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Cognitive Underpinnings of Language: A Framework for the Study of Multilingualism

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Abstract: An increase in research demonstrating the evidence of a connection between children's cognitive skills and language abilities is available. Accordingly, cognition would be a necessary component to the development of language skills. Indeed, both working memory and sustained attention deficits have been linked to primary language impairments. The impact of multilingualism on cognition has also been greatly documented. Although some studies suggest a cognitive advantage of multilingualism, debates on this topic still remain. Moreover, the influence of cognition on the language development of multilingual children has yet to be well documented. For instance, do cognitive skills have the same impact on the language abilities of multilingual children than they have on monolingual children? The purpose of this article is to propose a framework for the study of multilingualism, which would involve the analysis of multiple cognitive abilities and that would focus on the cognitive underpinnings that are common to all languages.

Keywords: Multilingualism, Language Development, and Cognition

Introduction

There is growing evidence to support the theory that cognitive and language skills are correlated in children (Ebert and Kohnert 2009; Kohnert and Ebert 2010). Moreover, a relationship between language skills, processing speed, sustained attention and working memory has been documented (Archibald and Gathercole 2007; Bishop and Norbury 2005; Gathercole 2006; Hoffman and Gillam 2004; Kohnert and Windsor 2004; Miller, Kail, Leonard, and Tomblin 2001; Montgomery 2008; Windsor and Kohnert 2009). There is also evidence that children with primary language impairment (PLI) perform below their peers on nonlinguistic cognitive processing tasks, although they do not perform below the norm (Ebert, Rentmeester-Disher, Kohnert 2012). Essentially, cognitive skills would be needed for children to develop their language skills. Even though the impact of multilingualism and bilingualism on cognition is still an open debate, some studies suggest a cognitive advantage to being multilingual.

Recent studies (e.g. Ebert, Rentmeester-Disher, Kohnert 2012), have suggested that language skills can be improved by working on cognitive skills. The use of a cognitive approach could prove to be successful in improving linguistic skills in more than one language at once. Thus increasing efficacy of treatment by reducing overall intervention time. This method could also be beneficial for Speech-Language Pathologists (SLPs) who need to intervene in a language unknown or unfamiliar to them.

Since cognitive and linguistic skills are connected, the purpose of this article is to propose a framework for the study of bilingualism and multilingualism, which would involve the analysis of multiple cognitive abilities and that would focus on the cognitive underpinnings that are common to all languages. When assessing the linguistic competencies of multilingual children with primary language impairment (PLI), cognitive skills such as processing speed, working memory and sustained attention should be incorporated within the evaluation process. Moreover, according to Ebert et al. (2012) the addition of non-linguistic cognitive tasks should be included within the intervention plans of multilingual children who have PLI. The strategy would ensure that prerequisite skills, such as cognition, are acquired to facilitate the acquisition of linguistic skills.

Cognitive Underpinnings of Language

The relationship between cognitive and language skills is of growing interest. According to numerous studies, processing speed, sustained attention and working memory are all correlated with language skills (Archibald and Gathercole 2007; Bishop and Norbury 2005; Gathercole 2006; Hoffman and Gillam 2004; Kohnert and Windsor 2004; Miller, Kail, Leonard, and Tomblin 2001; Montgomery 2008; Windsor and Kohnert 2009). Indeed, learning language without sufficient cognitive skills could prove to be difficult. Researchers now recognize that cognitively demanding tasks can modulate the development of the brain, in turn modifying cognition (e.g. Green and Bavelier 2003; Maguire et al. 2000; Polk and Farah 1998; Salthouse and Mitchell 1990). If we think of learning a new language as a cognitively demanding task, acquiring a new language could therefore improve cognition.

Bilingualism, Multilingualism and Language Development

Although bilingual children's experiences with each language can vary greatly, simultaneous bilinguals can become proficient in both languages if a continuous input and new opportunities to develop each language are present (Kohnert 2009). As for sequential bilinguals, they will usually be more skilled in their first language (L1) than in their second language (L2) (Kohnert 2007; Kohnert 2010; Meisel 2006; Valdés 2003). However, the language dominance can fluctuate across ages and learning opportunities (Kohnert 2010). That being said, the dominant language may not always be the strongest in all settings; some tasks may be better performed in L1 and others in L2 (e.g. Kohnert and Bates 2002; Ordóñez, Carlo, Snow, and McLaughlin 2003; Peña, Bedore, and Zlatic-Giunta 2002; Snow 1990; Snow 1991). This phenomenon may be apparent for children who use each language with different communication partners (Kohnert 2010), which may be the case for a child who speaks one language with one parent and another with the other parent. Another example would be a child that speaks one language at home and another at school.

Cross-language associations or transfers may be present in children learning more than one language (Bialystock 2001; Kohnert 2010). A bilingual advantage in bilingual children has been documented on some basic cognitive processing tasks (e.g. Bialystok 2007). Research has demonstrated that in bilinguals, both languages are always active to a certain degree, even in situations that support only one of the languages (e.g. Francis 1999; Grainger 1993; Kroll and de Groot 1997; Rodriguez-Fornells, Rotte, Heinze, Nosselt, and Munte 2002; Thierry and Wu 2007). A 2011 study by Bialystock found that balanced bilingual children performed better than monolingual children in dual-modality conditions, demonstrating a bilingual advantage in executive control (selective attention, inhibition, shifting and working memory).

Cognition and PLI

Children with PLI have difficulty learning language (Kohnert 2010) and represent approximately 7% of school-aged children (Tomblin et al. 1997). These children typically have a persisting language delay (American Psychiatric Association 1994; Bishop 1992; Leonard 1998). Within a clinical setting, PLI defines language learning difficulties in the absence of other developmental difficulties (Kohnert 2010; Tomblin et al. 2003). This suggests that the difficulties occur mainly within the language domain, without implying that treatment of information or working memory difficulties could not be co-existent.

Children with PLI do not have a specific lesion site, nor are their language delays caused by a clear cognitive impairment (Kohnert, Windsor, and Ebert 2009). However, new findings support the possibility of a neurological component to PLI (see Ullman and Pierpont 2005 for a review). According to Kohnert (2010), PLI is due to innate factors that negatively interact with the demands of language-learning. Some of the reported markers of PLI are limited vocabulary

(e.g., Gray 2004; Rescola 2005), morphosyntactical difficulties (e.g., Bedore and Leonard 2001; Cleave and Rice 1997), shorter and less complex narrative discourse (e.g., Gutiérrez-Clellen 2004; Mayer-Crittenden 2013; Scott and Windsor 2000), and difficulties with social language (Fujiki et al. 1999). Children with PLI are also at risk for reading and writing difficulties (Bishop and Snowling 2004). This could in turn put them at risk for reduced academic, economic, and social outcomes (Kohnert 2010). Until recently, children with a language impairment were thought to have intact cognitive skills (Leonard 1998). We now know that children with PLI may have general processing capacity limitations which lead to a reduced performance in both the verbal and nonverbal areas (Leonard et al. 2007; Miller et al. 2001; Weismer and Hesketh 1996).

There is growing evidence that children with PLI have poor performances in cognitive non-linguistic areas. Attention, working memory and processing speed are examples of functions that would be affected in children with PLI (Archibald and Gathercole 2007; Bishop and Norbury 2005; Gathercole 2006; Hoffman and Gillam 2004; Kohnert and Windsor 2004; Miller, Kail, Leonard, and Tomblin 2001; Montgomery 2008; Windsor and Kohnert 2009). It has been proposed that children with PLI may experience limitations in general processing capacity which lead to poor performances in both verbal and non-verbal tasks (e.g. Leonard et al. 2007; Miller, Kail, Leonard, and Tomblin 2001; Weismer and Hesketh 1996).

Sustained attention would be more impacted when children with PLI process information that is language-based than information nonlinguistic based (Ebert and Kohnert 2011). According to Marton (2008), children with PLI have difficulty controlling their attention, which was observed with the Wisconsin Card Sorting Task (reference WCST). The phonological loop, or verbal working memory, provides a temporary storage of verbal information and plays an important role in sub-vocal rehearsal (Baddeley and Hitch 1974). A study by Leonard et al. (2007) demonstrated a causal relationship between processing speed and PLI. Language skills could therefore be predicted from non-linguistic factors.

It is plausible that these children have difficulty processing the information that is needed to acquire language adequately. That is, language itself may not be the problem; instead, processing limitations may significantly affect the child's ability to access language from the input and, once (finally) acquired, use it with facility. (Leonard et al. 2007, p. 408)

Multilingualism and Cognition

Speaking two or more languages on a daily basis produces changes in cognition (e.g., Bialystok 2009; Morales, Calvo, and Bialystok 2013). *"The mechanism by which bilingualism leads to this experience-induced cognitive change is likely based on the need to monitor attention to the target language in the context of joint activation of the other language (Morales et al. 2013, p. 188)."* Researchers now recognize that cognitively demanding tasks can modulate the development of the brain, in turn modifying cognition (e.g. Green and Bavelier 2003; Maguire et al. 2000; Polk and Farah 1998; Salthouse and Mitchell 1990).

A recent study by Morales et al. (2013) demonstrated an advantage for bilingual children in working memory. Indeed, they found that bilinguals outperformed monolinguals in response time and accuracy. Since the bilingual children's advantage was larger in the more difficult trials, other cognitive functions would also come into play during these tasks. A bilingual advantage has been shown in children as young as 24 months who have minimal experience in language production (Poulin-Dubois, Blaye, Coutya, and Bialystok 2011). *"...it is clear that bilingualism is an experience that has significant consequences for cognitive performance (Poulin-Dubois et al. 2011, p. 569)".*

Bilingual or multilingual children with PLI have difficulty learning all of the languages to which they are exposed (Kohnert 2010). Indeed, they often learn both languages at a slower pace

(Hakansson, Salameh, and Nettelblatt 2003). There is no evidence indicating that bilingual children with PLI have an advantage or are at a disadvantage versus monolingual children with PLI (Kohnert 2010). In a study by Kohnert, Windsor, and Ebert (2009), bilingual children with PLI had the same cognitive processing weaknesses as monolinguals with PLI.

Intervention of Non-Linguistic Cognitive Skills

Ebert, Rentmeester-Disher, and Kohnert (2012) conducted a study that looked at different intervention models for working with bilingual children with PLI. In fact, they targeted cognitive skills during intervention in order to see if this would have an effect on the linguistic skills in both languages spoken. For the treatment of cognitive skills to impact the language abilities of children with PLI, a correlation and a causal association are required between non-linguistic processing weaknesses and language skills (Ebert, Rentmeester-Disher, and Kohnert 2012). New studies have shown that it is possible to improve language learning in children who have PLI by working on cognitive non-linguistic processing tasks (e.g. Ebert and Kohnert 2009; Ebert, Rentmeester-Disher, and Kohnert 2012). In 2009, Ebert and Kohnert's study revealed that two children aged 7 and 8 with PLI made gains in expressive language skills after participating in activities targeting auditory memory and speed of processing for visual information. In 2012, Ebert, Rentmesster-Disher, and Kohnert revealed that two bilingual children (Spanish-English) made gains in cognitive non-linguistic processing skills as well as gains in language ability after participating in activities targeting processing speed and sustained attention. Given that cognitive processing deficits contribute to language learning delays in PLI, it is not surprising that the improvement of processing skills positively affected the linguistic skills (Ebert, Rentmeester-Disher, and Kohnert 2012). Since this treatment method does not target a specific language, gains can be made in both languages known to bilingual or multilingual children (Ebert, Rentmeester-Disher, and Kohnert 2012).

Since both languages are affected in bilingual children with PLI (Kohnert 2010), they typically learn each one of them at a slower pace (Hakansson, Salameh, and Nettelblatt 2003). Non-linguistic cognitive therapy could be a very effective approach in the intervention of bilingual children. Since the cognitive gains made from this type of intervention increases skills in both languages of a bilingual child (Ebert, Rentmeester-Disher, and Kohnert 2012), a speech-language pathologist (SLP) who has no or limited knowledge of the foreign language could assist in increasing linguistic skills within that language by using a cognitive non-linguistic treatment approach. Not only could this technique help improve the learning of a language unbeknownst to an SLP, it could also improve skills within two languages at once, in turn reducing intervention time and costly dollars associated with extended treatment sessions.

Framework for the Study of Multilingualism in Children

Given that cognition and language skills are correlated and that the intervention of cognition can bring gains in all languages of a multilingual child, the incorporation of cognitive tasks within an assessment and intervention framework of a multilingual child seems sensible.

Framework for the Assessment of Multilingual Children

A complete assessment is a critical step in the successful intervention of children with PLI (Kohnert 2010). When assessing the language skills of bilingual or multilingual children, not only is it important to assess all languages, but adding cognitive tasks could prove to be beneficial (Mayer-Crittenden 2013; Thordardottir, Keheyia, Lessard, Sutton, and Trudeau 2010). The cognitive score can help to rule out cognitive delays, as well as provide a more complete picture of the child's overall underlying abilities and difficulties. A complete picture of all linguistic and non-linguistic skills and difficulties is needed. Although an ideal assessment

incorporates complete testing in all of the child's languages, this is not always possible if the speech-language pathologist is not fluent in one of the languages. At times, a parent or translator could facilitate the assessment process. However, this is not always possible due to human resources scarcities or time constraints.

Standardized tests such as the Leiter International Scale-Revised (Leiter-R, Roid and Miller 1997) and the Test of Nonverbal Intelligence (TONI-4, Brown, Sherbenou and Johnsen 2010) could be good choices since they involve non-verbal tasks. This would reduce the probability that a child was unsuccessful due to the linguistic component.

Framework for the Intervention of Multilingual Children

In most settings, whether it be in the private sector or in a government-funded center, children with PLI receive intervention sessions on a weekly basis for a predetermined period of time. The predetermined duration of therapy often depends on funding available and resources. Having said this, it is often difficult to provide services in all of the languages spoken. As mentioned above, apart from the funding possibilities, SLPs very seldom speak all of the child's languages and translators are often hard to come by.

The proposed framework suggests the addition of cognitive non-linguistic tasks during the intervention of multilingual children with PLI. As shown in previous studies, these tasks can improve language skills by improving cognitive functions. Since improvements could be made in more than one language, SLPs who are not familiar with one or more of the languages that a child speaks could make gains in those languages without directly targeting them. This is important since SLPs are not always familiar with all of the child's languages. It could also reduce the intervention hours needed since intervention is not received in all languages.

Since cognitive skills are a prerequisite to linguistic skills, it is important to increase cognition in order to increase language skills. Working on language without the appropriate cognitive skills could prove to be frustrating both for the child and SLP who don't see gains from intervention. Proper non-linguistic intervention can lead the way to changes in cognitive function and successful language gains. For bilingual children, gains could be made in the child's first language (L1) as well as the second language (L2) even though only one is often targeted during direct linguistic intervention. Not only could this technique help improve the learning of a language unbeknownst to a speech-language pathologist, it could also improve skills within two languages at once, in turn reducing intervention time and costly dollars associated with extended treatment.

Non-linguistic games such as *Blink* (Staupe 2001), *Bop-it* and *Simon Trickster* have been shown to increase cognitive skills, which in turn increase language skills (Ebert, Rentmesster-Disher, and Kohnert 2012). These games could be motivating for the child who has worked on language for many years. In fact, since children are motivated by technology (Kulik 1994; McFarlane, Sparrowhawk, and Heald 2002), an approach that combines non-linguistic games with technology could be particularly motivating. Robillard and Mayer-Crittenden (under review) proposed a treatment model that incorporates non-linguistic treatment with the use of technology, such as apps that can be used on an iPad (Apple 2013) or other tablet, combined with traditional linguistic therapy. As Robillard and Mayer-Crittenden's model proposes the addition of indirect hours of cognitive therapy with the use of technology on days when linguistic intervention is not received, gains could be made more quickly as the overall treatment hours are increased.

Since some studies have shown gains in linguistic abilities from working solely on cognitive tasks (i.e. Ebert, Rentmesster-Disher, and Kohnert 2012), another possibility would be to only intervene with non-linguistic cognitive tasks. This model could be of possible interest for the child who has been working on language for many years without much success.

Conclusion

There is undoubtedly an existent relationship between cognitive and language skills. In fact, children with PLI often have reduced processing speed, sustained attention and working memory skills, alongside their more salient language difficulties. A relationship is also present between multilingualism and cognition, which, in certain circumstances, indicates an advantage for children who are exposed to more than one language. Since recent studies have demonstrated that language gains can be made when working on non-linguistic cognitive tasks and that these gains can be seen in more than one language, a new framework for the study of multilingualism was proposed. This framework recommends that the focus be on the cognitive underpinnings common to all languages during the intervention of multilingual children with PLI.

When assessing children's language skills, speech-language pathologists should include cognitive assessments, especially those that measure processing speed, sustained attention and working memory (see Mayer-Crittenden and Robillard (in preparation) for a review of the available non-linguistic assessment tools). The intervention of multilingual children with PLI should include non-linguistic cognitively based tasks in order to increase cognitive functions, which in turn can bring gains into the language domain, and that, in more than one language. The framework presented in this paper could prove to be more efficient and cost effective by indirectly treating more than one language at once in multilingual children. Also, clinical work could be greatly facilitated by the availability of various treatment models. However, the next step in this research, aiming to develop a new framework for the treatment of multilingual children with PLI is the verification of the efficacy of this model. Also, empirical research that compares the traditional linguistic approach to the non-linguistic cognitive approach are also needed. Such work is currently underway.

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