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# Linguistics in the service of communication disorders

## New frontiers

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Linguistics and Communication Disorders are considered two different disciplines by most students and scholars in both fields as well as by researchers working in other relevant fields such as psychology and education. However, most core disorders, disabilities and delays in communicative ability directly concern language, especially in conjunction with human development from infancy to adulthood, but also as related to the loss of communicative skills in the aging brain. Linguistics thus emerges as a major source of scientific insights and practical applications for the field of communication disorders. While it is obviously impossible to account for the diverse and sometimes contradictory views of linguistics in a single paper, we nonetheless focus on the contribution of novel linguistic and psycholinguistic approaches to the current conceptualization of communication disorders from different perspectives. We first discuss the nature of evidence and research methods in the two disciplines, with the current usage-based and typological approaches to corpus linguistics as a case in point. Consequently, we discuss the interface of linguistics and communication disorders through four contexts which are considered infelicitous to language acquisition and processing. These are, as follows: (i) hearing loss, (ii) language impairment and dyslexia, (iii) growing up in a low socio-economic environment, and (iv) situations of bilingualism.

### Introduction

*Communication Disorders* is a clinical profession aimed at facilitating language, speech, hearing and oral motor functions by diagnosis, treatment and therapy. In the last few decades, the domain of Communication Disorders has grown exponentially and has come to encompass much more than audiology, speech impediments and early language impairment. A variegated array of impairments is now considered under the scope of Communication Disorders (henceforth: CD) in addition to speech and voice impediments, constituting of the full range of developmental language disorders from structural to lexical and pragmatic, with much focus on discourse, reading, writing, and arithmetic impairments. In the same way that innovative research in child and adolescent development, executive control, attention and memory functions are brought to the attention of CD experts, they find new frontiers in linguistics of ultimate interest and relevance to their work.

The role of language in CD, based on the realization that most developmental and learning disorders are language-based or language-related, is evidenced by the numerous studies

encompassing every facet of linguistic knowledge in thematic disorders journals such as *American Journal of Speech-language Pathology*, *Communication Disorders Quarterly*, *Journal of Communication Disorders*, *Language Speech and Hearing Services in Schools*, *The International Journal of Language & Communication Disorders*, or *Topics in Language Disorders* — to name a few. At the same time, language and communications disabilities, side by side with atypical linguistic development and processing, occupy a fair share of language-oriented journals (e.g., *Brain and Language*, *Journal of Memory and Language*, *Journal of Speech, Language and Hearing Research*, *Language and Cognitive Processes*, or *Reading and Writing*) and of journals specializing in language acquisition (e.g. *Journal of Child Language*, *First Language*, or *Language, Interaction and Acquisition*) — as well as cognition-oriented, non-thematic journals such as *Cognition*, *Cognitive Science*, *Trends in Cognitive Sciences* or *Developmental Science*. The central role spoken and written language, discourse and literacy now occupy in CD research underscores the value of linguistic science to providing solutions for cognitive, developmental and learning issues in clinical and educational contexts.

Since most core disorders directly concern language, especially in conjunction with human development from infancy to adulthood and onwards in the aging brain, linguistics emerges as a major source of scientific insights for the theoretical understanding of communicative disorders, and of application in the practice of CD practitioners — Speech/Language Pathologists (SLPs). Consequently, SLPs and their trainers are now aware that linguistic knowledge is crucial for the identification, diagnosis and therapy of a broad range of disabilities across the life span. Indeed, a glance at any of the current curricula in CD departments of major universities reveals to what extent this need for a robust linguistic, psycholinguistic, neurolinguistic, and sociolinguistic foundation for SLPs is attended to. Linguistics is definitely regarded as indispensable for the understanding and treatment of communication disabilities at different stages of human development and in various social and communicative contexts. Against this background, the current paper intends to shed light on the contribution of linguistics to CD while taking into account differences in the motivation and methods for studying language, its acquisition and processing. Given the versatile and even contradictory views of language and its processing currently held by linguists themselves, as well as their interface with other domains (such as psycholinguistics, sociolinguistics, neurolinguistics) we take a neutral and inclusive view of “language” and “linguistics” in discussing their applications to CD. We thus highlight diverse facets of the sciences of language as they become relevant to different requirements of CD researchers.

### **Methodological issues**

Despite their shared interest in language and communication, linguistics and CD are motivated and informed by different theoretical and applied approaches to these domains. While linguistic scholarship is motivated by the wish to gain insights about the nature of linguistic knowledge and processing, CD science is interested in gaining information about language and communication impairments, identifying their patterns and using linguistic knowledge to treat them.

One domain of difference between the two cultures of linguistics and communication disorders is in the nature of what is considered as research methodology and the nature of scientific evidence, which essentially comes down to the difference between empirical research and structured introspection (Goodluck and Zweig, 2013; Kertész and Rákosi, 2012). As in the social and health sciences, the underpinnings of CD is empirical, based on the assumption that knowledge arises from human experience and that formulating and testing hypotheses which lead to valid conclusions require data acquired by direct observation or experience. This means reliance on proper designs with successful control over extraneous variables, meeting behavioral criteria of reliability, validity and replicability to ensure the credibility of empirical research, as well as using well-motivated

analytic methods (qualitative or quantitative) which allow the interpretation of the data (Goodwin, 2005). At the same time, it is recognized by CD scholars that linguistic theory can inform research design, provide hypotheses about disorders, contribute to data interpretation and explain its clinical implications. CD experts rely on linguistics to provide the answers to theoretical questions about the nature of language, its structure and functions, language origins and change, how it is encoded in the brain, as well as questions of its acquisition, knowledge, and processing in humans. Thus, different theoretical linguistic frameworks and changes in linguistic theories have influenced SLPs' approaches to diagnostics and therapy. For example, treating children's innovative errors such as *holded* or *mouses* as signs of linguistic development rather than mistakes that need to be eradicated derives from the basic insights in the linguistic study of first (and second) language acquisition that errors indicate a state of linguistic knowledge and development.

Linguistic methodology itself has undergone great changes at the same time, which has brought linguistic approaches closer to CD methodological criteria. Chomsky (1985) set the goal of linguistics as an explanation of speakers' ability to extend their limited linguistic experience to new acceptable forms, based on the assumption that human linguistic competence makes it possible to judge sentences as grammatical or ungrammatical. As grammar was conceived as a mental construct, the mainstream method of inquiry into data in linguistics was informally gathered acceptability judgments by individual respondents, most often linguists (Phillips 2010; Schütze 2011a,b). The last decade has however seen some doubt cast regarding what psychologists and linguists came to call the 'weak empirical foundation' of theories (such as Universal Grammar or syntactic movement) based on intuitive and metacognitive grammaticality judgments (Edelman & Christianson 2003; Evans & Levinson 2009). Linguists became aware of cognitive and cultural sources of sentences' acceptability beyond their grammaticality (Bresnan 2007; Hofmeister et al. 2013), and of the unstable and contextual nature of such judgments (McClelland et al. 2010). Currently, while some researchers advocate the adoption of canonical empirical methods for data collection and analysis (Gibson & Fedorenko 2013), others discuss the limitations of quantitative methodology (Phillips 2010) and present evidence for the reliability of traditional linguistic methodology (Sprouse & Almeida 2013, Sprouse, Schütze & Almeida 2013). The consensus seems to be that given the multiple mechanisms involved in language use, linguists should be encouraged to test theories in psycholinguistically sound ways without giving up reliance on key linguistic insights (Piantadosi & Gibson in press; Tily & Jaeger 2011).

### Contributions of linguistics to CD science

One major domain where linguistic research interests coincide with those of CD involves the interface of language and cognition. Specifically, they are both concerned with questions such as whether and to what extent language is independent of other cognitive systems and / or guided by universal properties, the relationship between conceptual and linguistic acquisition and knowledge in different languages, and the role of memory and frequency in language evolution, processing and learning (Bybee 2006; Carruthers 2008; Harris 2003). This relationship is an inherent issue in the ongoing debate between linguistic theories and approaches regarding the question of modularity of mind and the existence of hard-wired language-dedicated systems (Berwick, Pietroski, Yankama & Chomsky 2011; Cinque 2013; Slobin 1996). The current status of linguistic thought, most especially the debate about the language / cognition interface, informs CD research and practice in both research design and its application (Friedmann 2013; Joanisse & Seidenberg, 1998). CD leaders consider it critical for SLPs to gain an understanding of how language knowledge is structured and of the bases of language disorders (Bishop & Norbury 2008; Jarmulowicz & Taran 2013). In fact, what drives diagnosis and therapy of CD is current research about the nature, structure and interaction of grammar and

lexicon as well as how they relate to general cognitive processes (McArthur, Ellis & Atkinson 2009; van der Lely 2005). Clearly, CD researchers, like psychologists, rely on linguistic-generated insights as the evidence-based scientific framework against which language disabilities are captured and clinical solutions sought.

In the wake of recent debates in the linguistic world relating to what exactly the human adaptation in language is, the nature of the language and cognition interface, and the construal of innateness in language acquisition, more connections can now be pointed out between language analysis and its clinical applications. CD professionals and practitioners have always assumed that knowledge arises from experience and have sought ways not only to diagnose and treat the disorder but also to explain its cognitive and neurological sources. The changes in linguistic theory from the perception of language as a narrow grammatical faculty to its construal as a broadly based cognitive faculty have brought about a concurrent shift in CD science: Rather than seeking the specific source of a deficit or a disorder (e.g., auditory or grammatical bases of language impairment), CD researchers now regard them as deriving from a language-learning disability (Bishop 2009).

Current usage-based models of language structure and use, deriving from the Cognitive Linguistics tradition (Lakoff 1991; Langacker 1987), assume language knowledge to be a non-autonomous cognitive faculty (Croft & Cruse 2004), and thus extremely sensitive to other cognitive domains. This approach encourages SLPs to broaden treatment from language structure to its use in different communicative contexts. Usage based theories regard linguistic acquisition as a data-driven, bottom-up task strongly leaning on mind-reading socio-cognitive abilities on the one hand, and the changing nature of linguistic input, on the other (Rowland et al. 2012; Tomasello 2003). Thus, it is extremely important for CD researchers and SLPs to gain information about patterns of use in naturally occurring language, from morpho-phonology through syntax to discourse structures and their functions, so as to base study design and subsequent treatment on real data. Fortunately, Corpus Linguistics approaches to language analysis provide such solutions through analyzing large scale corpora containing both frequent, conventional patterns, and less frequent, novel uses of language — making it possible for SLPs to set goals for both oral and literate language gains. The analyses conducted are statistically based, taking the corpus to be a representation of one's experience with language (Bybee 2010; Gries & Stefanowitsch 2007), making it possible to account for the role of memory and frequency in all aspects of language. Evidence-based features of produced discourse, when used in systematic research, can be immensely helpful in the diagnosis and treatment of disorders (Berman & Ravid 2008; McNamara, Crossley & McCarthy 2010). For example, Berman and Ravid (2008) showed that the ability to produce expository texts emerges around the 7th grade and thus becomes a useful tool for the assessment of writing abilities around high-school age.

One of the merits of corpus linguistics is that it allows the comparison of usage patterns of the same conceptual space in a variety of languages, thus accounting for the diversity of languages in a typological perspective, with immense benefits for psychological, clinical and educational applications. Typology, in linguistics, is the search for patterns “that occur systematically across languages” (Croft 2003:1) with the goal of reaching genuine typological generalizations. Linguistic thinking has long been dominated by the specific properties of English, which are not necessarily shared by the world's languages (Chung 2009; Evans & Levinson 2009; Haspelmath 2012). However, from a communication disorders perspective, the typology of a language has been found to be crucial for the understanding of language development and language disorders (Berman & Slobin 1994; Ravid, Levie & Avivi Ben-Zvi 2003). Specifically, typological structure has been shown to account for the severity of morphological impairment in languages of differential morphological complexity (Dromi, Leonard & Shteyman 1993). In the same way, the study of the characteristics of orthographies other than English in conjunction with phonological and grammatical structures

of languages in possession of these orthographies has contributed immensely to theories and application of reading, writing and spelling (Frost 2012; Share 2008) in the last decades (see review in Ravid 2012).

Given the experience-based approach to learning prevalent in CD, it is no wonder that it finds great advantages in technological advancements which provide highly sophisticated tools and better-grounded, finer grained analyses of ambient language (Graesser & McNamara 2011). CD researchers can now make use of advanced statistical methods to investigate the role of frequency in language, such as Multidimensional Scaling (Baayen 2008) and Multiple Correspondence Analysis (Levshina, Geeraerts & Speelman 2013). For example, Dattner (in preparation) has shed light on the role the typologically specific system of the Hebrew verb conjugations (the *binyan* system) plays in structuring conceptual spaces in Dative constructions. This will make it possible for Israeli SLPs to construct meaningful treatment of Hebrew syntax in conjunction with its rich derivational morphology.

Corpus linguistics has made another kind of impact on the scope and breadth of knowledge required of SLPs in treating language and communication disorders, which is the domain of written discourse in later language development.

### Written discourse

Written text production has been considered outside the domain of both core linguistics and CD in the not so recent past, but is gaining importance and significance in both domains. The early Saussurean reaction of linguistic science to previous philological preoccupation with written texts of dead languages pointed at spoken language, the hallmark of humanity, as the natural, direct, uncontrived and 'real' linguistic phenomenon. In contrast, written language was regarded as merely a written shadow of 'real language' — in fact, no more than a mirror, the transcription of oral production. This placed the study of written language squarely outside the domain of linguistic analysis seeking to achieve theoretical insight. Given the close attention CD specialists have always paid to arenas of linguistic concerns, their focus too has been on oral language disabilities or on grammatical deficits rather than on problems in written text production, which were relegated to educators. But the psycholinguistic investigation of how language users learn to control and shape the flow of information in written discourse through linguistic means has now been shown to lead to important insights about language structure, use and development (Berman, 2005; Ravid, 2005; Sun & Nippold, 2012).

Evidence points to skilled writers being able to construct coherent texts with longer and denser information packages in hierarchically complex syntactic constructions (Ravid in press; Ravid & Berman, 2010) which can be re-read, reviewed and revised by readers within their context without the pressures of on-line processing (Berman & Ravid, 2008; Ravid & Tolchinsky, 2002). This enables researchers to investigate the elusive concept of "syntactic complexity" in the context of writing. Writing moreover encourages the retrieval of higher-register, literate lexical items, and marked morpho-syntactic structures (Ravid & Berman 2009; Ravid & Levie 2010). At the same time, these very same features impose a greater burden on less experienced writers such as children, who still lack the executive functions for monitoring large pieces of text, especially in expository writing (Berman 2008). It is even harder for children to construct a linguistic space within which both spoken and written modalities can be simultaneously and appropriately accessed (Berman & Nir-Sagiv 2010; Ravid 2006).

These features of written discourse make it an appropriate context for the evaluation of later language development, a period of intense linguistic development taking place during the school years — ages 5 to young adulthood (Berman 2004; Nippold 2007; Ravid, Dromi & Kotler 2009). During this period, the cognitive and linguistic demands of written text construction (and comprehension) exacerbate the problems of children with language impairment, reading and writing

disabilities and children with poor SES background, which stand out even more during the school years (Berman, Nayditz & Ravid 2011; Williams, Larkin & Blaggan 2013). Many language disabilities are thus manifested in this age group as dyslexia and learning disabilities, and require the attention of expert CD professionals. Linguistic analyses of texts of different genres written by children and adolescents with developmental and language disorders reveal academic weaknesses and relations with other linguistic abilities and thus pinpoint areas for remedial therapy and improvement (Mackie, Dockrell & Lindsay 2013; Nippold, Mansfield, Billow & Tomblin 2009). At the same time, analyses of written discourse can be of great value to linguists and psycholinguists in their search for an understanding of how the structure of language interfaces with its different modalities and discourse functions (Strömqvist & Verhoeven 2004).

### **The linguistics / disorders interface**

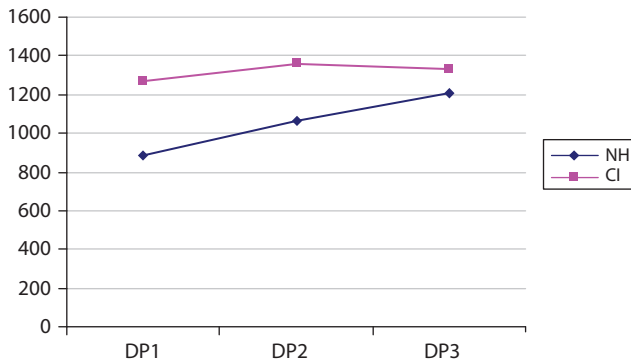
Having established the relevance of linguistic theory, methodology and scope to the study of language learning and disorders, the next section examines the contribution of linguistic science to the understanding, identification and treatment of four language / communication disorders which all share less than felicitous conditions of language learning. Clearly, adequate learning conditions are necessary for children to develop language proficiently. This is because neuroplasticity — the ability of the brain to adapt to current contingencies — is at its highest in early childhood, permitting the reorganization of neural pathways and architecture (Stiles et al. 2012) at a time when a native tongue is learned in close conjunction with maternal care. During this crucial period, children need to have access to linguistic input that is both quantitatively and qualitatively appropriate to enable the coherent category formation, which is essential to generalization and consolidation of language knowledge (Gathercole & Hoff 2007).

In this context, two types of inadequate learning conditions are likely to impair optimal language development in the early stages, and to impinge negatively on the subsequent acquisition of literacy at school age. One of these conditions is a function of perceptual and cognitive factors internal to the individual which prevent them from taking maximal advantage of the linguistic input in their environment. In relation to the infelicitous learning conditions introduced above, these are the cases of (i) children suffering from hearing loss and (ii) language impairment and dyslexia. A second type of inadequate learning condition is rooted in external socio-economic environmental factors (infelicitous condition iii), where paucity in linguistic input puts at risk the optimal achievement of language and literacy skills from early childhood onwards. This is the widely-researched condition of children growing up in low socio-economic situations. In contrast to these language disorders and less than ideal contextual learning conditions, we refer to a communicative setting which, though eventually beneficial to language and cognitive development, raises interesting issues of language growth and consolidation which are relevant in the current context — bi- and multilingualism (condition iv).

#### *Hearing loss*

Speech perception is critical for picking up the phonological, lexical and morpho-syntactic patterns of a language (Houston 2002), and thus it requires massive exposure to linguistic input. Therefore, children born with congenital deafness are at grave risk regarding the acquisition and development of spoken and written language (Coppens et al. 2013). Linguistic science has made important contributions to the preservation or restoration of the auditory system in cases of prelingual hearing impairment, where developing neural organization related to speech perception is affected by auditory deprivation. One example is the way language sampling, storage and analysis technology combined with hospital-based newborn hearing screening programs now result in the earlier referral,





**Figure 1.** Median of open and closed-class tokens at each data point ((1) 1;10–2;0; (2) 2;1–2;3; (3) 2;4–2;5) in normally hearing and implanted children, by hearing age (Herzberg 2010)

diagnosis, and treatment of deaf infants and children. Such screening programs are positively related to measures of expressive and receptive language (vocabulary size and quality, standardized phonological inventories, speech intelligibility) and better language outcomes at school age (Nelson et al. 2008). Another contribution relates to the cooperation of linguists, psycholinguists and CD professionals in cochlear implantations, which expose the deaf child's auditory system to a quality of sound experience not available with hearing aids alone. In cases of profound hearing loss from 90dB and above, most outer hair cells in the cochlea are absent or dysfunctional, so that hearing aids do not provide the necessary sensory information for speech perception and comprehension or the auditory feedback needed for speech production and language learning. Prior to the advent of the cochlear implant in the 1990's, children born with congenital deafness had great difficulty in acquiring their native tongue (Paul & Quigley 1994), with linguistic gains at half the pace of hearing children (Svirsky 1999). The cochlear implant has revolutionized the rehabilitation of severe to profound hearing loss by transmitting acoustic information through direct electrical stimulation of the auditory nerve, thus bypassing the damaged cochlea and resulting in partial restoration of the frequency resolution of the cochlea (Nicholas & Geers 2007). Recent studies have shown that when implantation is carried out early on, in the first of life, coupled with appropriate language therapy, improvement can be expected in language acquisition (Schauwers, Gillis & Govaerts 2008). For example, a study comparing the development of the early Hebrew lexicon in three children with cochlear implants and three normally hearing children (Herzberg 2010) showed that when matched for hearing age (for the implanted children, the time elapsed since implant activation), the CI children had more content and function words than normally hearing children across their early development (Figure 1). This means that the combination of rehabilitative care by SLPs and the degree of speech perception provided by the CI, catapult deaf children into spoken language. These advances could not have been possible without the close cooperation of linguistic experts, providing the phonological, lexical and morpho-syntactic measures for assessing language learning, with CD professionals, responsible for the audiological and therapeutic methods employed to rehabilitate deaf children.

#### *Language impairment*

A second example of language learning under adverse neuro-cognitive conditions is linguistic impairment. Most researchers regard language impairment as a core developmental disability in the domain of CD (Clark & Kamhi 2010; Paul 2007). Language impairment is characterized by a later



onset and slower pace of language development than in children without deficits, with continuing problems in language comprehension and / or production and in the acquisition of literacy skills (Bishop & Norbury 2008; Nippold 2007). Research shows that children with language impairment have difficulty in processing various types of linguistic information — phonological, lexical, morphological, syntactic, preventing them from acquiring a large and diverse lexicon. They also find the production and comprehension of extended discourse challenging (Swisher et al, 1995). Once at school, they have difficulty in acquiring command of linguistic literacy, that is, written language skills related to thinking about language (Ravid & Tolchinsky 2002), of writing and reading, of written text comprehension and text production (Scott & Windsor 2000).

Side by side as being a central, typical language disorders syndrome, language impairment has been at the center of a linguistic debate for several decades regarding language representation in the mind and in the brain (Leonard & Deevy 2006). In this case, gaining more knowledge of the disorder would help contribute to a linguistic debate about modularity of mind. The disorder is often termed Specific Language Impairment (SLI), that is, a language disorder in the absence of other primary disorders such as hearing impairment, brain damage, mental retardation, or emotional problems (Leonard 2010), with a discrepancy of about 15 points between verbal and non-verbal IQ (De Villiers 2002; Leonard 2009). If, indeed, LI is SLI, that is specific to language (rather than having implications for or sources in other cognitive systems), and even more specific to particular linguistic systems such as morphological inflection or pragmatics, this would constitute evidence for domain-specificity of language and modularity of mind (Friedmann & Novogrodsky 2004; Rice & Wexler, 1996; van der Lely, Jones & Marshall, 2011). In turn, CD researchers would come up with specific diagnostics and treatment of those areas in language which are supposed to be discretely impaired. Evidence against this conclusion would come from studies indicating that general processing systems underlie language impairment (Joanisse & Seidenberg 1998; Tallal 2004), from research indicating additional, non-linguistic deficits in individuals with language impairment (Berman & Ravid 2010; Hill 2001), or from the instability of classification into LI subtypes such as grammatical, lexical or pragmatic impairments (e.g., Conti-Ramsden 1999). If language impairment is indeed coupled with other disorders, more general rehabilitation will be required. Further investigations into the nature of this prevalent language disorder will not only inform therapists (Cirrin & Gillam 2008) but also contribute towards resolving a major debate in linguistics.

### *Dyslexia*

Dyslexia is a disorder characterizing individuals with difficulties in learning to read (and spell) that are not related to cognitive impairment. Currently, CD scholars strongly link dyslexia to language impairment, with the two disabilities described as different manifestations of the same underlying problem (Catts 1991) or two disorders that present considerable overlap (Bishop & Snowling, 2004). Traditionally, however, dyslexia was not considered as a prototypical CD arena. This apparently stems from the fact that over many years dyslexia had been mostly attributed to a visual deficit, as illustrated by the famous phrase coined by Morgan (1896) “congenital word blindness”. This is not surprising since the primary sensory system involved in reading is the visual system, and the famous reversal errors regarded as the hallmark of the disability (e.g. reading / writing *b* for *d* or *was* for *saw*) were perceived as evidence of visual problems (Catts & Kamhi 1999). Dramatic changes in the approach to dyslexia occurred in the 1970s with the advent of the groundbreaking research of Liberman, Shankweiler and their colleagues suggesting that phonological skills, in particular phonemic awareness, play a crucial role in learning to read (Liberman, Shankweiler, Fisher & Carter 1974). We know today that phonology is important to reading because writing systems represent spoken language and learning to read in alphabetic systems means mapping graphemes onto phonemes.

Over the last 30 years a considerable body of studies have supported the importance of phonemic awareness in learning to read and reinforced the concept of phonological-deficit based dyslexia. However, despite these persuasive findings, it is not clear yet if there is indeed a causal link between low phonological awareness and dyslexia, or whether there is a third variable or mechanism influencing both problems (Castles & Coltheart 2004). Many studies demonstrate various difficulties characterized dyslexic individuals in different ages. Most of them relate to phonological processes such as auditory perception (Gaab et al. 2007; Schulte-Körne et al. 1998) or short-term memory for speech sounds (Berninger et al. 2006). Others report difficulties in (implicit) learning abilities, such as learning sequences of symbols (Gabay, Schiff & Vakil 2012), or the ability to benefit from stimulus-specific repetitions (Ahissar 2007), supporting the notion of a generally impaired learning mechanism that underlies dyslexia. A large body of research indicates a strong linguistic component in this disorder (Schiff & Ravid 2007, 2013; Snowling, Gallagher & Frith 2003).

An interesting relationship between language typology and dyslexia is worth mentioning. While typological studies in the last decade did not contradict the importance of phonology to success in learning to read, they have indicated that the nature of the relationships between them is language-dependent. For one thing, phonological processing is not uniquely important for reading alphabetic orthographies: it is also involved in non-alphabetic systems, however the latter differ from alphabetic systems in the size of the phonological unit that the graphemes or characters activate — either a simple phonological syllable, as in the Japanese *Kana*, or else syllabic morphemes as in Chinese (Perfetti 2011). Moreover, although alphabetic systems share the grapho-phonemic principle, the specific nature of the sensitivity to word or syllable structure (e.g. dividing the syllable into *body-coda* or *onset-rime* units) is affected by the unique phonological and orthographic characters of each language (Share & Blum 2005). Finally, the transparency of the orthography (i.e., to what extent a written word reliably represents its phonology) dictates the degree of importance of the phonemic awareness to reading (Seymour, Aro & Eirskine 2003).

In this context, Share (2008: 596) notes that “the extreme degree of non-transparency in English has exaggerated the role that phonemic awareness plays in more conventional alphabets and has overshadowed issues that have critical importance across orthographies.” One of these issues is the role of language domains other than phonology in reading. It is well known that while writing systems can represent spoken language, they are not mere transcriptions mirroring phonological sequences but rather encode various aspects of the language system such as its morphology and syntax (Derwing 1992). Obviously, in many cases spelling represents morphemic identity rather than phonology (e.g. English *-tion*) (Deacon & Kirby 2004; Ravid 2012). Thus, beyond phonological decoding, readers would rely heavily on morpho-orthographic representations in single word recognition. While phonology is mostly needed for unfamiliar word decoding, morphology has an important role in enhancing whole-word recognition in both morphology-rich and poor languages (Bar-On & Ravid 2011; Carlisle 2000). Moreover, proficient and automatic word recognition is essential for efficient reading, but it is not enough. In Hebrew for example, reading without adherence to the semantico-syntactic context may lead to nonsensical decoding. This is because approximately 25% of the words in any non-voweled text in Hebrew are homographic (i.e. can be decoded as having different phonological [and meaning] characteristics, as in English *wind*). Thus, reliance on the grammatical context, especially on morphological structure, is an inherent part of the reading process in Hebrew (Bar-On, 2011). That means that learning to read involves knowledge about the relationship between a writing system and the language it encodes (Perfetti 2003). Even though the investigation of dyslexia and its causes is still under way, informing SLPs of the linguistic processes involved in reading and writing benefits research, diagnosis and therapy of dyslexia in the field of CD.

*Language in low-SES contexts*

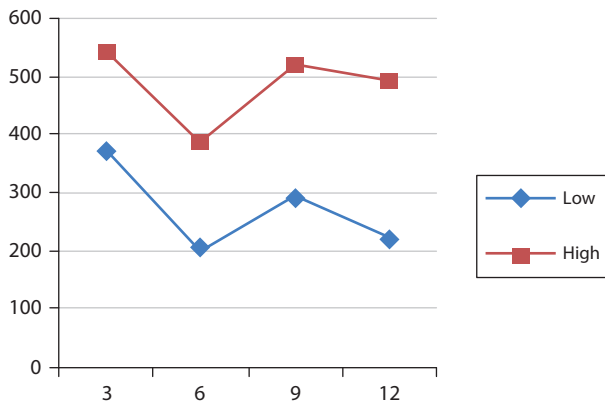
In addition to internal, neuro-cognitive obstacles to proficient language and literacy acquisition, external, environmental problems can also hinder optimal language learning. Thus the relevance of linguistics to CD extends beyond the core disorders discussed above to inadequate learning conditions resulting from external background factors such as socio-economic status (SES) (Chiu & McBride-Chang 2006). The link between social progress and literacy education has been recognized in social psychology for many years (Bernstein 1960); but since the groundbreaking work of Hart and Risely (1995), robust evidence has pointed to a disadvantage in language and literacy skills of children from poorer, less educated, low SES backgrounds compared with children raised in more favorable circumstances (Bradley & Corwyn 2002). Such environmental factors have been shown to impede the optimal command of linguistic proficiency (Raviv, Kessenich & Morrison 2004) and to be detrimental to gaining literacy skills (Aram, Korat & Levin 2006; McCarthey 1997). Children from less economically established homes and with less educated parents may enter school with a disadvantage (Natriello, McDill & Pallas 1990; Neuman & Celano 2001) which is consistently retained in school. Low SES children manifest relatively high rates of failure from the very lowest grades (Battin-Pearson et al. 2000), and their attainments remain lower than average across the school years (Purcell-Gates & Dahl 1991). They demonstrate poorer vocabulary and reading compared with their mainstream, middle-class peers (Au 1998; Snow et al. 1991). Reading accuracy, reading comprehension, spelling and writing abilities are also weaker among children of low SES background (Chevrot, Nardy & Barbu 2011).

Where do these differences come from? In the past, the linguistic perspective on differential language performance and knowledge in socio-economic contexts was anchored more in socio-linguistic questions of sociolect and dialect than in clinical deficiencies (Furrow & Nelson 1984; Labov & Harris 1986; Williamson 1986). Yet a torrent of research work points at genuine, early emerging effects of SES background on language abilities (Fernald, Marchman & Weisleder 2013; Fish & Pinkerman 2003). SES has been found to affect various linguistic domains, from sensitivity to the phonetic structure of spoken words (Blachman et al 1999; Nitttrouer 1996), through lexical development (Arriaga et al. 1998; Qi et al. 2006), inflectional and derivational morphological abilities (Ravid 1995; Ravid & Schiff 2006; Schiff & Ravid 2012) and discourse production (Price, Roberts & Jackson 2006) to acquisition of figurative language (Berman & Ravid 2010) and theory of mind (Cutting & Dunn 1999; Shatz et al. 2003). These deficiencies are related both to the development of crucial brain regions (Kishiyama et al. 2009; Noble, Norman & Farah 2005) as well as to important cognitive functions such as executive control (D'Angiulli et al. 2008; Engel, Santos & Gathercole 2008; Farah et al. 2006).

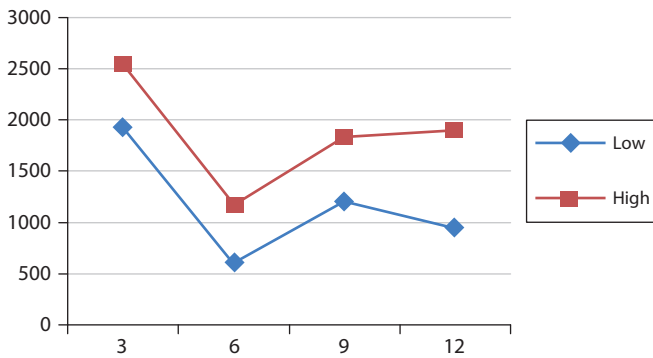
Recent technological advancements in studying child and adult language and approaches such as Corpus Linguistics, discussed above, are highly relevant to this issue. Recently, psycholinguistic studies have shown that amount and quality of linguistic input addressed to children have a connection with the SES background of mothers (Hoff, 2003, 2006), with scarcer input resulting in a slower and less effective rate of language acquisition (Black, Peppé & Gibbon 2008; Ginsborg 2006).

Moreover, from infancy on, children from low SES backgrounds are exposed to largely directive instructions rather than to elaborative and enriching language (Hoff 2013; Ninio 1980; Rowe 2008; Shimpi, Fedewa & Hans 2012), they fail to receive appropriate linguistic and communicative mediation from their surroundings, they are less actively involved as conversational partners in family get-togethers, and they engage less than their more advantaged peers in joint book-reading and interactive writing with their parents (Anderson & Stokes 1984; Aram & Biron 2004).

To illustrate the critical impact of SES background on children's linguistic development, consider Figures 2–3. They represent some findings from a recent study comparing Hebrew Child Directed

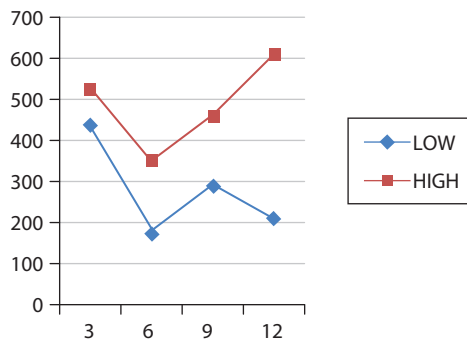


2a. Word types In Child Directed Speech to infants 3–12 months



2b. Word tokens In Child Directed Speech to infants 3–12 months

**Figure 2.** CDS word types and tokens at each data point (3 months, 6 months, 9 months, 12 months) in high-SES and low-SES mothers (Ravid, Peleg & Peleg, 2013)



**Figure 3.** Percentage of utterances with fine-tuning at each data point (3 months, 6 months, 9 months, 12 months) in CDS by high-SES and low-SES mothers (Ravid, Peleg & Peleg, 2013)

Speech by two mothers to their respective infants in the first year of life — a low SES and a high SES mother. All variables — familial and social (e.g., child sex, order of siblings in the family) — were carefully controlled for in selecting the mothers for this comparison. Their speech was sampled when their babies were 3, 6, 9 and 12 months old respectively (Ravid, Peleg & Peleg 2013). Figure 2 shows the number of word types and tokens the infants were exposed to: at each data point the low-SES baby heard a lesser amount of words, and at one year of age, when linguistic input is critical given early word acquisition, a wider gap opens between the two mothers. In fact, this study showed that overall the high-SES infant heard 1.7 more speech than the low-SES one. Figure 3 compares the relative amount of utterances fine-tuned to the infant's developmental stage (slower, clearer, with varying pitch and emphasis, etc.): and again, not only does the high-SES mother produce more fine-tuned speech at all data points, this important behavior, facilitating babies' word learning, increases when the baby is one year old, when first words emerge; whereas the low-SES mother's fine tuning decreases. This was but a tiny sample of the diverse linguistic analyses carried out on the transcriptions of the two mothers, which all clearly pointed at the same direction: the infant from high-SES background was exposed to more and more qualitative CDS, than her low-SES peer.

### *Bilingualism*

In the same context of ambient language structure, bi- and multilingualism constitute our final example of linguistics benefitting CD research and treatment. Bilingualism is neither a detrimental nor a disordered condition. On the contrary — growing up in two or more languages has long been a topic of linguistic and psychological work (De Houwer 2009; Hoff & McCardle 2006), with a general consensus that it benefits bi- and multi-lingual individuals across the life span not only linguistically but also cognitively (Bialystok 2001; Grosjean & Li 2013; Hyltenstam & Obler 1989). Much of the debate in the domain has been devoted to the question of a window of age or a critical period in learning more than one language (DeKeyser, Alfi-Shabtay & Ravid 2010; Newport 1990; Ortega 2013). Two interesting, diametrically opposed, questions continuously challenge CD specialists in this context, with possible answers residing in current linguistic research. They can be summed up as “How much is enough?” and “can it be risky?”. The first question involves reaching native, or near-native, fluency and proficiency in the languages learned simultaneously or sequentially. CD researchers working in language acquisition are often tasked with the practical question of learning more than one language. They are thus interested in what enables some learners to make maximal attainments in bilingual learning despite the diminished input contexts for the acquisition of each language (Gathercole & Hoff 2007). The role of linguistic input in multiple language acquisition has gained attention and significance with the advent of systematic studies of the complexity of bilingual situations, which are fraught with conflicting factors of language knowledge and usage and of social settings (Abugov & Ravid 2013; De Houwer 2011; Gathercole et al. 2010). Beyond individual differences, the answer can probably be found in current investigations of the amount and types of linguistic input, communicative experience and diversity of opportunities for language exposure and usage in each of the languages learned (Gathercole 2010; Hoff et al. 2012; McCardle & Hoff 2006).

A second question concerns another facet of bilingualism where linguistics has an important say for CD researchers and therapists is the question of language disability in children growing up in bilingual environments (Armon-Lotem in press; Paradis 2010). This is the overlap between certain attributes of language impairment and bilingualism: For example, children learning English as a second language were shown to perform similar errors as monolingual children with linguistic impairment (Paradis, 2005), raising interesting questions on the possible interface of developmental trajectories in bilingualism and language impairment. This similarity has important clinical implications for the identification of children suffering from language disorder in communities where the

absence of certain grammatical morphemes (e.g., -s) might be the norm rather than the marker of a disorder (Pruitt & Oetting, 2009; Washington & Craig 2004).

### Conclusion

A journal article, even one that purports to review the interface between two venerable fields of scholarly investigation, cannot aspire to achieve more than a limited overview of its domain of inquiry. The current article aimed at establishing points of congruity between two independent though related disciplines — the theoretical and empirical study of linguistics, on the one hand, and the clinical field of CD, on the other. We hope to have shown that they can both feed each other's need for an evidence-based, insightful understanding of the interface between language and cognition, especially through their shared interest in developmental aspects of language learning and processing and the impact of different disorders and environmental conditions on linguistic development. We have also pointed out the increase in what is now thought to be areas of linguistic relevance such as discourse and written language, and to what extent this can teach us about language, communication and their disorders.

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