004). The search for common ground: Part I. Lexical performance by linguistically diverse learners. *Journal of Speech, Language, and Hearing Research, 47*(4), 877–890. https://doi.org/10.1044/1092-4388(2004/065)

Windsor, J., Kohnert, K., Lobitz, K. F., & Pham, G. (2010). Cross-language nonword repetition by bilingual and monolingual children. *American Journal of Speech-Language Pathology, 19*(4), 298–310. https://doi.org/10.1044/1058-0360(2010/09-0064)

Author's Note

Correspondence concerning this article should be addressed to Dr. Lisa Archibald, School of Communication Sciences and Disorders, Elborn College, Western University, London, Ontario, Canada, N6G 1H1. Email: **larchiba@uwo.ca**

Acknowledgements

The first author of this study received funding from King Abdulaziz University, Saudi Arabia. The second author received a Discovery Grant from the Natural Sciences and Engineering Research Council, Canada.

Disclosures

No conflicts of interest, financial or otherwise, are declared by the authors.