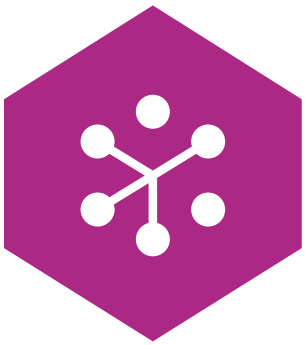

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An Interdisciplinary Framework for Speech-Language Pathologists

A Closer Look at Bilingual Language Development and Its Disorders

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An Interdisciplinary Framework for Speech-Language Pathologists: A Closer Look at Bilingual Language Development and Its Disorders

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Abstract: Speech-Language Pathologists examine language not only in its organization of complex linguistic structures, but also in terms of the processes on which it is partially dependent. Consequently, the object of research in speech-language pathology is language, together with human communication and human cognition as well as the social interactions that come into play. When studying language pathologies, we must be able to identify where the difficulties lie. It is not only the linguistic components that must be considered, but also the neurological, anatomical, physiological, cognitive, social and pragmatic aspects that are intrinsically associated. This paper defines interdisciplinarity within the field of speech-language pathology, more specifically, the study of bilingualism and the development of linguistic competencies, using an epistemological and praxeological standpoint. A theoretical framework which includes theories on emergentism, bioecological systems and dynamic systems is proposed in order to assess and treat monolingual and bilingual children with and without language impairments using a holistic and interdisciplinary approach.

Keywords: Speech-Language Pathology, Interdisciplinarity, Language Impairment

Preface

In recent years, it has been shown that the development of linguistic competencies is chaotic rather than linear (de Bot, Lowie, and Verspoor 2007; Herdina and Jessner 2002; Larsen-Freeman 1997; Larsen-Freeman and Cameron 2008). These authors have also shown that language development cannot be predicted and is shaped by a wide range of interconnected factors, both internal and external, such as one's motivation, aptitude, previous language knowledge, environment, input received and feedback given (Lowie, Verspoor, and de Bot 2009). All of these factors irrefutably call on many disciplines in order to better understand the development of linguistic competencies in one or two languages.

In this article we will highlight the fact that the profession of speech-language pathology is highly interdisciplinary. We will also aim to answer these questions: 1) What fundamentally distinguishes interdisciplinary research from monodisciplinary research? and 2) In what way can an interdisciplinary approach be useful to research on the bilingual development of language in speech-language pathology? We will also define interdisciplinarity within the field of speech-language pathology, more specifically, the study of bilingualism and the development of linguistic competencies, using an epistemological and praxeological standpoint. Speech-language pathology professionals, Speech-language Pathologists (SLPs), work with the full range of human communication and its disorders. SLPs assess and diagnose speech (i.e. phonation, articulation, fluency, resonance, and voice, including aeromechanical components of respiration); language (i.e. phonology, morphology, syntax, semantics, and pragmatic/social aspects of communication); cognitive-communication (i.e. attention, memory, problem solving, executive functions); and swallowing disorders (or upper aerodigestive functions such as infant feeding). They also treat speech, language, cognitive-communication and swallowing disorders in individuals of all ages, from infants to the elderly (ASHA 2010). Each discipline has its own

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jargon. Speech-language pathology, even if it is inherently interdisciplinary, also has its own terminology which is distinct from that of the disciplines from which it stems. At the outset, it seems imperative to shed light on two important concepts in the discipline; that of language and its disorders, as they are perceived by SLPs.

Language Disorders

It is crucial to understand what the term language disorder or its synonym, language impairment, means in order to understand the theoretical foundations of language and speech in the field of speech-language pathology, particularly among bilingual individuals. In this article, we will use Bloom and Lahey's (1978) and Lahey's (1988) definition of language. According to these authors, it comprises three major aspects: 1) Form: including primarily syntax, morphology, and phonology; 2) Content: essentially made up of the semantic components of language-knowledge of vocabulary and knowledge about objects and events; and 3) Use: the realm of pragmatics, which consists of the goals or functions of language, the use of context to determine what form to use to achieve these goals, and the rules for carrying out cooperative conversations. Lahey (1988) discussed and defined language disorders in terms of the interaction of these three aspects. Before addressing the question of how to define a language impairment, it is important to specify the elements that are fundamentally related to the acquisition of a language, i.e. those related to the typical development of language. According to Kohnert (2009), the development of linguistic competencies depends on the child's means, opportunities and motives. The individual must have the essential cognitive, sensory, social, emotional and neurobiological systems in order to learn a language with ease. Any deficits within these systems may cause difficulties related to both language use and language acquisition. Moreover, the opportunities should offer a rich environment in which they, in a given language, are favourable for the acquisition and use of a particular language, thus allowing for rewarding communicative interactions. Finally, and perhaps most importantly, the motive, which may stem from various sources, is of paramount importance. These various sources are either internal or external, such as environmental needs, opportunities and preferences associated with social contexts. All of these factors play an essential role in the acquisition and maintenance of one or more languages among children.

When it comes to children who have a language impairment, there is a persisting language delay (American Psychiatric Association 1994; Bishop 1992; Leonard 1998). Initially, the distinction is made between a specific language impairment (SLI) and a non-specific impairment. The term *specific* is synonymous with non-symptomatic, idiopathic and non-epigenetic (Dellatolas and Peralta 2007). The SLP is particularly interested in SLI without excluding non-specific impairments. The Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV) (American Psychiatric Association 1994) defines specific language impairments according to the following three criteria:

1. Standardized tests indicate skill area substantially below what is expected considering chronological age (CA), intelligence quotient (IQ), and education.
2. Difficulties interfere with academic or occupational achievement or with social communication.
3. If mental retardation, environmental deprivation, sensory or speech motor deficit is present, difficulties are greater than what is expected.

Until recently, the presence of a language impairments suggested that cognitive skills were intact (Leonard 1998), focusing the assessments on linguistic competencies. Nowadays, many studies show that certain non-linguistic abilities among children with language impairment are breached (e.g.: Amitay, Ahissar, and Nelken 2002; Archibald and Gathercole 2006; Bishop 1996; Evans and Pourcel 2009; Ellis Weismer, Evans, and Hesketh 1999; Gathercole and Baddeley 1990a; Gathercole and Baddeley 1990b; Gathercole, Willis, Emslie, and Baddeley 1994; Kohnert, Windsor, and Dongsun 2006; Leonard 1998; Montgomery and Evans 2009; Tallal

2003; Thordardottir and al. 2011; Ullman and Pierpoint 2005). These non-linguistic abilities include working memory (e.g.: Archibald and Gathercole 2006; Bishop 1996; Ellis Weismer et al. 1999; Gathercole et al. 1994; Kohnert et al. 2006; Leonard 1998; Montgomery and Evans 2009; Tallal 2003; Ullman and Pierpoint 2005), phonological working memory (PWM) or verbal working memory (e.g.: Archibald 2006; Bishop 1996; Bishop, Bishop, Bright, James, Delaney, and Tallal 1999; Wager, Smith and Jonides 2003), executive functions (e.g.: Baddeley, Gathercole, and Papagno 1998; Baddeley 1996; Bishop and Norbury 2005; Ullman and Pierpoint 2005), discrimination of nonverbal components (e.g.: Amitay and al. 2002; Tallal and Piercy 1973) procedural memory and abstraction (e.g.: Evans and Pourcel 2009), speed of information processing (e.g.: Catts, Adlof, and Ellis Weismer 2006) and auditory processing (e.g.: Tallal 2003), among others. This makes the study of SLI much more intricate and calls for knowledge in specific fields such as cognition, memory and attention, areas that were not typically explored by SLPs in the past.

The diagnostic criteria for SLI vary according to cultural and linguistic contexts as well as the assessment tools that are being used (Mayer-Crittenden *in press* for a review of the literature). In several studies conducted among children with SLI or a primary language impairment (PLI)[1], we note that the child's diagnosis is based on what is absent (exclusive) as well as what is present (inclusive). However, when a syndrome or a concomitant impairment such as a neurological disorder, a pervasive developmental disorder such as autism, a hearing impairment, or abnormalities in motor ability are present, the language impairment is not primary but rather secondary and dependent (Leonard 1998). One last crucial element in diagnosing SLI/PLI is, evidently, the presence of limited linguistic competencies in all of the spoken languages, whether it be a monolingual or a bilingual child.

Bilingualism

At first glance, the term bilingualism may seem to have a simple meaning. However, that initial simplicity does not give way to a simple definition of the term. Generally speaking, the term *bilingualism* is used when we refer to an individual or to a group of people who have linguistic competencies in two languages (See Butler and Hakuta 2006 for a review; Hamers & Blanc 1989). However, bilingualism is a linguistic behaviour that is both psychological and sociocultural in various ways (Butler and Hakuta 2006). Researchers do not seem to agree on a single definition of the term and many questions, such as the level of proficiency required in both languages in order to be considered bilingual, are left unanswered. Nevertheless, many definitions exist. For instance, Bloomfield defines bilingualism as "the native-like control of two languages" (Bloomfield 1935, 56). Macnamara (1967), on the other hand, proposes that a bilingual speaker is anyone who possesses a minimal competence in only one of the four language skills: listening comprehension, speaking, reading and writing, in a language other than his mother tongue. For Titone (1972), bilingualism is the individual's ability to speak a second language while following the concepts and structures of that language, rather than paraphrasing his or her mother tongue. Grosjean (1985) defines a bilingual speaker as more than the sum of two monolinguals in the sense that the bilingual has also developed some unique language behaviour (see Hamers and Blanc 1989 for a review of the different definitions).

That said, none of these definitions cover the span of variability that exists at the heart of bilingualism. It seems as though the concept of bilingualism also needs to be addressed from an interdisciplinary standpoint which takes into consideration the environmental, cultural, social, psychological and individual factors that are forever present and forever changing over the course of one's lifespan. We will propose a theoretical model that addresses this need later in this

[1] Primary language impairments (PLI) are deficits or inefficiencies in the comprehension and/or production of spoken or written language alongside more preserved functioning in other areas (Kohnert 2009, 148). The term PLI is used to account for a wider range of processing difficulties not always accounted for with SLI.

paper. Furthermore, the term *bilingualism*, even when defined using an interdisciplinary approach, may have a different meaning if it is interpreted from a socio-political standpoint than if it is interpreted from a speech-language pathology angle.

As seen in the field of cognitive psychology, speech-language pathology examines language not only in its organization of complex linguistic structures, but also in terms of the processes on which it partially depends (Lowie, Verspoor, and de Bot 2009). Therefore, the object of research in speech-language pathology is language, together with human communication and human cognition (Le Normand 2007) as well as the social interactions that come into play. Many children learning a second language have a language impairment. In fact, 7 % of school-aged children have difficulties acquiring certain linguistic competencies (Tomblin et al. 1997). Many SLPs who are working with these children do so without necessarily knowing what approach or which model to use in order to provide the most effective service.

MacWhinney and Bates have beautifully illustrated the interaction between the modalities listed above with the competition model (Bates and MacWhinney 1982; MacWhinney 1987), which was first developed to show how monolingual adults process sentences. According to this model, the real time comprehension of a given language is an interactional process of the form-usage applications explained above (Lahey 1988). It is the competition and the cooperation of lexical elements and grammatical tools that operate the system. In other words, language acquisition is manifested by a combination of cognitive processes that are always in competition. (Bates and MacWhinney 1982; MacWhinney 1987).

This model stems from the theory of emergentism and goes against Chomsky's nativist theory (Chomsky 1957). The latter states that language acquisition can be explained by an innate system of grammatical categories and principles. Chomsky considers that all utterances follow a specific syntax that can be characterised by a common formal grammar. Children are born with an innate knowledge of grammatical rules that serve as the foundation for every language. The human being possesses a Language Acquisition Device (LAD) that Chomsky refers to as the Universal Grammar (UG) (Chomsky 1957). On the other hand, emergentism theories (see Bertalanffy 1968; MacWhinney 1999; O'Grady 1999, 2001, and 2003) speak against common linguistic concepts claiming rather that complex language representations are the result of simple learning mechanisms as opposed to the aforementioned nativist theory of Chomsky.

> Emergentists believe that the complexity of language emerges from relatively simple developmental processes being exposed to a massive and complex environment. Thus, they substitute a process description for a state description, study development rather than the final state and focus on the language acquisition process rather than the language acquisition device. (Ellis 1998, 27)

It is therefore not surprising that some children experience difficulty in learning these complex language representations in their first language and more so, in their second language. When studying language pathologies in monolingual and bilingual children, SLPs must be able to identify where the difficulties lie. It is not only the linguistic components that must be considered, but also the neurological, anatomical, physiological, cognitive, pragmatic and social aspects that are intrinsically associated, as it is illustrated by the competition model (Bates and MacWhinney 1982; MacWhinney 1987).

Linguistic competencies in any language are part of a dynamic system whose realization is made possible by the relationships that the child has with the other elements of the system, be it lexical elements, grammatical tools or cognitive processes (Bates and MacWhinney 1982; MacWhinney 1987). This emphasizes once again the importance of adopting an interdisciplinary framework when working in the field of speech-language pathology and bilingual language development.

Discipline or Interdiscipline. To Be or Not to Be?

In the following section, the concepts of interdisciplinarity and monodisciplinarity will be described. The latter is characterized by work that can only be realized in one discipline. However, the criteria for monodisciplinarity vary according to the authors (Chettiparamb 2007). Consequently, we must first understand the discipline in order to determine what characterizes it and what differentiates it from the others.

A discipline is a specialization that gives meaning to certain objects. A discipline consists of what is unique to itself. Albeit some disciplines share certain attributes, this doesn't prevent them from having their own specific characteristics.

Certainly, the specialization aims to understand and elucidate certain objects. Empirically, the more complex the domain, the more we can simplify it into sub-disciplines (Morin 1999). This phenomenon can be illustrated in speech-language pathology where the following sub-domains can be found: fluency, voice, dysphagia, articulation, assistive communication and language. One can further elaborate this by creating sub-disciplines of sub-disciplines. To illustrate this, let's take a closer look at language impairments. This sub-discipline of speech-language pathology is further divided into neurological or acquired language impairments, congenital language impairments, specific or primary language impairments, pragmatic language impairments, phonological language impairments, among others. It is this division or ultra-specialization that calls for interdisciplinarity (Morin 1999) because interdisciplinary work is used to reconstruct, in a sense, the deconstruction achieved through specialization. If one illustrates this using speech-language pathology as an example, it is easy to conceive that this interdisciplinary field is only possible thanks to all of the disciplines that feed it, namely traditional linguistics (i.e. generative and structural linguistics), biology, psychology, sociology, as well as all of their sub-disciplines, specifically: phonetics, phonology, semantics, syntax, morphology, pragmatics, anatomy, physiology, neurology, cognitive psychology, the study of human development, sociolinguistics and psycholinguistics, among others. "Interdisciplinarity and specialization are parallel. They are mutually reinforcing strategies, and, thus, complementary descriptions of the process of knowledge production" (Weingart and Stehr 2000, 40).

This reconstruction of specializations is used to gather knowledge. When gathering knowledge, it is imperative that it be modeled in order to obtain analyses and interdisciplinary theories. Moreover, relations between the elements of the models are often bidirectional, and even abstract, ensuring that the studied phenomena can only be understood in systems (Morin 1999). The competition model (Bates and MacWhinney 1982; MacWhinney 1987) is a good example of such a model or *system* in the field of speech-language pathology. In fact Kohnert (2007) proposes the following definition of language when studying language impairments and bilingualism: "Language is defined as a dynamical system that emerges within a social context through interactions of cognitive, neurobiological, and environmental systems and subsystems across nested timescales" (Kohnert 2007, 13). This definition truly emphasizes the intrinsic interdisciplinary nature of speech-language pathology. A thorough explanation of the key terms can be found in the appendices (Appendix 1).

How Does the Study of Bilingual Language Development Lend Itself to Interdisciplinary Research or Work?

There exists a definition of interdisciplinary research that lends itself well to research on the bilingual development of linguistic competencies in speech-language pathology; that of Aboelela et al.

> Interdisciplinary research is any study or group of studies undertaken by scholars from two or more distinct scientific disciplines. The research is based upon a conceptual model that links or integrates theoretical frameworks from those disciplines, uses study design and methodology that is not limited to any one field, and requires the use of perspectives and skills of the involved disciplines throughout multiple phases of the research process. (Aboelela et al. 2007, 341)

These authors included in their definition the gathering of different specialists as well as the various theories that support their work. It also indirectly states that in order to perform interdisciplinary work or research, one must first develop the skills specifically related to the discipline or interdiscipline, as is the case with speech-language pathology.

Speech-language pathology and the study of bilingualism are, without a doubt, interdisciplinary fields for the simple reason that among all of the disciplines involved, there does not seem to be one that is more eminent than another. In fact, many of the sub-disciplines relinquish their boundaries, making this newer field virtually transdisciplinary[2]. SLPs receive training in various disciplines but in the end, they are practitioners of one interdiscipline and work alongside many other professionals who share the same interdisciplinary training. To summarize, we can refer to Mathurin (2002) who provides an overview of various interdisciplinary typologies. He adds that these typologies are polarized by two tendencies:

1. Epistemological: which allows us to understand how we can produce interdisciplinarity;
2. Praxeological: which allows us to better our work through interdisciplinarity.

In speech-language pathology, for instance, SLPs can only produce interdisciplinary work because of all the disciplines and sub-disciplines that underpin this work (epistemological). Moreover, the practice of speech-language pathology requires that SLPs work in collaboration with several other professionals; these include, among others, physical therapists, occupational therapists, social workers, teachers, physicians, psychologists (praxeological). In addition, therapists must not forget to take into consideration the importance of the involvement of families. Though they do not constitute a discipline, they are a part of the child's environment and cannot be neglected. Therefore, whatever the definition of interdisciplinarity, what emerges is that each discipline contributes - in its own way - to the better understanding of human beings.

The interdiscipline of human development lends itself very well to the field of speech-language pathology when adopting an emergentism approach as explained above. This interdiscipline can be defined as a grouping of disciplines which study the development of the human being from birth until death within a society, all the while keeping in mind the individual's historicity, in a moment in time (Lerner 2006). We turn to Uri Bronfenbrenner's (2005) bioecological model to better understand how the study of human development can be applied to speech-language pathology (Desmarais 2007). It encompasses human development at all levels such as the microsystem, the mesosystem, the exosystem, the macrosystem and the chronosystem of the individual. But first, we must look at the child who is at the centre of all these systems. This includes the child's means to learn a language, including both linguistic and cognitive competencies (Kohnert 2009). We must also take into consideration his or her motivation to learn a language which is often influenced by the environment in which the child lives (Kohnert 2009). The immediate surroundings of the child constitute the first system, the microsystem, which includes where the individual resides. In the majority of cases, it represents the home environment and the child's family. As mentioned above, it is important for SLPs to include family for the wellbeing of the child. The mesosystem includes the relationships between

[2] According to Thompson Klein (1990), "a transdisciplinary team engages in a more thorough assimilation of knowledge. In the area of child development, a teacher is placed in a central role, using the technique of 'role release' to communicate with the client. Role release authorizes one person to act as primary therapist in order to deliver services in a clear and trustful manner. […] "Transdisciplinarity" therefore, implies a true totality, and, for that reason, "transdisciplinarity" approaches are quite rare" (p.67-68).

the microsystem and the familial and social contexts. For example, a child whose parents come from an anglophone background will likely have a predisposition to the English language as well as to its culture. This system also includes the child's school environment, the daycare and the community: all of the contexts in which the child has direct interactions on a daily basis. Once again, in the field of speech-language pathology, it is imperative that we communicate frequently with a child's teacher or daycare worker in order to ensure that all of the adults who intervene with the child on a daily basis are made aware of the goals that have been implemented and ways in which they can help attain those goals. This will ensure that the child has more opportunities to practice certain skills in a given language, whether it is his or her first or second language (Kohnert 2009). This can also include the other health care professionals who work directly with the child. The exosystem includes the social experiences. Here, the interactions are not direct, however, they facilitate the direct interactions that the child experiences and help shape a child's life. For example, politics relative to a certain language in a given region may influence the choices that are made with regards to the language of instruction, which, in turn, could influence the child's motive in learning that language. The macrosystem incorporates cultural ideologies in which the individual evolves. For example, in certain cultures, children are not spoken to directly by adults until they reach a certain age. Finally, the chronosystem is the child's lifeline and encompasses time and all of the milestones. It can be related to the language that was first introduced in the home and will influence how a child learns that language or a second language once he or she is in school.

By using this theoretical framework to better explain the interdisciplinary field of speech-language pathology, it becomes clear that it is both epistemological and praxeological. Furthermore, the emergentism theory of language development also demonstrates how language emerges from all of the interactions and life experiences that a child will live through, once again showing the importance of the various levels of the bioecological system when helping monolingual and bilingual children who have language impairments. This being said, it is also important not to lose sight of the object of study, that is, the development of linguistic competencies in monolingual and bilingual children with and without language impairments. Some of the potential problems of an interdisciplinary approach to the science of communication disorders would be to lose focus of the language impairment and the ways in which we, as SLPs can help, when there are so many other contributing factors and/or players involved. One way to resolve this is to work with case managers or primary therapists (Thompson Klein 1990) who can ensure that other parties are also involved and assist the child and his or her family in other areas. For example, a child with a language impairment who is learning a second language may have difficulty experiencing success in school. A case manager could help oversee the involvement of the teacher, the special education consultant, the psychometrist, the social worker, the principal, even the educational assistant and perhaps assist the parents in finding a tutor for the child. This, in turn, would allow the SLP to work on the specific language difficulties, with the assurance that all of the other very important elements are met and looked after by the primary therapist or case manager. Another difficulty that may arise when adopting an interdisciplinary model could be in establishing the priorities related to the child's difficulties. Once again, this can be resolved with the help of a case worker, through school or team meetings, or by having a discussion with the parents in order to determine what is important for the child and his or her family, since they are, after all, in the centre of the system. In the end, the ultimate goal is to help the child attain success and attain his or her goals. We believe that this can be better achieved by using an interdisciplinary framework.

Conclusion

As human beings, we are affected by our physiology, our anatomy and our environment. Although SLPs might specialize in a given sub-domain of the field, it is important that they take

into consideration all the potential factors that come into play in the study of communication disorders; be it anatomical, physiological, psychological, social, or even political, among others.

The aim of this paper was to present various theories related to interdisciplinarity and link them to the field of speech-language pathology, more specifically dual language learning in children with and without language impairments, by proposing a conceptual model that can help SLPs better serve the population with which they work. To do so, we turned to the emergentism theories which, according to many, seem more in-line with the study of linguistic competencies and dual language learning than nativist theories. We also made reference to the competition model as well as the bioecological model to demonstrate how a) language is a dynamic system and b) a holistic approach must be adopted when studying linguistic competencies and bilingualism due to the inherently complex nature of these fields. Furthermore, we demonstrated the importance of looking at not only at the monolingual or bilingual child who is experiencing language difficulties, but also at the environment, whether it be proximal or distant. This will in turn ensure that there is consideration of all of the necessary elements involved in the development of linguistic competencies such as the child's means (cognitive and linguistic), opportunities to communicate and motivation to use the language or languages. This theoretical framework will ensure that every child and his or her family be given all of the tools required to succeed in the acquisition of one or two languages.

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Appendix

Explanation of the key terms found in the definition of language by Kohnert (2007).

Language is a dynamical system[1] that emerges[2] within a social context[3] through interactions of cognitive, neurobiological, and environmental systems and sybsystems[4] across nested timescales[5]. *The definitions of the following key elements are a direct citation from Kohnert 2007, 14-15.*	
dynamical system[1]	A system is continually changing through interactions with its environment. Language development or change is typically not linear, but may go in leaps or bounds, with growth or decline. As with other dynamical systems, over time language tends to settle. This "settling" has varying degrees of stability: a less stable state will be more susceptible to changes in resources and a more stable or settled system will require additional shifts in resources or conditions to change. Shifts in energy or resources can be positive or negative.
that emerges[2]	Emergent systems are self-organizing or reorganizing without a built-in goal. The outcome of the interacting factors may be inevitable, but this does not mean they are preprogrammed. The emergent system is more and different than the sum of its constituent parts, although it could not exist without them.
within a social context[3]	Language is viewed as our most complex as well as efficient communicative tool. It is a social tool, developed for the purposes of exchanging information and ideas within the social context. This social context in which language is developed and used includes a wide variety of communicative partners as well as communicative purposes. Communicative contexts, purposes, and partners change throughout the life but in all cases are embedded in social relationships and culture.
through the interactions of cognitive, neurobiological, and environmental systems and sybsystems[4]	The interactions between at least three primary systems are responsible for acquisition and use of language in typical individuals. The cognitive system includes basic perception, attention, emotion and memory mechanisms. The neurobiological system consists of complex motor,

	sensory (including hearing and vision), and neurological subsystems. The communicative environment refers to the social, cultural, and physical, acoustic, and visual context. Each of these systems and subsystems is incredibly diverse and complex. Interactions within and across these systems mean that the outcome or "product" is not always predictable based on input factors.
over nested timescales[5]	Development or change in language, as in other emergent, dynamic systems is an iterative process in that current levels of ability are critically dependent on previous levels of attainment. Also, behavioural change occurs over different timeframes: milliseconds, seconds, minutes, hours, days, weeks, months, years, infancy, early childhood, school-age, adulthood, or aging.

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