Primary or "Specific" Language Impairment and Children Learning a Second Language

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Abstract

We review empirical findings from children with primary or "specific" language impairment (PLI) and children who learn a single language from birth (L1) and a second language (L2) beginning in childhood. The PLI profile is presented in terms of both language and nonlinguistic features. The discussion of L2 learners emphasizes variable patterns of growth and skill distribution in L1 and L2 which complicate the identification of PLI in linguistically diverse learners. We then introduce our research program, designed to map out common ground and potential fault lines between typically developing children learning one or two languages, as compared to children with PLI.

Keywords

SLI; sequential bilingual; developmental language disorders; nonlinguistic processing

This article considers language and nonlinguistic processing performance in two populations: children with primary or "specific" language impairment (PLI) and early sequential bilinguals-those children who learn a single language (L1) from birth and a second language (L2) beginning at some point in childhood. PLI is a high incidence developmental disorder affecting an estimated 5 to 7 percent of children, boys somewhat more than girls (Paul, 2001; Tomblin et al., 1997). At present, PLI is identified on the basis of low language performance in the face of otherwise typical development. Children with PLI fail to make expected progress in language with no evident cause for the delay (American Psychiatric Association, 1994; Bishop, 1992; Leonard, 1998). That is, observed language lags in PLI are not caused by frank sensory or cognitive impairment as is the case in communication deficits associated with hearing loss or Down syndrome. Although there is no clear lesion site, recent anatomical findings indicate a clear neurological component to PLI (see Ullman & Pierpont, 2005 for review). The social environments for children with PLI also do not differ from those of children who are developing language typically. PLI is the most common type of developmental language disorder and the most studied, for both practical and theoretical reasons.

As with children with PLI, early sequential bilinguals are also prevalent. Immigrant children who acquire a minority L1 at home and the majority community language as L2 are well-represented in almost every nation of the world, including western countries such as Australia, England, Canada, Germany, Sweden and the Netherlands. In the United States it is estimated that one of every five school children will be a recent immigrant and speak a language other than English at home by 2010 (U.S. Bureau of Census, 2000). Home languages include

Cantonese, Hmong, Russian, Spanish, Somali and Vietnamese as well as more than a hundred other languages. In addition, children in many countries learn an indigenous L1 from birth and begin learning a different national language (L2) when they attend formal educational programs. This is the case, for example, with Igbo and English in Nigeria or Náhuatl and Spanish in some parts of Mexico. Children learning a single minority L1 from birth and a majority L2 beginning at some point during early childhood may not be directly comparable to monolinguals in either language in terms of experience or performance. That is, L2 learners may perform below expected levels for monolingual peers on traditional language measures. This relatively low performance is not due to some weakness in the neurological or cognitive-linguistic processing system as is the case in PLI. Rather, low performance for L2 learners at certain points in time as compared to monolingual peers can be attributed to natural variation in language-learning experiences. The highly dynamic L1-L2 proficiency profile in developing sequential bilinguals combined with few appropriate standards of comparison for young L2 learners present educators and speech-language pathologists with significant practical challenges. At the same time, children learning an L2 present an attractive alternative comparison group for considering monolingual children with PLI.

Investigations of language and nonlinguistic processing in young L2 learners and children with PLI have the potential to provide a unique vantage point from which to consider fundamental relationships between language, experience and general cognitive mechanisms. Given the high incidence of both populations, a number of practical considerations also motivate the joint study of these two groups. Because L2 learners and children with PLI may perform comparably on traditional language measures, albeit for very different reasons, there is as yet no clear way to distinguish language differences from primary language disorders in school age L2 learners. This practical limitation has led to over-identification, under-identification or misidentification of PLI in L2 learners (see Kohnert, 2008 for discussion).

In the following section we summarize language and nonlinguistic findings in monolingual PLI. In the second major section we turn our attention to general language characteristics of minority L1, majority L2 learners. In the third section we introduce our research program, designed to investigate areas of overlap and divergence in language and nonlinguistic processing performance for these combined populations. We conclude with a discussion of our research findings in terms of their potential contributions to unified theories of language acquisition and use under diverse circumstances as well as to improvements in clinical service to linguistically diverse children with suspected PLI.

Monolingual children with primary or "specific" language impairment

Children with PLI, referred to by various names, have long been the subject of active investigation in a variety of disciplines. These various names include childhood aphasia, language acquisition disorder, language learning disability and, most consistently over the past two decades, specific language impairment or SLI. Recently the terms procedural language impairment (Ullman & Pierpont, 2005) and primary language impairment (Kohnert, 2008; Kohnert, Windsor & Yim, 2006; Windsor & Kohnert, in press) have been proposed to encompass the subtle nonlinguistic processing weaknesses that exist alongside the obvious lags in language (see following sections). The term primary language impairment, or PLI, is preferred here as it is most consistent with available evidence without presupposing a particular etiological cause onto the diagnostic category (cf. Tomblin, Zhang, Buckwalter & O'Brien, 2003).

At present PLI is identified only on the basis of behavioral data. Conventional criteria for a diagnosis of PLI include the presence of delays in language alongside motor functioning, hearing and performance IQ scores within the normal range. Language performance one to

two standard deviations below peers is considered the critical cut-off level for PLI. Although co-morbidity of PLI with other disorders is frequently found on clinical caseloads, for better or worse children who fall into multiple diagnostic categories are typically excluded from empirical studies. Results from twin studies indicate that PLI as well as typical language skill is heritable. A positive family history of language or learning impairment is considered a risk factor for PLI (Plomin & Dale, 2000).

As with other disorders, symptom severity may range from mild to severe and vary in the specific presentation across children or within the same child at different periods in his or her life. Presenting symptoms will also interact with the child's internal and external resources to determine the impact the language disorder will have on his or her academic and social-emotional development (see reviews in Kohnert, 2008; Thal & Katich, 1996). We now turn our attention to the considerable evidence that must be accounted for by theories of PLI in language as well as in nonlinguistic domains.

Salient deficits: Language characteristics in monolingual children with PLI

Historically, preschool children with PLI have been characterized primarily by their impoverished verbal morphology systems. Indeed, young English-speaking children with PLI tend to omit short, unstressed verb forms indicating tense or agreement such as third person singular –s, regular past tense –ed, and the verb "be" (e.g., Cleave & Rice, 1997; see Leonard, 1998 for review). In recent years this characterization has been both expanded and challenged along several dimensions.

First, viewing PLI as a primary deficit in verbal morphology ignores cross-linguistic evidence; both the types of grammatical deficits apparent in PLI and their prominence differ by language. Evidence from French-speaking preschoolers with PLI indicates that morphosyntax is no more impaired than other areas of language (Thordardottir & Namazi, 2007). Spanish-speaking children with PLI appear to have particular difficulty with noun morphology, such as adjective-agreement inflections, clitic pronouns (dame<u>lo</u> /give me <u>it</u>), plural nouns, and articles (Bedore & Leonard, 2001; Restrepo & Gutiérrez-Clellen, 2001). The morphosyntactic profile of children with PLI is clearly variable and likely dependent on language-specific features, such the consistency of grammatical forms and their semantic value.

In addition, the most salient linguistic characteristics of children with PLI vary according to age, in part reflecting developmental shifts in characteristics of unaffected age-peers on which performance standards are based. While grammatical difficulties are often the central deficit for children in the early elementary years, they may be less notable at other ages. Very young children who may go on to demonstrate PLI are initially identified on the basis of limited expressive vocabulary (e.g., Rescorla, 2005). As children move through school, they may demonstrate difficulty with narrative skills, producing narratives that are shorter or less complex than those of their peers (cf. Gutierrez-Clellen, 2004; Scott & Windsor, 2000). In addition, school-age children with PLI may have significant difficulty acquiring written language skills (Kamhi & Catts, 1999). The language domains affected by PLI may extend even beyond morphosyntax, vocabulary, and narratives, to social language. Children with PLI may have marked difficulty in using language for social purposes and in interacting with peers (e.g., Fujiki, Brinton, Morgan, & Hart, 1999; Gertner, Rice, & Hadley, 1994).

Thus, the classic view of PLI as a primary deficit in verbal morphology must be supplemented by studies of children at different ages and stages of development, who speak different dialects and languages as well as those documenting performance in other linguistic domains. However, it is also important to consider that these documented language behaviors may be surface characteristics of an underlying problem, and that these surface skills are also affected by a child's experiences. A different class of tasks, language-based processing tasks, attempts to

strip away the influence of prior language experience on task performance by using stimuli that are equally familiar or equally unfamiliar to all participants (cf. Campbell, Dollaghan, Needleman, & Janosky, 1997; Laing & Kahmi, 2005). Language-based processing measures have been proposed as potentially less-biased alternatives to more traditional language tests for identifying PLI in culturally or linguistically diverse learners. Yet even these potentially less-biased measures may differ in their power to identify PLI across languages. One type of processing measure, the repetition of nonsense words, has been widely and successfully used in English. English-based nonword repetition tasks have been shown to distinguish children with PLI from typical peers across a wide age range (Graf-Estes, Evans, & Else-Quest, 2007). However, preliminary results indicate the nonword repetition task may not be as powerful in other languages, such as Cantonese (Stokes, Wong, Fletcher, & Leonard, 2006).

Other processing-based language tasks have indicated that children with PLI process language at a somewhat slower or less efficient rate. On timed measures of language processing, such as naming familiar pictures, matching a foreign cognate word to a picture, and determining whether a string of sounds is a real word, English-speaking children with PLI are consistently slower than typically developing peers (Edwards & Lahey, 1996; Lahey & Edwards, 1996; Kohnert, Windsor, & Miller, 2004). However, these tasks have not yet been investigated in other languages to determine whether the pattern of slowing is consistent.

Though processing-based profiles of PLI may vary somewhat cross-linguistically, they present a potential advantage in tapping into the underlying deficit of PLI. Indeed, some evidence supports a processing deficit at the root of language difficulty in PLI. Hayiou-Thomas, Bishop, and Plunkett (2004) induced typically-developing English-speaking children to perform like children with PLI when stimuli were speeded (to simulate slowed processing) or lengthened (to simulate poor memory). The children demonstrated good performance on noun morphology and poor performance on verb morphology under these conditions. This pattern suggests that poor memory and slowed information processing may contribute to PLI, raising the question of whether deficits in memory and processing skills are specific to language domains or are more general (Leonard et al., 2007).

Beyond language: Weaknesses in general information processing in PLI

Despite average or above average nonverbal intelligence as measured by standardized tests, mounting experimental evidence indicates that many children with PLI have subtle weaknesses in basic nonlinguistic processing skills (see reviews in Bishop, 1992; Hill, 2001; Kohnert & Windsor, 2004; Leonard, 1998; and Ullman & Pierpont, 2005). That is, although inefficiencies in PLI may be most evident in the area of language, perhaps because of the considerable demands of real-time language use, inefficiencies are not exclusive to the language domain. At the group level, children with PLI have been found to be slower or less efficient than unaffected age peers on a range of perceptual processing, fine motor sequencing and cognitive imaging tasks. For example, children with PLI are less skilled in detecting pure tones of brief duration, in replicating a series of colored lights, in rapidly tapping their fingers, in moving pegs along a board, in stringing beads, and in mentally rotating geometric shapes (e.g., Bishop, 1992; Johnston & Ellis Weismer, 1983; Miller et al., 2006; Miller, Kail, Leonard, & Tomblin, 2001; Owen & McKinlay, 1997; Powell & Bishop, 1992; Tallal & Piercy, 1974; Uwer, Albrecht, & von Suchodoletz, 2002; Windsor, Milbrath, Carney, & Rakowski,2001).

One argument is that nonlinguistic processing weaknesses may co-occur with the defining language deficit in PLI, but they are not related. To address this issue, Viding and colleagues (2003) investigated the extent to which PLI in one twin predicted nonlinguistic ability in a co-twin. Participants were 160 monozygotic and 131 same-sex dizygotic four-year-old sets of English-only speaking twins. PLI was defined conventionally: scores for participants with PLI fell below the 15th percentile on a general language battery and within the normal range on a

standardized nonverbal IQ measure. Key findings were that language problems in one twin predicted poor nonverbal ability in the co-twin, with the strength of this predictive relationship greater for monozygotic than dizygotic twins (Viding et al., 2003; see also Bishop, 2002). These results may provide the clearest evidence to date that general genetic factors implicated in PLI include language as well as subtle nonverbal problems. It remains open whether nonlinguistic and language deficits in PLI are correlated due to a common underlying neurological deficit (Ullman & Pierpont, 2005) or causally related, with subtle general motor, perceptual and cognitive weaknesses resulting in the obvious lags in language (e.g., Bishop, 1994; Windsor, 2002; see also Leonard 1998 and Ellis Weismer & Evans, 2002 for reviews).

Treatment studies that examine language change following the training of nonlinguistic processing skills may shed light on the nature of the relationship between general cognitive processing mechanisms and specific language abilities. To our knowledge there are no published treatment studies investigating the relationship between language and nonlinguistic processing in children with PLI. A few studies indicate that general cognitive treatments result in some improved language performance in adults with aphasia, an acquired primary language impairment (e.g., Coehlo, 2005; Helm-Estabrooks, 2000; Kohnert, 2004). Results from studies documenting nonlinguistic processing weaknesses in children with PLI combined with evidence of cross-domain transfer following nonlinguistic treatment in adult aphasia indicate, at a minimum, that this is a viable area for future investigation. A recent single-subject experimental design study in our research clinic treated nonlinguistic memory and general information processing speed in two English-speaking children with severe PLI. Preliminary results for both children indicated notable improvements in language may accompany such training. Improvements in lexical access, as demonstrated by performance on rapid automatic naming tasks, expressive vocabulary testing, and expressive sentence formulation were the most salient effects of the nonlinguistic treatment (Ebert & Kohnert, in preparation).

In summary, the PLI profile includes a variety of performance weaknesses on tasks that require little or no language ability. These collective findings qualify characterizations of PLI as a "specific" language impairment. However, the precise nature of the relationship between nonlinguistic and language weaknesses within PLI is unresolved. On the practical side, the utility of nonlinguistic processing tasks for either identifying PLI or for treating PLI once identified requires empirical investigation. Research on nonlinguistic information processing in PLI has been restricted to children who learn a single language. It remains an open question as to whether nonlinguistic processing deficits documented in the monolingual literature may be used to separate children with PLI from typically developing children learning two languages.

Early sequential bilinguals: Children learning an L2

In this section we focus on general language characteristics in a particular type of early sequential bilinguals-- minority L1 speakers who are introduced to a majority L2 in early childhood. Most children acquiring a majority L2 continue to need L1. For example, native Spanish-speakers in the U.S. may use L1 to communicate with parents and other family members and use English (L2) in educational and community settings. In an effort to recognize the continuing relevance of both languages, L2 learners are also referred to in the developmental literature as early sequential bilinguals—children with consistent experience in one language beginning at birth, who then acquire L2 at some point during childhood.

There are at least three defining characteristics of language proficiency in these early sequential bilinguals. First, both absolute and relative levels of ability in L1 and L2 are fluid, changing with age and corresponding experiences in each language across development. Second, during the prolonged developmental period, a single language may not be completely "dominant" or

stronger: relative strengths and weaknesses may be differentially distributed across the two languages. Third, there is considerable individual variation in acquisition rates and outcomes, even among children acquiring the same two languages under very similar circumstances.

Until the introduction of L2, L1 acquisition is expected to parallel that of monolingual children given comparable social, economic and health circumstances. However, once a majority L2 is introduced a number of different patterns of L1 development have been observed in early sequential bilinguals. These patterns include continued L1 growth but at a slower pace than is expected of monolingual children (Jia, Kohnert, Collado, & Aquino-Garcia, 2006; Kohnert & Bates, 2002; Kohnert, Bates, & Hernandez, 1999), a leveling off or plateau in L1 ability (Kan & Kohnert, 2005); or a regression or "loss" of previously attained L1 proficiency (Anderson, 2004; Jia & Aaronson, 2003; Francis, 2005; Leseman, 2000; Wong-Fillmore, 1991). These patterns negate the validity of direct comparisons between L1 in early sequential bilinguals and monolingual L1 speakers for the purpose of separating typical from impaired language development. Factors that contribute to slowed rates of growth, plateaus or regression in L1 include low social status of a minority L1 in the broader community, immersion in L2 in early childhood educational programs with few opportunities to use L1 outside the home, and the child's level of L1 development at the time L2 is emphasized (see Anderson, 2004 and Kohnert, 2008 for reviews). Some aspects of language are also more susceptible to decline in the face of reduced input whereas others are more resilient (cf., Jia et al., 2006; Montrul, 2005).

In the incipient stages of L2 learning, L1 ability is obviously greater. With the developing child's increasing experiences in L2, however, studies consistently show that the majority L2 gradually emerges as the stronger or "dominant" language (e.g., Eilers & Oller, 2003; Jia, Aaaronson, & Wu, 2002; Kohnert et al., 1999; Rolstad, Mahoney, & Glass, 2005; Yeni-Komshian, Flege, & Liu, 2000). The transition from greater proficiency in L1 to L2 is evident after several years of experience with the majority language. This long-term outcome of greater ability in L2 for minority L1 speakers reflects the rapid acquisition of L2 alongside the slowing, stabilization or regression of L1, resulting from different social experiences, opportunities and demands for the two languages.

Even when L2 becomes the child's relatively stronger language, it may not be the case that his or her L2 abilities will be directly comparable to those of monolingual speakers. For example, proficient school-age sequential bilinguals were found to be disproportionately affected by classroom noise on a phonological processing task in L2 (English) as compared to monolingual English-only speaking peers (Nelson, Kohnert, Sabur, & Shaw, 2005). Scores on standardized vocabulary measures for early sequential bilinguals may also be significantly lower than those reported for monolingual children (e.g., Peña, Iglesias, & Lidz, 2001; Peña & Quinn, 1997; Umbell, Pearson, Fernández, & Oller, 1992; Schiff-Meyers, 1992). At the morphosyntactic level, error patterns by typical L2 learners have been found to be remarkably similar to error patterns produced by monolingual speakers with PLI (Håkansson & Nettelbladt, 1996; Paradis, 2005; Paradis & Crago, 2000). These grammatical comparisons suggest children with PLI and typical L2 learners follow similar developmental paths in the early stages of grammatical acquisition. Persisting differences in language performance between sequential bilingual children and their monolingual peers reflect fundamental differences in language experiences between these groups.

During the gradual shift from overall dominance in L1 to L2 there is the potential for distributed language abilities along the way, in terms of strengths and weaknesses across the range of skills that comprise language proficiency. Proficiency in language is constructed from interwoven layers of knowledge and processing skills in receptive and expressive domains at multiple linguistic levels (Kohnert, 2008). Different aspects of language proficiency come on-line at different times during development for monolingual children. For early sequential bilinguals,

subcomponents of language proficiency come on-line at different times as well and may be developed to different levels in each language, depending on communicative demands and opportunities. If tested on the full range of tasks that comprise language proficiency at any point during this dynamic period of development, a child may perform better on some tasks in L1 and better on others in L2 (e.g., Kohnert & Bates, 2002; Pham & Kohnert, 2007; Snow, 1990; 1991).

In addition to relative strengths and weakness across language tasks, distributed knowledge may also be absolute, as when some knowledge or processing skills are present only in one language but not the other. This "distributed versus duplicated" nature of language has been most studied in the area of lexical-semantic skills, using parallel versions of vocabulary tasks administered in L1 and L2. Researchers score performance by identifying concepts lexicalized in both languages (such as a piece of furniture used for sitting named alternatively as "silla" and "chair" by a Spanish-English speaking child) as compared to concepts named or identified in one language but not the other. Results from these types of comparisons consistently show that a significant portion of children's vocabulary knowledge in both receptive and expressive domains is unique to each language (e.g., Kan & Kohnert, 2005; Pearson, Fernández, & Oller, 1993; Peña, Bedore, Zlatic-Giunta, 2002; see Peña & Stubbe-Kester, 2004 for review). With increasing proficiency in both languages the proportion of distributed lexical-semantic information decreases as cross-linguistic duplication of world knowledge increases (Kan & Kohnert, 2005). However, it is also the case that even for proficient adult bilinguals, there remains some distribution of lexical knowledge as reflected by performance on vocabulary measures (Kohnert, Hernandez, & Bates, 1998). From a practical standpoint these findings indicate that single language scores will not adequately capture the total vocabulary knowledge of many sequential bilinguals.

In addition to the dynamic and distributed patterns of L1 and L2 characteristic of early sequential bilinguals, substantial individual variation is also endemic in this population. Although individual variation is inherent in typical monolingual acquisition, it is further compounded in sequential bilinguals by the number of languages learned interacting with cognitive, neurological, social and emotional development. Considerable individual variation in performance is found even within relatively homogenous participant groups (e.g., Kan & Kohnert, 2005; Kohnert, 2002; Kohnert & Danahy, 2007). For example, Kohnert, Kan, and Conboy (2007) used a story retell task to measure lexical diversity and grammatical development in both L1 (Hmong) and L2 (English) in 3 to 5-year old children. All participants attended the same early childhood educational program, had similar cultural and language experiences and were drawn from the same socioeconomic group. Among this relatively homogenous group, 79% (15/19) of participants demonstrated greater L1 performance on both word and grammar measures; two children demonstrated comparable performance in L1 and L2 and two other children had greater L2 performance on both lexical and grammatical measures.

A practical implication from research which has identified core characteristics of L1 and L2 proficiency in early sequential bilinguals is that single language assessments or monolingual comparisons on conventional language measures may not adequately separate typical learners with diverse experiences from their peers with PLI. Alternative points of comparison between typical L2 learners and children with PLI may be on either language-based processing tasks or nonlinguistic tasks. These comparisons are discussed in the following section.

Comparisons of typical L2 learners and monolingual speakers with PLI

Our "Common Ground" research project is designed to identify potential fault lines between children with PLI and typically developing children learning a first or second language. In this

section we describe a series of studies in which we compared performance of a cohort of 100 children; 22 typically developing sequential Spanish-English bilinguals (BI) who learned Spanish as L1 then English as L2, 28 monolingual English speakers with PLI, and 50 typically developing monolingual English speakers (EO). All children lived in the United States and ranged from 8 to 13 years old. Each child met criterion performance on language, nonverbal intelligence, hearing, and educational measures to ensure that they were typically developing; and to document the language impairment in the PLI group. The sequential bilingual children had 4 to 8 years of consistent English experience, were proficient in both Spanish and English, and were performing at or above grade level (for full details see Windsor & Kohnert, 2004). Our main goal was to identify points of commonality and divergence for the BI children and children with PLI across a range of cognitive tasks in a systematic way that has not been attempted previously The17 tasks were designed to emphasize perceptual-motor demands, nonlinguistic, or linguistic demands. All tasks were administered in English. By using this type of within-language cognitive 'continuum,' we were able to explore the different mechanisms that appear to be at play in sequential bilingual and PLI performance, and to clarify the nonlinguistic deficits that have been proposed for PLI.

We anticipated that the PLI group would perform with less skill than the EO group on the language tasks and with less skill than the two typically developing groups on perceptual-motor and nonlinguistic tasks – with deficits in these areas known to accompany the PLI profile. We also expected that the language tasks would favor the EO rather than the BI group because of the experience-dependent nature of these tasks, but we expected that the nonlinguistic measures should be less confounded by the groups' different language experiences. Finally, Bialystok and colleagues (Bialystok, 1999; Bialystok & Majumder, 1998; Bialystok & Martin, 2004) have argued that bilingual language learners may have an advantage over monolingual individuals on cognitive tasks that emphasize selective attention and executive control. Our tasks were not designed to manipulate attentional demands; no task prima facie required inhibition of irrelevant information. Thus, it was not anticipated that the BI group would outperform the EO group in these tasks (see also Bialystok, 2006 and Bialystok, Craik, & Ryan, 2006 for tasks on which no adult bilingual advantage has been found).

The task results are summarized in Table 1, with most tasks being speeded tasks in which response time (RT) for accurate responses was the main variable of interest. Table 1 shows the tasks in five different groups that each represented different cognitive demands. The first group of four tasks carried a heavy perceptual-motor versus symbolic component. Group I included, for example, a choice visual detection task in which children pressed one of two response buttons to indicate the appearance of a blue or red shape on a computer screen. As expected, both typically developing groups were equivalently faster than the PLI group in these tasks, with the difference most apparent in the choice visual detection task (Kohnert & Windsor, 2004).

The five tasks in Group II included nonlinguistic tasks that presumably are more cognitively demanding than the perceptual-motor tasks included in Group I, but require less complex symbolic manipulation than mental rotation or form completion, included in Group III. These tasks were expected to show weaker PLI performance and equivalently robust EO and BI performance. The one auditory task showed the anticipated equivalence in accuracy of the EO and BI groups and poorer PLI performance (Yim, Kohnert, & Windsor, 2005). Also, when there were group differences on the four visual tasks, the EO group outperformed the PLI group (Windsor, Kohnert, Loxtercamp, & Kan, in press). In two tasks, visual serial memory and visual number search, the BI group tended to outperform the EO group, although this difference was not statistically significant. However, the BI group's performance clearly fell at a midpoint between the EO and PLI groups' accuracy for visual serial memory, and for RT in odd man out, and visual and auditory pattern matching. This result was unanticipated as both EO and

BI groups were comprised of typically developing children, with presumably intact cognitive processing systems.

One partial explanation for the unexpected findings on some tasks in this group is that there is a speed-accuracy tradeoff for the bilingual children, at least for auditory pattern matching and also for visual serial memory. However, this suggestion does not explain why these particular cognitive tasks produced this effect and why the bilingual group was more affected than the two monolingual groups. Individual variation in adult performance on cognitive tasks has been attributed to a range of factors, such as stimulus features, task complexity, and cognitive style (Nęcka & Orzechowski, 2005). Whether these types of factors influence individual variation during development has received much less attention (though see Thomas & Karmiloff-Smith, 2003).

Group III included two higher-level symbolic tasks, mental rotation and form completion (Windsor et al., in press). These tasks are complex visual tasks assessing mainly spatial simulation and mental analogy. On these cognitively demanding nonlinguistic tasks we anticipated comparable performance between the two typically developing groups and lower performance by children with PLI. We found that BI and EO groups' accuracy was higher than the PLI group's accuracy on both tasks and their mental rotation RT was also faster. The BI group was statistically comparable in RT to the EO group, yet not clearly separated statistically from the PLI group. The mean RT of the BI group again fell at a midpoint between the EO and PLI groups' mean RT. This may speak to verbal mediation or strategy use invoked on these the two symbolic tasks.

Groups IV and V both included tasks with English stimuli, with tasks that were more heavily experience-dependent in Group V. Group IV was composed of four tasks with some level of linguistic mediation, but which did not draw heavily on acquired semantic or syntactic knowledge of English (Danahy, Windsor, & Kohnert, 2007; Kohnert, Windsor, & Yim, 2006; Windsor et al., 2007). Group V included a conventional speeded confrontation naming and word recognition task (Windsor & Kohnert, 2004). The experiential distinction between these two tasks and the span and repetition tasks in Group IV is somewhat arbitrary, with the key distinction being that the Group V tasks involved English-specific semantic knowledge.

By definition, we expected that the PLI group would show poorer performance than the EO group on all six of the tasks in Groups IV and V. The anticipated results were found across tasks, with poorer PLI RT but not accuracy in word recognition. Because the two tasks in Group V emphasized accumulated English language knowledge or proficiency, we also expected that they might disadvantage even the proficient sequential bilingual children relative to the EO children who had several more years of English experience. This proved to be the case, with the group differences on these tasks favoring the EO group. The BI and PLI groups showed similar performances, although presumably for different reasons – an underlying deficit in cognitive integrity for the PLI group and less English exposure for the BI group. However, three of the four Group IV tasks also placed the BI group at a relative disadvantage to the EO group, the two span tasks and the nonword repetition task. This suggests that language experience also plays a role in these verbal working memory tasks. Only the simple arithmetic task separated the EO and BI groups from the PLI group, with the results for this task similar to the results for the higher-level symbolic tasks in Group III.

In summary, whether bilingual or monolingual, typically developing children generally outperformed monolingual children with PLI on a broad range of perceptual-motor tasks and higher-level symbolic tasks. The most robust differences between typical (EO and BI) and atypical (PLI) performance were found on four different nonlinguistic tasks with varying processing demands: Choice Visual Detection (considered here as a perceptual motor task and

discussed in Group I), Auditory Pattern Matching (lower-level symbolic task from Group II), and Mental Rotation and Visual Form Completion (higher-level symbolic tasks from Group III) (Table 1). Linguistically mediated/language tasks favored typically-developing EO children who had longer experience with the target language, even when compared to the relatively proficient L2 speakers included here in the BI group. These results replicate and extend separate bodies of literature on sequential bilingual and PLI performance. These group results may mask individual variation for typical sequential bilinguals and monolingual children with PLI. However, they provide a unique point of departure for examining different instances of typical bilingual and monolingual language learning and language impairment within the same cognitive framework.

The search for common ground: Contributions and future directions

The innovation of the "Common Ground" research project described in the previous section is that it takes the fundamental step of addressing the PLI phenotype within the context of linguistic diversity. This is done by comparing performance between children with PLI to that of typically developing L2 learners on a range of tasks that vary in cognitive-linguistic processing demands. Our research at the intersection of PLI and L2 learners has four basic premises. First, performance on conventional language tasks is inherently affected by previous language experience, presenting a systematic task bias. It may be, however, that selected processing tasks may help to identify robust cognitive underpinnings for language that are relatively invariant across development and diverse language experiences. Second, the repeated finding that many children with PLI show subtle nonlinguistic deficits provides a new theoretical and empirical window to characterize PLI performance, independently as well as in relation to other populations. Third, to develop a reliable phenotype that is useful for research and clinical purposes, we must examine the processing abilities of children learning two languages, along with those of monolingual children. Fourth, a combination of processing-based tasks rather than performance on a single measure, may better characterize the PLI profile and developmental trajectory. Systematic exploration of task and child factors that underlie within-and across-group performance seems critical to help shape robust theory. To inform our broader understanding of relationships between cognition, language and their related neurological underpinnings it is important to delineate which aspects of performance along the cognitive continuum are influenced by variations in learner experiences and which aspects are more closely related to the integrity of the underlying processing system.

To date, results from our combined studies point to clear areas of overlap among typical monolingual and bilingual learners as well as fault lines that separate these typical learners from children with PLI. The most robust areas of separation between children with PLI and their typical, albeit linguistically diverse, peers were on nonlinguistic tasks. These nonlinguistic tasks invoked different cognitive demands, relying almost exclusively on perceptual motor processing to higher-level symbolic processing demands. Importantly, we have also begun the process of identifying those nonlinguistic tasks which are less informative in tapping into the integrity of the cognitive-linguistic processing system while simultaneously bypassing variation in social circumstances.

Tasks that required language mediation generally placed even sophisticated L2 learners at a disadvantage, at least compared to typically developing monolingual peers. However, it was also the case that language processing measures, as opposed to traditional experience dependent measures, may present some opportunities for valid comparisons among linguistically diverse learners when used as part of an assessment battery (e.g., see counting span task in Group IV). Typical L2 and PLI group performance overlapped on the more heavily mediated language tasks (Group V). Thus, performance at the very ends of the cognitive continuum seem to be more clear; tasks in the middle (e.g., Group II) more puzzling and, as

such, in need of additional investigation. Documenting more precisely where the nonlinguistic weaknesses are in PLI as compared to diverse groups is an essential step as it paves the way to more refined methods for testing hypothesized causal factors in PLI (cf. Ullman & Pierpont, 2005). From a practical perspective, findings from these combined studies also point us in a new direction for the development of less-biased assessment and, possibly, intervention techniques. Specifically, it may be that performance on some set of nonlinguistic processing tasks can be used to help identify children with PLI in a linguistically diverse population. It may also be the case that treatment programs that aim to improve a subset of nonlinguistic information processing abilities may help to ameliorate language in PLI. Importantly, for both assessment and intervention the potential use of nonlinguistic techniques would serve to complement, not replace, language assessment and treatment measures.

Despite promising results from the first round of studies reported here, there are a number of formidable issues yet to be addressed. Important for both theoretical and practical purposes, it remains to be determined if findings documented at the group level are both sensitive and specific to PLI when applied to individual children. In addition, given changes in the most salient symptoms of PLI across development, it will be important to determine if the weaknesses in nonlinguistic processing for the PLI group found here that distinguished them from L2 learners are stable for either younger or older children. Also, it will be important for future studies to include a broader skill range in both the intact and impaired groups to determine a range of typical performance and critical cut-offs, should they exist.

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Table 1

Tasks	Description	Accuracy	Response time
I. Perceptual-motor tasks			
Simple auditory detection[1]	Identifying the presence of a pure tone	---	EO = BI > PLI *ns*
Choice auditory detection[1]	Identifying the presence of 1 of 2 pure tones	---	EO = BI > PLI *ns*
Simple visual detection[1]	Identifying the presence of a colored shape	---	EO = BI > PLI *ns*
Choice visual detection[1]	Identifying the presence of 1 of 2 colored shapes	---	EO = BI > PLI
II. Lower-level nonlinguistic tasks			
Visual odd man out[3]	Identifying non-paired stimulus in spatial displays	---	EO > PLI, BI = EO and PLI
Visual pattern matching[3]	Comparing shape displays with 1- to 4-sec delay	---	EO > PLI, BI = EO and PLI
Auditory pattern matching[2]	Comparing 2- to 5-tone auditory sequences	EO = BI > PLI	EO > PLI, BI = EO and PLI
Visual serial memory[3]	Repeating 2- to 5-item sequences in visual displays	EO > PLI, BI = EO and PLI	EO = BI = PLI[f]
Visual number search[3]	Identifying target numbers in serial displays	---	EO = BI = PLI[f]
III. Higher-level symbolic tasks			
Mental rotation[3]	Matching nonsense shapes at 4 rotation angles	EO = BI > PLI	EO = BI > PLI *ns*
Visual form completion[3]	Mentally assembling 2 to 5 component shapes[a]	EO = BI > PLI[e]	EO > PLI, BI = EO and PLI
IV. Linguistically-mediated tasks			
Simple addition[3]	Verifying 2- to 5 single-digit sums in visual displays	---	EO = BI > PLI *ns*
Counting span[4]	Recalling lists of counted dots[b]	EO > BI > PLI	*n/a*
Listening span[5]	Recalling lists of sentence-final words[c]	EO > BI = PLI	*n/a*
Nonword repetition[5]	Imitating 1- to 4-syllable nonwords[d]	EO > BI > PLI[e]	*n/a*
V. Language tasks			
Confrontation naming[6]	Naming pictures with varying age of acquisition	EO > PLI > BI[e]	EO > BI = PLI
Word recognition[6]	Lexical decision with varying word frequency	EO = BI = PLI	EO > BI = PLI[e]

Note.

EO = English-only speaking children; BI = Bilingual Spanish-English speaking children; PLI = English-only speakers identified with primary language impairment using conventional criteria.

[1] Kohnert & Windsor (2004),

[2] Yim, Kohnert, & Windsor (2005),

[3] Windsor, Kohnert, Loxtercamp, & Kan (in press),

[4] Danahy, Windsor, & Kohnert (2007),

[5] Kohnert, Windsor, & Yim (2006),

[6] Windsor & Kohnert (2004).

[a] adapted from Likert and Quahsa (1970)

[b] adapted from Case, Kurland, and Goldberg (1982)

[c] from Gaulin and Campbell (1994)

[d] from Dollaghan and Campbell (1998)

[e] The pattern was evident only in the hardest task condition (i.e., 5-component shapes, 4-syllable nonwords, words with a late age of acquisition, and nonwords, respectively). There was equivalent performance across groups in easier conditions in Visual form completion, Confrontation naming, and Word recognition. The EO group outperformed BI and LI groups in easier conditions in nonword repetition.

[f] Although groups' performances were statistically equivalent, the BI group tended to be a little faster than the other two groups.

--- identifies RT tasks in which there was no significant difference among groups but in which the expected high accuracy may have precluded small group differences; *n/a* indicates no RT measure was obtained; > identifies a statistically significant difference; = identifies no significant difference; *ns* identifies a non-significant but clear trend. As might be expected with these sample sizes, there was within-group variability that precluded statistical significance in some instances. Non-significant trends are given in cases where effect size and visual inspection showed an observable group difference.